

A Geophysical Survey of Wash Green, Wirksworth, Derbyshire



Archaeological Research Services Ltd
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Executive Summary

Archaeological Research Services Ltd were commissioned by Connaught PLC to undertake a geophysical survey of land outlined for development at Wash Green near Wirksworth, Derbyshire.

The survey identified a number of anomalies of a possible archaeological origin. Positive anomalies indicated the presence of possible cut features such as pits and ditches and negative anomalies identified in the southern region of the site suggested the presence of former banks or earthworks.

1. Introduction

1.1. Scope of work

- 1.1.1. This geophysical survey report has been prepared by Richard Smalley of Archaeological Research Services Ltd and commissioned by Connaught Partnerships Ltd. The objective of the survey was to identify any anomalies of a possible archaeological origin within the survey area in order that they may be assessed prior to development.
- 1.1.2. The geophysical survey has been carried out in accordance with government guidance on planning for the historic environment (PPS 5) and with the guidelines outlined in 'Geophysical Survey in Archaeological Field Evaluation' (English Heritage 2008).
- 1.1.3. The survey was undertaken by Richard Smalley and Brian Marshall of Archaeological Research Services Ltd over one day from the 1st June 2010. Weather conditions during the survey were wet.

1.2. Location and topography

- 1.2.1. The survey area is centred at NGR SK 292 539 and is approximately 0.6ha in extent (see Figures 1 and 2).
- 1.2.2. The study site comprises two fields, the smaller of which was recently cleared of overgrown vegetation. The larger field is an area of meadow. Overall the study site slopes downhill to the south and west. The site is bounded to the north by the B5035 and to the east by a track and field boundary. A telegraph pole is present within the survey area which may affect the geophysical data in its immediate environs.
- 1.2.3. The location of the survey grid together with referencing information has been plotted in Figure 2.
- 1.2.4. The solid geology of the site is Carboniferous Mudstone, Siltstone and Sandstone. No superficial geology is recorded for the site (British Geological Survey 1:625000, V5 Bedrock and V4 Superficial).

1.3. Site History and Archaeological Potential

- 1.3.1. Documentary sources make reference to Wash Green as early as 1415. Historic map regression of the site indicates that the original green at Wash Green was triangular in shape and is likely to have been an area of common land eventually enclosed into smaller plots. It is likely that settlement activity will have taken place adjacent to the green. Therefore there is potential for Medieval settlement activity to be present along the northern extent of the study site.

2. METHODOLOGY

2.1. Survey Technique

2.1.1 Detailed gradiometry was deemed the most suitable technique for this survey. It is an efficient and effective method of locating anomalies of an archaeological origin. It is particularly useful for identifying cut features such as pits and ditches.

2.2. Basic Gradiometry Principle

2.2.1 This survey technique relies on measuring small differences in the magnetic properties of the soil that may be associated with archaeological deposits. Activities such as digging and backfilling of a pit or a ditch and the presence of thermoremanent features such as kilns or hearths produce distortions in the earth's magnetic field. These anomalies can be identified and recorded using a gradiometer.

2.2.2 The fluxgate gradiometer measures the relative difference between the magnitude of the vertical component of the local field measured by two sensors positioned one above the other (English Heritage 2008).

2.2.3 By mapping these anomalies detailed plans of sites can be obtained. Where anomalies have characteristic shapes or values interpretations may be attributed to them. Further investigation is often required in order to ascertain detailed information on the origin of these anomalies.

2.3 Grid Locations and Referencing

2.3.1 A series of 30m x 30m grids was set up across the survey area using a Leica TCR 307 (TPS 300 Series) Total Station Theodolite or similar. The location of these grids was referenced using topographical features around the site such as fences and field boundaries. The location and referencing of the survey grids can be seen in Figure 2.

2.4 Survey Equipment Specifications

2.4.1 This survey was undertaken using a Bartington Grad 601-2 Gradiometer, manufactured by Bartington Instruments Ltd. The parameters set for this instrument were as follows:

Grid Size:	30m x 30m
Start:	North
Pattern:	Zigzag
Lines/m:	1
Samples/m	4
Range	100nT
Audio:	On
Volume:	High
Threshold:	1nT
Sensors:	2
Reject:	50Hz

2.4.2 The Bartington Grad 601-2 has a maximum depth of scan of around 0.5m-1.0m. However strongly magnetic features may be recorded at a greater depth.

- 2.4.3 With a range setting of ± 100 nanoTeslas (nT), values are recorded with a resolution of 0.01nT. However, due to the internal noise of the instrument, the actual resolution achieved is approximately 0.03nT. When used with a range setting of ± 1000 nT, values are recorded with a resolution of 0.1nT. For this survey the instrument had a range setting of 100nT.
- 2.4.4 Data was collected along traverses 1m apart and readings were taken at 0.25m intervals. Therefore each complete 30m x 30m survey grid contains 3600 readings.
- 2.4.5 Data is collected consecutively at a fixed rate and is automatically saved to the data logger at the end of each traverse and grid. The data is downloaded daily and a copy is made to a memory stick. On the completion of a survey the data is copied to a server at ARS Ltd.

2.4. Data Processing

2.4.1 Processing is undertaken using specialist software called *Geoplot 3.00v* manufactured by *Geoscan Research Ltd.* Through this software it is possible to mitigate for 'artefacts' introduced into the data during data collection and employ image processing methods to enhance features of interest. It is also possible to apply processes that use mathematical descriptions of the measurements to infer information about causative features.

2.4.2 The following processes have been carried out on the gradiometer data in this report:

- **Despike:**
This function can be used to automatically locate and remove "iron spikes" often evident in gradiometer data. It operates over the whole of the data set.
 - *Geoplot Settings*
X Radius: 1
Y Radius: 1
Threshold: 3 Std Dev.
Spike Replacement Mean
- **Zero Mean Traverse:**
This function sets the mean background of each traverse within a grid to zero. It is particularly useful for removing the striping effects that can sometimes occur in gradiometer data.
 - *Geoplot Settings*
Least Mean Square Fit: Off
- **Interpolate:**
This function gives a smoother appearance to the data and can improve the visibility of larger, weak archaeological features.
 - *Geoplot Settings*
Direction: X then Y
Mode: Expand
Expand Method: Linear

2.5. Data Presentation

- 2.5.1 Raw (or minimally processed) data collected during the survey is presented in greyscale format and a colour scale plot is provided to highlight extreme values within the data set (see Figures 3 and 4).
- 2.5.2 Processed data is also presented in greyscale format and can be seen in Figure 6.
- 2.5.3 An interpretation of anomalies can be seen on the 'Abstraction and Interpretation of Anomalies' plot (see Figure 7).

3. RESULTS

- 3.1. The gradiometer survey undertaken at Wash Green near Wirksworth, Derbyshire has identified a number of features of a possible archaeological origin.

Area 1

- 3.2. A number of positive area anomalies can be noted in the north-western region of Area 1. These anomalies may be related to cut features such as pits and ditches and may be of an archaeological origin. Other positive anomalies, indicating the presence of possible cut features, are evident in the central and southern areas of the site. Discrete positive anomalies representing pits of a possible archaeological origin can be noted throughout the survey area. However, no definitive layout or pattern is discernable that may relate to a formalised area of settlement activity.
- 3.3. Positive linear anomalies with a north-west to south-east orientation are evident in the central region of the site. These anomalies are likely to be of an agricultural origin and may be related to ploughing activity.
- 3.4. Two negative linear anomalies can be noted in the southern region of Area 1. These anomalies may represent former banks or earthworks of a possible archaeological origin.
- 3.5. Three discrete areas of magnetic disturbance can be noted in the northern region of Area 1. These anomalies have a magnitude which is lower than would be expected of a ferrous object, but greater than what would be usually expected for a cut feature. A thermoremanent interpretation cannot be ruled out; however the regular spacing of these features may suggest a more modern origin. Further investigation is required to ascertain the nature of these anomalies.
- 3.6. Discrete bipolar anomalies are evident throughout the survey area. These anomalies are likely to represent buried ferrous objects.
- 3.7. Large areas of magnetic disturbance can be noted within Area 1. This disturbance has been caused by ground disturbance and the presence of modern features such as the electricity pylon and the track ways. A linear area of disturbance in the southern region of the site has been interpreted as being related to a land drain or service.

Area 2

- 3.7.1. The data in Area 2 is dominated by the presence of magnetic disturbance likely to have been caused by made ground or ground disturbance. Any subtle features of an archaeological origin that may be within this area are likely to be obscured by these high levels of magnetic disturbance.

4. CONCLUSION AND RECOMMENDATIONS

- 4.1. The historical core of Wash Green is thought to be in close proximity to the northern edge of Area 1 where the gradiometer survey has identified a number of cut features of a possible archaeological origin. Further investigation, such as evaluation trenching, in this area would help to ascertain as to whether these features are related to Medieval Wash Green.
- 4.2. The large area of magnetic disturbance evident in the northern region of Area 1 may be masking any subtle archaeological features in that area and as a result may benefit from further investigation. The same can be said for the made ground evident in Area 2.
- 4.3. The three discrete areas of magnetic disturbance identified in Area 1 may warrant further investigation as their origin currently remains unknown.

5. PUBLICITY, CONFIDENTIALITY AND COPYRIGHT

- 5.1. Any publicity will be handled by the client.
- 5.2. Archaeological Research Services Ltd will retain the copyright of all documentary and photographic material under the Copyright, Designs and Patent Act (1988).

6. STATEMENT OF INDEMNITY

- 6.1. All statements and opinions contained within this report arising from the works undertaken are offered in good faith and compiled according to professional standards. No responsibility can be accepted by the author/s of the report for any errors of fact or opinion resulting from data supplied by any third party, or for loss or other consequence arising from decisions or actions made upon the basis of facts or opinions expressed in any such report(s), howsoever such facts and opinions may have been derived.

7. ACKNOWLEDGEMENTS

- 7.1. Archaeological Research Services Ltd would like to thank Dean Graham and Gary Brothers of Connaught PLC. Thanks are also expressed to Dave Barrett at Derbyshire Council.

8. REFERENCES

Bartington Instruments. *OM1800 Operation Manual for Grad 601 Magnetic Gradiometer.*

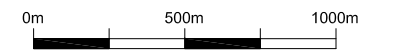
English Heritage (2008) *Geophysical Survey in Archaeological Field Evaluation.*



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Site Code: WASH 10
Drawing Ref: FIG 1
Date: 3-06-2010
Drawn: RAJS
Scale: 1:25000

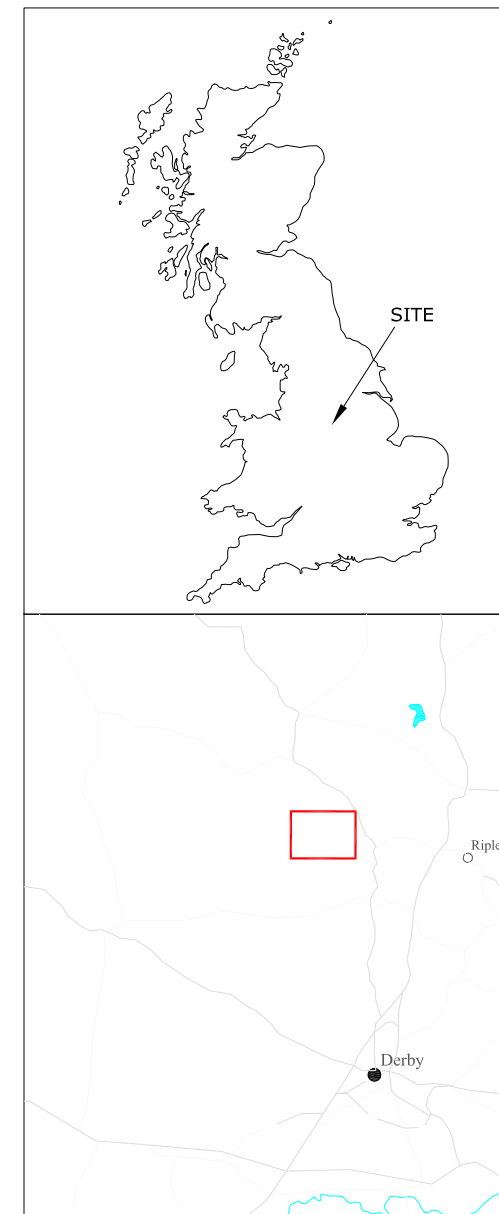
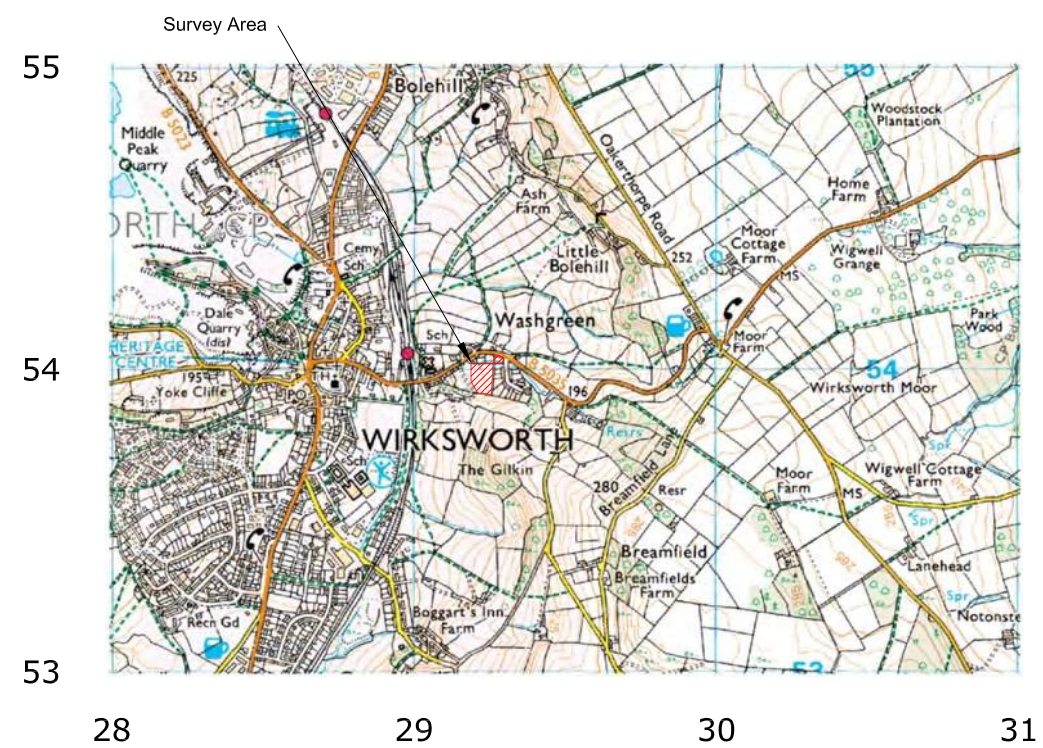


Client:
Connaught PLC

Figure 01:
Geophysical Survey
Wash Green, Wirksworth, Derbyshire

Subject:
Site Location Map

Ordnance Survey NGR: SK 292 539

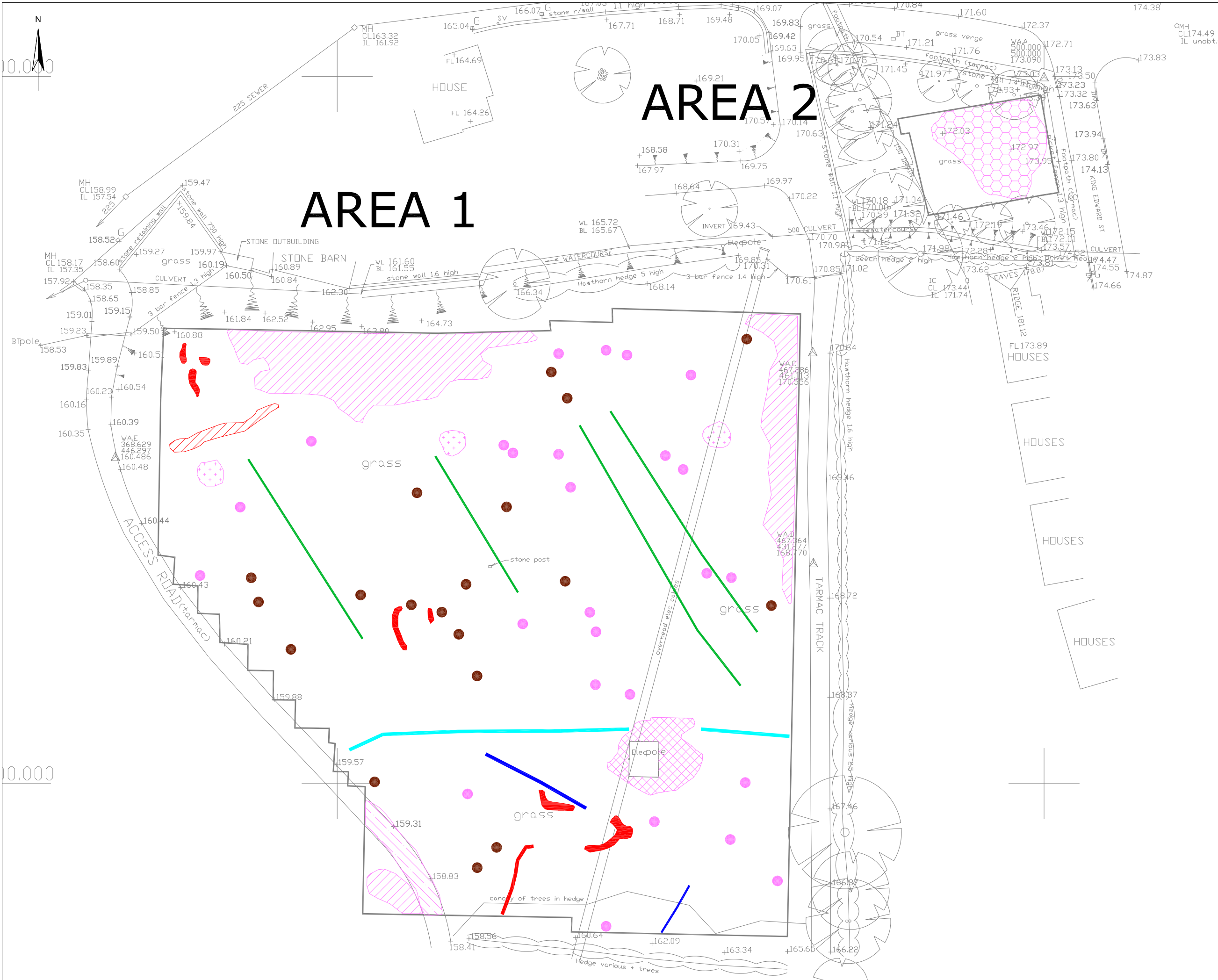


Notes:

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AREA 1

AREA 2

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Site Code: WASH 10
 Drawing Ref: FIG 06
 Date: 02-06-2010
 Drawn: RAJS
 Scale: 1:500

0m 20m

Client:
 Connaught PLC

Figure 06:
 Geophysical Survey
 Wash Green, Wirksworth, Derbyshire

Subject:
 Abstraction and Interpretation of Gradiometer
 Anomalies

Key:

	Discrete positive anomaly- pit of possible archaeological origin
	Positive linear anomaly- cut feature of possible archaeological origin
	Positive area anomaly- cut feature of possible archaeological origin
	Weak positive area anomaly- cut feature of possible archaeological origin
	Negative linear anomaly- possible former earthwork or bank
	Discrete magnetic disturbance of unknown origin
	Agricultural mark
	Bipolar anomaly- spike caused by ferrous object
	Possible land drain or service
	Area of magnetic disturbance
	Area of magnetic disturbance related to track
	Area of magnetic disturbance related to electricity pylon
	Area of magnetic disturbance possibly related to made ground

Notes:

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