ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Boldron Parish History Group

The Green, Boldron
Barnard Castle
County Durham

geophysical surveys

report 3164
June 2013

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted on The Green at Boldron, near Barnard Castle, in County Durham.

1.2 The works were commissioned by the Boldron Parish History Group and conducted by Archaeological Services Durham University.

Results

1.3 Members of Boldron Parish History Group received training in geophysical survey techniques and were given the opportunity to conduct surveys on The Green.

1.4 In some places the geomagnetic survey was adversely affected by the presence of services and near-surface debris, as well as the effects of nearby buildings and vehicles, while in other parts the technique provided data with relatively few anomalies, indicating a probable absence of archaeological or historic features in those places.

1.5 The resistance data were complementary and some anomalies were recorded by both techniques. For example, a probable former path to Manor House has been detected by both techniques while a probable former path to the church has only been identified in the resistance data; its presence in the geomagnetic survey has almost certainly been obscured by the presence of a ferrous pipe.

1.6 Additionally the resistance survey has detected several small areas of high resistance across The Green, which almost certainly reflect concentrations of brick rubble or stone, perhaps materials associated with construction projects around The Green.

1.7 Neither survey technique has recorded the presence of structures or linear features such as wall-footings or ditches across The Green, which would support the notion that the area has always been open.

2. Project background

Location (Figure 1)

2.1 The surveys were undertaken on The Green in Boldron village, near Barnard Castle, in County Durham (NGR centre: NZ 0355 1431). The Green principally occupies land along the southern side of West Lane in the village.

2.2 The north side of The Green is bordered by residential properties, while to the south are occasional houses, the church, Boldron Mission, village hall and fields.

Objectives

2.3 The principal aims of the survey were twofold: to determine the nature and extent of any sub-surface features of potential archaeological or historic significance on The Green, and to provide an opportunity for members of Boldron Parish History Group and the wider community to receive training and engage in local heritage research.

Methods statement

2.4 The surveys have been undertaken in accordance with proposals agreed with the Group and their funding bodies, and in line with national standards and guidance (para. 5.1 below).

Dates

2.5 Survey was undertaken on 14th May 2013. This report was prepared for June 2013.

Personnel

2.6 Fieldwork was conducted by Duncan Hale (the Project Manager) and Ashley Hayes (Supervisor). The geophysical data were processed by Ashley Hayes. This report was prepared by Duncan Hale with illustrations by Janine Watson.

Archive/OASIS

2.7 The site code is **BVG13**, for **B**oldron **V**illage **G**reen 20**13**. The survey archive will be deposited at the Bowes Museum in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-152004**.

Acknowledgements

2.8 Archaeological Services is grateful to Hazel Yeadon and her colleagues at the Boldron Parish History Group for initiating the survey and for their support and hospitality. The group is supported by the Heart of Teesdale Landscape Partnership, Barnard Castle Vision, the Heritage Lottery Fund and Durham County Council.

3. Historical and archaeological background

3.1 The Boldron Parish History Group has a website, which provides detailed historical information about the village (http://www.boldronhistory.com). The Group have also produced a booklet 'The History of Boldron' which is available on the internet (http://www.tomorrows-history.com/projects/PJ0100210001/Booklet.htm).

3.2 The origins of the village remain uncertain. There have been many variations in the spelling of its name, which may have Scandinavian roots. The village was mentioned

in the Domesday Book of 1086 and again in 1280 as 'Bulerun' during the 'Yorkshire Inquisition'.

3.3 The structure and layout of the village, and The Green itself, have not changed significantly since the tithe map of 1841, save for the addition of several buildings. For example, Boldron Chapel and Boldron Mission Church were both built on the south side of The Green in the second half of the 19th century, and additional housing has infilled gaps on the north side.

4. Landuse, topography and geology

4.1 The surveys were undertaken over grassed areas, principally The Green to the south of West Lane, as well as a small area west of the main Green. The main survey area contained occasional paths, driveways and service inspection covers. The surveys were undertaken in fine, dry weather, although the ground immediately south of the road was noticeably damper than elsewhere.

4.2 The Green occupies a very gentle north-east-facing slope, with elevations of approximately 245m OD at Hilltop Cottage in the west and approximately 235m OD at The Garth in the east.

4.3 The underlying solid geology comprises Namurian limestone of the Great Limestone Member, which is overlain by Devensian till.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques, such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, with little known about the early history of the Green, it was considered possible that remains of both cut and built features could be present beneath the surface. These features might include, for example, ditches and pits, wall foundations, trackways and fired structures such as kilns and hearths.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study areas a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

5.5 Given the possible presence of wall-footings or other structural remains an electrical resistance survey was also considered appropriate, and would complement the results of the magnetometer survey. Earth electrical resistance survey can be particularly useful for mapping stone and brick features. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which retain more moisture, will provide relatively low resistance values.

Field methods

5.6 A 20m grid was established across available areas and related to known features shown on the Ordnance Survey. Two survey areas were established on the main part of the Green (Areas 1 & 2), on slightly different alignments to reflect a kink in the road. A third smaller area was established to the west (Area 3).

5.7 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 1,600 sample measurements per 20m grid unit.

5.8 Measurements of earth electrical resistance were determined using Geoscan RM15D Advanced resistance meters with MPX15 multiplexers and a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was 0.1ohm, the sample interval was 1m and the traverse interval was 1m, thus providing 400 sample measurements per 20m grid unit.

5.9 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.10 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-4; the trace plots are provided in Figure 5. In the greyscale images, positive magnetic and high resistance anomalies are displayed as dark grey while negative magnetic and low resistance anomalies are displayed as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla/ohm.

5.11 The following basic processing functions have been applied to the geomagnetic data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
destagger	corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

5.12 The following basic processing functions have been applied to the resistance data:

despike	locates and suppresses spikes in data due to poor contact resistance
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretations are provided. Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

5.14 Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

Interpretation: features

5.15 A colour-coded archaeological interpretation plan is provided.

Areas 1 & 2

5.16 A chain of intense dipolar magnetic anomalies, which corresponds to a band of low resistance values, has been detected along the southern side of West Lane. These anomalies almost certainly reflect a ferrous pipe. A second ferrous pipe has almost certainly been detected aligned north-south heading to Manor House. Further possible services may extend north-east from the Mission and from Manor Cottage.

5.17 Further intense magnetic anomalies reflect iron railings around the church, adjacent buildings, vehicles and inspection covers noted on the ground. Additional magnetic anomalies reflect materials used in the driveway to Hilltop Cottage and in the path to the Mission (such as brick rubble or clinker), but not generally in the driveways to Manor House, Manor Cottage or the village hall. Electrical resistance survey was not generally possible over the hard surfaces of drives and trackways, due to the high contact resistance between the probes and the surface, but where it was possible it provided high resistance anomalies as expected.

5.18 The geomagnetic survey also detected two strong, narrow chains of anomalies across the front of Manor House, which correspond to a narrow band of high resistance and almost certainly reflect a former path to the house.

5.19 Many small, discrete dipolar magnetic anomalies have been detected across The Green. These almost certainly reflect small items of near-surface ferrous and/or fired debris (such as horseshoes and brick fragments, for example) and the majority are probably associated with the construction of the nearby buildings and the road, as well as pipe-laying. A sample of these anomalies is shown on the geophysical interpretation plan, however, they have been omitted from the archaeological interpretation plan.

5.20 The magnetic effects of the pipes, buildings and buried ferrous/fired debris may have hindered the detection of weaker magnetic anomalies, such as those that might reflect soil-filled ditches for example, however, the electrical resistance technique is not so adversely affected by the presence of such features.

5.21 The resistance survey has complemented the geomagnetic survey and detected corresponding anomalies associated with most of the features above, including the former path to Manor House. Additionally the resistance survey has detected a probable former path to the north-east of the church and several other small areas of high resistance across The Green; these latter anomalies almost certainly reflect concentrations of brick rubble or stone. A concentration at the western limit of Area 2 is more likely to reflect brick rubble as this broadly corresponds to an area of strong magnetic anomalies. Conversely, two areas of high resistance either side of the track to Manor Cottage are more likely to reflect stone, since there are no corresponding magnetic anomalies.

Area 3

5.22 This small area of grass and parking was surveyed geomagnetically. Large and intense dipolar magnetic anomalies were detected here, which are not considered likely to reflect archaeological or historic features.

6. Conclusions

6.1 Geomagnetic and earth resistance surveys have been undertaken on The Green in Boldron, near Barnard Castle in County Durham.

6.2 Members of Boldron Parish History Group received training in geophysical survey techniques and were given the opportunity to conduct surveys on The Green.

6.3 In some places the geomagnetic survey was adversely affected by the presence of services and near-surface debris, as well as the effects of nearby buildings and vehicles, while in other parts the technique provided data with relatively few anomalies, indicating a probable absence of archaeological or historic features in those places.

6.4 The resistance data were complementary and some anomalies were recorded by both techniques. For example, a probable former path to Manor House has been detected by both techniques while a probable former path to the church has only been identified in the resistance data; its presence in the geomagnetic survey has almost certainly been obscured by the presence of a ferrous pipe.

6.5 Additionally the resistance survey has detected several small areas of high resistance across The Green, which almost certainly reflect concentrations of brick rubble or stone, perhaps materials associated with construction projects around The Green.

6.6 Neither survey technique has recorded the presence of structures or linear features such as wall-footings or ditches across The Green, which would support the notion that the area has always been open.

7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

http://www.boldronhistory.com

http://www.tomorrows-history.com/projects/PJ0100210001/Booklet.htm

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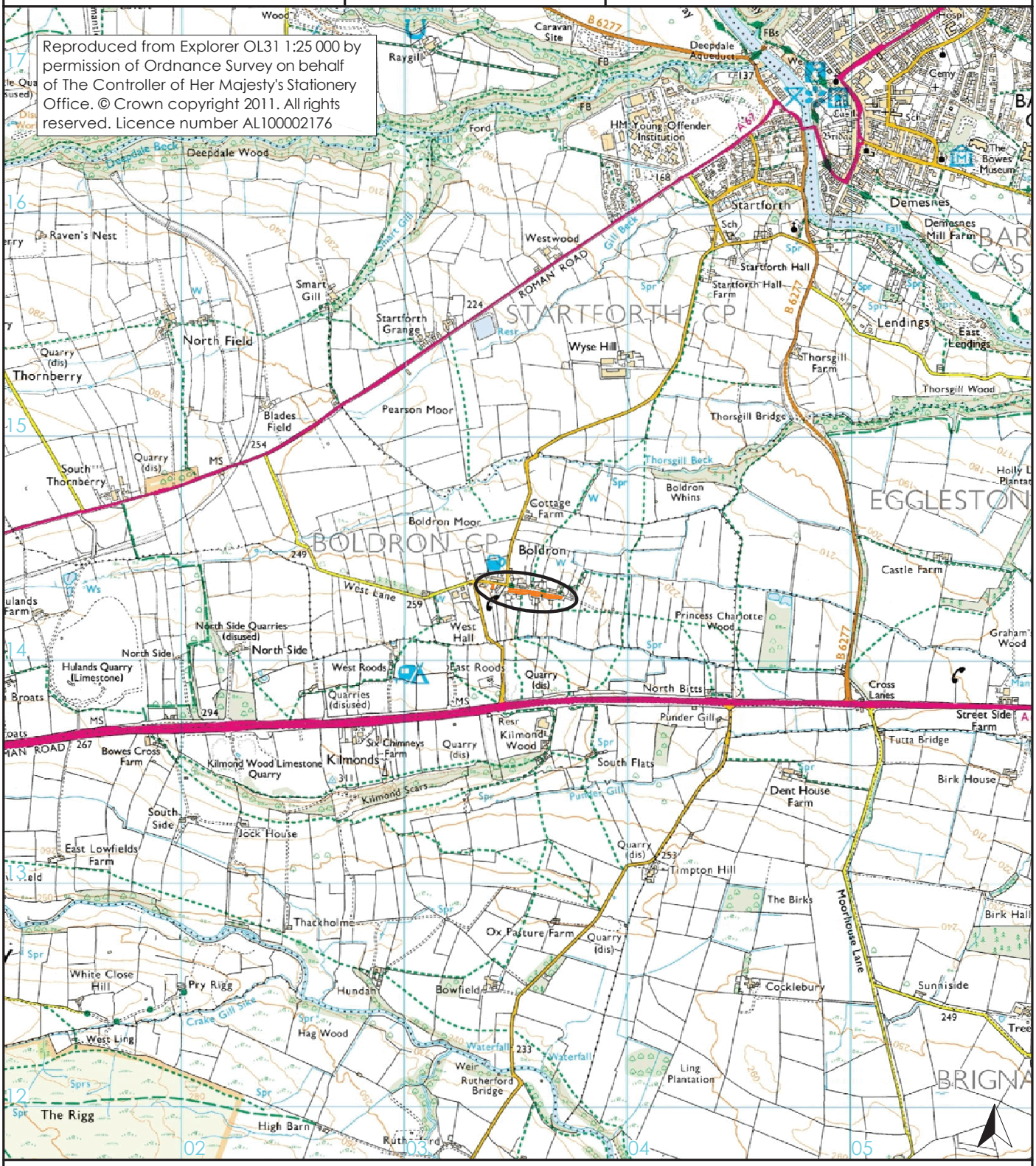
Figure 1: Site location



location of surveys

0 1km
scale 1:25 000 for A4 plot

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magnetic survey

-20 nT 20

dipolar magnetic anomaly

positive magnetic anomaly

0 50m
scale 1:1000 for A3 plot

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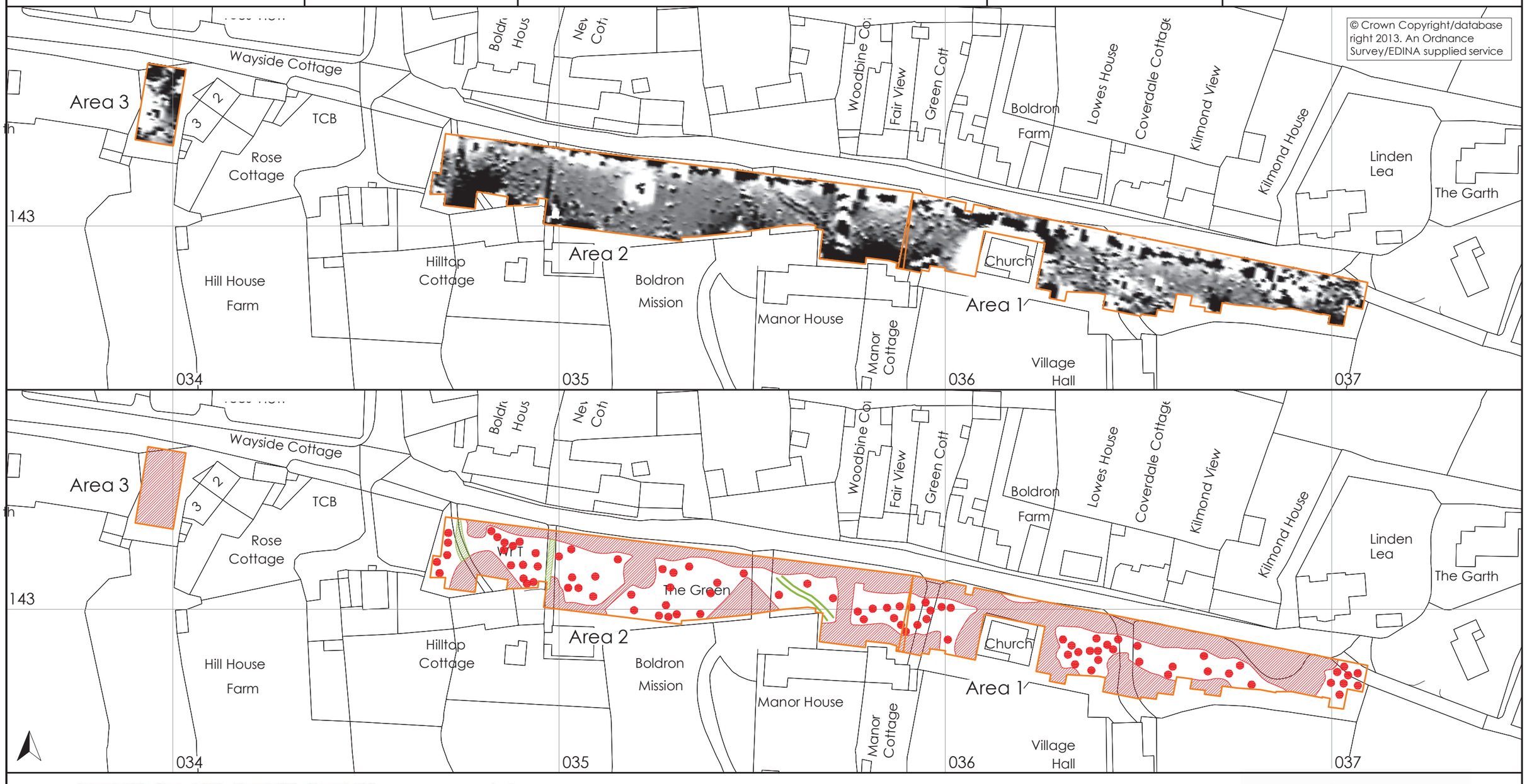
Figure 2: Geomagnetic survey and geophysical interpretation



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resistance survey

15 ohm 45

high resistance anomaly

low resistance anomaly

0 50m
scale 1:1000 for A3 plot

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Figure 3: Resistance survey and geophysical interpretation

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magnetic survey
stone / rubble
pipe
telegraph pole
resistance survey
disturbed area
former path / track
inspection cover

0 50m
scale 1:1000 for A3 plot

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Figure 4: Archaeological interpretation

144
143
034
035
036
037
Moorcroft
The Bungalow
1
5
Tees View
Wayside Cottage
Area 3
2
3
TCB
Rose Cottage
Conifer Lodge
George and Dragon (PH)
Boldron House
Newton Cottage
Boldron
Woodbine Cott
Fair View
Green Cott
Boldron Farm
Lowes House
Coverdale Cottage
Kilmond View
Kilmond House
Linden Lea
The Garth
Wr T
The Green
Area 2
Hilltop Cottage
Hill House Farm
Boldron Mission
Manor House
Manor Cottage
Church
Area 1
Village Hall

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0 50m
scale 1:1000 for A3 plot

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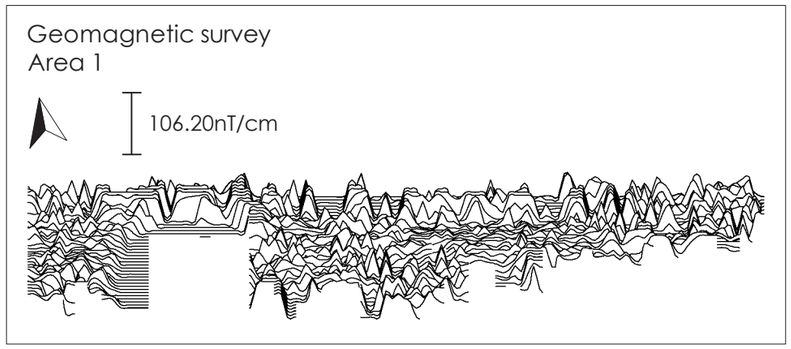
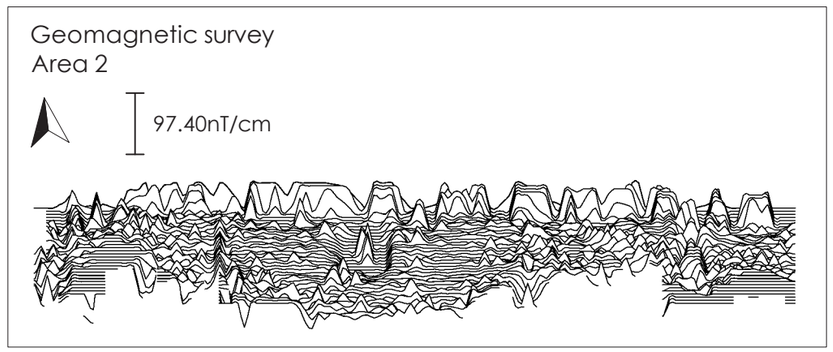
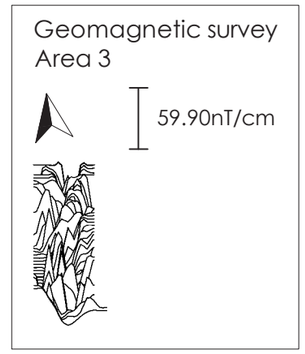
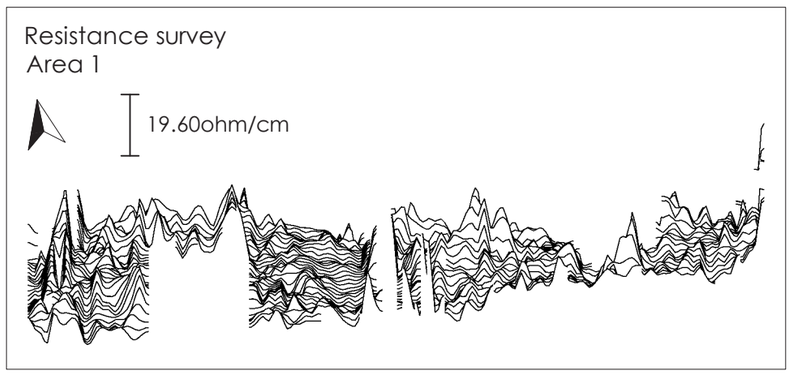
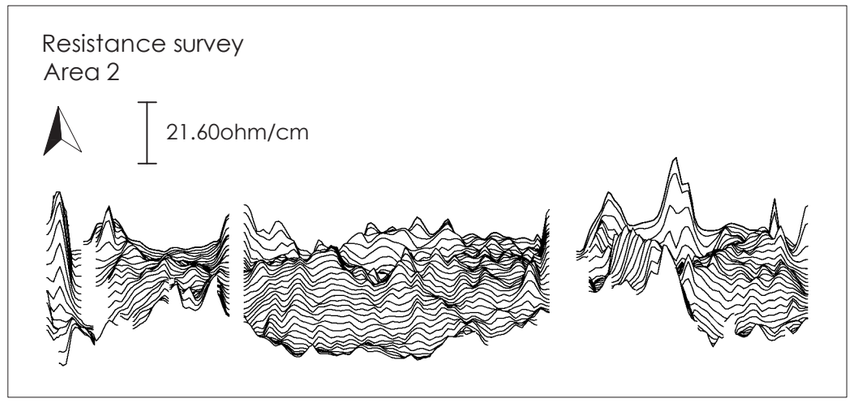
Figure 5: Trace plots of geomagnetic and resistance data











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