Archaeological Services
University of Durham

Land at Kirknewton Primary School, Kirknewton, Wooler, Northumberland

geophysical survey

for

PLANit Design (NE) Ltd

on behalf of

North Tyneside Guide Association

Report 1676
June 2007

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1 Braemar Gardens, Tunstall, Sunderland SR3 1ND

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Contents

1. Summary 1
2. Project background . . . 2
3. Archaeological and historical background. 3
4. Landuse, topography and geology . . 3
5. Geophysical survey . . . 3
6. Conclusions 7
7. Sources 7
Appendix I: Trace plots of geophysical data . 8

1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted in advance of proposed development on land at Kirknewton Primary School, Kirknewton, Northumberland. The works comprised both geomagnetic and earth resistance surveys.

1.2 The works were commissioned by PLANit Design (NE) Ltd on behalf of the North Tyneside Guide Association and conducted by Archaeological Services in accordance with a brief provided by the Northumberland National Park Archaeologist and a written scheme of investigation (WSI) provided by Archaeological Services.

Results

1.3 The majority of anomalies detected in both areas reflect modern activities, with the exception of possible brick footings, a stone path and traces of ridge and furrow.

2. Project background

Location (Figure 1)

2.1 The study area is located at Kirknewton Primary School, Kirknewton, Wooler, Northumberland (NGR: NT 91419 30252). The proposed development area covers approximately half a hectare and is bounded on the north and east by the B6351, to the south by the old vicarage and to the west by St Gregory's Church.

Development proposal

2.2 The geophysical survey was conducted in advance of a planning application (ref.: 05/NP/69) to change the use of the existing school building to Girl Guide residential accommodation, involving construction of a first floor extension, a shower/toilet block and additional car parking.

Objective

2.3 The principal aim of the survey was to assess the nature and extent of any sub-surface features of potential archaeological significance within the proposed development area, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in advance of development.

Methods statement

2.4 The surveys have been undertaken in accordance with a brief provided by the Northumberland National Park Archaeologist and a WSI provided by Archaeological Services.

Dates

2.5 Fieldwork was undertaken between 14th and 15th June 2007. This report was prepared between 16th and 30th June 2007.

Personnel

2.6 Fieldwork was conducted by Lorne Elliott (Supervisor) and Aidan Bell. This report was prepared by Lorne Elliott with illustrations by Janine Wilson. The Project Manager was Dan Still.

Archive/OASIS

2.7 The site code is **KWN07**, for **K**irknewton, **W**ooler, **N**orthumberland 20**07**. The survey archive will be supplied on CD to the Museum of Antiquities at Newcastle. Archaeological Services 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 **archaeol3-27682**.

Acknowledgements

2.8 Archaeological Services is grateful for the assistance of Ted Brown at the Old Vicarage in facilitating this scheme of works.

3. Archaeological and historical background

3.1 The site is located opposite the historic St Gregory's Church in an area designated as high to medium archaeological sensitivity during a recent survey undertaken for the NNPA Historic Village Atlas.

3.2 Other known sites of archaeological significance include an Iron Age hillfort at Yeavering Bell and the Anglo-Saxon Palace at Yeavering known as Ad Gefrin.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised the old school grounds and included a lawn, a play area, hardstanding for a basketball/netball court and a small drive. To the east of the lawn was an overgrown area.

4.2 The survey area was predominantly level at a mean elevation of *c*.60m OD.

4.3 The underlying solid geology of the area comprises extensive andesitic and basaltic lavas and tuffs, which are overlain by alluvium and river terrace deposits and morainic drift.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage Research and Professional Services Guideline No.1, *Geophysical survey in archaeological field evaluation* (David 1995); the Institute of Field Archaeologists Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2001).

Technique selection

5.2 Geophysical surveying enables the relatively rapid and non-invasive identification of potential archaeological features within landscapes and can involve a variety of complementary techniques such as magnetometry, electrical resistance, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of 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, it was considered likely that cut features, such as ditches and pits, might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present. Due to the igneous geology of the study area and the likelihood that a geomagnetic survey may not prove useful, the use of both geomagnetic and earth electrical resistance survey techniques was specified. The resistance technique was expected to be particularly useful at detecting stone wall-footings.

5.4 Fluxgate gradiometry involves the use of hand-held magnetometers to detect and record minute 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 Earth electrical resistance is the most widely used electrical survey method and relies on the relative inability of materials to conduct an electrical current. When a small electrical current is injected through the earth it encounters sub-surface resistance which can be measured. Since resistance is linked to moisture content and porosity, rocky features such as wall foundations will give relatively high resistance values while soil-filled cut features, which retain more moisture, will provide relatively low resistance values. When measurements are taken over a regular grid, a map of sub-surface archaeological features can be produced. Although more time-consuming than magnetometry, this method can be used in a wider range of locations since it is not affected by the presence of buildings, wire fences, services or igneous geology.

Field methods

5.6 A 20m grid was established across the survey area and tied-in to known, mapped Ordnance Survey points using a Leica TR307 total survey station.

5.7 Measurements of vertical geomagnetic field gradient were determined using a Bartington Grad601-2 fluxgate gradiometer. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 1600 sample measurements per 20m grid unit.

5.8 Measurements of electrical resistance were determined using a Geoscan RM15D resistance meter with 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 set to 0.1ohm, the sample interval to 1.0m and the traverse interval to 1.0m, 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 (unfiltered) data. The greyscale images and interpretations are presented in Figures 2-3; the trace plots are provided in Appendix I. In the greyscale images, positive magnetic/high resistance anomalies are displayed as dark grey and negative magnetic/low resistance anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla/ohm.

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

Clip	clips, or limits 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.
Despike	locates and suppresses random iron spikes in gradiometer data.
Destagger	corrects for displacement of geomagnetic anomalies 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 gradiometer data have been interpolated to 0.25 x 0.25m intervals.

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

Despike	locates and suppresses spikes caused by very high probe contact resistance.
Interpolate	increases the number of data points in a survey to match sample and traverse intervals. In this instance the earth resistance data have been interpolated to 0.25 x 0.25m intervals.

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretation plans are provided in Figures 2-3. 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.

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

5.14 Colour-coded archaeological interpretation plans are provided in Figures 2-3. Except where stated otherwise in the text below, positive magnetic anomalies are taken to reflect relatively high magnetic susceptibility materials, typically sediments in cut archaeological features (such as furrows, ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

Area 1 (Figures 2-3)

5.15 Linear positive magnetic anomalies detected in the western half of the survey, which correspond to high resistance anomalies, probably reflect brick footings or clay drains. These may be associated with the manhole cover noted nearby, also evident as a strong dipolar and high resistance anomaly.

5.16 An area of strong dipolar magnetic anomalies detected at the southern edge of the survey appears to correspond to a slight depression on the surface. This may reflect a large pit infilled with ferrous material and rubble. This is also shown as an area of anomalously high resistance, indicating rubble and/or voids.

5.17 Weak parallel discontinuous positive and negative magnetic lineations recorded in the eastern part of the survey aligned east-west, possibly represent remains of ridge and furrow.

5.18 Two chains of strong dipolar anomalies detected in the northwest corner of the survey, almost certainly reflect service pipes; one of these is ferrous and corresponds to a low resistance anomaly.

5.19 Additional large dipolar magnetic anomalies detected in the southwestern part of the survey represent a hardstanding court and basketball/netball hoop.

5.20 A line of dipolar magnetic anomalies along the northern edge of the survey reflects wire fencing inside the hedgerow.

5.21 A line of anomalously high resistance with a northeast-southwest orientation was detected in the eastern part of the survey. This does not correspond to a magnetic anomaly and may reflect either stone fill in a service trench or a stone path.

5.22 An area of low resistance anomalies traversing the central part of the survey with an east-west orientation presumably reflects a geomorphological variation.

5.23 The only other anomalies detected here are small, discrete dipolar magnetic anomalies. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments. Two small discrete areas of anomalously low resistance in the southern part of the survey may represent removed tree boles.

Area 2 (Figure 3)

5.24 Due to the small size of the area and the close proximity of buildings and services it was considered inappropriate to use the gradiometer for this area.

5.25 An area of low resistance values recorded in the southern part of the area corresponds to the removal of a large tree bole.

6. Conclusions

6.1 Both geomagnetic and electrical resistance surveys have been carried out on land at Kirknewton Primary School.

6.2 The majority of anomalies detected in both areas reflect modern activities, with the exception of possible brick footings, a stone path and traces of ridge and furrow.

7. Sources

David, A, 1995 *Geophysical survey in archaeological field evaluation*, Research and Professional Services Guideline **1**, English Heritage

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

Schmidt, A, 2001 *Geophysical Data in Archaeology: A Guide to Good Practice*, Archaeology Data Service, Arts and Humanities Data Service

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Figure 1
Location of geophysical surveys

for
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geophysical surveys

0 1km

scale 1:25 000 - for A4 plot

a) Geophysical survey

outline of survey area

10.00
8.33
6.67
5.00
3.33
1.67
0.00
-1.67
-3.33
-5.00
-6.67
-8.33
-10.00 nT

b) Geophysical interpretation

positive magnetic anomalies

negative magnetic anomalies

dipolar magnetic anomalies

c) Archaeological interpretation

soil-filled features

service pipes

orientation of ridge and furrow

manhole cover

basketball hoop

0 25m

scale 1:500 - for A2 plot

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geophysical survey

Report 1676

Figure 2

Geophysical survey, geophysical and archaeological interpretations (magnetic)

a) Geophysical survey

outline of survey area

150.00
143.33
136.67
130.00
123.33
116.67
110.00
103.33
96.67
90.00
83.33
76.67
70.00 ohm

b) Geophysical interpretation

high resistance

low resistance

c) Archaeological interpretation

possible rubble-filled feature

possible tree removed

manhole cover

0 25m

scale 1:500 - for A2 plot

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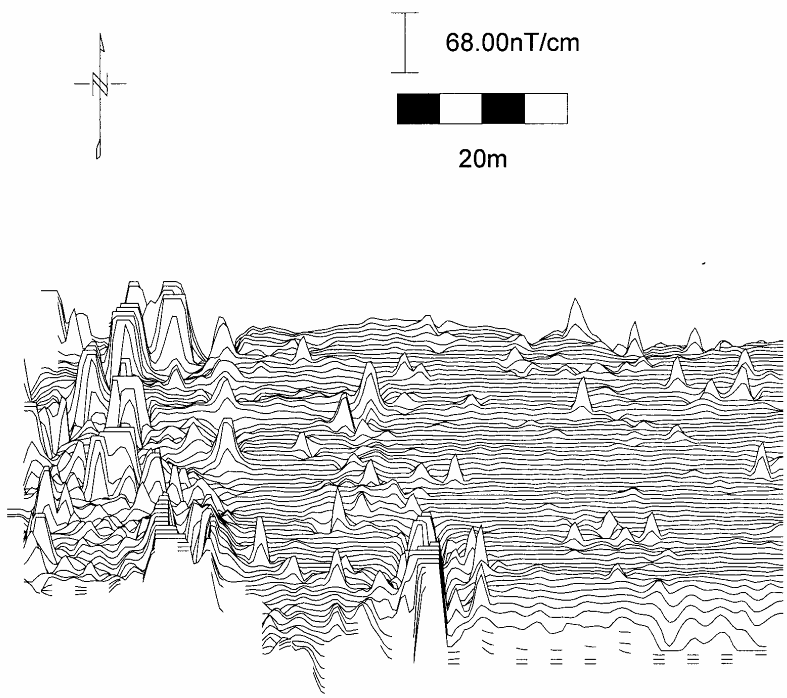
Figure 3

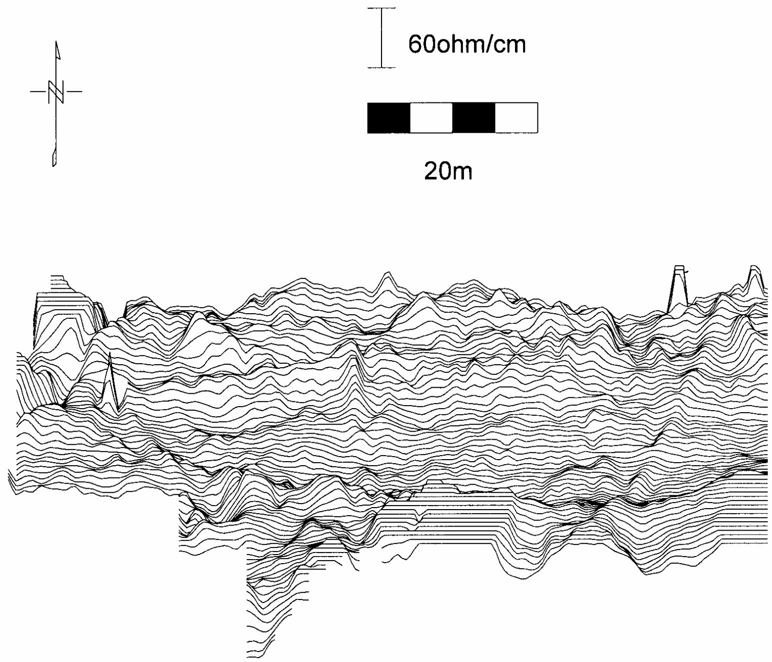
Geophysical survey, geophysical and archaeological interpretations (resistance)

Appendix I: Trace plots of geophysical data

Area 1, Magnetic data



Area 1, Resistance data



Area 2, Resistance data