Archaeological Services
University of Durham

Belper Parks Historic Landscape Survey, Belper, Derbyshire

geophysical surveys

on behalf of
ARCUS

Report 1619
February 2007

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Contents

1. Summary

The project

1.1 This report presents the results of geophysical surveys undertaken as part of the Belper Parks Historic Landscape Survey. The works comprised two areas of magnetometer survey totalling approximately 4ha.

1.2 The works were commissioned by ARCUS and conducted by Archaeological Services in accordance with instructions supplied by ARCUS.

Results

1.3 Anomalies which may reflect traces of ridge and furrow cultivation have been identified in Area A.

1.4 No other features of potential archaeological significance have been identified within the surveys.

2. Project background

Location (Figure 1)

2.1 The study areas are located at Belper Parks, Belper, Derbyshire (NGR: SK 5149 7375).

Objective

2.2 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological significance, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be undertaken as part of the Historic Landscape Survey.

Methods statement

2.3 The surveys have been undertaken in accordance with instructions provided by ARCUS.

Dates

2.4 Fieldwork was undertaken between 31st July and 1st August 2006 and the 5th and 6th February 2007. This report was prepared between 7th and 15th February 2007.

Personnel

2.5 Fieldwork was conducted by Edward Davies, Richie Villis and Graeme Attwood (Supervisor). This report was prepared by Graeme Attwood with illustrations by David Graham. The Project Manager was Duncan Hale.

Archive/OASIS

2.6 The site code is **BPD07**, for **B**elper **P**arks, Belper, **D**erbyshire 20**07**. The survey archive will be supplied on CD to ARCUS for deposition with the project archive. 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-**23805.

3. Archaeological and historical background

3.1 The Friends of Belper Parks group was set up to protect and restore the natural diversity of the Belper Parks, while investigating the historical importance of this part of Belper.

3.2 For a detailed history of the Belper Parks see http://www.belperparks.org.uk/index.html

4. Landuse, topography and geology

4.1 At the time of survey Area A comprised a field of scrub land, with very thick vegetation to the north of the field; this prevented survey in this area. Area B

consisted of a recreation ground made up of football pitches and short grass. To the eastern end of this area there was a considerable drop off in the land which again made survey impractical.

4.2 Survey Area A sloped from the north at *c*. 85m OD to the south by Coppice Brook at *c*. 75m OD, while survey Area B was predominantly level at a mean elevation of *c*.120m OD.

4.3 The underlying solid geology of the area comprises Namurian strata of the Upper Carboniferous Millstone Grit Series.

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, based on previous work, it was considered likely that cut features, such as ditches and pits, would 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.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting each of the types of feature mentioned above. This technique 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.

Field methods

5.5 A 30m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using Trimble Pathfinder Pro XRS global positioning system (GPS) with subsequent RINEX calibration.

5.6 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 30m 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 3600 sample measurements per 30m grid unit.

5.7 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

5.8 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 Figure 2; the trace plots are provided in Appendix I. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

5.9 The following basic processing functions have been applied to each 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.
Destagger	corrects for displacement of anomalies caused by alternate zig-zag traverses.
Despike	locates and suppresses random iron spikes in gradiometer data.
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.

Interpretation: anomaly types

5.10 Colour-coded geophysical interpretation plans are provided for each survey area. Two 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.

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.

Interpretation: features

5.11 Colour-coded archaeological interpretation plans are provided for each survey area.

General comments

5.12 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.

5.13 Small, discrete dipolar magnetic anomalies have been detected in both of the survey areas. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes, tin cans and brick fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plans, however, they have been omitted from the archaeological interpretation plans and the following discussion.

Area A (Figure 2)

5.14 A series of parallel positive magnetic anomalies aligned east - west may reflect former ridge and furrow cultivation of the land.

5.15 Several small positive magnetic anomalies have been identified across the survey area; these could represent the remains of soil-filled features, possibly pits.

5.16 A chain of dipolar magnetic anomalies was detected along the southern edge of the survey area and reflects the presence of a service pipe.

5.17 A large area of dipolar magnetic anomalies in the western half of the survey reflects an area of disturbed ground.

Area B (Figure 2)

5.18 A series parallel positive magnetic anomalies almost certainly reflects the presence of land drains.

5.19 Several small positive magnetic anomalies have been identified across the survey area; these could represent the remains of soil-filled features, possibly pits.

5.20 Dipolar magnetic anomalies have been detected throughout the area; these represent soil litter as mentioned above and the various goal posts, post sockets and park benches which are sited throughout the recreation ground.

6. Conclusions

6.1 Geomagnetic surveys have been carried out in the Belper Parks.

6.2 Anomalies which may reflect the presence of ridge and furrow cultivation have been identified in Area A.

6.3 No other features of likely archaeological significance have been identified within the surveys.

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

Area A

Area B

The Park

BELPER

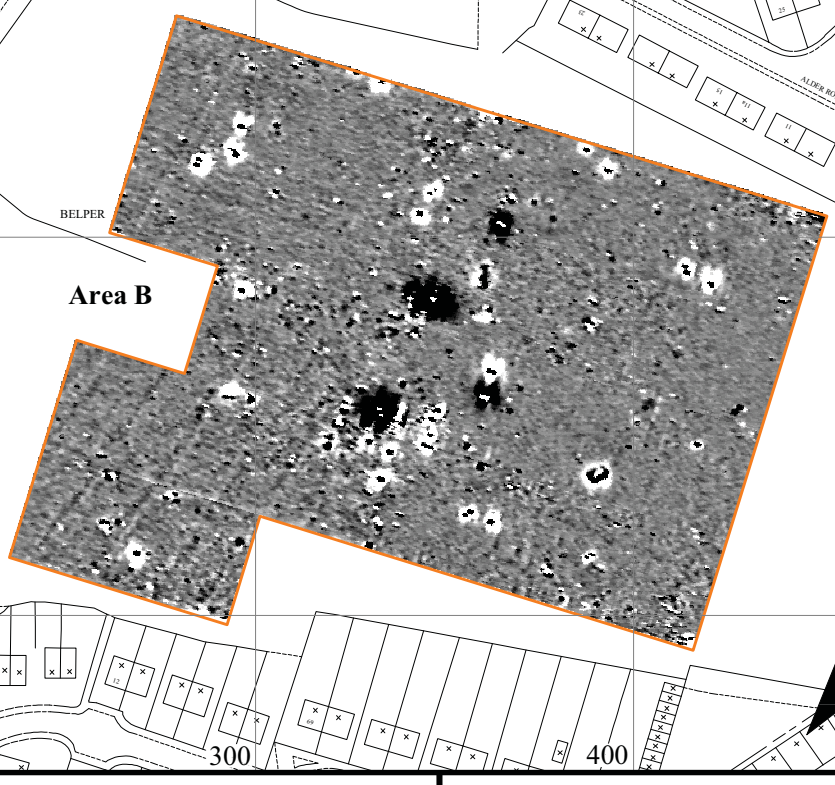

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Figure 1
Areas A and B, geophysical surveys

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0 1km
insert scale 1:25 000 - for A3 plot

0 100m
scale 1:2000 - for A3 plot

outline of survey area

5.00
4.17
3.33
2.50
1.67
0.83
0.00
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

Areas A and B, geophysical surveys

5.00
4.17
3.33
2.50
1.67
0.83
0.00
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

outline of survey area

Areas A and B, geophysical interpretation

outline of survey area

positive magnetic anomalies

dipolar magnetic anomalies

Areas A and B, archaeological interpretation

outline of survey area

soil-filled features

service pipes

?ridge and furrow

disturbed ground

field drains

goal posts and settings

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Figure 2
Geophysical surveys

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0 50m
scale 1:1000 - for A1 plot

Appendix I: Trace plots of geophysical data

Area A

Area B