ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Halcrow Group Ltd

Windy Bank
Hamsterley
County Durham

geophysical survey

report 2667
May 2011

Durham University

Contents

Figures

South Road · Durham · DH1 3LE · tel 0191 334 1121 · fax 0191 334 1126
archaeological.services@durham.ac.uk · www.dur.ac.uk/archaeological.services

1. Summary

The project

1.1 This report presents the results of a geophysical survey conducted in advance of proposed development south of Windy Bank Road, Hamsterley, County Durham. The works comprised the geomagnetic survey of 22ha of mixed use farmland.

1.2 The works were commissioned by Halcrow Group Ltd and conducted by Archaeological Services Durham University.

Results

1.3 The survey has not detected anomalies consistent with convent or other building wall remains, reported to have stood in Area 2 until the mid-19th century and then been removed. Indeed, a cluster of anomalies in the recorded location of the convent is consistent with disturbed ground there. In different circumstances, i.e. if it wasn't for the convent location being shown on the Ordnance Survey, some of the anomalies at this location could be interpreted as the remains of a small unenclosed settlement, comprising ring-ditches and possible small-scale industrial debris.

1.4 Probable soil-filled features were detected in most of the survey areas. Some of these almost certainly reflect former boundaries of small fields and paddocks, while others are of less certain origin and some may not be anthropogenic.

1.5 Ridge and furrow remains were detected in Areas 1, 3, 5, 7 and 9.

1.6 A service pipe was almost certainly detected in Area 11; possible land drains were detected in a number of areas.

Recommendations

1.7 The geomagnetic survey has not identified areas of potential convent or other building remains which might have required clarification by targeted use of earth resistance survey.

1.8 However, a programme of trial trenching may be required in order to determine the nature and origin of some of the anomalies.

2. Project background

Location (Figures 1 & 2)

2.1 The study area was located south and east of Windy Bank Road and Hamsterley Forest, south-west of Hamsterley village, County Durham, (NGR centre: NZ 070 290). The northern part of the area lies within South Bedburn parish, the southern part within Lynesack and Softley parish. The proposed development area is bounded to the north and west by Windy Bank Road and to the east by a lane that connects Windy Bank Road and Crane Row Lane, which forms the southern boundary of the site.

2.2 Eleven surveys, covering approximately 22ha, were conducted in twelve land parcels.

Development proposal

2.3 The development proposal is for a wind farm comprising five turbines, crane hardstanding areas, a construction compound and cable and access tracks.

Objective

2.4 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 relation to the development.

Methods statement

2.5 The surveys areas were agreed by Halcrow Group and Durham County Council Archaeology Section. The surveys were undertaken in accordance with a Written Scheme of Investigation (WSI) provided by Archaeological Services Durham University and approved by Durham County Council Archaeology Section, and with national standards and guidance (see para. 5.1 below).

Dates

2.6 Fieldwork was undertaken between 3rd and 11th May 2011. This report was prepared for 27th May 2011.

Personnel

2.7 Fieldwork was conducted by Jamie Armstrong, Tom Fitton, Annie Marie-Sohler and Natalie Swann (Supervisor). Geophysical data processing and report preparation were conducted by Duncan Hale (the Project Manager) and Natalie Swann, with illustrations by Janine Watson.

Archive/OASIS

2.8 The site code is **HWB11**, for **H**amsterley **W**indy **B**ank 20**11**. The survey archive will be supplied on CD to the client for deposition with the project archive 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 **archaeol3-101884**.

3. Historical and archaeological background

Previous archaeological works

3.1 An archaeological desk-based assessment of the proposed development area has previously been undertaken (ASWYAS 2010). The results of that assessment are summarised here.

3.2 Two archaeological assessments have been conducted on the eastern edge of the proposed development area (PRN 4896 & 5003). These assessments identified former field boundaries, traces of ridge and furrow cultivation and remains associated with quarrying.

The prehistoric period (up to AD 70)

3.3 No evidence of prehistoric activity has been recorded within the proposed development area, though a mound of unknown origin which could be a prehistoric barrow has been identified south of the proposed development area (PRN 4744).

The Roman period (AD 70 to 5th century)

3.4 There are no known features dating to the Roman period within the proposed development area, though possible Romano-British enclosures have been identified as cropmarks at Butterknowle (PRN 2038), east of the proposed development area.

The medieval period (5th century to 1540)

3.5 A medieval convent (PRN 2035) is recorded as being situated within the proposed development area, approximately 600m west of Linburn Hall. The site was occupied throughout the medieval period up to the Dissolution in the 16th century when it was abandoned, though its walls were still visible up to 1853 when they were removed. The site of the convent is recorded on the Ordnance Survey (OS) map of 1857 and subsequent early editions. An area of irregular ground was recorded on the site in 1956.

3.6 Medieval coal mines have been identified at Cold Hurst, approximately 2.2km to the south-east of the proposed development site, and the monks of Finchale Priory established a colliery at Softley, approximately 1.8km to the south-east, in 1326.

The post-medieval period (1541 to 1899)

3.7 The proposed development site was enclosed by 1763, a process which established much of the existing field pattern. From the mid-17th century there was an increase in coal mining throughout County Durham and a number of disused mine shafts were recorded throughout the Woodland area in the 18th century (SMR No. 6806). The Ordnance Survey maps of 1859 and 1898 show the locations of the Woodland and Crake Scar collieries, along with the associated shafts and reservoirs. The original shafts of the Crake Scar colliery were situated at the southern end of the proposed development site in the mid-19th century. By 1898, the focus of the colliery had moved to the east of the proposed development site, beside the Woodland Branch mineral railway which linked the Woodland and Crake Scar collieries. Much of the coal extracted in the area was turned into coke at the coke ovens located beside Crake Scar colliery and the mineral railway.

3.8 The Ordnance Survey maps of 1923 and 1924 show no major changes within the proposed development site from the late 19th century. Work at the Crake Scar and Woodland collieries gradually wound down in the late 1920s and 1930s and the

railway line was abandoned. The remains of the disused shafts and opencast workings are still extant throughout the study area.

4. Landuse, topography and geology

4.1 At the time of fieldwork the specified survey areas were predominantly within pasture fields, some containing upstanding ridge and furrow earthworks. Further information is provided in the table below.

Area	Size (ha)	Landuse	Topography	NGR
1	5.16	pasture	gentle east-facing slope; ridge and furrow earthworks	NZ 07211 29229
2	5.60	pasture	gentle south-east-facing slope	NZ 07030 29082
3	3.72	arable, cereal	gentle south-east-facing slope	NZ 06877 28941
4	2.16	pasture	gentle south-east-facing slope	NZ 07131 28966
5	2.48	pasture	gentle south-east-facing slope; ridge and furrow earthworks	NZ 07033 28779
6	1.00	rough pasture, very boggy	gentle south-east-facing slope	NZ 07199 28785
7	1.00	pasture	gentle east-facing slope; ridge and furrow earthworks in N field	NZ 06984 28378
8	0.01	pasture	gentle east-facing slope; ridge and furrow earthworks	NZ 06797 28476
9	1.00	pasture	gentle east-facing slope ridge and furrow earthworks in SW field	NZ 06595 28608
10	0.01	pasture	gentle east-facing slope	NZ 06739 28767
11	0.48	pasture	gentle east-facing slope	NZ 08117 27064
12	0.01 (not surveyed)	pasture	gentle east-facing slope	NZ 07976 27432

4.2 It was not possible to collect data in one specified 10m by 10m area (Area 12) due to the presence of bullocks in the field.

4.3 The survey areas typically occupied the top and upper east- and south-east-facing slopes of a north-east/south-west aligned ridge, at elevations between 280-300m OD. Area 11, in the south of the site, was on land with a mean elevation of approximately 330m OD.

4.4 The underlying solid geology of the area comprises Carboniferous sandstone of the Pennine Lower Coal Measures Formation, which are overlain by Devensian till in places.

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) *Draft Standard and Guidance for archaeological geophysical survey* (2010); 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* (draft 2nd edition, Schmidt & Ernenwein 2010).

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, based on desktop and aerial photographic cropmark evidence, it was considered possible that remains associated with a former convent might be present on the site, and that other types of feature such as ditches, pits, trackways 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 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 Although the walled remains of the convent were reportedly removed in 1853, a contingency for earth electrical resistance survey was included on the WSI, to be employed if the geomagnetic surveys indicated possible building remains. 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 each survey area and tied-in to known, mapped Ordnance Survey points using a Trimble Pathfinder Pro XRS global positioning system with real-time correction.

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 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

5.9 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 3-5; the

trace plots are provided in Figure 6. 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.

5.10 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

Interpretation: anomaly types

5.11 A colour-coded geophysical interpretation plan is 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

Interpretation: features

General comments

5.12 A colour-coded archaeological interpretation plans is provided.

5.13 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 ditches or pits) whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

5.14 A relatively high concentration of small, discrete dipolar magnetic anomalies has been detected in most of the survey areas. These anomalies almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments, and may be associated with night-soiling and manuring practices; such

anomalies typically have little or no archaeological significance. A sample of these is shown on the geophysical interpretation plan, however, they have been omitted from the archaeological interpretation plan and the following discussion.

5.15 Series of parallel, weak, positive magnetic anomalies, which almost certainly reflect former ridge and furrow cultivation, have been detected in the following surveys: Areas 1, 3, 5, 7 and 9. Areas 8 and 10 were too small to enable identification of such features, though upstanding ridge and furrow remains were noted in parts of the field containing Area 8.

Area 1

5.16 The ridge and furrow here is bounded by a weak anomaly reflecting a headland and another adjacent weak anomaly which almost certainly reflects a former field boundary, as shown on the 1859 OS.

5.17 Several other linear positive magnetic anomalies in this area are generally aligned north-east/south-west and could reflect further soil-filled features. It is not clear if these are the truncated remains of archaeological ditches, or drains, or possibly small fissures in the rockhead.

5.18 Relatively intense magnetic anomalies near the centre of the survey could possibly reflect remains associated with a small structure.

Area 2

5.19 Several linear positive magnetic anomalies in this area are similar to those detected in Area 1 (para. 5.17 above) and could reflect soil-filled features of unknown origin.

5.20 Other linear and curvilinear positive magnetic anomalies detected here, particularly near the south-eastern edge of the field, are considered more likely to reflect archaeological ditches, some of which may form enclosures and continue into the adjacent field, Area 4.

5.21 A cluster of relatively strong magnetic anomalies in the south-western part of the field broadly corresponds to the location of the former convent as shown on early OS maps. The anomalies are positive magnetic and dipolar, typically indicating materials with high magnetic susceptibility and permanent magnetisation such as some sediments and brick rubble/ferrous debris. The survey has not detected any negative magnetic anomalies here, which would be more likely to reflect sedimentary stone wall-footings or rubble, though, as mentioned above, the walls were reportedly entirely removed in the 19th century. The area of disturbed ground indicated by the anomalies is relatively small, less than 20m by 60m, and there do not appear to be any other, possibly associated, anomalies which might reflect tracks, paths, gardens or any other features. Some of the positive magnetic anomalies are arcuate, measuring up to approximately 10m in diameter. These would often be interpreted as soil-filled ring-ditches, perhaps associated with roundhouses or small cairns and barrows, however, in this instance they could simply be associated with the removal of the convent walls. If the location of the former convent is incorrectly marked on OS plans then these anomalies would take on greater significance.

Area 3

5.22 Several positive magnetic anomalies have been detected in this area (in addition to those reflecting probable traces of former ridge and furrow). Some of the anomalies are very weak, while others are strong, and again probably reflect soil-filled features, which are more likely to be former field boundaries and paddocks than occupation features.

Area 4

5.23 As detected in Areas 2 and 3, above, and Area 5, below, the linear magnetic anomalies here probably reflect the former boundaries of small fields and paddocks; some of the anomalies extend into adjacent survey areas.

Area 5

5.24 A number of probable soil-filled features have been detected here, perpendicular and oblique to the upstanding ridge and furrow remains. Some of these continue into Area 4 and probably reflect former boundaries of small fields and paddocks.

5.25 Some extremely weak, small, curvilinear anomalies could possibly reflect the remains of ring-ditches.

5.26 A large intense magnetic anomaly towards the southern corner of this area corresponds to a brick-built cover over a spring.

Area 6

5.27 A very weak negative magnetic anomaly was detected across the southern corner of this area; this probably reflects a field drain.

Area 7

5.28 This survey area spanned a stone wall with an adjacent electric fence and a telegraph pole towards the southern corner.

5.29 Ridge and furrow earthworks were evident in parts of the larger, northern area, and have been detected geomagnetically. However, similar anomalies aligned north-south in part of this area indicate another, earlier, phase of ridge and furrow here.

Area 8

5.30 This survey area was too small to identify the shapes of any weaker anomalies which might be present, or to enable their interpretation. Occasional positive or magnetic spikes probably indicate small items of ferrous/fired litter.

Area 9

5.31 This survey area spanned a stone wall with an adjacent electric fence.

5.32 Ridge and furrow earthworks were evident in the smaller, southern area, and have been detected geomagnetically.

5.33 In the larger, northern area the survey has detected broad bands of small dipolar magnetic anomalies. There is a high concentration of such anomalies throughout the survey area but there appear to be five bands of particularly high concentrations. These could possibly reflect some sort of land drainage, where fired brick or tile

rubble has been used to make French drains. Although this interpretation is uncertain, it is quite likely that these features are not of archaeological significance.

5.34 A few extremely weak positive magnetic anomalies could possibly reflect soil-filled features.

Area 10

5.35 This survey area was too small to identify the shapes of any weaker anomalies which might be present, or to enable their interpretation. Occasional positive or magnetic spikes probably indicate small items of ferrous/fired litter.

Area 11

5.36 A chain of intense dipolar magnetic anomalies has been detected across this area, aligned broadly north-south towards a group of farm buildings and a mast. This almost certainly reflects a service pipe.

5.37 A few extremely weak positive magnetic anomalies could possibly reflect soil-filled features.

6. Conclusions and recommendations

6.1 Approximately 22ha of geomagnetic survey was conducted at Windy Bank, near Hamsterley in County Durham, prior to a proposed wind farm development.

6.2 The survey has not detected anomalies consistent with convent or other building wall remains, reported to have stood in Area 2 until the mid-19th century and then been removed. Indeed, a cluster of anomalies in the recorded location of the convent is consistent with disturbed ground there. In different circumstances, i.e. if it wasn't for the convent location being shown on the OS, some of the anomalies at this location could be interpreted as the remains of a small unenclosed settlement, comprising ring-ditches and possible small-scale industrial debris.

6.3 Probable soil-filled features were detected in most of the survey areas. Some of these almost certainly reflect former boundaries of small fields and paddocks, while others are of less certain origin and some may not be anthropogenic.

6.4 Ridge and furrow remains were detected in Areas 1, 3, 5, 7 and 9.

6.5 A service pipe was almost certainly detected in Area 11; possible land drains were detected in a number of areas.

6.6 The geomagnetic survey has not identified areas of potential convent or other building remains which might have required clarification by targeted use of earth resistance survey.

6.7 A programme of trial trenching may be required in order to determine the nature and origin of some of the anomalies.

7. Sources

ASWYAS 2010 *Windy Bank, County Durham: an archaeological desk-based assessment*. Unpublished report **2063**, Archaeological Services WYAS

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 2010 *Draft Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2010 (draft) *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

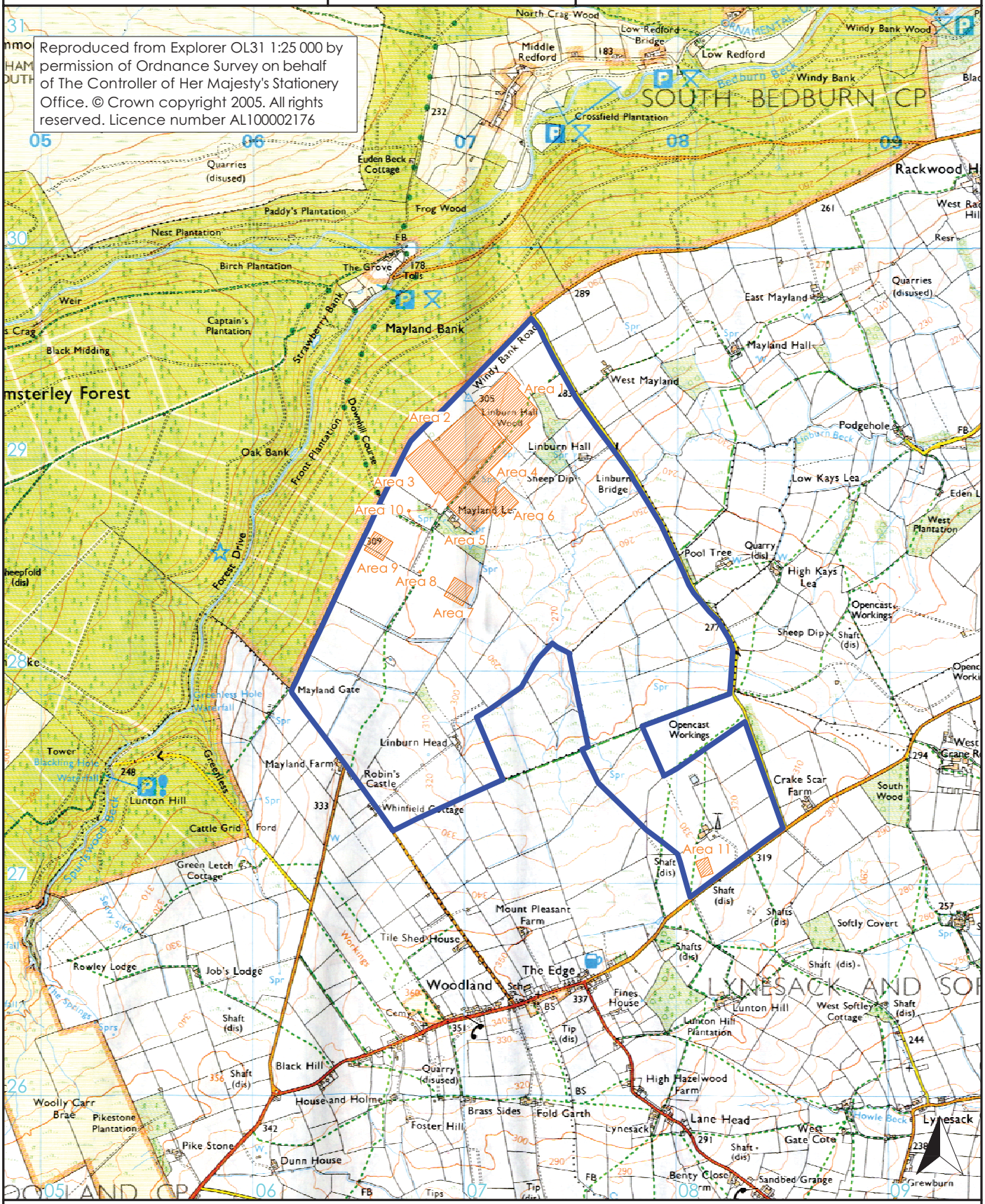
on behalf of

Halcrow Group Ltd

Windy Bank, Hamsterley, County Durham

geophysical survey report 2667

Figure 1: Site location



site boundary

survey areas

0 1km

scale 1:25 000 for A4 plot

site boundary

Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

Area 7

Area 8

Area 9

Area 10

Area 11

29

28

27

07

08

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Halcrow Group Ltd

0 500m
scale 1:10 000 for A3 plot

Windy Bank
Hamsterley
County Durham

geophysical survey
report 2667

Figure 2: Geophysical survey overview

WINDY BANK ROAD

Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

Area 7

Area 8

Area 9

Area 10

Area 11

Track

Track

Spr

Spr

Spr

Low Wood

Shaft (dis)

294
293
292
291
290
289
288
287
286
285
284
271
270
066
067
068
069
070
071
081
082

magnetic survey

-5 nT 5

0 50m

scale 1:1000 for A0 plot

on behalf of

Halcrow Group Ltd

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

Windy Bank
Hamsterley
County Durham

geophysical survey
report 2667

Figure 3: Geophysical surveys

WINDY BANK ROAD

Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

Area 7

Area 8

Area 9

Area 10

Area 11

Track

Track

Spr

Spr

Spr

Low Wood

Shaft (dis)

294 293 292 291 290 289 288 287 286 285 284

066 067 068 069 070 071 081 082

271 270

magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly
negative magnetic anomaly

0 50m
scale 1:1000 for A0 plot

on behalf of
Halcrow Group Ltd

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

Windy Bank
Hamsterley
County Durham

geophysical survey
report 2667

Figure 4: Geophysical interpretations

WINDY BANK ROAD

Area 1

T1

Area 2

T3

Area 3

Area 4

T2

Area 5

Area 6

Area 7

T4

Area 8

Area 9

T5

Area 10

Area 11

Track

Track

Spr

Spr

Spr

spring outlet

Low Wood

Shaft (dis)

294
293
292
291
290
289
288
287
286
285
284
271
270

066
067
068
069
070
071
081
082

magnetic survey
soil-filled feature
possible disturbed area
service pipe
ridge and furrow earthworks
possible ridge and furrow
possible drain
former field boundary
track
telegraph pole
proposed development

0 50m
scale 1:1000 for A0 plot

on behalf of
Halcrow Group Ltd

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

Windy Bank
Hamsterley
County Durham

geophysical survey
report 2667

Figure 5: Archaeological interpretations

Windy Bank
Hamsterley
County Durham

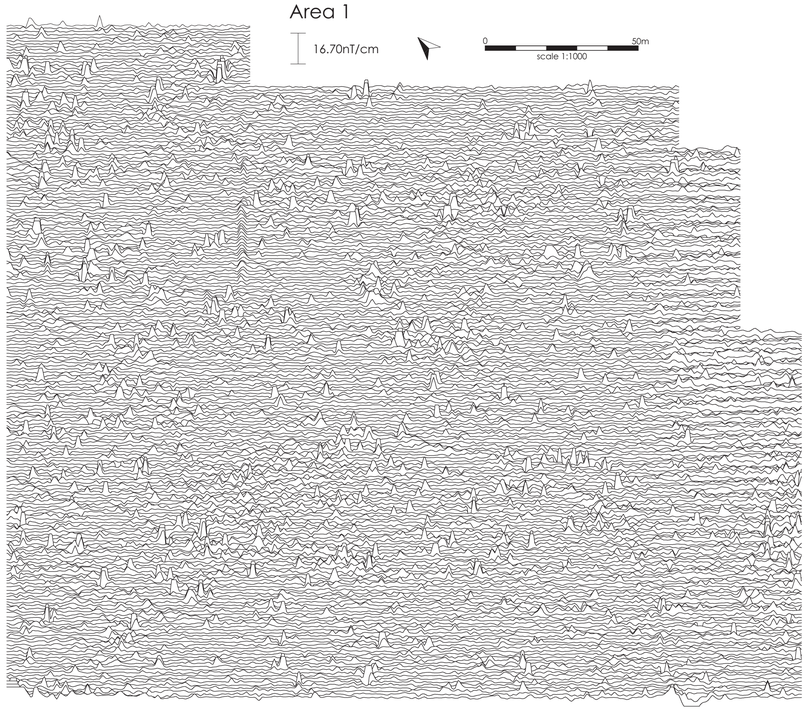
geophysical survey
report 2667

Figure 6:
Trace plots of geomagnetic data

Area 1

16.70nT/cm

0 50m
scale 1:1000



Area 2

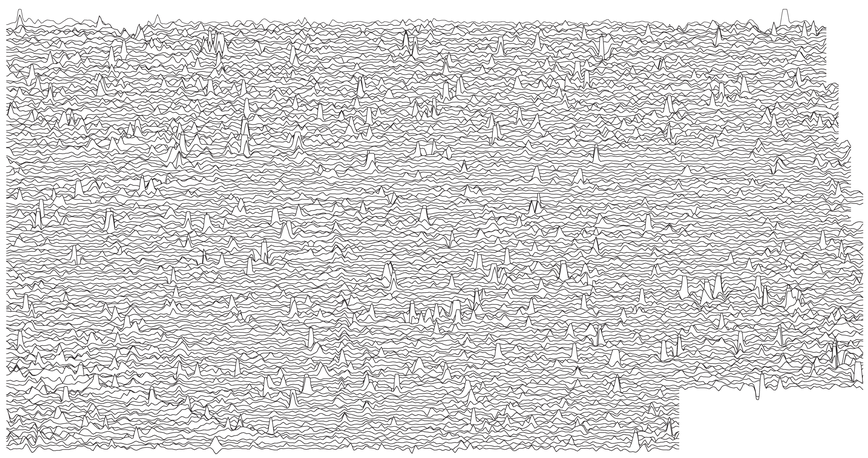
29.60nT/cm

0 50m
scale 1:1000

Area 3

14.30nT/cm

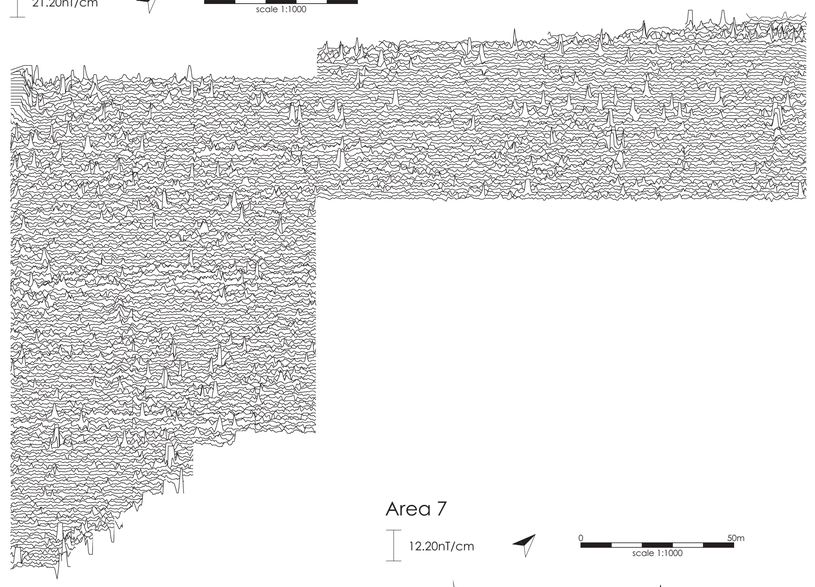
0 50m
scale 1:1000



Area 4

21.20nT/cm

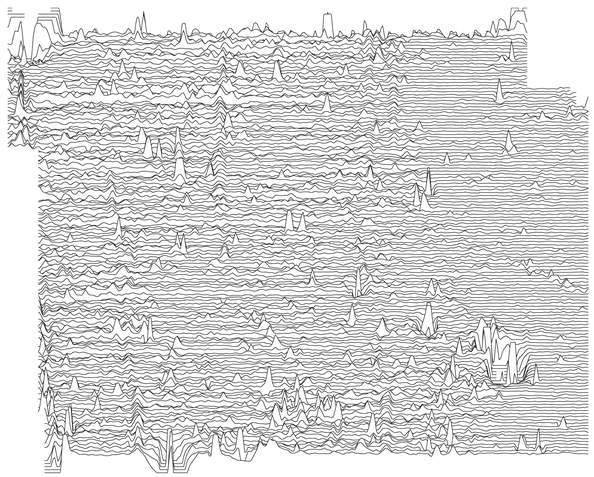
0 50m
scale 1:1000



Area 5

19.60nT/cm

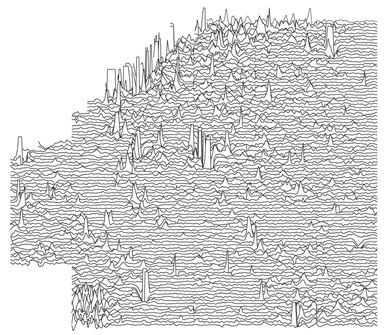
0 50m
scale 1:1000



Area 6

15.70nT/cm

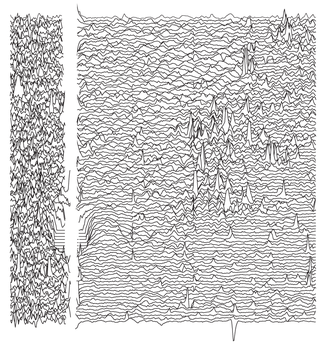
0 50m
scale 1:1000



Area 7

12.20nT/cm

0 50m
scale 1:1000



Area 8

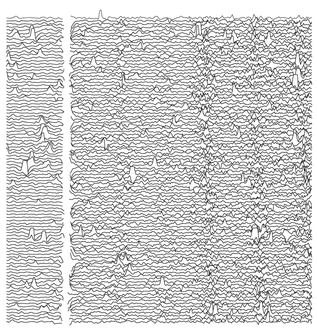
17.00nT/cm

0 50m
scale 1:1000

Area 9

38.80nT/cm

0 50m
scale 1:1000



Area 10

17.00nT/cm

0 50m
scale 1:1000

Area 11

11.20nT/cm

0 50m
scale 1:1000