ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Arcus Renewable Energy Consulting Ltd

Wingate Grange Wind Farm
Wingate
County Durham

geophysical survey

report 2998
October 2012

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted in advance of a proposed wind farm development at Wingate Grange Farm, County Durham. The works comprised the geomagnetic survey of nine areas totalling 8.6ha in size.

1.2 The works were commissioned by Arcus Renewable Energy Consulting Ltd and conducted by Archaeological Services Durham University.

Results

1.3 Occasional, probable soil-filled ditch features were identified in each survey area except Areas 6 and 8.

1.4 Former field boundaries were identified in Areas 5 and 9.

1.5 Traces of former and recent ploughing were identified in Areas 2, 3, 4, 6, 8 and 9.

1.6 Probable land drains were identified in Areas 1, 5, 6, 7 and 9.

1.7 A modern service was identified in Area 8.

Recommendations

1.8 No further geophysical survey is recommended in relation to the proposed development, however, the local planning authority may require further archaeological works, for example targeted trial trenching, to investigate features identified in the geophysical survey.

2. Project background

Location (Figure 1)

2.1 The proposed development area was located on land at Wingate Grange Farm, west of the village of Wingate, County Durham (NGR centre: NZ 38740 38002). Nine surveys totalling 8.6ha were conducted in six land parcels. To the north of the site lies woodland and the A181 road, to the east is woodland and to the west and south is open farmland. Wingate Grange Farm lies to the south.

Development proposal

2.2 The development proposal is for a five-turbine wind farm and associated infrastructure.

Objective

2.3 The principal aim of the surveys 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

2.4 The surveys have been undertaken in accordance with a specification provided by Durham County Council Archaeology Section (DCCAS; Appendix 1) and a Written Scheme of Investigation provided by Archaeological Services Durham University and approved by DCCAS.

Dates

2.5 Fieldwork was undertaken between 17-19th September 2012. This report was prepared for 3rd October 2012.

Personnel

2.6 Fieldwork was conducted by Tony Liddell, Natalie Swann, Nathan Thomas and Richie Villis (Supervisor). The geophysical data were processed by Natalie Swann. This report was prepared by Natalie Swann, with illustrations by Janine Watson, and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **DWG12**, for **D**urham **W**ingate **G**range 20**12**. 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 **archaeol3-134277**.

3. Historical and archaeological background

3.1 The proposed development lies in a landscape of some archaeological sensitivity, with potential for features dating to the prehistoric and medieval periods in particular to be impacted upon.

3.2 The development site contains within it two mounds that have been interpreted as a Neolithic long cairn and a Bronze Age round barrow. Though neither feature has

been excavated they do indicate that there is the potential for features dating to the prehistoric period to survive within the proposed development area.

3.3 The scheduled site of Old Wingate deserted medieval village lies immediately outside the western boundary of the site and there is the potential for features relating to the medieval period, for example former field systems, to survive within the proposed development area.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised six fields of arable land. Five of the fields contained stubble from oilseed rape and one field, Area 9, was ploughed.

4.2 The area sloped gently down from approximately 160m OD in the west to 130m OD in the east.

4.3 The geology comprises Late Permian dolostone of the Ford Formation, 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, based on known sites in the local area, 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.

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.

Field methods

5.5 A 30m grid was established across each survey area and related to known, mapped Ordnance Survey points and the National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.6 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 30m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 3,600 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 (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-8; the trace plots are provided in Figure 9. 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 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

5.10 Colour-coded geophysical interpretation plans 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

General comments

5.11 Colour-coded archaeological interpretation plans are provided.

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

5.13 Some series of parallel positive magnetic lineations detected across Areas 2, 3, 4, 6, 8 and 9 almost certainly reflect former and recent cultivation.

5.14 Further series of narrow parallel positive magnetic anomalies which were detected in Areas 1, 5, 6, 7 and 9 almost certainly reflect land drains.

5.15 Small, discrete dipolar magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes 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 1

5.16 Three linear positive magnetic anomalies were detected in this area, two aligned north-west/south-east and one north-east/south-west. These anomalies may reflect soil-filled features such as ditches.

Area 2

5.17 A broad linear positive magnetic anomaly was detected in this area aligned approximately north/south which may reflect a soil-filled ditch or drainage feature.

Area 3

5.18 A broad linear positive magnetic anomaly was detected near the western edge of this area, aligned north/south. This anomaly is similar to the feature detected in Area 2 and may also reflect a soil-filled ditch or drainage channel.

5.19 A second linear positive magnetic anomaly was detected aligned north-west/south-east which may also reflect a soil-filled feature such as a ditch.

5.20 The linear dipolar anomaly detected along the eastern side of this area corresponds to an existing track.

Area 4

5.21 Two linear positive magnetic anomalies were detected in the north of this area, which could reflect soil-filled ditches or former field boundaries.

5.22 A weak, discontinuous curvilinear positive magnetic anomaly was detected in the north of this area. This could reflect the truncated remains of a soil-filled ditch.

5.23 The dipolar magnetic anomalies detected at the eastern edge of the area reflect an existing track.

Area 5

5.24 Three linear positive magnetic anomalies were detected in the south east part of this area. The central, broader anomaly corresponds to a former field boundary shown on the historic Ordnance Survey (OS) maps. The other slightly narrower anomalies either side of the field boundary reflect land drains.

5.25 A further positive magnetic anomaly was detected aligned north-west/south-east, which probably reflects a former ditch.

5.26 Linear and curvilinear positive magnetic anomalies detected in the western part of this survey area probably also reflect soil-filled features such as enclosure or boundary ditches.

Area 6

5.27 The only anomalies detected in this area reflect land drains and traces of former ploughing as discussed above.

Area 7

5.28 A weak linear positive magnetic anomaly was detected in this area aligned north-west/south-east. This may reflect the remains of a ditch.

5.29 A short curvilinear positive magnetic anomaly was detected on the western edge of this area, which could also reflect the remains of a soil-filled ditch.

5.30 Intense anomalies detected on the eastern edge of the survey reflect the existing track.

Area 8

5.31 An intense dipolar magnetic anomaly was detected along the western edge of this area; this almost certainly reflects a service pipe along the field boundary.

Area 9

5.32 A strong linear positive magnetic anomaly was detected at the west end of this area, aligned approximately north/south, which probably reflects a former ditch.

5.33 A second, strong linear positive magnetic anomaly was detected aligned approximately north-west/south-east. This corresponds to a former field boundary shown on historic OS maps.

5.34 A further linear positive magnetic anomaly aligned north/south also corresponds to a former field boundary shown on historic OS maps.

6. Conclusions and recommendations

6.1 8.6ha of geomagnetic survey was undertaken on land west of Wingate in County Durham prior to the proposed Wingate Grange wind farm development.

6.2 Occasional, probable soil-filled ditch features were identified in each survey area except Areas 6 and 8.

6.3 Former field boundaries were identified in Areas 5 and 9.

6.4 Traces of former and recent ploughing were identified in Areas 2, 3, 4, 6, 8 and 9.

6.5 Probable land drains were identified in Areas 1, 5, 6, 7 and 9.

6.6 A modern service was identified in Area 8.

6.7 No further geophysical survey is recommended in relation to the proposed development, however, the local planning authority may require further archaeological works, for example targeted trial trenching, to investigate features identified in the geophysical survey.

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

Appendix: Project specification

SPECIFICATION FOR GEOPHYSICAL SURVEY: Wingate Wind Farm, Wingate, Co. Durham.

1 Site Location and background

1.1 This specification is for a geophysical survey in advance of a proposed wind farm development at Wingate, County Durham. The site is centred on grid reference NZ 38740 38002.

1.2 The site is located to the west of the village of Wingate, which is in turn south-west of the larger town of Peterlee. The site is currently agricultural land with woodland along it's northern, eastern and part of the southern boundary. Beyond the western boundary of the site farm fields extend to meet the B1278 (see Figures 1 & 2).

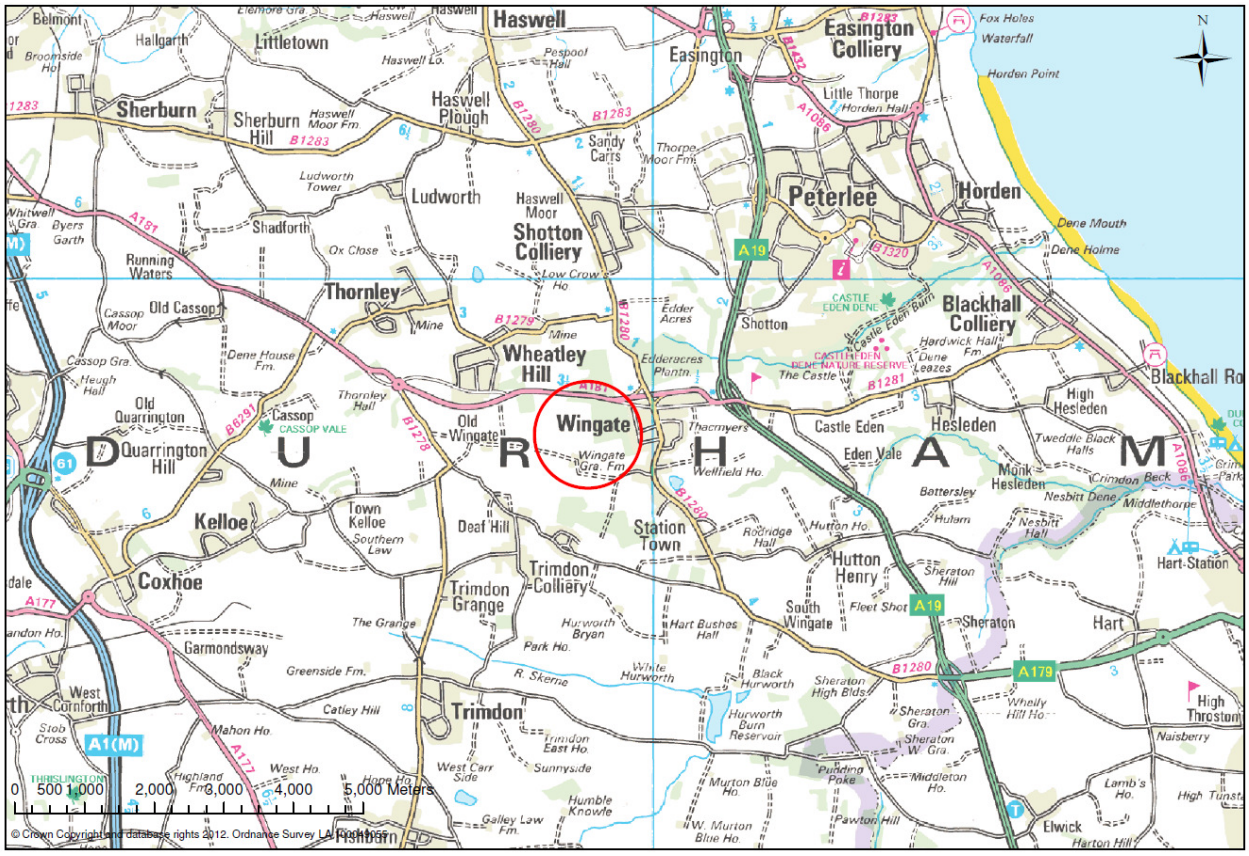

Figure 1: Site location shown in red (© Durham County Council)

2 The Development

2.1 A wind farm comprised of 5 turbines, associated access roads, construction compound, hard-standing for a crane pads and connection point to the national grid is proposed for the site (see Figure 2).

2.2 Arcus Renewable Energy Consulting Ltd, acting as agents for the developer, are preparing a desk-based assessment for the site, and field assessment will also be required to support an application for planning permission.

2.3 The first phase of this will take the form of a geophysical survey to identify potential archaeological features. The survey will target areas around the base of each turbine, along the proposed line of new access roads (with a buffer), and in the area for the crane pads, compound and substation.

2.4 The results of this survey will determine the need for further evaluation at this stage (trenching on anomalies) mitigation or micro-siting where feasible.

2.5 The appointed contractor will need to liaise with the applicant over scale plans of the site layout.

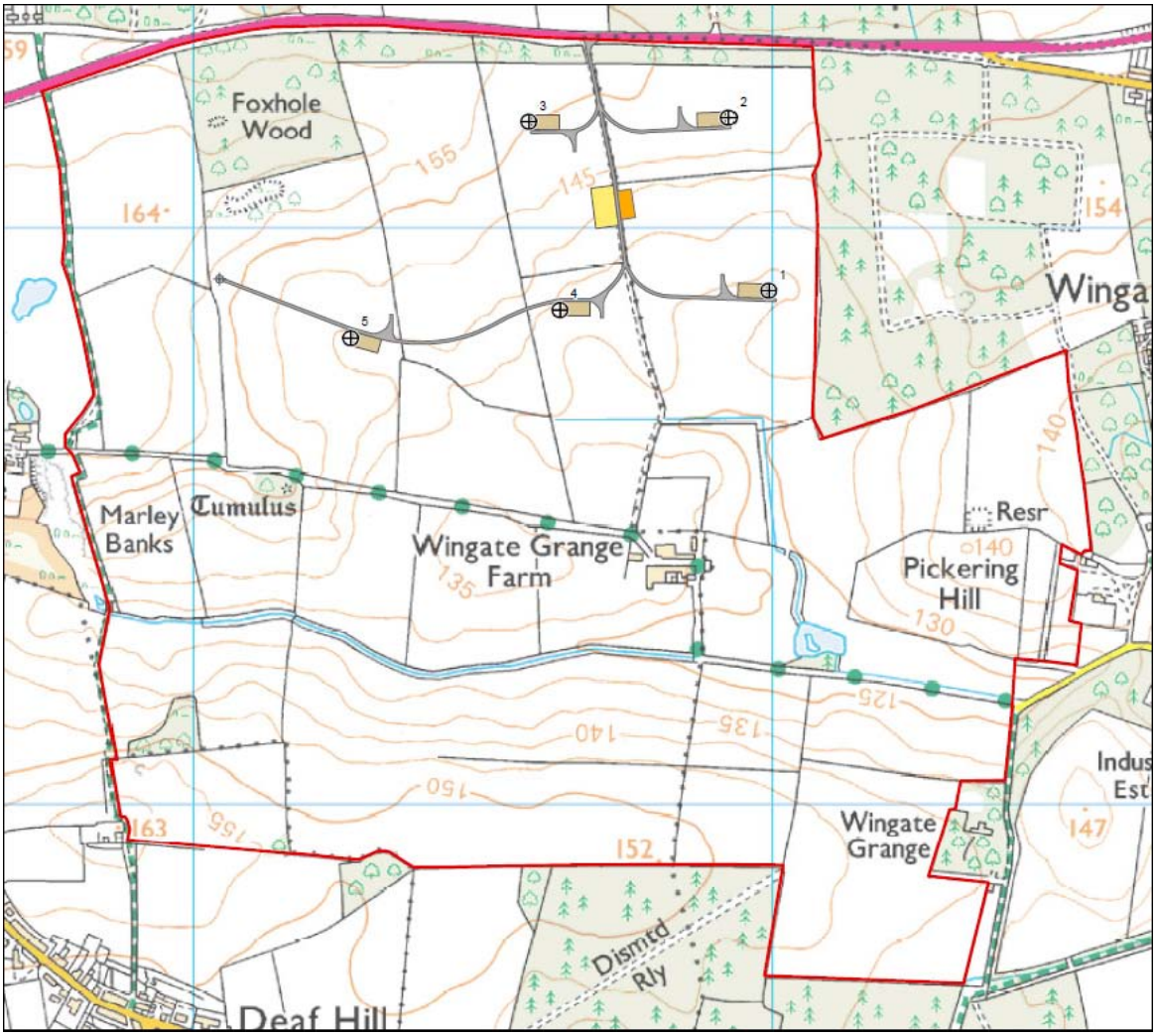

Figure 2: Proposed site layout showing site boundary in red, numbered turbines and crane pads, and new access roads, compound and substation (©InfinisArcus)

Regeneration & Economic Development: Design & Historic Environment

3 Background

3.1 The development lies in a landscape of some archaeological sensitivity, with potential for features datable to the Prehistoric and/or Medieval period in particular to be impacted upon by the work.

3.2 The development site contains within it two mounds that have been interpreted as a Neolithic long cairn and a Bronze Age round barrow. Whilst these interpretations are open to debate (neither site has been excavated) they do strongly suggest a prehistoric presence in the immediate vicinity of the ground works.

3.3 The scheduled site of Old Wingate deserted Medieval village lies immediately outside the site's western boundary, with the potential for field system evidence to extend into the development area.

3.4 A full desk-based assessment detailing the potential impacts of the scheme will be submitted with the results of the geophysical survey in support of the planning application for the wind farm.

4 Archaeological brief

4.1 This brief sets out the archaeological works required in order to assess and evaluate the site, and how they must be carried out. The report on the current works must be submitted and accepted by Durham County Council Archaeology Section before it can be used to support any application for planning permission.

4.2 It is expected that the archaeological works will be carried out according to archaeological best practice as set out in the following publications: Yorkshire, the Humber and the North-East: A Regional Statement of Good Practice for Archaeology in the Development Process (WYAAS 2009) and Standard and Guidance: an archaeological evaluation (IFA 1999).

4.3 In order to determine the potential for archaeological remains, the development site must initially be evaluated by geophysical survey. Depending on the results of this survey, targeted trial-trenching, further archaeological monitoring or excavation may be necessary.

Geophysical Survey

4.4 In order to evaluate the archaeological potential for remains of any period the site will be subject to a geophysical survey to provide archaeological evaluation data from within the development area. The use of remote sensing geophysical techniques (magnetometry) will be required to help define the potential archaeological features that may exist on the site.

4.5 The survey must cover the following; a minimum of 1 hectare around each turbine location (this area must include the site of the associated crane pad), the corridor of the proposed new access tracks with a 20m buffer (to allow for slight relocation if features are identified and can feasibly be avoided -existing tracks to be widened are exempt), the construction compound and substation areas with the line of any service connection if it deviates from the access roads.

4.6 A contingency for further magnetometer survey on a price per hectare basis must be costed into the project, to be used in the event of probable features extending beyond the survey area. The contingency budget can only be utilised after a consultation meeting between the client or their agent, the contractor, and the Durham County Council Archaeology Section.

4.7 Areas exempt from this survey are defined as those where ground conditions, vegetation or water cover makes it impracticable to carry out the survey. In addition a buffer zone around field boundaries and buildings may be needed to reduce interference from fences, footpaths and debris often associated with field boundaries. Partial grids may be excluded if they prove to be impractical.

4.8 The overall purpose of the geophysical survey will be:

- to establish the presence/absence, and nature of any archaeological anomalies within the area specified so that this data may then be utilised to inform the layout of an evaluation trenching programme should this be necessary.
- to define the extent of any such anomalies, and to characterise, if possible.
- to establish the presence/absence, and nature of any known modern anomalies within the area of proposed development which may affect the results

4.9 Methodologies must be clearly costed in the tender document and information on how the contractor proposes to conduct the work clearly set out in the written scheme of investigation submitted by the appointed contractor to the DCC Assistant Archaeology Officer for approval.

4.10 A survey grid of 30m x 30m must be placed across the site and must be accurately tied in to local topographic features and overlaid onto an appropriate OS map base. The grid tie-in information should be made available in, or with, the final report so that the location plan can be related to the OS National Grid. Once the survey is complete any markers used must be removed from site. The results, including archaeological interpretation of the data must be set out in a report format with maps and must be available to inform the trial trenching phase. Interpretation plans must include OS contour data.

4.11 Depending on the results of this survey phase, further works may be required to mitigate the impact of the development on any archaeological remains. This will be dealt with by a separate brief should this be required.

4.12 This brief does not constitute the "written scheme of investigation" which must be submitted by the appointed contractor for approval by Durham County Council Archaeology Section prior to work commencing. This document must include a plan showing the areas to be surveyed.

5 OASIS

5.1 The Durham County Council Archaeology Section supports the Online Access to Index of Archaeological Investigations (OASIS) Project. The overall aim of the OASIS project is to provide an online index to the mass of archaeological grey literature that has been produced as a result of the advent of large scale developer funded fieldwork.

5.2 The archaeological contractor must therefore complete the online OASIS form at http://ads.ahds.ac.uk/project/oasis/ within 3 months of completion of the work. Contractors are advised to ensure that adequate time and costings are built into their tenders to allow the forms to be filled in.

5.3 Technical advice must be sought in the first instance from OASIS (oasis@ads.ahds.ac.uk) and not from Durham County Council Archaeology Section.

5.4 Once a report has become a public document by submission to or incorporation into the HER, Durham County Council Archaeology Section will validate the OASIS form thus placing the information into the public domain on the OASIS website.

5.5 The archaeological consultant or contractor must indicate that they agree to this procedure within the specification/project design/written scheme of investigation submitted to DCCAS for approval

6 The Report

6.1 This report will potentially be the first stage of a phased programme of archaeological works.

6.2 The report must include the following:

- executive summary
- a site location plan with NGR references at an appropriate scale to show both the site location within the wider area and specifically/detailed site location
- OASIS reference number
- Unique Site code
- contractor's details including dates work carried out
- nature and extent of the proposed development, including developer/client details
- description of the site location and geology
- photographs, maps and plans to illustrate the report as necessary
- discussion of potential impacts of the development on known and potential archaeological sites
- geophysical technical and processing information
- geophysical results
- geophysical discussion and interpretation
- OS contour data must also be displayed on the interpretation plots
- a plot of the raw geophysical data (to an appropriate scale)
- geophysical plots must show the location of modern intrusions (i.e. services etc)
- geophysical X-Y trace and greyscale and/or dot density plots (to an appropriate scale)
- geophysical interpretative feature map (to an appropriate scale)
- additional plans/map extracts to display noted and recorded archaeological features as appropriate
- suggestions regarding the need for, and scope of, any further archaeological work, including publication
- references
- bibliography

6.3 The report must be presented in an ordered state and contained within a protective cover/sleeve or bound in some fashion (loose-leaf presentation is unacceptable). The report must contain a title page listing site/development name, district and County together with a general NGR, the name of the archaeological contractor and the developer or commissioning agent, as well as the OASIS reference number. The report must be page numbered and supplemented with sections and paragraph numbering for ease of reference. All maps, figures and photographs must be cross referenced to the text.

7 Publication

7.1 All assessments, evaluations and watching briefs which do not progress to further excavation and research (with the relevant post-excavation and publication scheme and costs), must have a time and budget allocation identified for publication. This must be to a minimum standard to include a summary of the work, findings, dates, illustrations and photographs and references to where the archive is lodged.

7.2 Editors of regional journals, either the Durham Archaeological Journal or Archaeologia Aeliana must be contacted for information on outline publication costs, fuller figures may be worked out on completion of the watching brief. As the final note is largely unpredictable in advance a contingency sum must be set aside at the outset of work in the tender.

7.3 County Durham Archaeology Section produce an annual publication every March which highlights the archaeological work conducted in the county over the previous 12 months. To this end, it is now a requirement of every specification that a précis of archaeological works conducted in the county as a result of PPS 5 must be submitted to the DCC Archaeology Section.

7.4 The précis must be no more than 500 words in length and it would be appreciated if TIFF images of 300dpi are also included. The summary must be sent to the County Archaeologist by the beginning of December of the same year in which the work was conducted.

8 The Tender

8.1 Tenders for the work must include a method statement for the client and the following:

8.2 Brief details of the organisation and the number of staff who are proposing to carry out the work including any relevant specialisms or experience.

8.3 The earliest date at which the work can be commenced and the amount of notice required to initiate the assessment and geophysical survey

8.4 Statement agreeing to complete the OASIS forms on completion of the survey.

8.5 An estimate of how long the work will take broken down by time and cost in terms of data collection and report production (the anticipated extent of the work must be confirmed with the client in advance). The tender must include a breakdown of costs attributable to:

- travelling and subsistence
- fieldwork
- report production
- administration
- archiving costs for deposition with the Bowes Museum
- contingency for additional magnetomtry at a price per hectare • other

9 Submission of Report

9.1 At least two copies of the report, or more if required, must be sent to the client. One hard copy of the report as well as a digital copy (.pdf) with images of the site for the *Keys To The Past* website must be sent to the Archaeology Section, Durham County Council for inclusion in the County Durham Historic Environment Record (HER) at:

Regeneration & Economic Development: Design & Historic Environment

Archaeology Section Durham County Council Design & Historic Environment Team Regeneration & Economic Development The Rivergreen Centre Aykley Heads Durham DH1 5TS

10 The Archive and Submission to a Museum

10.1 The site archive comprising the original paper records and plans, photographs, negatives, etc, must be deposited in the appropriate museum (the Bowes Museum, Durham) at the completion of post-excavation. This must be in accordance with the Durham County Council Historic Environment Record Revised Charging Scheme (2011-12) a copy of which is available from DCC Archaeology if required.

11 References

Archaeological Archives Forum 2007 Archaeological Archives: A guide to best practice in creation, compilation, transfer and curation.

English Heritage 1991 Management of Archaeological Projects 2

2002 Guidelines for Environmental Archaeology: a guide to the theory and practice of methods from sampling and recording to post-excavation

2008 Geophysical Survey in Archaeological Field Evaluation

Institute for Archaeologists (IFA) 1999 Standard and Guidance: Archaeological Evaluation.

Petts, D and Gerrard, C 2006 Shared Visions: The North East Regional Research Framework for the Historic Environment

United Kingdom Institute of Conservation 1990 Guidelines for the Preparation of Excavation Archives for long-term storage ,

South Yorkshire Archaeological Advisory Service (SYAS) 2011 Yorkshire, The Humber & The North-East: A regional statement of good practice for Archaeology in the development process

11/01/2012

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Durham County Council

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Wingate
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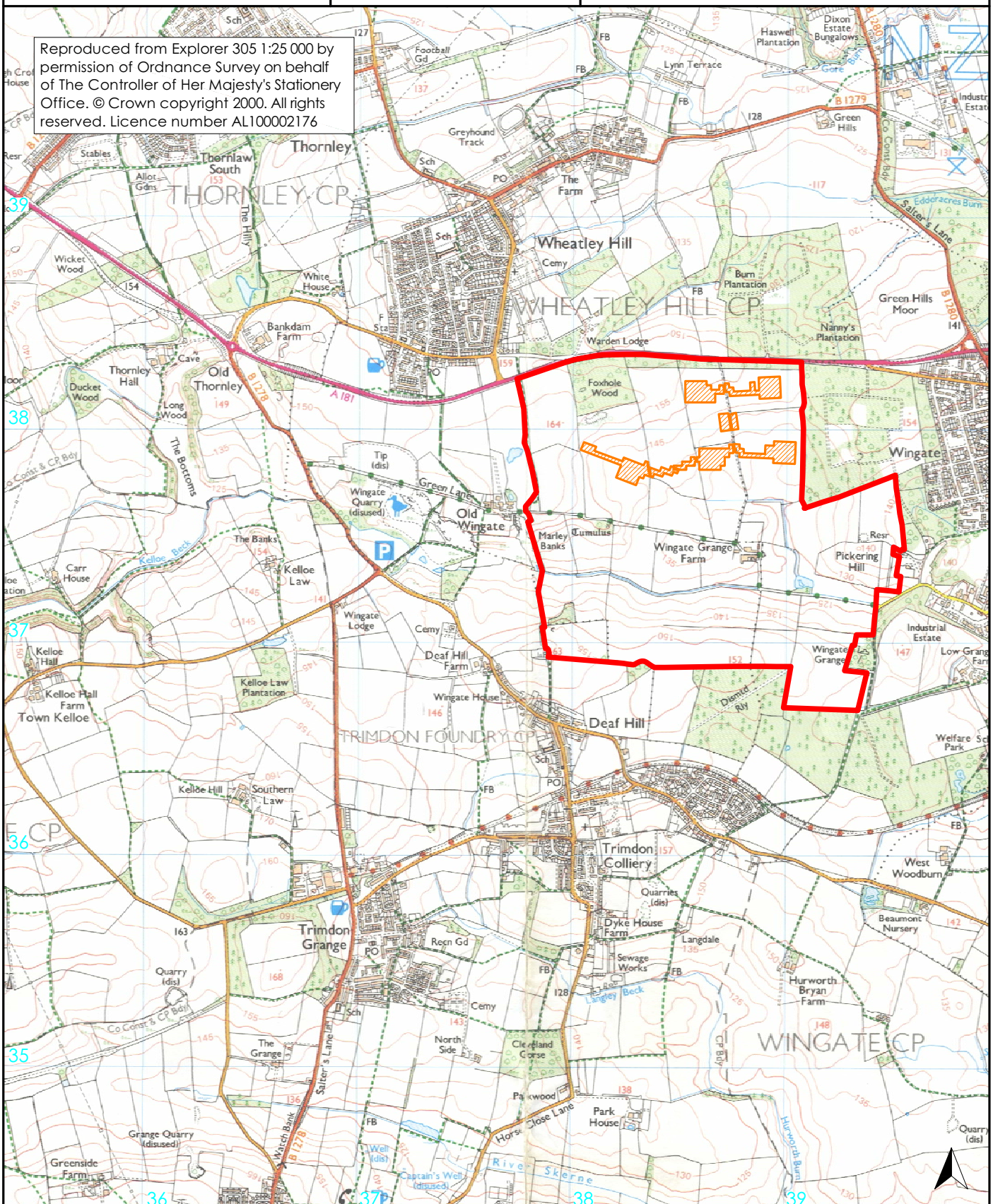
Figure 1: Site location



site boundary

location of geophysical surveys

0 1km

scale 1:25 000 for A4 plot

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site boundary

magnetic survey

-5 nT 5

0 150m
scale 1:3000 for A3 plot

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Figure 2: Geophysical survey overview

A181

Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9

383
382
381
380
379
378
377

380 381 382 383 384 385 386 387 388 389 390 391

Area 4

Area 1

Area 3

Area 2

Area 7

Area 6

Area 5

Area 8

382
381
380
379

385
386
387
388
389
390

magnetic survey
-5 nT 5

0 50m
scale 1:1000 for A1 plot

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Figure 3: Areas 1-7, geophysical survey

Area 4

Area 1

Area 2

Area 3

Area 7

Area 6

Area 5

Area 8

382
381
380
379
378

385
386
387
388
389
390

magnetic survey
dipolar magnetic anomaly
positive magnetic anomaly

0 50m
scale 1:1000 for A1 plot

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Figure 4: Areas 1-7, geophysical interpretation

Area 4

Area 1

Area 2

Area 3

Area 7

Area 6

Area 5

Area 8

382
381
380
379
378

385
386
387
388
389
390

magnetic survey
proposed development
soil-filled feature
land drain
former ploughing
former field boundary

0 50m
scale 1:1000 for A1 plot

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Figure 5: Areas 1-7, archaeological interpretation

379

378

381

382

383

384

385

Area 8

Area 9

magnetic survey

-5 nT 5

0 50m

scale 1:1000 for A2 plot

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Figure 6: Areas 8-9, geophysical survey

379

378

381

382

383

384

385

Area 8

Area 9

magnetic survey

dipolar magnetic anomaly

positive magnetic anomaly

0 50m

scale 1:1000 for A2 plot

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Figure 7: Areas 8-9, geophysical interpretation

379

378

381

382

383

384

385

Area 8

Area 9

magnetic survey

proposed development

soil-filled feature

land drain

service pipe

former ploughing

former field boundary

0 50m

scale 1:1000 for A2 plot

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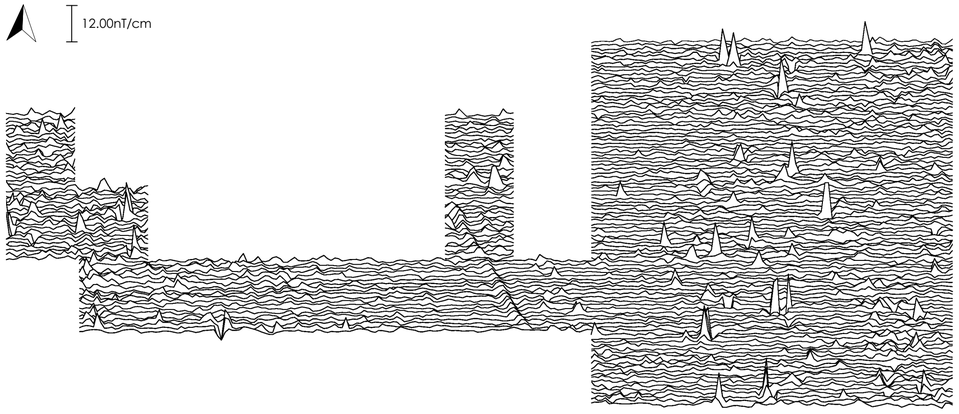
Figure 8: Areas 8-9, archaeological interpretation

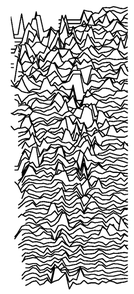
Area 1

12.00nT/cm



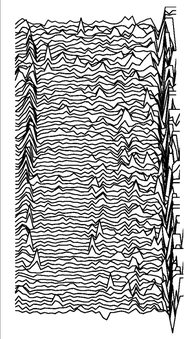
Area 2

16.00nT/cm



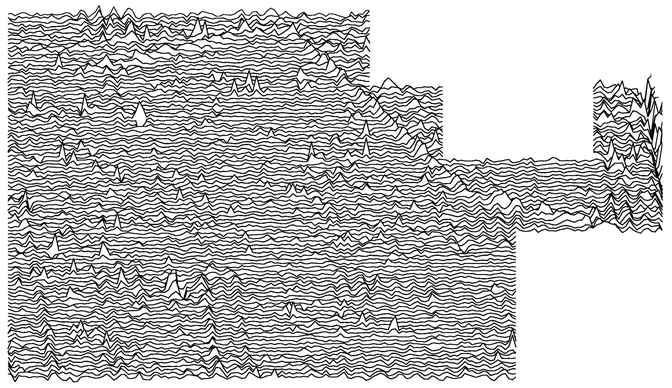
Area 3

20.00nT/cm



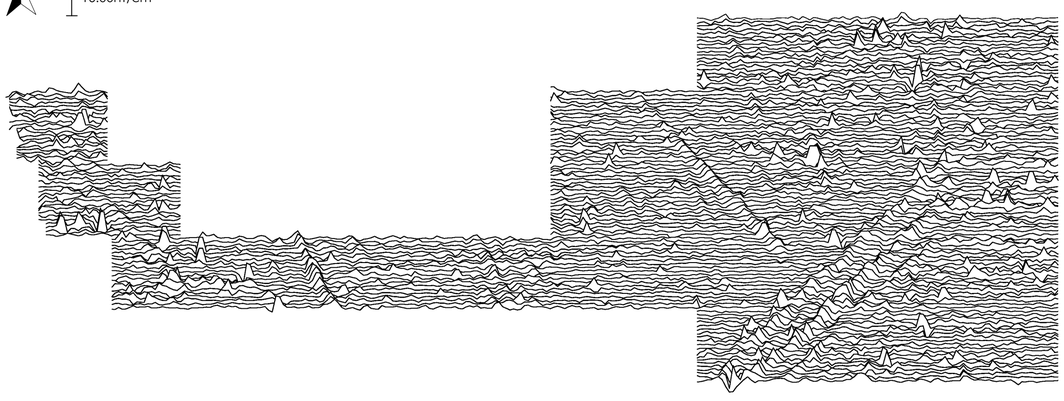
Area 4

24.00nT/cm



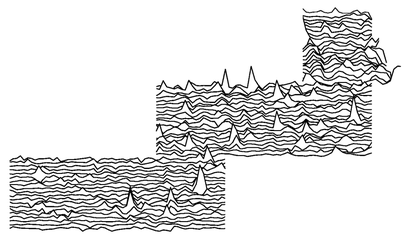
Area 5

16.00nT/cm



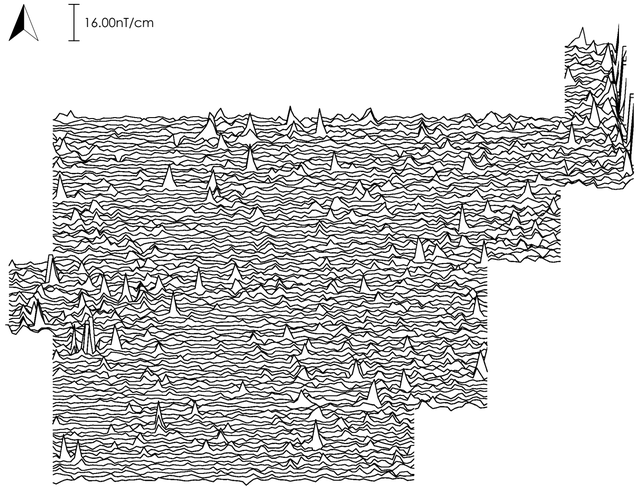
Area 6

16.00nT/cm



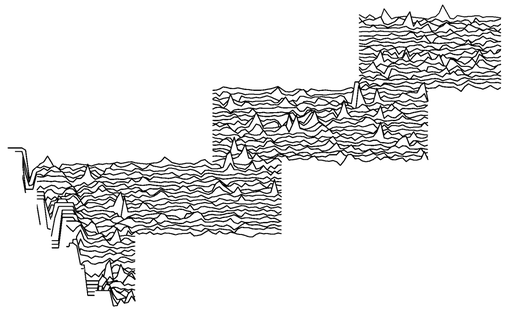
Area 7

16.00nT/cm



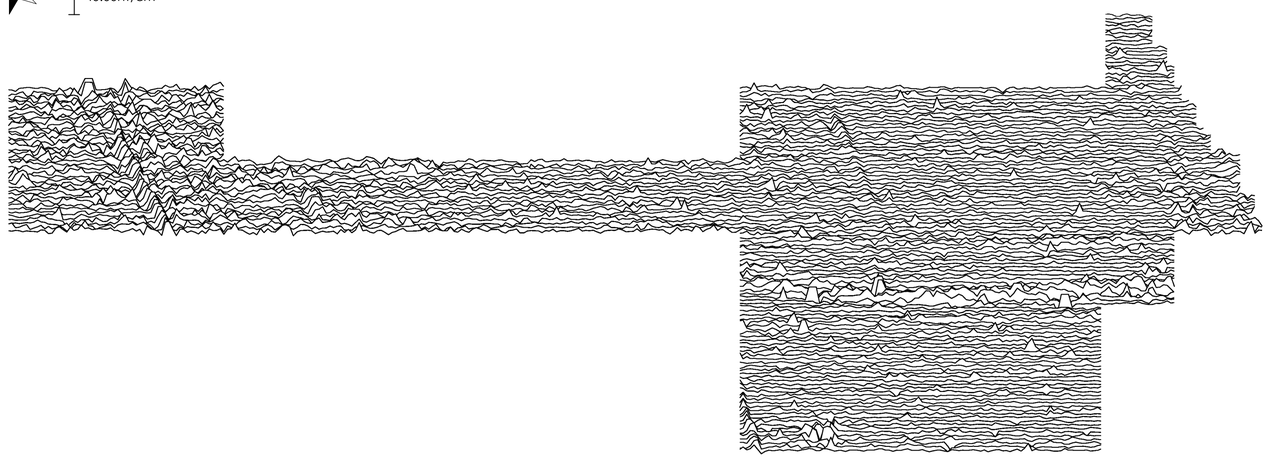
Area 8

12.00nT/cm



Area 9

40.00nT/cm



0 50m

scale 1:1000 for A1 plot

on behalf of
Arcus Renewable Energy Consulting Ltd

ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

Wingate Grange Wind Farm
Wingate
County Durham

geophysical survey
report 2998

Figure 9: Trace plots of geomagnetic data