ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Bellway Homes

Stainsby Hall Farm
Middlesbrough
Teesside

geophysical survey

report 2745
October 2011

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of a geophysical survey conducted in advance of proposed development at Stainsby Hall Farm, Middlesbrough, Teesside. The works comprised *c*. 11ha of geomagnetic survey in four land parcels.

1.2 The works were commissioned by Bellway Homes and conducted by Archaeological Services Durham University.

Results

1.3 Possible heavily plough damaged soil-filled features have been identified.

1.4 A modern ploughing regime has been identified.

1.5 A modern service has been identified at the west edge of Area 4

2. Project background

Location (Figure 1)

2.1 The proposed development area was located at Stainsby Hall Farm, Middlesborough, Teesside (NGR centre: NZ 4791 1519). Four surveys totalling *c*. 11 ha were conducted in four land parcels. To the north and east was a housing estate; to the west was farmland and south the A174.

Development proposal

2.2 Bellway Homes propose to develop the site for housing and associated services.

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, 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 instructions from the client and to current national standards and guidance (see para. 5.1 below).

Dates

2.5 Fieldwork was undertaken between 20th and 23rd September 2011. This report was prepared for October 2011.

Personnel

2.6 Fieldwork was conducted by Lorne Elliott and Duncan Hale. The geophysical data were processed by Duncan Hale. This report was prepared by Richie Villis with illustrations by David Graham and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **MSH11**, for **M**iddlesbrough **S**tainsby **H**all 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 **archaeol3-112535**.

3. Historical and archaeological background

3.1 Archaeological evidence from the prehistoric to the post-medieval periods has been discovered across Teesside. Examples in the vicinity of Stainsby include a Romano-British villa and settlement at Quarry Farm in Ingleby Barwick to the west (Archaeological Services 2008); Anglo-Saxon funerary activity at Stainton to the south (Archaeological Services 2001) and medieval and post-medieval settlement at Thornaby to the north (Archaeological Services 2007).

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised 4 fields of arable land with cereal stubble. It was not possible to collect data in the east of area 1 due to tall vegetation, a former tarmac track and an area of burning.

4.2 The area was predominantly level with a mean elevation of approximately 35m OD.

4.3 The underlying solid geology of the area comprises Triassic strata of the Mercia Mudstone Group, which are 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) *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 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 tied-in to known, mapped Ordnance Survey points using a Leica GS15 global navigation satellite system (GNSS) with real time kinematic (RTK) corrections.

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 2-5; 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.

5.9 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
despike	locates and suppresses 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 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

Interpretation: features

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 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.

5.14 A series of closely spaced, parallel, positive and negative magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect a modern ploughing regime.

5.15 A few very weak and diffuse positive magnetic anomalies have been detected; these may reflect the location of heavily truncated soil-filled features of archaeological significance.

5.16 A number of former field boundaries are shown on old OS maps of the proposed development area. These have not been identified in the geophysical data. The apparent non-existence of these features beneath the modern ploughing regime, combined with only very weak and diffuse anomalies detected, suggest that the area may have been heavily ploughed.

5.17 The linear chain of intense dipolar magnetic anomalies detected along the west edge of Area 4 is likely to reflect the location of a service.

6. Conclusions

6.1 Approximately 11ha of geomagnetic survey was undertaken on land at Stainsby Hall Farm, Middlesbrough prior to development.

6.2 Possible heavily plough damaged soil-filled features have been identified.

6.3 A modern ploughing regime has been identified.

6.4 A modern service has been identified at the west edge of Area 4.

7. Sources

Archaeological Services 2001 *The church of St Peter & St Paul, Stainton, Middlesbrough: archaeological monitoring, March – April 2001.* Unpublished report **795**, Archaeological Services Durham University

Archaeological Services 2007 *Sun Street, Thornaby, Stockton-on-Tees: archaeological desk-based assessment*. Unpublished report **1642**, Archaeological Services Durham University

Archaeological Services 2008 *A Romano-British villa and settlement at Ingleby Barwick, Stockton-on-Tees: archaeological excavation*. Unpublished report **1709**, Archaeological Services Durham University

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

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

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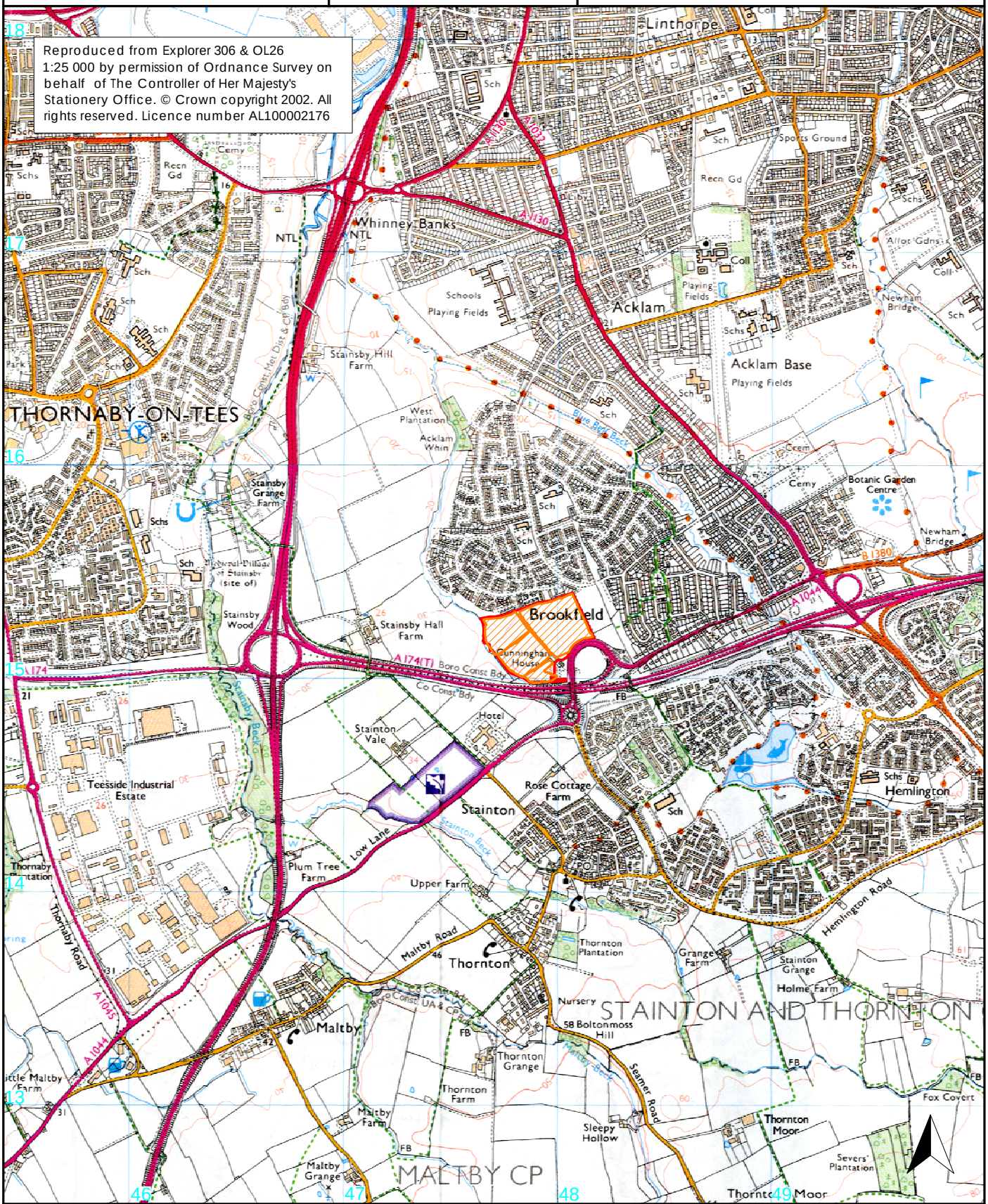
Figure 1: Site location



site location

0 1km

scale 1:25 000 for A4 plot

Brookfield

Fiske Court

Duddon Sands

Gayton Sands

Area 3

Area 4

Area 2

Area 1

Cunningham House

Drain

A 174

A 1044

154

153

152

151

150

477

478

479

480

481

482

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Figure 2: Geophysical survey overview

0 100m
scale 1:2000 for A3 plot

site boundary

magnetic survey

-4 nT 6

Brookfield

Fiske Court

Duddon Sands

GAYTON SANDS

Area 3

Area 4

Area 2

Area 1

Drain

A 174

A 174

A 1044

Cunningham House

154

153

152

151

150

477

478

479

480

481

site boundary

magnetic survey

-4 nT 6

0 50m

scale 1:1000 for A1 plot

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Figure 3: Geophysical survey

Brookfield

Fiske Court

Duddon Sands

GAYTON SANDS

Area 3

Area 4

Area 2

Area 1

Cunningham House

Drain

A 174

A 174

A 1044

154

153

152

151

150

477

478

479

480

481

site boundary

magnetic survey

dipolar magnetic anomaly

positive magnetic anomaly

negative magnetic anomaly

0 50m

scale 1:1000 for A1 plot

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Figure 4: Geophysical interpretation

Brookfield

Fiske Court

Duddon Sands

GAYTON SANDS

BALDOON SANDS

Area 3

Area 4

Area 2

Area 1

Cunningham House

Drain

A 174

A 1044

154

153

152

151

150

477

478

479

480

481

site boundary

magnetic survey

soil-filled feature

service pipe

0 50m

scale 1:1000 for A1 plot

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Figure 5: Archaeological interpretation

Stainsby Hall Farm
Middlesbrough
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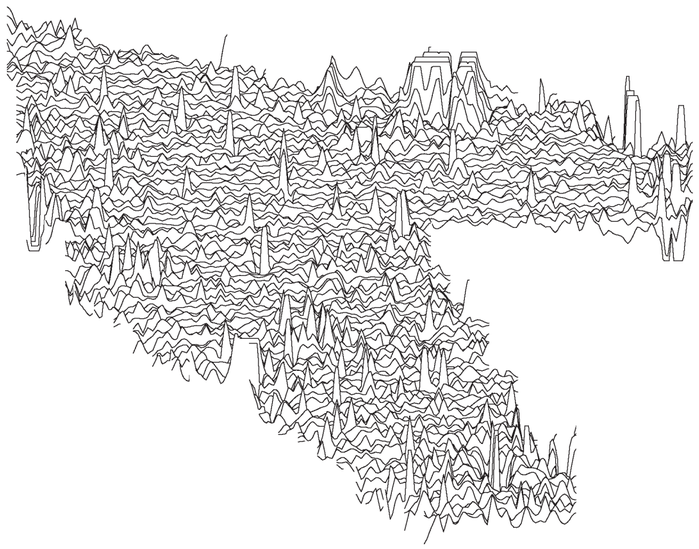
Figure 6:
Trace plots of geomagnetic data

Area 1

12.10nT/cm

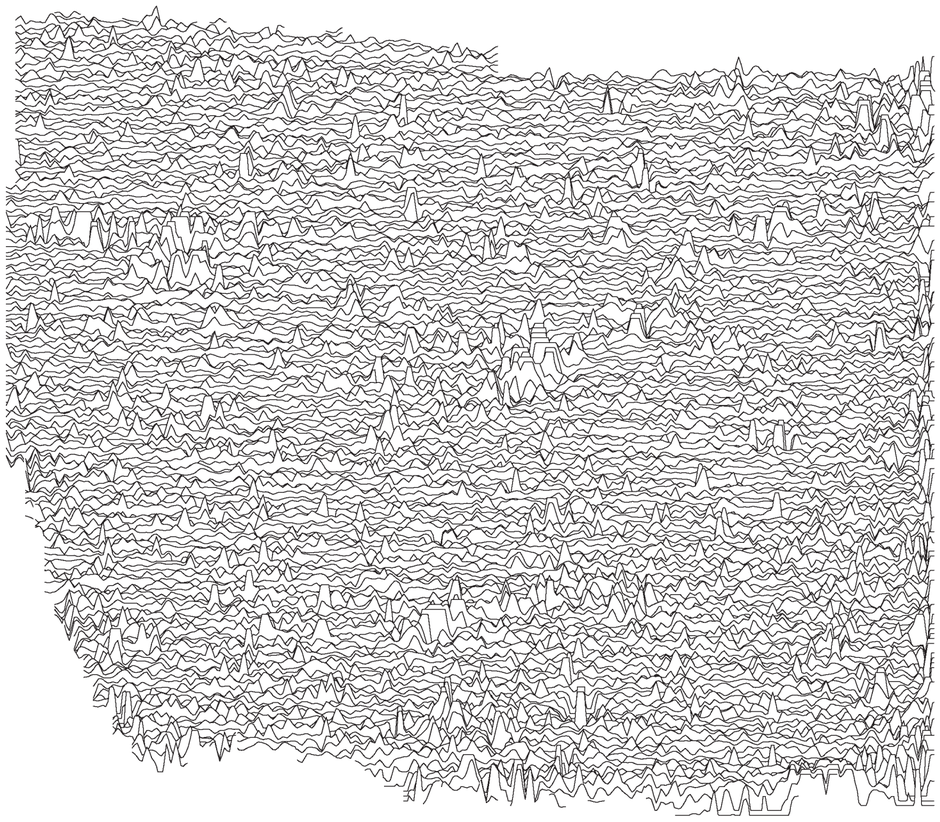
0 50m
scale 1:1000



Area 2

15.90nT/cm

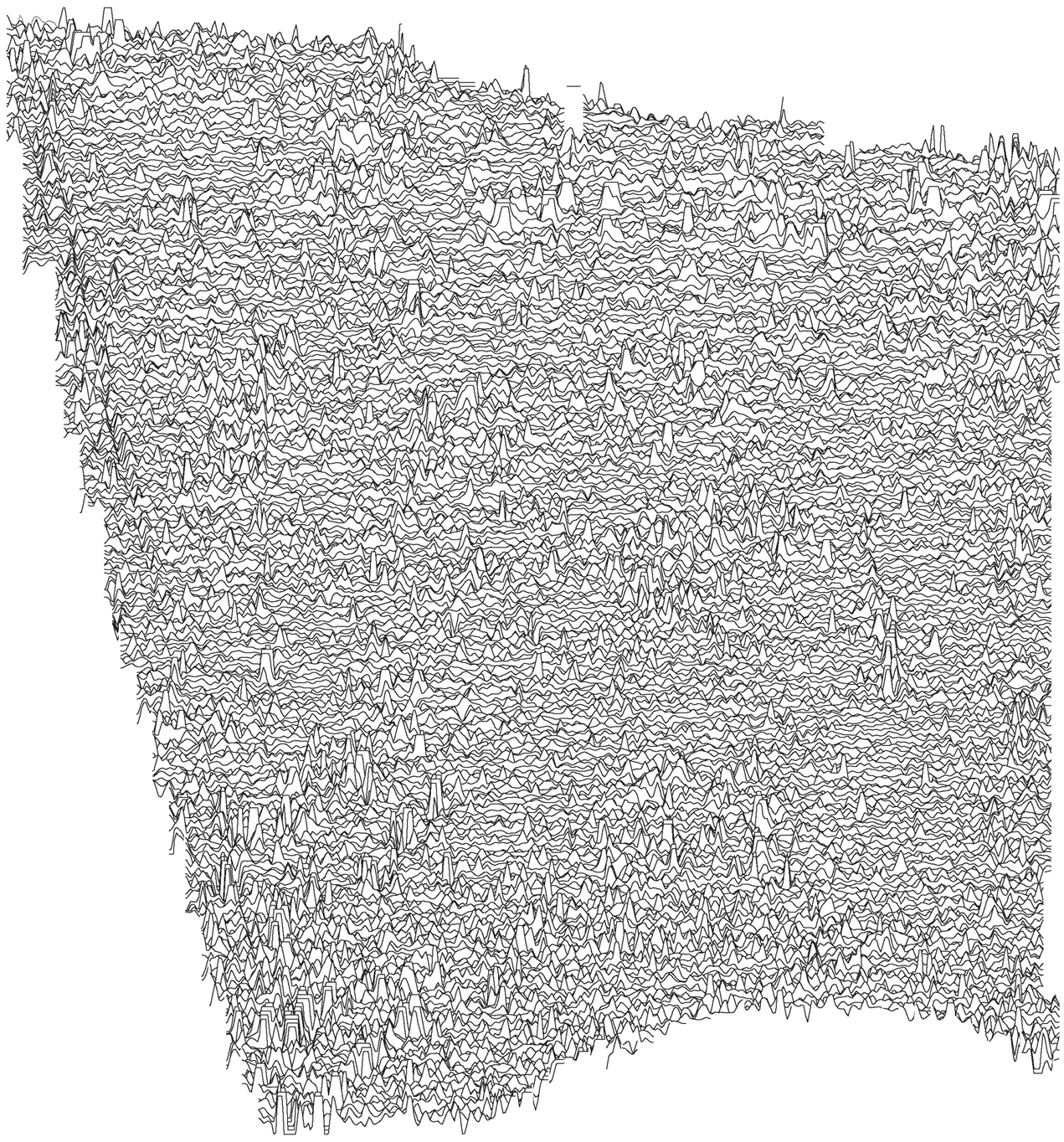
0 50m
scale 1:1000



Area 3

14.00nT/cm

0 50m
scale 1:1000



Area 4

11.30nT/cm

0 50m
scale 1:1000