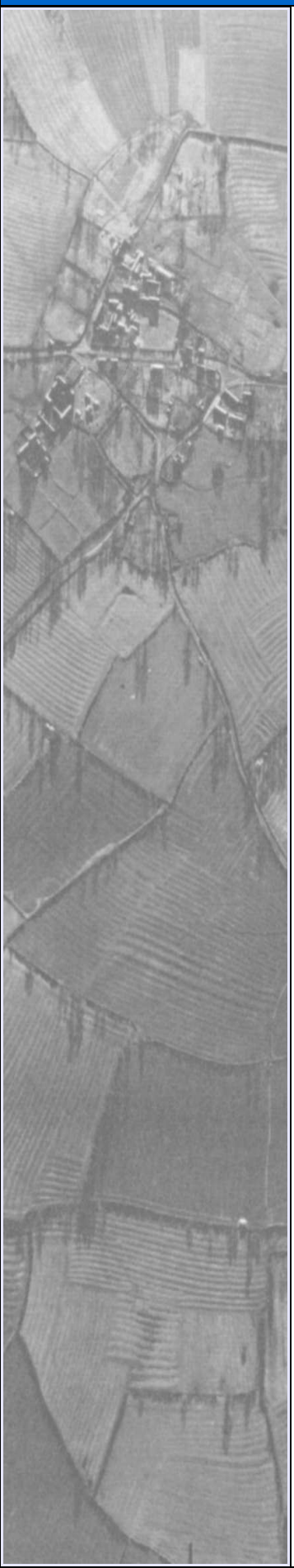


Land behind West View Gardens
Gislingham
Suffolk

MAGNETOMETER SURVEY REPORT

for

New Hall Properties (Eastern) Ltd

David Sabin and Kerry Donaldson

December 2014

Ref. no. 580

ARCHAEOLOGICAL SURVEYS LTD

Land behind West View Gardens
Gislingham
Suffolk

Magnetometer Survey Report

for

New Hall Properties (Eastern) Ltd

Fieldwork by David Sabin
Report by David Sabin BSc (Hons) MIFA and Kerry Donaldson BSc (Hons)

Survey date – 14th December 2014
Ordnance Survey Grid Reference – TM 07705 71685

Suffolk HER Event No: ESF22567
OASIS ID: archaeol20-196821

Archaeological Surveys Ltd
1 West Nolands, Nolands Road, Yatesbury, Calne, Wiltshire, SN11 8YD
Tel: 01249 814231 Fax: 0871 661 8804
Email: info@archaeological-surveys.co.uk
Web: www.archaeological-surveys.co.uk

CONTENTS

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

SUMMARY

A detailed magnetometer survey was carried out by Archaeological Surveys Ltd, at the request of New Hall Properties (Eastern) Ltd, within an area of land at Gislingham in Suffolk. The survey located a number of very weakly positive linear anomalies, and although it is possible that they relate to cut features, their weak response and lack of coherent morphology prevent confident interpretation. Several discrete positive responses within the field appear to relate to pit-like features that may be anthropogenic in origin. The locations of two relatively recently removed field boundaries can also be seen within the results, as can zones of magnetic debris which may relate to dumped magnetically thermoremnant material around the field margins.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by New Hall Properties (Eastern) Ltd to undertake a magnetometer survey of an area of land at Gislingham in Suffolk. The site has been outlined for a potential residential development and the survey forms part of an archaeological assessment of the site.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2014) and issued to Suffolk County Council Archaeology Service prior to commencing the survey. A Suffolk Historic Environment Record (HER) Event number (ESF22567) has also been issued for the survey.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to development of the site. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 The survey and report generally follow the recommendations set out by: English Heritage (2008) *Geophysical survey in archaeological field evaluation;* and Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations*. The work has been carried out to the Institute for Archaeologists (2011) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3 Site location, description and survey conditions

1.3.1 The site is located on the eastern edge of Gislingham in Suffolk. It is centred on Ordnance Survey National Grid Reference (OS NGR) TM 07705 71685,

see Figures 01 and 02. It lies to the south of Thornham Road, east of West View Gardens and north of the properties on Coldham Lane.

1.3.2 The geophysical survey covers approximately 1.6ha within a 2.7ha field left as stubble. It was not possible to survey a 30m wide strip along the southern edge of the site as the ground had been roughly ploughed and was saturated.

Plate 1: Survey area looking west

1.3.3 The ground conditions across the site were generally considered to be favourable for the collection of magnetometry data, with the exception of the ploughed zone mentioned above. Weather conditions during the survey were fine although heavy rain had saturated the soil prior to the commencement of the work.

1.4 Site history and archaeological potential

1.4.1 An Archaeological Desk-Based Assessment has been carried out by John Newman Archaeological Services (2014). It outlines that there are no Scheduled Monuments directly within, or within 500m of, the survey area. However, there have been a number of metalwork finds located within the field that date to the Roman, early Saxon, medieval and post-medieval periods. Within the surrounding vicinity there are several other findspots of Roman, Saxon and medieval cultural material. A moated site is located 300m to the east, and the 14th/15th century St Mary's church, 75m to the north.

1.4.2 The presence of metalwork finds within the site indicates there is potential for it to contain heritage assets that may date from between the Roman and post-

medieval periods. Although the soil was mainly not visible within the surveyed area, two sherds of possible early medieval pottery were noted within patches of open soil along the northern side of the site.

1.5 Geology and soils

1.5.1 The underlying solid geology across the site is Crag Group sand with overlying glacial till deposits of the Lowestoft Formation (BGS, 2014).

1.5.2 The overlying soil across the survey area is from the Beccles 1 association and is a typical stagnogley. It consists of a slowly permeable, seasonally waterlogged, fine, loamy over clayey soil (Soil Survey of England and Wales, 1983).

1.5.3 Magnetometry survey carried out across similar soils has produced variable results due to low magnetic susceptibility contrast between natural material and the fill of former cut features of archaeological potential.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance are factors associated with the formation of localised fields. Additional details are set out below and within Appendix A.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T).

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers spaced 0.5m apart with readings recorded at 20 Hz. The gradiometers have a range of recording data between 0.1nT and 10,000nT. They are linked to a Leica GS10 RTK GPS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Data are collected along a series of parallel survey transects wherever possible. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared and automatically compensated using SENSYS MAGNETO®DLMGPS software. Georeferenced raw data are then exported in ASCII format for further analysis and display using TerraSurveyor.

2.3.2 The data are collected at ±10000nT and clipped for display at ±10nT. Data are resampled to a resolution of effectively 0.5m between tracks and 0.15m along each survey track. Appendix C contains specific information concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on any processes, such as clipping, carried out on the data.

2.3.3 A TIFF file (OSGB36) is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot.

2.3.4 The raster images are combined with base mapping using ProgeCAD Professional 2014 and AutoCAD LT 2007, creating DWG file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. Quality can be compromised by rotation of graphics in order to allow the data to be orientated with respect to grid north; this is considered acceptable as the survey results are effectively georeferenced allowing relocation of features using GPS, resection method, etc.

2.3.5 An abstraction and interpretation is offered for all geophysical anomalies located by the survey. A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing.

2.3.6 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over approximately 1.6ha.

3.1.2 Magnetic anomalies located can be generally classified as positive anomalies of an uncertain origin, areas of magnetic debris and disturbance and strong discrete dipolar anomalies relating to ferrous objects.

3.2 Statement of data quality

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset. Localised magnetic disturbance has been caused by modern ferrous objects.

3.2.2 The data have revealed only a small number of very weak linear anomalies and no anomalies that can clearly be attributed to modern arable cultivation; this may infer very poor magnetic contrast due to the properties of the soil.

3.3 Data interpretation

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A basic explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, a basic key is indicated to allow cross referencing to the abstraction and interpretation plot. CAD layer names are included to aid reference to associated digital files (.dwg/.dxf). Sub-headings are then used to group anomalies with similar characteristics within the survey area.

Report sub-heading CAD layer names and plot colour	Description and origin of anomalies
Anomalies with an uncertain origin AS-ABST MAG POS LINEAR UNCERTAIN AS-ABST MAG POS DISCRETE UNCERTAIN AS-ABST MAG POS UNCERTAIN 	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The

AS-ABST MAG BOUNDARY	anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation.
Anomalies associated with magnetic debris AS-ABST MAG DEBRIS AS-ABST MAG STRONG DIPOLAR	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. It often occurs where there has been dumping or ground make-up and is related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, or hearths and may therefore be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies associated with magnetic disturbance AS-ABST MAG DISTURBANCE	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc.. Often a significant area around such features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically and with hysteresis adjacent to strong magnetic sources.

Table 1: List and description of interpretation categories

3.4 List of anomalies

Area centred on OS NGR 607705 271685, see Figures 03 & 04.

Anomalies with an uncertain origin

(1) – A weakly positive linear anomaly extends across the central part of the survey area and is oriented north to south. It is generally parallel with extant and removed field boundaries within and surrounding the site; however, it is not possible to determine its date or function, although a former boundary ditch is possible.

(2) – A weakly positive linear anomaly appears to extend towards anomaly (1) from the south east. Another is located parallel with it to the south west. As with all the other linear anomalies within the survey area, the response is very narrow and weak (<1nT) and it is not possible to determine if they relate to cut features.

(3) – The survey area contains a number of short positive linear and possible curvilinear anomalies. They are weak and lack a coherent morphology and it is therefore not possible to determine if they relate to cut, ditch-like features, or if they are naturally formed features.

(4) – Two weakly positive responses are located in the eastern part of the survey area. Again, they are weak, generally less than 1nT, and it is not possible to determine if they relate to magnetically enhanced anomalies with an anthropogenic

or natural origin.

(5) – The survey area contains a number of discrete positive responses. Some have a magnitude of 3-5nT, with others 20-35nT and some dipolarity which may indicate ferrous or magnetically thermoremnant material. It is possible that these relate to cut, pit-like features.

Anomalies associated with land management

(6) – Extending north to south in the eastern part of the survey area is a linear zone of magnetic debris which relates to a former mapped land boundary, removed during the 20th century.

(7) – A strongly positive linear anomaly associated with magnetic debris is related to a recently removed field boundary that extended east to west within the southern part of the survey area.

Anomalies associated with magnetic debris

(8) – Magnetic debris is evident along the edges of the survey area. It is caused by magnetically thermoremnant material, such as brick and tile, and although generally related to modern dumped or demolished material, can be associated with archaeological material.

(9) – The survey area contains a number of strong, dipolar anomalies which are a response to ferrous and other magnetically thermoremnant objects within the topsoil.

Anomalies associated with magnetic disturbance

(10) – Magnetic disturbance has been caused by a large ferrous object or material just to the north of the former land boundary (7).

4 CONCLUSION

4.1.1 The results of the detailed magnetometer survey reveal a number of weakly positive anomalies; however, their response is weak and indistinct preventing confident interpretation. Several discrete positive anomalies are also evident, and although these have a stronger response than the more linear anomalies, it is not possible to determine if they are naturally or anthropogenically formed pit-like features.

4.1.2 The location of a formerly mapped field boundary can be seen to extend north to south in the eastern part of the survey area, with a second extending east to west in the southern part. Zones of magnetic debris are also evident close to the field margins and the former field boundaries.

5 REFERENCES

Archaeological Surveys, 2014. *Land behind West View Gardens, Gislingham, Suffolk, Geophysical Survey Written Scheme of Investigation.* Unpublished typescript document.

British Geological Survey, 2014. *Geology of Britain viewer, 1:50 000 scale [online]* available from http://mapapps.bgs.ac.uk/geologyofbritain/home.html [accessed 21/11/2014].

English Heritage, 2008. *Geophysical survey in archaeological field evaluation. Research and Professional Service Guideline No.1.* 2nd ed. Swindon: English Heritage.

Institute for Archaeologists, 2002. *The use of Geophysical Techniques in Archaeological Evaluations*. IfA Paper No. 6. IfA, University of Reading.

Institute for Archaeologists, 2011. *Standard and Guidance for archaeological geophysical survey*. IfA, University of Reading.

John Newman Archaeological Services, 2014. *Thornham Road, Gislingham, Suffolk, Archaeological Desk-Based Assessment.* Unpublished typescript document.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 4 Eastern England.*

Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material.

Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field.

Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried field. The difference between the two sensors will relate to the strength the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. It has been found that clipping data to ranges between ±20nT and ±10nT often improves the appearance of features associated with archaeology. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Appendix C – survey and data information

COMPOSITE
Path: D:\Business\Jobs\J580 Gislingham\Data\Mag\comps\
Filename: J580-mag-proc.xcp
Description: Imported as Composite from: J580-mag.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 31U
Survey corner coordinates (X/Y):
Northwest corner: 607629.437301195, 271762.367401436 m
Southeast corner: 607782.437301195, 271596.617401436 m
Direction of 1st Traverse: 90 deg
Collection Method: Parallel
Sensors: 1
Dummy Value: 32702

Source GPS Points: 532100

Dimensions
Composite Size (readings): 1020 x 1105
Survey Size (meters): 153 m x 166 m
Grid Size: 153 m x 166 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 11.05
Min: -11.00
Std Dev: 4.60
Mean: -0.16
Median: -0.08
Composite Area: 2.536 ha
Surveyed Area: 1.671 ha

Processes: 1
1 Base Layer

GPS based Proce3
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 Clip from -10.00 to 10.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire (see inside cover for address). Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

Surveys are reported on in hardcopy (recycled paper) using A4 for text and A3 for plots (all plots are scaled for A3). A paper copy will be supplied to the Suffolk HER with a CD containing the CAD, PDF report and figures and the raw data as a CSV file. A PDF copy of the report will be uploaded to Online AccesS to the Index of archaeological investigations (OASIS).

This report has been prepared using the following software on a Windows XP platform:

- TerraSurveyor version 3.0.23.0 (geophysical data analysis),
- SENSYS MAGNETO®ARCH version 1.00-04(geophysical data analysis),
- ProgeCAD Professional 2014 (report graphics),
- AutoCAD LT 2007 (report figures),
- OpenOffice.org 3.0.1 Writer (document text),
- PDF Creator version 0.9 (PDF)

Digital data produced by the survey and report include the following files:

- TerraSurveyor grid and composite files for all geophysical data,
- CSV files for raw and processed composites,
- geophysical composite file graphics as Bitmap images,
- AutoCAD DWG files in 2000 and 2007 versions,
- report text as OpenOffice.org ODT file,
- report text as Word 2000 doc file,
- report text as rich text format (RTF),
- report text as PDF / PDF/A,
- PDFs of all figures.

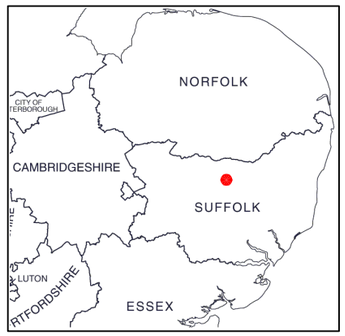
Archaeological Surveys Ltd

Geophysical Survey
Land behind
West View Gardens
Gislingham, Suffolk

Map of survey area

Survey location

Site centred on OS NGR
TM 07705 71685



Survey location

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

FIG 01

Archaeological Surveys Ltd

Geophysical Survey
Land behind
West View Gardens
Gislingham, Suffolk

Referencing information

Referencing grid to OSGB36 datum at 50m intervals

Data collected at 20Hz and georeferenced to ETRS89 zone 30 with conversion to OSGB36 using OSTN02

607550 271700

Development boundary

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 02

Archaeological Surveys Ltd

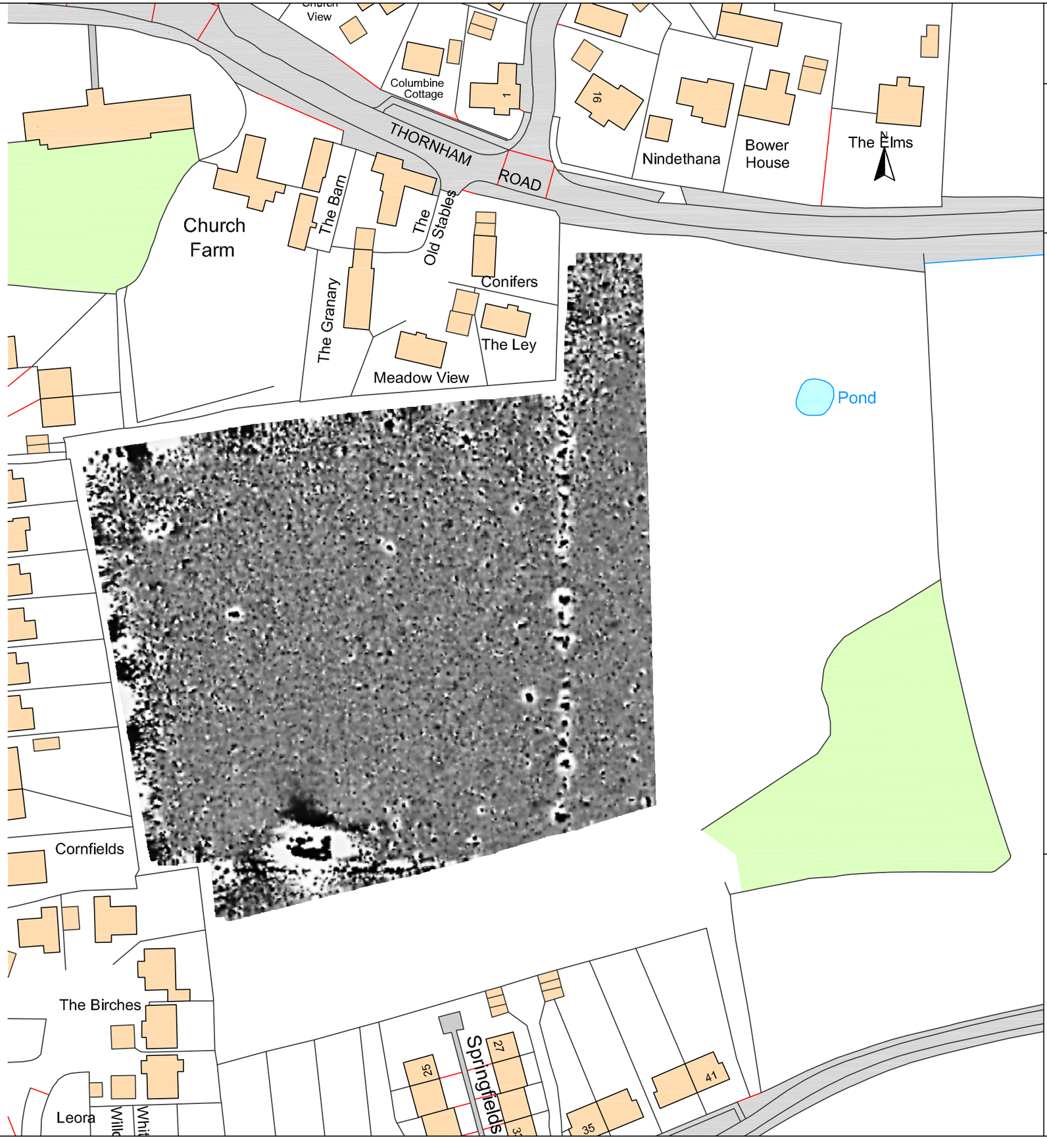
Geophysical Survey
Land behind
West View Gardens
Gislingham, Suffolk

Greyscale plot of minimally processed magnetometer data

+10nT

-10nT +10nT

-10nT



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 03

Archaeological Surveys Ltd

Geophysical Survey
Land behind
West View Gardens
Gislingham, Suffolk

Abstraction and interpretation of magnetometer anomalies

- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - possible former field boundary
- Discrete positive response - possible pit-like feature
- Positive anomaly - magnetically enhanced material
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

FIG 04

THORNHAM ROAD
Columbine Cottage
1
16
Nindethana
Bower House
The Elms
N
Church Farm
The Barn
The Old Stables
Conifers
The Granary
The Ley
Meadow View
Pond
8
2
9
5
1
4
3
6
10
7
Cornfields
The Birches
Leora
Springfields
27
25
35
41