ARCHAEOLOGICAL EVALUATION REPORT:

GEOPHYSICAL SURVEY BY MAGNETOMETRY: HORNCASTLE FLOOD ALLEVIATION SCHEME, LINCOLNSHIRE

NGR: TF 2290 7539
Planning Reference: S/011/00649/14
AAL Site Code: HOFA 14
OASIS Reference Number: allenarc1-217800

Report prepared for the Environment Agency

By
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Allenarchaeology

Contents

List of Appendices

List of Figures

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Cover Photo: View of site looking east over the river

Executive Summary

- Allen Archaeology Limited (hereafter AAL) was commissioned by the Environment Agency to undertake a geophysical survey by magnetometry in advance of the Horncastle Flood Alleviation Scheme (hereafter Horncastle FAS).

- The survey identified a number of features of potential archaeological interest. Whilst a large number of the amorphous positive anomalies likely relate to water activity on the site, due to the proximity of the river, there are a number of linear features that suggest anthropogenic activity, including a potential trackway, a former path and field boundary and potential cultivation trends along with possible field drains. It is possible some of the amorphous positive anomalies could relate to pits.

- Overall, the site has a moderate archaeological potential of local significance.

1.0 Introduction

1.1 Allen Archaeology Limited (hereafter AAL) was commissioned by the Environmental Agency to undertake a geophysical survey to assess the archaeological potential of two areas of groundworks as part of the Horncastle Flood Alleviation Scheme. This document is an amalgam of the previous geophysical survey and a new survey with areas that were not possible to survey originally.

1.2 The document has been completed with reference to current national guidelines, as set out in the Institute for Archaeologists '*Standard and guidance for archaeological desk-based assessments'* (IfA 1994, revised 2001 and 2008), '*Geophysical Survey in Archaeological Field Evaluation*' (English Heritage 2008), '*The Use of Geophysical Techniques in Archaeological Evaluations*' (IFA Paper 6) and the Institute for Archaeologists '*Standard and guidance for archaeological geophysical survey*' (IfA 2011). Local guidelines in the Lincolnshire Archaeological Handbook (LCC 2012) were also followed.

2.0 Site Location and Description

2.1 The proposed development consists of an embankment of *c.*720m length together situated on the River Bain around 0.9km northwest of Hemingby, immediately upstream of Watermill Farm, crossing the river at TF 229 753. The maximum flood storage area will extend upstream approximately 1.5km. This watching brief focuses on 12.6ha of pasture and arable land that has been designed as a part of the flood storage area immediately upstream of the proposed embankment.

2.2 The geology comprises of the mudstone bedrock of the Kimmeridge Clay Formation, with overlying superficial geology of normally soft to firm consolidated, compressible silty clays, which may contain layers of silt, sand, peat and basal gravels, of Flandrian Age (http://mapapps.bgs.ac.uk/geologyofbritain/home.html).

3.0 Planning Background

3.1 A planning application for the *'…construction of a flood storage reservoir with embankment and associated flow control structures, on the River Bain upstream of Horncastle, construction of access tracks, erection of fencing, provision of a temporary construction compound and erection of a temporary electricity kiosk…'* was submitted in March 2015 and is awaiting a decision (Reference S/011/00588/15).

3.2 The planning application was accompanied by an Environmental Statement (Environment Agency 2015), which included a cultural heritage chapter comprising desk-based research of the site and surrounding areas, fieldwalking, and geophysical survey of accessible parts of the impact areas.East Lindsey District Council's recommendations for heritage aspects to be considered are: *Impact of the proposed development on the character, appearance and setting of listed buildings, conservation areas, sites of ancient monuments and archaeology within the site and in the wider area* (*ibid.*).

3.3 The approach and method adopted was consistent with the recommendations of the National Planning Policy Framework (NPPF), with the particular chapter of relevance being

'Chapter 12: Conserving and enhancing the historic environment' (Department for Communities and Local Government 2012).

4.0 Archaeological and Historical Background

4.1 The site falls to the southwest of the Lincolnshire Wolds, which is rich in archaeological remains. There is evidence that the area was habited during the prehistoric era. A large enclosure and a ring-ditch has been identified from cropmarks immediately to the northwest of the site (LHER no. 90937) and a prehistoric route might have formed a precursor to Caistor High Street, which lies just over half a kilometre to the west of the proposed development (LHER no. 99396). There are a number of flint scatters and isolated find spots in the wider landscape, including retouched flake uncovered during fieldwalking at the site and thought to date to the Neolithic or Bronze Age (AAL, 2015). Previous borehole data indicates alluvial deposits in the Site, with deep alluvial deposits recorded along the side of the River Bain and the western area of the Site. The association of rivers and prehistoric activity is well known, and it is possible that the alluvial layers contain and/or seal evidence of this date.

4.2 There is limited evidence of Roman-British activities in the area. A single isolated Roman coin has been described from around 0.6km to the south of the proposed development (LHER no. 43386) and a heavily abraded single shard of a miscellaneous greyware jar/bowl was found whilst field walking the site, although this might have been brought to site during manuring or cultivation of the fields (AAL, 2015).

4.3 There is limited evidence of Anglo-Saxon activities in the vicinity of the site. A mid-late 5th century copper alloy Anglo-Saxon sword pommel (LHER no. 43147) was recovered just over 600m southeast of the proposed embankment, although no other archaeological remains have been found. Nonetheless, the Church of St. Swithin at Baumber (EH Ref. 1063173) and Church of All Saints at Great Sturton (EH Ref. 1063098) are thought to date from the 11th century AD and might indicate a strong presence in the wider area during the Anglo-Saxon era.

4.4 There is greater evidence of Medieval activities within the area. A Deserted Medieval Village is documented as Bainthorpe, which is thought to be located near the water mill (Cullen et al. 2011). The Lincolnshire Wolds contains a number of other deserted and shrunken medieval villages,including Hemingby and Baumber (Robinson 2009) A single shard of pottery of Toynton Medieval Ware was found whilst field walking at the western side of the proposed development area (AAL, 2015).

4.5 The end of the post-medieval era and onset of the Early Modern period brought large-scale manufacturing and prosperity to many parts of Lincolnshire, although the Wolds experienced only very small-scale development, mainly geared towards agriculture and the building trades (Rawding 2001). A water mill (LHER no. 48157) utilising the River Bain stood immediately to the southwest of the proposed development and hints at this at these changes. The weir still survives from the mill and a number of buildings also remain from this time and form part of Water Mill Farm (EH Ref. 1359925). A couple of shards of 18th to 20th century pottery and a single piece of ceramic building material , alongside a whetstone, commonly used for sharping scythes during harvesting, were recovered during field walking at the site (AAL, 2015). Geophysical survey of the proposed development site, shows magnetic noise that might be indicative of the water management, including

the potential maintenance/dredging of the river bank and channel, and linear features possibly representing former ditches, paths, boundaries, tracks or field drains (AAL, 2015).

5.0 Methodology

5.1 The geophysical survey consisted of a detailed gradiometer survey of as much of the development area as it was possible to cover. The survey was undertaken in a combination of a series of 30m and 20m grids across the site. Initially the fieldwork was carried out by a team of two experienced geophysicists from AAL on Tuesday 13th and Wednesday 21st to Friday 23rd January 2015. This area totalled 5.9 hectares. The fieldwork was resumed on Wednesday 8th and Thursday 9th July 2015 and a further 5.7 hectares was surveyed. The survey area was accurately located using a Leica GS08 Netrover GPS receiving RTK corrections. This accurately plotted the area of investigation in 3D and tied it into the National Grid.

5.2 The survey was carried out using a Bartington Grad601-2 Dual Fluxgate Gradiometer with an on-board, automatic DL601 data logger. This instrument is a highly stable magnetometer which utilises two vertically aligned fluxgates, one positioned 1m above the other. This arrangement is then duplicated and separated by a 1m cross bar. The 1m vertical spacing of the fluxgates provides for deeper anomaly detection capabilities than 0.5m spaced fluxgates. The dual arrangement allows for rapid assessment of the archaeological potential of the site. Data storage from the two fluxgate pairs is automatically combined into one file and stored using the on-board data logger.

5.3 Data collection was undertaken in a zigzag traverse pattern, using a sample interval of 0.25m and a traverse interval of 1m.

5.4 The fieldwork and reporting was carried out in accordance with the procedures in 'Geophysical Survey in Archaeological Field Evaluation' (English Heritage 2008), 'The Use of Geophysical Techniques in Archaeological Evaluations: IfA Paper 6' (Gaffney *et al*. 2002), 'Archaeological Prospection' (Bartington and Chapman 2004) and 'Applications Manual for Portable Magnetometers' (Breiner 1999).

5.5 Summary of Survey Parameters:

Fluxgate Magnetometer

Instrument 1:	Bartington Grad601-2 Dual Fluxgate Gradiometer
Sample interval:	0.25m
Traverse interval:	1.00m
Traverse separation:	1.00m
Traverse method:	Zigzag
Resolution:	0.01 nT
Processing software:	Terrasurveyor 3.0.27
Surface conditions:	A mixture of pasture and recently harvested land
Area surveyed:	5.9 ha and 5.7 ha
Date surveyed:	Tuesday 13th and Wednesday 21st to Friday 23rd January 2015, Wednesday 8th and Thursday 9th July 2015
Surveyor:	Robert Evershed BSc (Hons)

Survey assistants:	Iain Pringle, Ryan Godbold
Data interpretation:	Robert Evershed BSc (Hons)

5.6 The grids were marked out using pre-programmed coordinates on the Leica GS08 Netrover. The collection of magnetic data using a north – south traverse pattern is preferable as the fluxgate gradiometer is set up and balanced with respect to the cardinal points. Since the data is plotted as north-south traverses there is considerable merit sampling the north – south response of a magnetic anomaly with as many data points as is possible, this is accomplished as the density collected along the traverse line is greater than that between traverses (Aspinall 2008). On this occasion magnetic data was collected on a north – south alignment due to the orientation of the pre-programmed survey grids.

The data collected from the survey has been analysed using the current version of Terrasurveyor 3.0.27. The resulting data set plots are presented with positive nT/m values and high resistance as black and negative nT/m values and low resistance as white.

The data sets have been subjected to processing using the following filters:

- De-stripe
- Clipping
- De-staggering

The de-stripe process is used to equalise underlying differences between grids or traverses. Differences are most often caused by directional effects inherent to magnetic surveying instruments, instrument drift, instrument orientation (for example off-axis surveying or heading errors) and delays between surveying adjacent grids. The de-stripe process is used with care however as it can sometimes have an adverse effect on linear features that run parallel to the orientation of the process.

The clipping process is used to remove extreme data point values which can mask fine detail in the data set. Excluding these values allows the details to show through.

The de-staggering process compensates for data correction errors caused by the operator commencing the recording of each traverse too soon or too late. It shifts each traverse forward or backwards by a specified number of intervals.

Plots of the data are presented in processed linear greyscale (smoothed) with any corrections to the measured values or filtering processes noted, and as separate simplified graphical interpretations of the main anomalies detected.

6.0 Geophysical Survey Results

6.1 For the purposes of interpreting the anomalies, the survey data has been processed to the values of -3 to 3 nT/m (Figure 3). This enhances faint anomalies that may otherwise not be noted in the data. The survey results revealed a number of anomalies across the data set, and these are discussed in turn and noted as single or double digit numbers in square brackets.

6.2 There are various areas of magnetic noise across the entire survey area, mostly around field boundaries: [1] produced readings of between -7 and 10 nT/m and is likely to represent a combination of modern waste/detritus and the field boundary. Anomaly [2]

produced readings between -10 and 10 nT/m, with some larger spikes. This area lies adjacent to the river and the readings are likely to represent waste/detritus associated with both the field edge and with potential maintenance/dredging of the river bank and channel. Anomaly [3] produced readings of -100 to 100 nT/m, likely indicating a dump of modern waste/detritus, possibly associated with the weir on the river. Area [4] runs most of the way around the field, with readings of -50 to 50 nT/m, with some much larger spikes. This represents the metal fence around the field and associated waste/detritus. Anomalies [5], [6], [7] and [8] likely represent dumps of modern waste/detritus and produced readings of -10 to 15 nT/m, -20 to 40 nT/m, -10 to 10 nT/m and -10 to 5 nT/m respectively. The areas of magnetic noise [9] close to the field boundary, producing readings of -30 to 20 nT/m likely represents a metal object within the hedgerow.

6.3 The areas of magnetic noise [10] and [11], produced readings of -5 to 5 nT/m (with occasional much higher spikes- -10 to 15 nT/m) that likely relate to spreads of waste/detritus within the field.

6.4 Anomaly [12] is a linear/curvilinear positive feature, 2 nT/m, which likely represents a former field boundary seen on historic OS maps. Also seen on historic OS maps is a trackway across the field, producing the linear positive anomaly [13], 1 to 1.5 nT/m. Two potential positive linear anomalies [14], 1 nT/m, roughly orientated north-northeast to south-southwest, possibly represent former ditches, paths, boundaries, tracks or field drains. Features [15] and [16] are linear positive anomalies, 2 to 3 nT/m, likely representing former ditches, paths, boundaries, tracks or possibly field drains.

6.5 The potential parallel positive linear features [17], running roughly east to west, 1 to 2 nT/m, may represent parallel ditches possibly either side of a track.

6.6 The positive linear feature [18], 1 to 3 nT/m, represents a former field boundary seen on historic OS maps.

6.7 The long potential positive linear feature [19], 1 to 2 nT/m, running roughly northeast to southwest could relate to a ditch, path or track across the field. It is possible it relates to a former water channel.

6.8 The positive linear features [20], 1 to 2 nT/m, may relate to ditches, paths or tracks or could be representing a former cultivation trend within the field.

6.9 There are a large number of amorphous positive anomalies across the entire survey area. These produce varying magnetic readings and likely represent pits, soil-filled hollows, former ponds or geological variations. Anomaly [21] produced readings of 4 to 10 nT/m; [22] a reading of 3 nT/m; [23] a reading of 10 nT/m; [24] a reading of 4 to 6 nT/m; [25] a reading of 4 to 10 nT/m and [26] a reading of 6 to 8 nT/m.

6.10 The amorphous/linear positive features [27], 2 to 4 nT/m, may represent pits, soil-filled hollows or former ponds, but are more likely to represent former water channels probably relating to the river to the west. The amorphous positive anomalies [28] and [29], producing readings between 4 and 8 nT/m, likely represent former ponds or soil-filled hollows, probably relating to the proximity of the river and flooded areas.

6.11 It seems likely that due to the proximity of the river and large ponds/flooded areas within the Site, that a large number of the positive anomalies relate to natural geological variations or former ponds. The curvilinear negative anomaly [30], -4 to -3 nT/m, relates

to a former river/stream channel clearly visible in the topography of the field. The linear dipolar feature [31], -100 to 100 nT/m, running north-northeast to south-southwest alongside a short field boundary, likely represents a modern service pipe.

6.12 Scattered randomly throughout the site are a number of strong and weak dipolar responses, examples of which are highlighted as [32]. The characteristic dipolar response of pairs of positive and negative 'spikes' suggest near surface ferrous metals or other highly fired material.

7.0 Conclusions

7.1 The survey identified a number of features of potential archaeological interest. Whilst a large number of the amorphous positive anomalies likely relate to water activity on the site, due to the proximity of the river, there are a number of linear features that suggest anthropogenic activity, including a potential trackway, a former path and field boundary and potential cultivation trends along with possible field drains. It is possible some of the amorphous positive anomalies could relate to pits.

7.2 Overall, the geophysical survey indicates moderate archaeological potential, although it was not possible to survey some parts of the site due to flooding/large ponds.

8.0 Effectiveness of Methodology

8.1 The non-intrusive survey methodologies employed were appropriate to the scale and nature of the sites and identified a moderate archaeological potential for the proposed development area.

9.0 Acknowledgements

9.1 Allen Archaeology would like to thank the Environment Agency for this commission.

10.0 References

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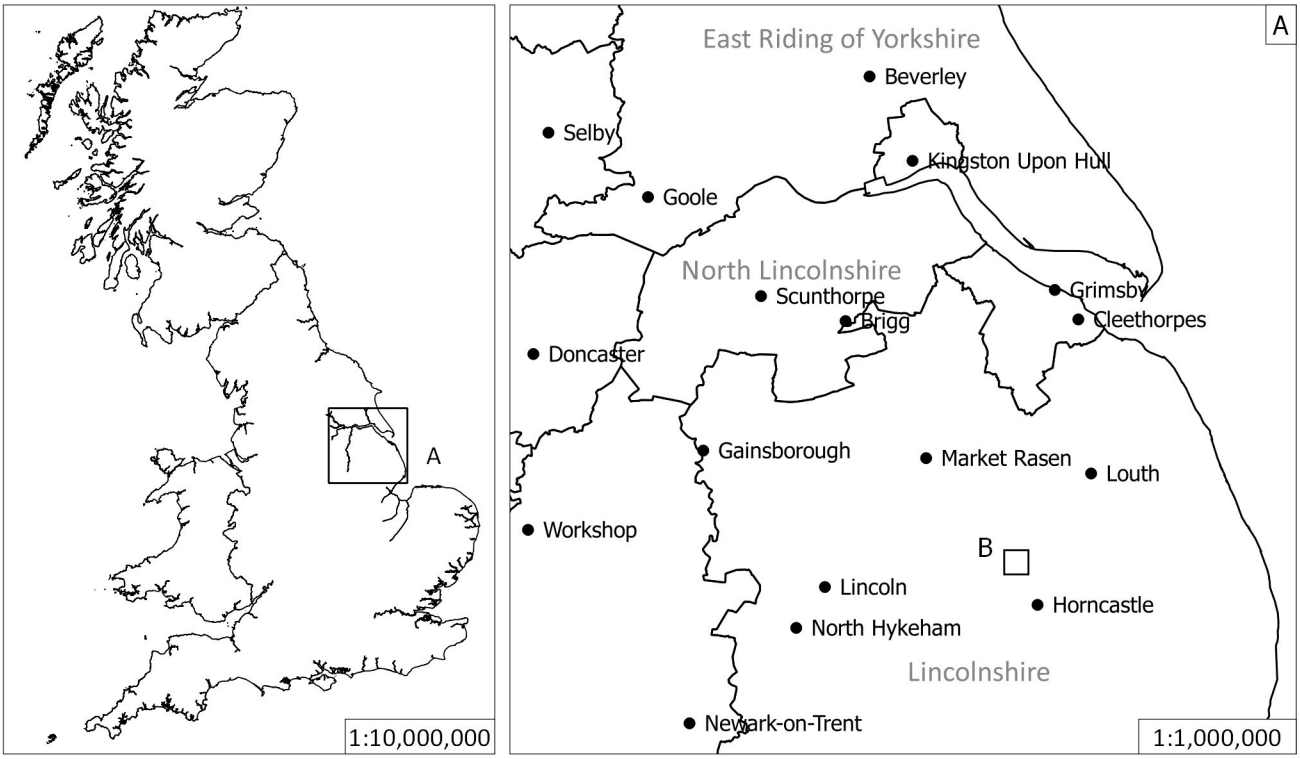

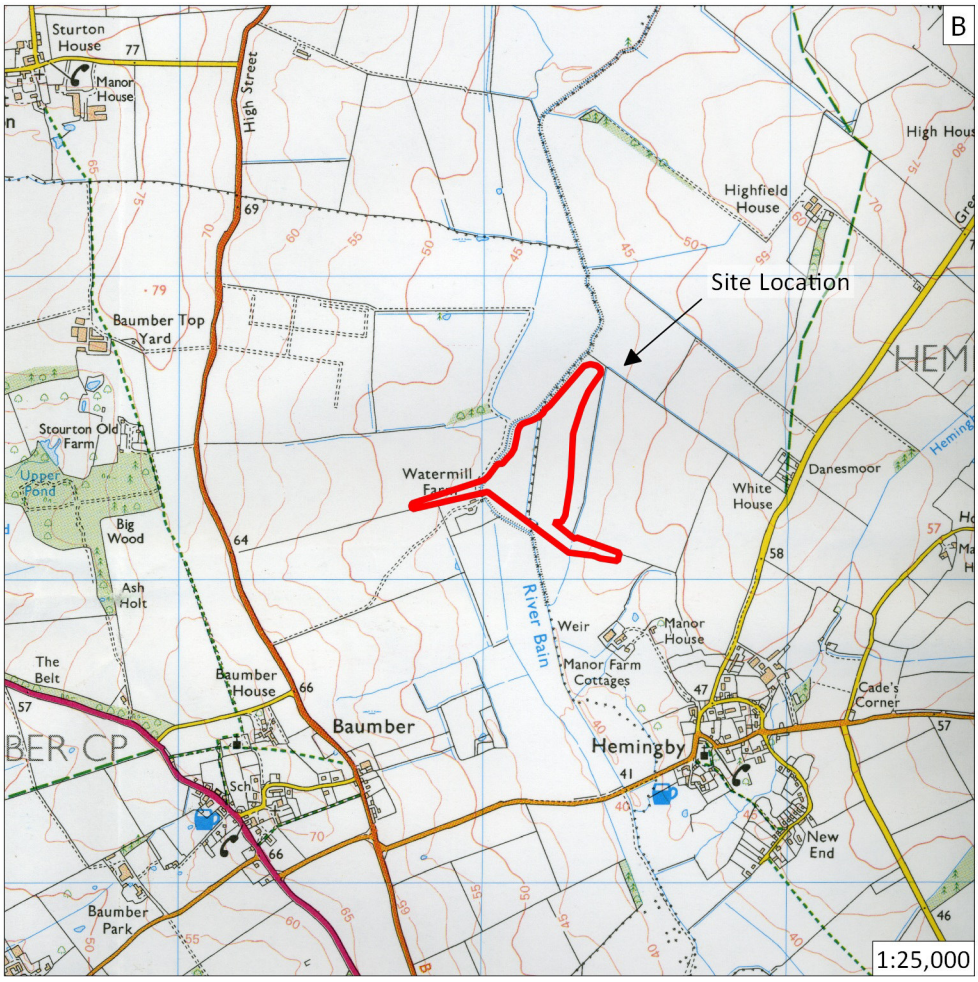

Figure 1: Site location outlined in red

Site Code	HOFA 15
Scale	1:25,000 @ A4
Drawn by	J. Hogue
Date	03/07/15

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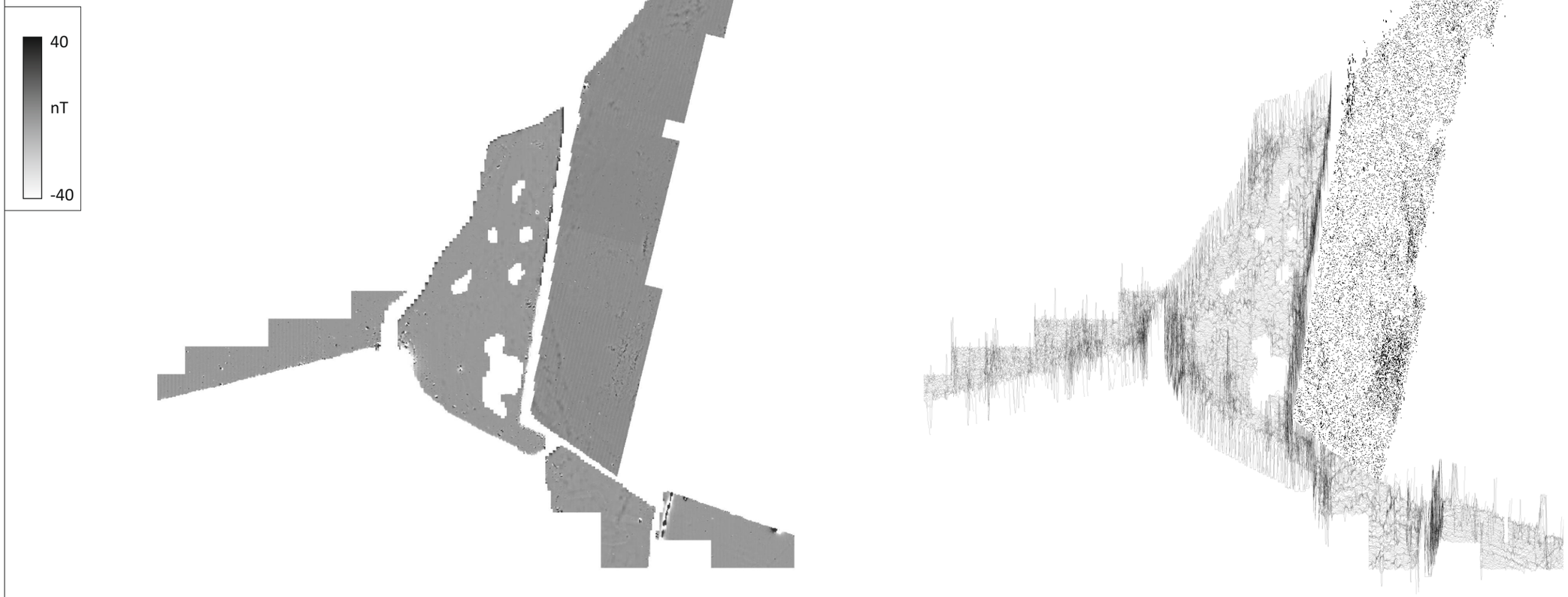
Raw data (clipped to +/- 40 nT)

Trace Plot (ZMT and clipped to +/- 25nT)



Site Code	HOFA 14
Scale	1:5,000 @ A3
Drawn by	Robert Evershed
Date	14/07/15

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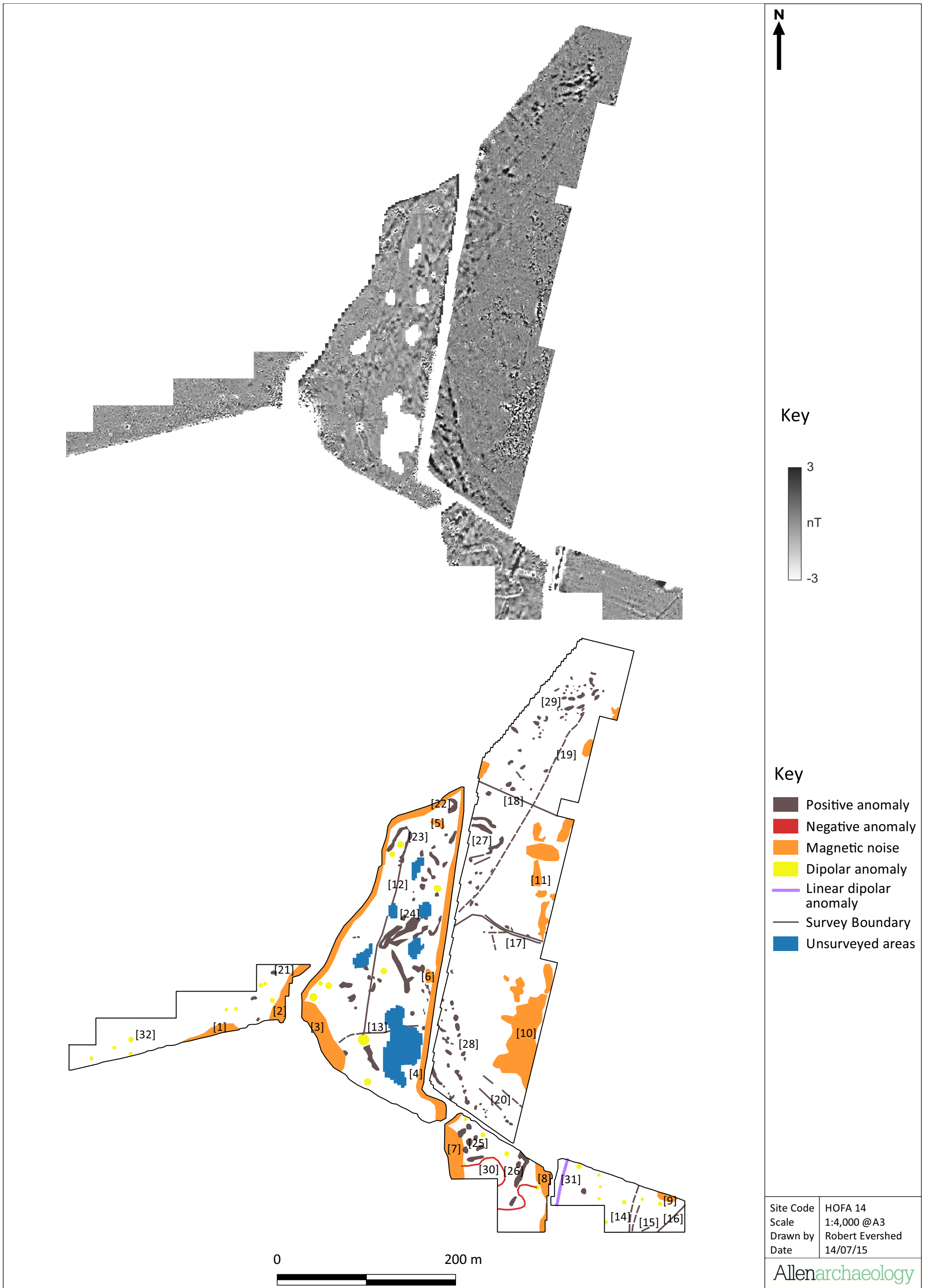
Figure 2: Greyscale raw data and processed trace plot



Site Code	HOFA 14
Scale	1:4,000 @A3
Drawn by	Robert Evershed
Date	14/07/15

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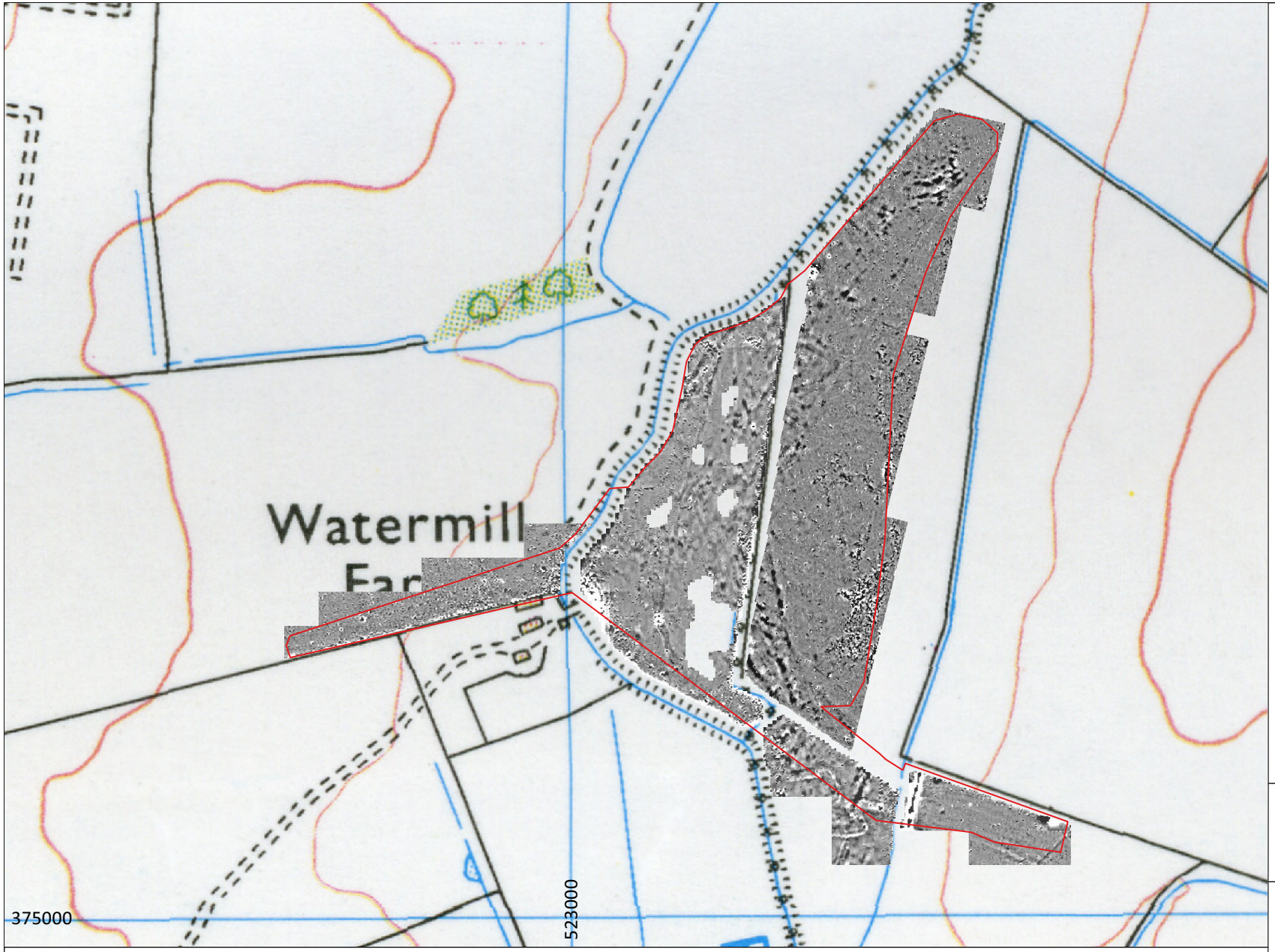
Figure 3: Processed greyscale plot and interpretation



Site Code	HOFA 14
Scale	1:5,000 @ A4
Drawn By	Robert Evershed
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Figure 4: Processed greyscale location

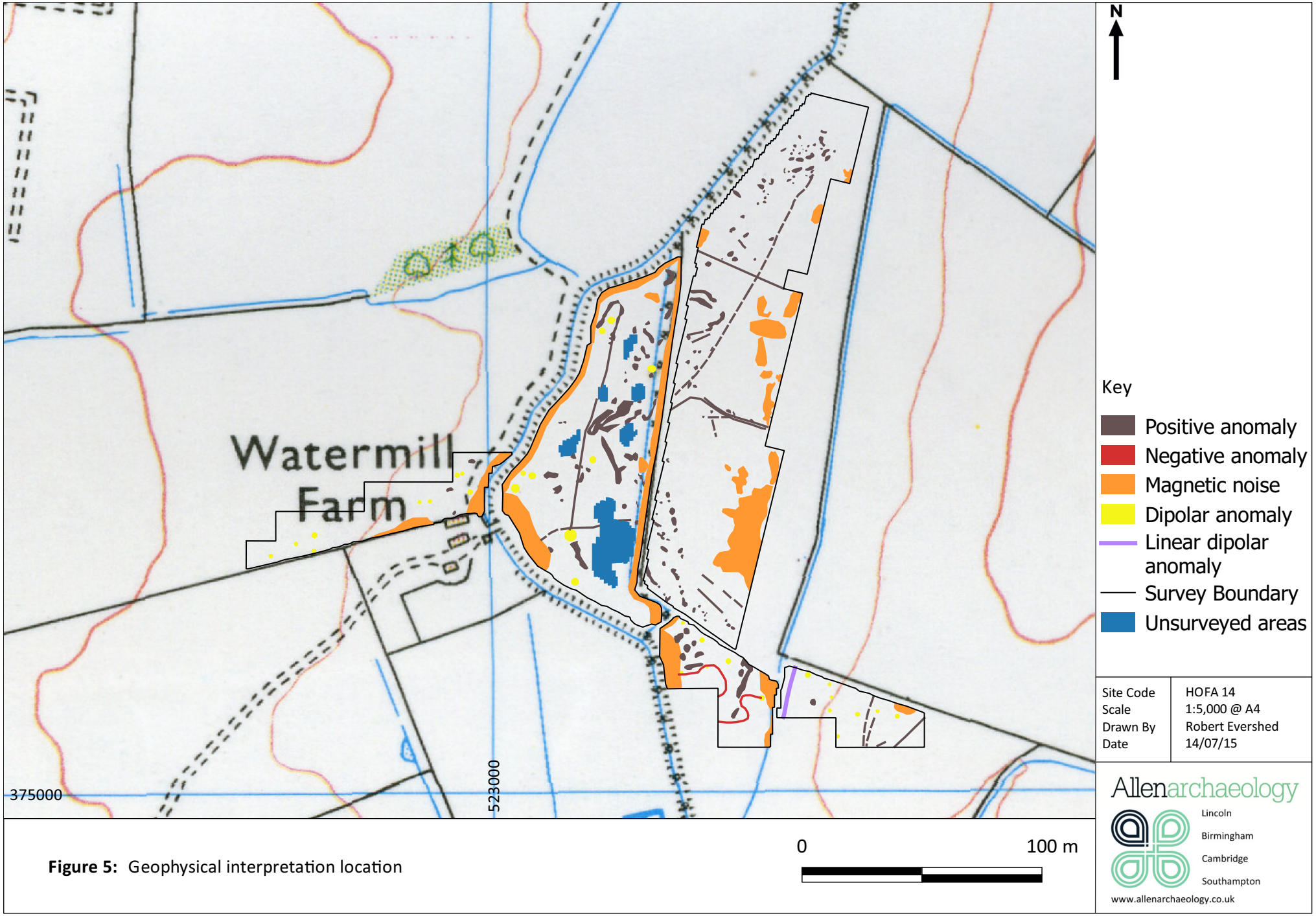

Figure 5: Geophysical interpretation location

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