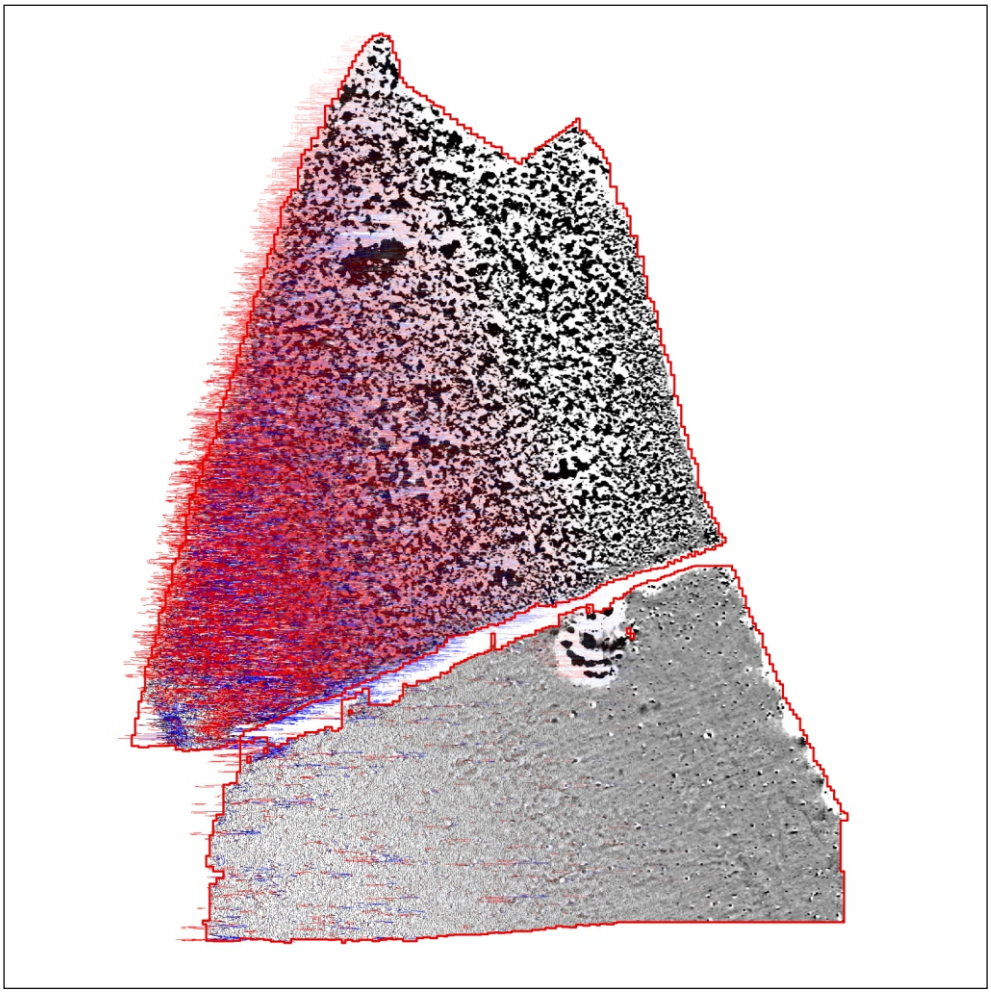
making sense of heritage

Moto M25, Junction 10
Watford, Herefordshire

Detailed Gradiometer Survey Report



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geoservices

Moto M25, Junction 10
Watford, Hertfordshire

Detailed Gradiometer Survey Report

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Detailed Gradiometer Survey Report

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Summary

A detailed gradiometer survey was conducted over land adjacent to Junction 20 of the M25, near Watford, Hertfordshire (centred on NGR 507724, 200907). The project was commissioned by The Millbridge Group Plc on behalf of Moto Hospitality Ltd with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of a planning application for the development of the site as a new motorway service station.

The site comprises two pasture fields located directly south-east of Junction 20 approximately 2 km west of Abbots Langley and 1.9 km south of Kings Langley, covering an area of 14.3 ha. The geophysical survey was undertaken between 18th and 22nd April 2016. The detailed gradiometer survey has demonstrated the presence of a number of anomalies of possible archaeological interest.

The anomalies identified as potentially being of archaeological interest are primarily clusters of pit-like features. These features identified as such can be seen widespread across the southern field. It is difficult to be certain about their origins but an archaeological interpretation cannot be excluded with the currently available information.

The northern field is dominated by strong ferrous responses likely from the construction of the M25. However, there are some faint linear and curvilinear trends extending across this field. It is possible that these trends relate to modern features.

Additionally, this archaeological investigation has detected areas of increased magnetic response, areas of near surface geological change and evidence for historic cultivation.

Moto M25, Junction 10
Watford, Hertfordshire

Detailed Gradiometer Survey Report

Acknowledgements

Wessex Archaeology would like to thank The Millbridge Group Plc for commissioning the geophysical survey on behalf of Moto Hospitality Ltd. The assistance of Graham Clarke and Antonella Noto is gratefully acknowledged in this regard.

The fieldwork was undertaken by Ali Salisbury, Jen Smith and Becky Hall. Ali Salisbury and Jen Smith processed and interpreted the geophysical data. Jen Smith wrote the report. The geophysical work was quality controlled by Lizzie Richley and Lucy Learmonth. Illustrations were prepared by Jen Smith. The project was managed on behalf of Wessex Archaeology by Lucy Learmonth.

Moto M25, Junction 10
Watford, Hertfordshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by The Millbridge Group Plc to carry out a geophysical survey at land off Junction 20 of the M25, near Watford, Hertfordshire (hereafter "the Site", centred on NGR 507724, 200907) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for the development of the Site as a new motorway service station.

1.1.2 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

1.2 The Site

1.2.1 The Site is located 2 km west of Abbots Langley, 1.9 km south of Kings Langley and 6.7 km south-east from the centre of Hemel Hempstead, in the county of Hertfordshire.

1.2.2 The Site consists of a 14.3 ha area of agricultural land over two fields, currently utilised for pasture. The Site is bounded by the M25 to the west, the A41 to the north and east, and by further agricultural land to the south.

1.2.3 The Site has a steep incline in the northern field sloping from 100m aOD at the western edge to approximately 70m aOD at the eastern edge. The southern field only has a slight incline sloping from approximately 85m aOD at the western edge to 70m aOD at the eastern edge.

1.2.4 The solid geology comprises of Chalk of the Lewes Nodular Chalk Formation and the Seaford Chalk Formation. There are no superficial geological deposits recorded at this location (BGS 2015).

1.2.5 The soils underlying the Site are likely to consist of typical paleo-argillic brown earths soils of the 581e (Stone Street) association and of calcareous alluvial grey soils of the 812c (Agney) association (SSEW SE Sheet 6 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The following information is summarised from the Heritage Gateway website (www.heritagegateway.org.uk). A search was performed to support archaeological interpretation of the dataset for all heritage assets within a 1 km radius of the Site. No desk-based assessment has been made available at this time.

2.1.2 There are no designated historical assets within the Site. However, there is one Scheduled Monument within the 1 km radius recorded 0.8 km to the north of the Site. The monument comprises a sub-rectangular moated site and a series of outer enclosures. The internal mound and hollow appear to mark the position of an earlier lodge belonging to the Royal Park of the King's Langley Estate and dating to the 14th century. There are no standing structures in the moat today. The outer enclosures appear as low earthworks mainly to the north of the moat, and may be the remains of ancillary buildings or horticultural earthworks contemporary with the moat (NHLE 1010911).

2.1.3 There are no World Heritage Sites, Registered Parks and Gardens, Conservation Areas or Historic Battlefields identified within the extents of the search however three Grade II* and 23 Grade II listed buildings are recorded.

2.1.4 A handful of previous archaeological works recorded within the extents of the search have been undertaken between 1991 and 2007 at various locations around the Site. These works include several Desked Based Assessments and Building surveys as well as archaeological evaluations and watching briefs. The results of these previous archaeological works have yielded little of archaeological interest.

2.1.5 Medieval and post-medieval records are predominantly occupied by buildings associated with the rural landscape, comprising numerous houses, farmsteads and barns dating from the 14th to 19th centuries. Other structures include the Grade II* and Grade II listed buildings of the Church of St Paul, associated Lynch Gate and a late 19th century memorial cross just outside the Site extent to the south-east. There is also the King's Head Public House and the Unicorn Public House which are 18th and 17th century respectfully. Approximately 300 m to the east of the Site is a late 18th century canal lock and associated house. Also recorded is a 1935 telephone kiosk that was designed by Sir Giles Gilbert Scott which is located on Bridge Road.

2.1.6 Historic mapping indicates that the Site area has been in use as agricultural fields from at least the 18th century to present with little change to the internal field boundary that still exists today.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between the 18th and 22nd April 2016. Field conditions at the time of the survey were good with dry conditions throughout the period of survey. An overall coverage of 14.1 ha was achieved, with reductions due to a hedgerow and a tree line traversing the Site.

3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- to conduct a detailed survey covering as much of the specified area as possible, allowing for artificial obstructions;
- to clarify the presence/absence and extent of any buried archaeological remains within the site;
- to determine the general nature of the remains present.

3.3 Fieldwork methodology

3.3.1 Individual survey grid nodes were established at 30 m x 30 m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02 m and therefore exceeds Historic England recommendations (English Heritage 2008).

3.3.2 The detailed gradiometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1 m between sensors. Data were collected at 0.25 m intervals along transects spaced 1 m apart with an effective sensitivity of 0.03 nT, in accordance with Historic England guidelines (English Heritage 2008). Data were collected in the zigzag method.

3.4 Data processing

3.4.1 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse function (±5 nT thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied throughout the survey area, with no interpolation applied.

3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

4.1.1 The detailed gradiometer survey has identified magnetic anomalies across the Site, along with some areas of increased magnetic response, superficial geology and a large amount of ferrous. Results are presented as a series of greyscale plots, XY plots and archaeological interpretations at a scale of 1:3000 (**Figures 2** to **4**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image and ±25 nT at 25 nT per cm for the XY trace plots.

4.1.2 The interpretation of the datasets highlights the presence of possible archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

4.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.

4.1.5 Gradiometer survey may not detect all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.

4.2 Gradiometer survey results and interpretation

4.2.1 Across the entire southern field there are numerous clusters of small strong positive anomalies as seen at **4000** to **4005** with readings ranging from +1 to +4.5 nT. These anomalies have been interpreted as possible archaeology as they may represent clusters of pit-like features. Their ephemeral appearance may be an indicator of the poor preservation of these potential archaeological features but may indicate a more natural origin.

4.2.2 The areas of increased magnetic response near **4003** and **4004** are possibly remnants of early agricultural practices on the Site but it is not possible to determine this from the dataset alone.

4.2.3 Numerous linear and curvi-linear trends can be seen throughout the southern field. It is likely that the majority of these are the result of ploughing, or other agricultural activity, and these extend predominately north-east to south-west.

4.2.4 The northern field is dominated by strong ferrous responses which are likely to relate to disturbance and debris from the construction of the M25. However, there are a few faint linear and curvilinear trends that are visible extending across this field. These are predominately aligned NNW to SSE and appear to terminate at the western and southern field extents as there is no evidence for them in the southern field. It is possible that these relate to modern features such as pipes, drains or construction practices but this is not possible to interpret these trends with any certainty with the currently available information.

5 DISCUSSION

5.1.1 The detailed gradiometer survey has been successful in detecting anomalies of possible archaeological interest in the southern field. In addition to these, anomalies interpreted as ploughing trends, areas of increased magnetic response and superficial geology have also been identified. Due to the disturbed nature of the northern field it is difficult to identify anomalies from the background noise.

5.1.2 The anomalies of archaeological interest appear to be primarily pit-like features. These features identified as such can be seen widespread across the southern field with clusters seen at **4000** to **4005**. It is difficult to be certain about their origins but an archaeological interpretation cannot be excluded entirely, resulting in their classification as being of possible interest. No clear coherent spatial patterns are apparent within their distribution; however, it is possible that they are natural or agricultural in origin.

5.1.3 The areas of increased magnetic response in the southern field are more difficult to define. These areas have no definite form or shape and can represent areas of former burning or contain debris. The three areas to the south of **4004**, however, are all sub-circular in shape and could be suggestive of having been small wooded areas similar to the small clusters of trees observed further south in the field. Their origins are otherwise unknown.

5.1.4 Frequent ploughing trends are visible across the southern field on a predominate alignment of north-east to south-west. These are likely to be post-medieval and modern in provenance as historical mapping indicates that the Site has been in use as agricultural fields from at least the 18th century to the present day.

5.1.5 The northern field is dominated by strong ferrous responses likely relating to the construction of the M25. This makes any archaeological interpretation of this area extremely difficult. However, there are a few faint linear and curvilinear trends that are noticeable extending across this field. It is possible that these trends are pipes or drains, or even just part of the debris left behind from the motorway construction but it is not possible to determine their origins from the dataset alone.

6 REFERENCES

6.1 Bibliography

English Heritage 2008 *Geophysical Survey in Archaeological Field Evaluation. Research and Professional Service Guideline No 1.* Swindon (2nd Edition)

6.2 Cartographic and documentary sources

1760 Topographic map of Hartford-Shire, 7

1938 Ordnance Survey 6”

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 6, Soils of Midland and Western England.* Southampton.

6.3 Online resources

British Geological Survey Geology of Britain Viewer (accessed April 2016)
http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Heritage Gateway (accessed April 2016)
http://www.heritagegateway.org.uk/Gateway

Old Maps Online Viewer (accessed April 2016)
http://www.old-maps.co.uk

7 APPENDICES

7.1 Appendix 1: Survey Equipment and Data Processing

Survey methods and equipment

The magnetic data for this project will be acquired using a non-magnetic cart fitted with 4x Bartington Grad-01-1000L magnetic gradiometers. The instrument has four sensor assemblies fixed horizontally 1 m apart allowing four traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03 nT over a ±100 nT range, and measurements from each sensor are logged at a rate of 6 hz (intervals of sub 0.25 m). All of the data are stored on a Leica Viva CS35 tablet controller using the data acquisition program MLGrad 601. This also collects readings streamed by a Leica GS14 GNSS receiver, which is fixed to the cart at a measured distance from the sensors.

The use of the non-magnetic cart has several advantages over the use of the Bartington Grad 601-2 fluxgate gradiometer instrument. Perhaps chief amongst these is that it has a higher sample rate resulting in higher resolution dataset. The addition of the GPS receiver also negates the need to establish a survey grid prior to the survey and therefore increases efficiency. Mounting the instrument on the cart also reduces the occurrence of operator error caused by inconsistent walking speeds and variation in traverse position due to varying ground cover and topography.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. When not using the handheld Bartington 601-2 dual magnetic gradiometer, both types depend upon the establishment of an accurate 20 m or 30 m site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02 m in real-time and therefore exceed the level of accuracy recommended by Historic England (English Heritage 2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25 m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20 m x 20 m or 30 m x 30 m grids, and data are collected at 0.25 m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20 m or 30 m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125 m intervals along traverses spaced up to 0.25 m apart, resulting in a maximum of 28800 readings per 30 m grid,

exceeding that recommended by Historic England (English Heritage 2008) for characterisation surveys.

Post-Processing

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps for the non-magnetic cart fitted system may include:

- Smooth – Applying a smooth function removes any small scale spiking or 'fuzziness', generally caused by internal system noise. This effectively 'destripes' the data and reduces the appearance of dominant anomalous readings.
- Spline interpolation – Gridding the data with splines allows the application of minimum and maximum data values and reduces oscillations for potential fields such as gravity or magnetic.

Typical data and image processing steps for the dual magnetic gradiometer system may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by
- directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.

7.2 Appendix 2: Geophysical Interpretation

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

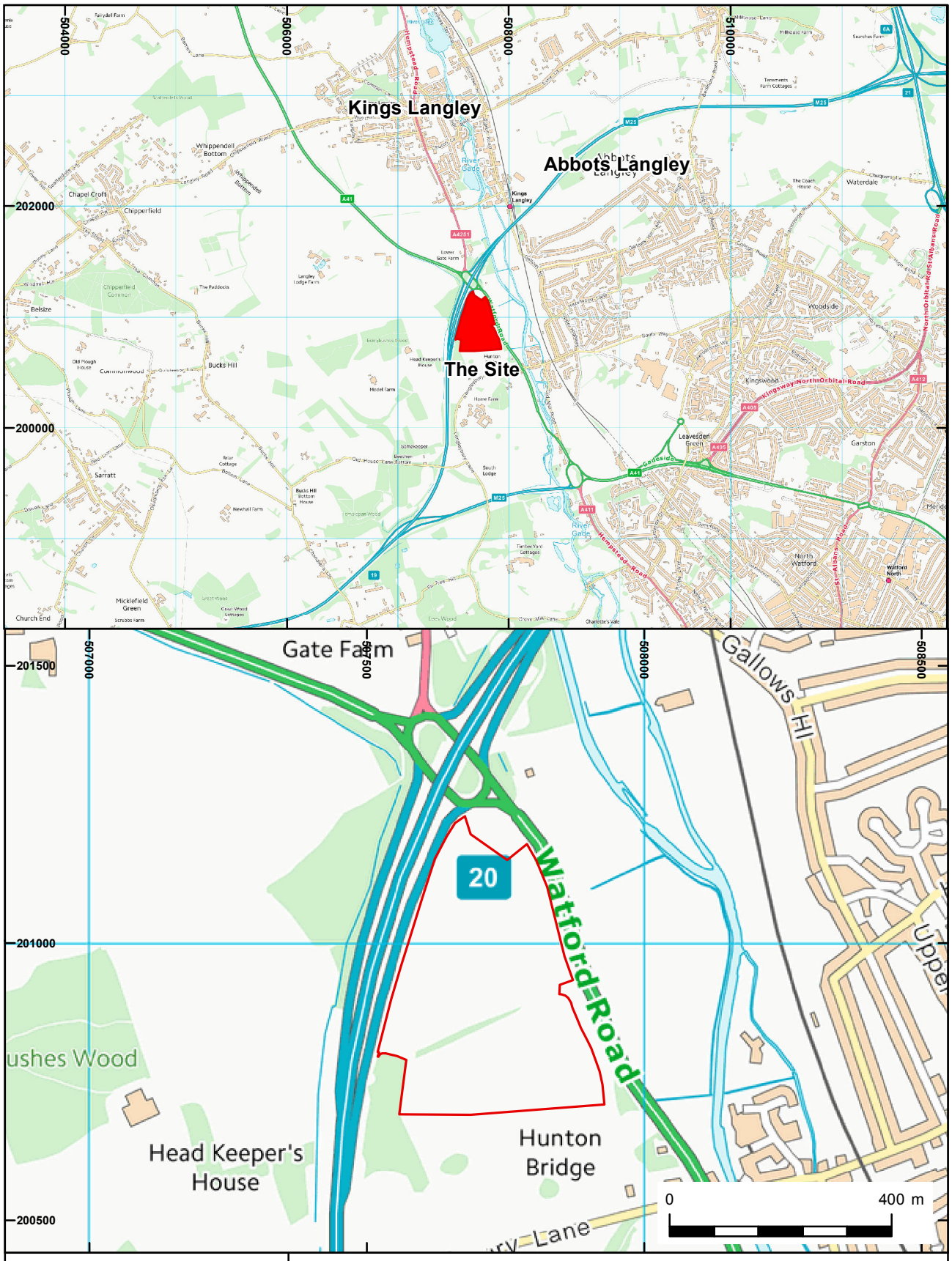
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative or broad bipolar (positive and negative) anomalies.



Survey Area

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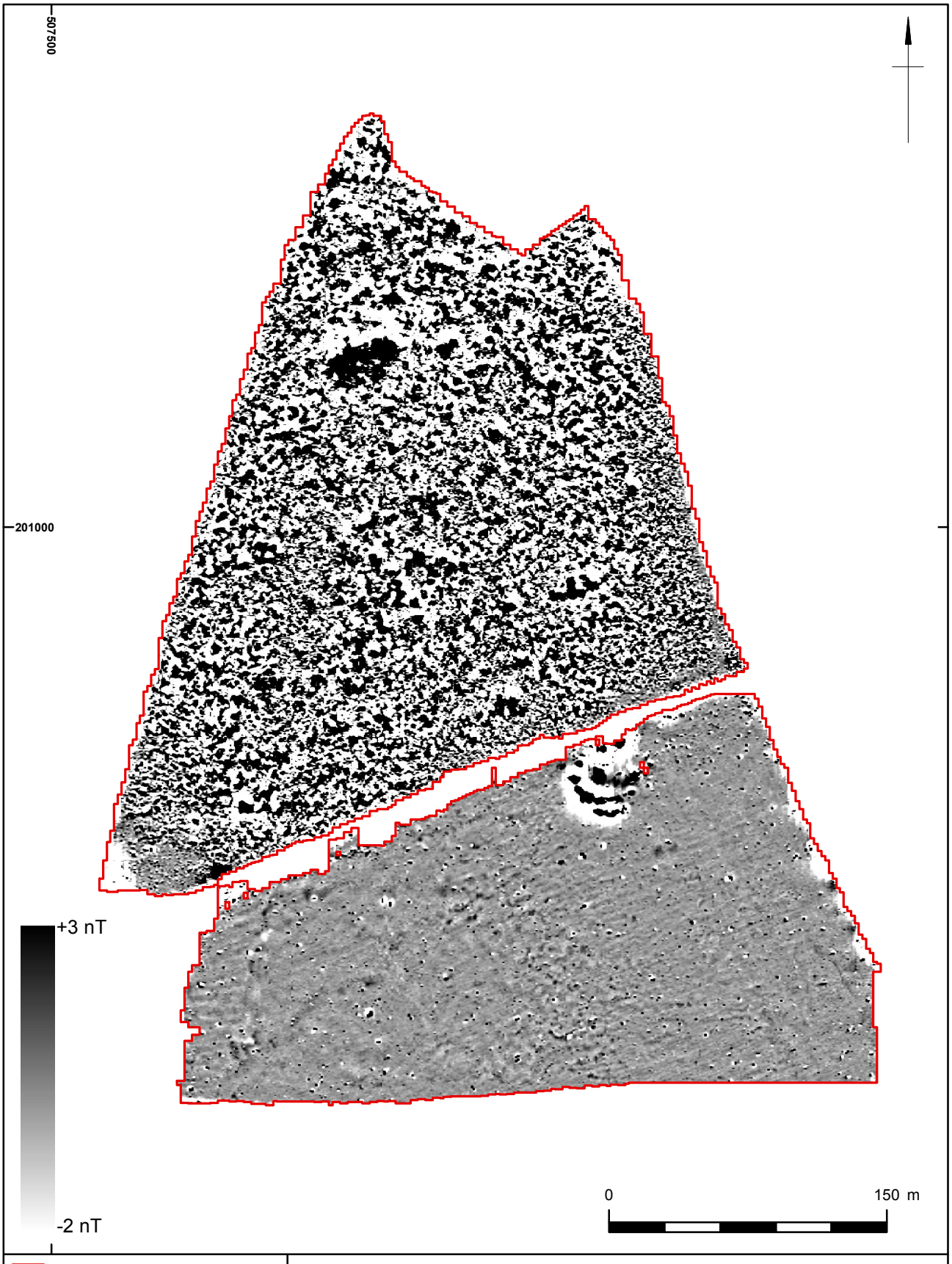
Site Location and Survey Extents

Figure 1



Detail Survey Extents

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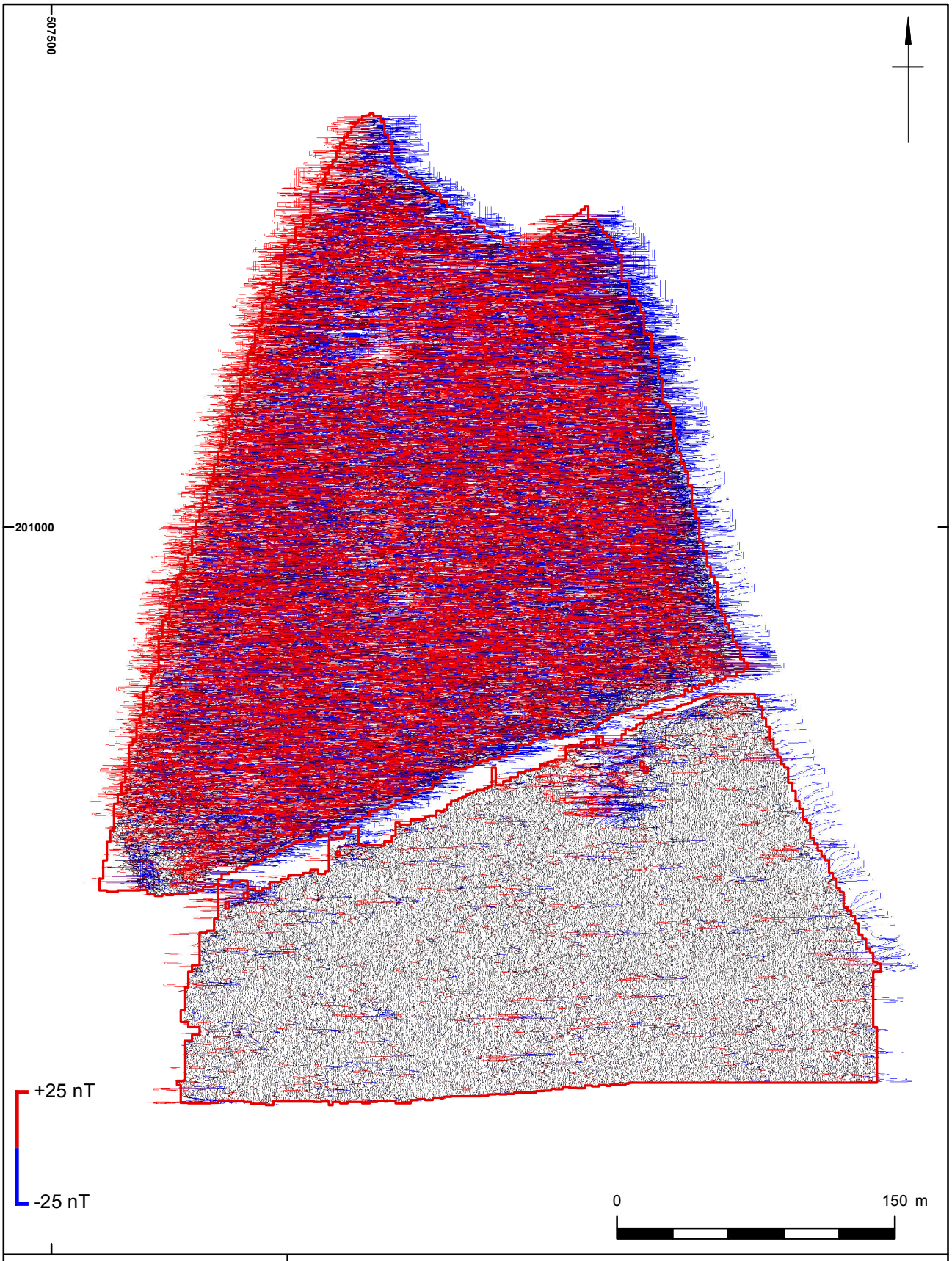
Greyscale Plot

Figure 2



Detailed Survey Extents

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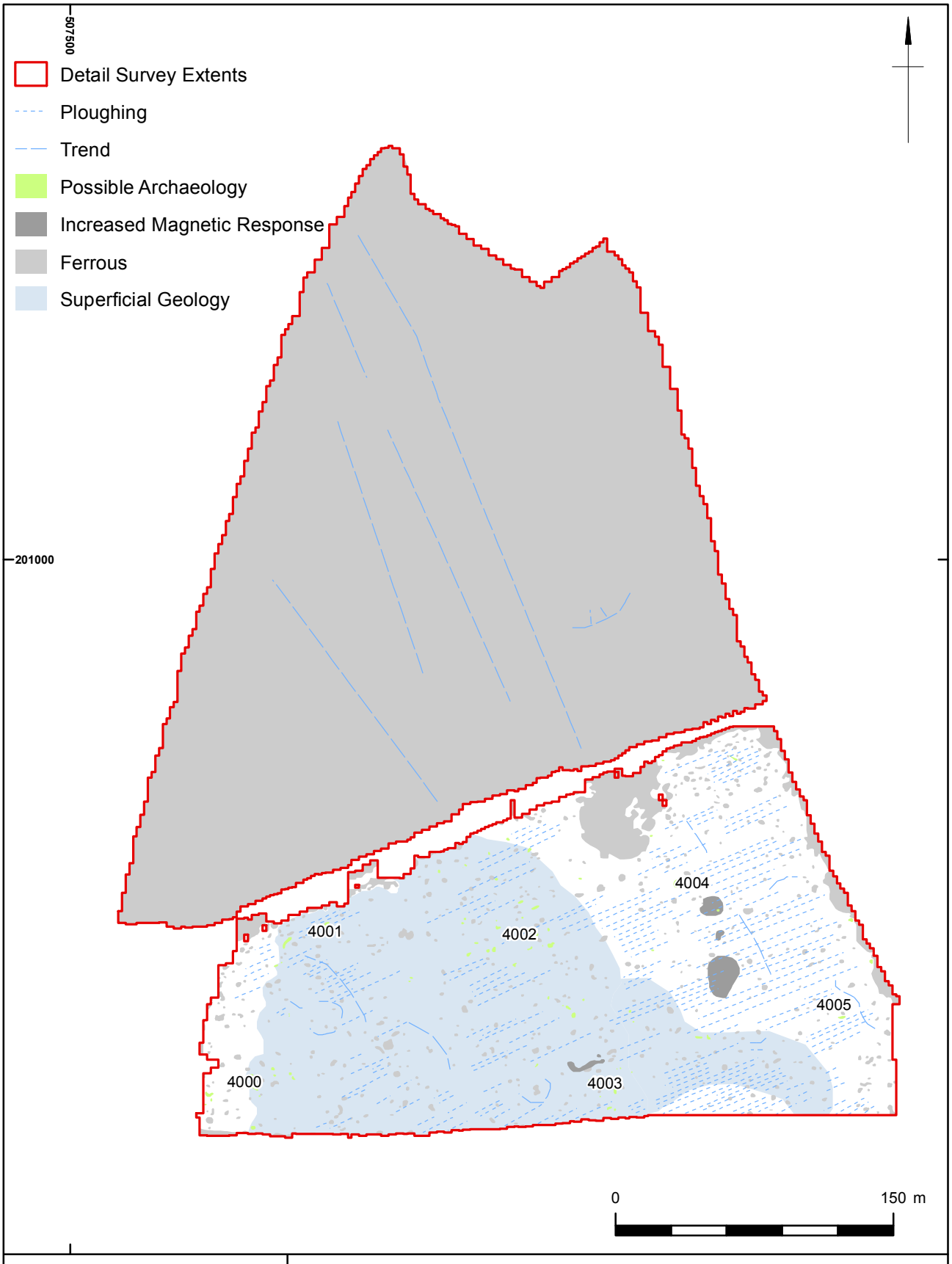
XY Plot

Figure 3



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Archaeological Interpretation

Figure 4

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