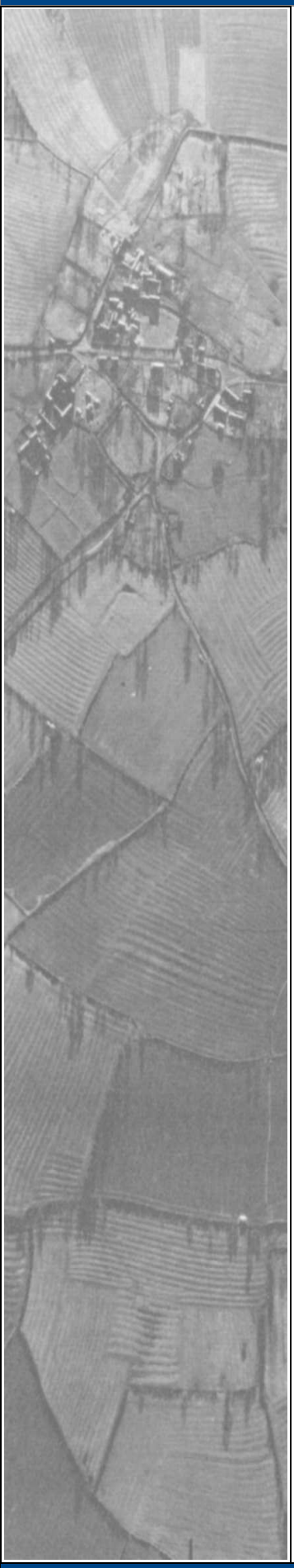

Malmesbury Road Solar Park
Cricklade
Wiltshire

MAGNETOMETER SURVEY REPORT

for

Orion Heritage

Kerry Donaldson & David Sabin

November 2020

Ref. no. J834

ARCHAEOLOGICAL SURVEYS LTD

Malmesbury Road Solar Park
Cricklade
Wiltshire

MAGNETOMETER SURVEY REPORT

for

Orion Heritage

Fieldwork by David Sabin BSc (Hons) MCIfA
Report by Kerry Donaldson BSc (Hons)
Report checked by David Sabin
Primary archive location - Archaeological Surveys Ltd, Yatesbury, Wiltshire

Survey dates – 12th to 16th October 2020
Ordnance Survey Grid Reference – **SU 08165 93890**

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SUMMARY

A geophysical survey, comprising detailed magnetometry, was carried out over 18ha at Windmill Farm to the north of Malmesbury Road, Cricklade, ahead of a solar farm development. The results demonstrate the presence of a number of positive linear and discrete responses of uncertain origin within all of the six survey areas, although they generally lack a coherent morphology for them to be confidently interpreted as cut features. Patches of magnetic debris within two of the survey areas are associated with the site of a demolished 19th century agricultural building known as Spackman Stalls. Negative linear anomalies and magnetic enhancement also appear to be associated with this feature. Anomalies relating to former ridge and furrow cultivation appear widespread across the site.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Orion Heritage, on behalf of Wessex Solar Energy, to undertake a magnetometer survey of an area of land at Windmill Farm, to the west of Cricklade, Wiltshire. The site has been outlined for a proposed development of a solar farm and the survey forms part of an archaeological assessment.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2020) and issued to the client prior to commencing the fieldwork.

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 Geophysical survey can provide useful information on the archaeological potential of a site; however, the outcome of any survey relies on a number of factors and as a consequence results can vary. The success in meeting the aims and objectives of a survey is, therefore, often impossible to predetermine.

1.3 Standards, guidance and recommendations for the use of this report

1.3.1 The survey and report follow the recommendations set out by: European Archaeological Council (2015) *Guidelines for the Use of Geophysics in Archaeology;* Institute for Archaeologists (2002) *The use of Geophysical*

Techniques in Archaeological Evaluations. The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey.*

1.3.2 Archaeological Surveys Ltd provide a detailed geophysical survey report and it is recommended that where possible the contents should be considered in full. The Summary provides a brief overview of the results with more detail available in the Discussion and/or Conclusion. The *List of anomalies* within the Results provides a detailed assessment of the anomalies within separate categories which can be useful in inferring a level of confidence to the interpretation. Quality and factors influencing the interpretation of anomalies is also set out within the results.

1.3.3 It is recommended that the full report should always be considered when using data and interpretation plots; where this is not possible, in the field for example, the abstraction and interpretation plots should retain their colour coding and be used with a corresponding legend.

1.3.4 Where targeting of anomalies by excavation is to be carried out, care should be taken to place trenches over solid lines or features visible on the abstraction and interpretation plots. Archaeological Surveys abstraction and interpretation avoids the use of dashed or dotted line formats, and broken or fragmented lines used in interpretive plots may well correspond closely with truncation of archaeological features.

1.4 Site location, description and survey conditions

1.4.1 The site is located at Windmill Farm, to the west of Cricklade and north of Malmesbury Road. It is centred on Ordnance Survey National Grid Reference (OS NGR) SU 08165 93890, see Figs 01 and 02.

1.4.2 The geophysical survey covers approximately 18ha of pasture land split between six separate fields. The southern part of the site is elevated at around 100m ODN with land falling to the north to around 85m ODN. Field boundaries are hedgerows and there is surviving ridge and furrow with little evidence of modern cultivation in the northern half of the site.

1.4.3 The ground conditions across were generally considered to be favourable for the collection of magnetometry data. Weather conditions during the survey were mainly fine.

1.5 Site history and archaeological potential

1.5.1 The Wiltshire and Swindon Historic Environment Record (HER) indicates that there are a number of 19th century outfarms recorded within a 500m radius, including one immediately to the south of the site. A further 19th century agricultural building is recorded as Spackman Stalls, on Ordnance Survey mapping between 1877 and 1887, but this had been removed by 1900. It was

located at the south western corner of Area 2 and the north western corner of Area 3. A ring ditch and linear cropmarks are located approximately 500m to the east and a number of sherds of medieval pottery were located along the route of an Esso pipeline c550m east. The site lies 1.5km west of the medieval town of Cricklade and within 1.5km of the multi-phase settlement sites at Latton to the north.

1.5.2 Field observations during the course of the survey indicated the presence of low ridge and furrow in the northern half of the site. The most northerly field (Area 1) contains two low linear banks with flanking parallel ditches that appear to indicate that it was formerly divided into three small fields. The banks and ditches post-date the ridge and furrow. In the north western part of the site (Area 2), a large earth bank was noted in the field boundary in the vicinity of the former Spackman Stalls, but it is not known if it is directly associated with the former agricultural building.

1.5.3 The site is likely to have been part of the agricultural hinterland of Cricklade since the medieval period; however, there is always potential for the survey to locate previously unrecorded archaeological features, should they exist within the site.

1.6 Geology and soils

1.6.1 The underlying solid geology across the site is mudstone from the Oxford Clay Formation (BGS, 2017).

1.6.2 The overlying soil across the survey area is from the Denchworth association and is a pelo-stagnogley. It consists of a slowly permeable, seasonally waterlogged, clayey soil (Soil Survey of England and Wales, 1983).

1.6.3 Magnetometry survey carried out across similar soils has produced variable results as mudstone geologies can be associated with low magnetic susceptibility. However, where there is long-term human occupation and/or industrial activity, there can be sufficient magnetic contrast between the fill of cut features and the surrounding soils. The underlying geology and soils are, therefore, considered acceptable for magnetic survey.

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 (also known as thermoremanence) are factors associated with the formation of localised fields.

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). Additional details are set out in 2.2 below and within Appendix A.

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 (FGM650) spaced 0.5m apart with readings recorded at 20Hz. The cart was towed by an All Terrain Vehicle (ATV) with a hand-pushed system used around field margins. Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical component of a magnetic anomaly is measured. The gradiometers have a measurement range of ±8000nT, although the recorded range is ±3000nT, and resolution is around 0.1nT. They are linked to a Leica GS10 RTK GNSS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.

2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. 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. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible

areas (Aspinall, Gaffney and Schmidt, 2009).

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <100s.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor. The removal of the offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 The minimally processed data are collected between limits of ±3000nT and clipped for display at ±3nT. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 Additional data processing has been carried out in the form of high pass filtering. This effectively removes low frequency variation along a traverse that has been caused by large magnetic bodies, cultivation or rapid temperature change. Data treated to additional processing have been compared to unprocessed data to ensure that no significant anomalies have been removed.

2.3.5 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix

B for further information on processing.

2.3.6 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. With regard to the Sensys MXPDA, minimally processed data are considered by the manufacturer to be data that are compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to the very high density of data collection. In addition, traceplots cannot be meaningfully plotted against base mapping and in areas of complexity traces may be lost or highly confused. Traceplots may be used to demonstrate characteristic magnetic profiles across discrete features where it is considered beneficial.

2.3.7 The raster images are combined with base mapping using ProgeCAD Professional 2020, creating DWG (2018) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GNSS, resection method, etc.

2.3.8 An abstraction and interpretation is drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing. Appendix E sets out CAD layer names with colour and graphic content for each interpretation category, see 3.3.

2.3.9 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.

2.3.10 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 a total of 6 survey areas covering approximately 18ha.

3.1.2 Magnetic anomalies located can be generally classified as positive and negative anomalies of an uncertain origin, anomalies associated with an agricultural building, anomalies associated with land management, linear anomalies of an agricultural origin, areas of magnetic debris and disturbance and strong discrete dipolar anomalies relating to ferrous objects. Anomalies

located within each survey area have been numbered and are described in 3.4 to 3.9 below.

3.2 Statement of data quality and factors influencing the interpretation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset.

3.2.2 Magnetic disturbance and debris across the site is very localised and considered unlikely to have obscured any significant anomalies. Magnetic contrast associated with former cut features appears moderate to low and is typical of the clay soils of the region. Former ridge and furrow cultivation has produced linear anomalies which can infer that the soil is capable of supporting useful magnetic contrast.

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 general explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	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. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. 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 associated with agricultural building	Anomalies can be negative, generally relating to foundations/walling or positive, depending on material used in construction eg brick. Burning can also result in magnetic enhancement. This category relates to anomalies associated with formerly mapped features.
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 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 with an agricultural origin	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing. This category does not include agricultural features of early date or considered to be of archaeological potential (e.g. animal stockades, enclosures, farmsteads, etc).
Anomalies associated with magnetic debris	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. They often occur where there has been dumping or ground make-up and are 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, hearths and nail spreads from former wooden structures or rooves and may, therefore, be archaeologically significant.
Anomalies with a modern origin	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 these 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 adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.

Table 1: List and description of interpretation categories

3.4 List of anomalies – Area 1

Area centred on OS NGR 408068 194122, see Figs 06 – 08.

Anomalies with an uncertain origin

(1) – The survey area contains a number of weakly positive linear anomalies (0.5nT). They are short, indistinct and lack a coherent morphology, and it is not clear if they relate to cut features. However, several appear to have been fragmented by the ridge and furrow, which indicates that they could relate to features that pre-date the cultivation.

(2) – A small number of negative linear anomalies have been located. Their origin is uncertain.

(3) – A cluster of discrete positive anomalies with responses of 6-12nT could relate to a pit-like feature or area of burning.

Anomalies associated with land management

(4) – A linear anomaly relates to an extant bank with flanking ditches. Although this is not mapped as a field boundary and has no associated hedge, it appears to relate to a formally planned field boundary that has truncated the earlier ridge and furrow. The anomaly relates to extant banks and ditches that may once have separated the field into three areas.

Anomalies with an agricultural origin

(5) – Linear anomalies relating to extant ridge and furrow.

3.5 List of anomalies – Area 2

Area centred on OS NGR 408088 193970, see Figs 09 – 11.

Anomalies associated with former agricultural building

(6) – Located in the south western corner of Area 2 are a group of discrete positive responses, negative linear anomalies and a rectangular area of magnetic debris (11). The magnetic debris (11) relates to the site of the Spackman Stalls, mapped

between 1877 and 1897, but gone by 1900. The other responses lie close to the former stalls, within a small formerly mapped enclosure. The positive responses relate to magnetically enhanced material, and are likely to be associated with the former use of the stalls, although the origin of the enhancement is unknown. The negative linear anomalies could relate to walling.

Anomalies with an uncertain origin

(7) – A positive linear anomaly could relate to former ridge and furrow. It appears to fragment into a line of discrete positive responses. It is possible that it relates to an unmapped field boundary.

(8) – The survey area contains a number of discrete, positive anomalies. It is not clear if they relate to naturally formed pit-like features, tree throw pits or if they have some anthropogenic or archaeological origin.

Anomalies with an agricultural origin

(9 &10) – Linear anomalies relating to former ridge and furrow cultivation.

Anomalies associated with magnetic debris

(11) – A response to magnetically thermoremnant material, likely to be brick, associated with the former Spackman Stalls, mapped between 1887-1897.

(12) – Magnetic debris associated with an infilled pond.

Anomalies with a modern origin

(13) – Magnetic disturbance in the north western part of the survey area is associated with two electricity poles. The field entrances are also associated with magnetic disturbance.

3.6 List of anomalies – Area 3

Area centred on OS NGR 408135 193860, see Figs 09 – 11.

Anomalies with an uncertain origin

(14) – A small number of positive linear anomalies have been located within Area 3. It is not clear if they relate to cut features.

(15) – A number of discrete, positive responses have been located. It is not possible to determine if they are naturally formed features, tree throw pits or associated with anthropogenic activity.

Anomalies with an agricultural origin

(16) – Linear anomalies relate to extant ridge and furrow.

Anomalies associated with magnetic debris

(17) – A small patch of magnetic debris at the north western corner appears to be associated with the southern end of the former Spackman Stalls.

3.7 List of anomalies – Area 4

Area centred on OS NGR 408185 193765, see Figs 12 – 14.

Anomalies with an uncertain origin

(18) – The survey area contains a number of weakly positive linear anomalies, some of which could have been truncated by ridge and furrow; however, it is not certain if they relate to cut, ditch-like features.

Anomalies with an agricultural origin

(19) – Linear anomalies relating to extant ridge and furrow.

Anomalies associated with magnetic debris

(20) – A patch of magnetic debris relates to an infilled pond.

(21) – The survey area contains strong, discrete, dipolar anomalies. Although all the areas contain such responses, in Area 4 they are more widespread and numerous. This is generally associated with ferrous and other magnetically thermoremnant objects being spread during manuring.

3.8 List of anomalies – Area 5

Area centred on OS NGR 408210 193645, see Figs 12 – 14.

Anomalies with an uncertain origin

(22) – A positive linear anomaly extends south westwards from the eastern edge of the survey area. While the response could relate to the fill of a cut, ditch-like feature it does not appear to extend eastwards into Area 6. A small number of other weakly positive linear and discrete anomalies can also be seen in the survey area.

3.9 List of anomalies – Area 6

Area centred on OS NGR 408335 194700, see Figs 12 – 14.

Anomalies with an uncertain origin

(23) – Situated on the northern edge of the survey area are a number of positive and negative responses. The negative responses appear rectilinear which could suggest walling, the positive responses are more amorphous and indicate magnetic enhancement. The morphology of the responses could indicate that they relate to a former agricultural building. However, none has been mapped by the Ordnance Survey, and the anomalies are located adjacent to a gateway and a former pond (25), so it is possible that the material is associated with ground consolidation.

(24) – Elsewhere within the survey area are a number of positive linear and discrete anomalies that lack a coherent morphology.

Anomalies associated with magnetic debris

(25) – Strongly magnetic debris relates to modern material used to infill a formerly mapped pond.

(26) – Widespread magnetic debris, likely to relate to dumped material is evident within a small, separate land parcel at the south eastern corner of Area 6.

4 CONCLUSION

4.1.1 The results of the geophysical survey demonstrate the presence of a number of linear and discrete positive responses within all of the survey areas. However, they are generally very weak and lack a coherent morphology preventing confident interpretation.

4.1.2 At the south western corner of Area 2 and the north western corner of Area 3, magnetic anomalies are associated with the site of a formerly mapped 19th agricultural building. Similar responses can be seen at the northern edge of Area 6; however, no agricultural building has been mapped and the anomalies could relate to ground consolidation or make-up.

4.1.3 Former ridge and furrow cultivation has produced characteristic linear anomalies and there is evidence of several infilled ponds.

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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 magnetic field. The difference between the two sensors will relate to the strength of 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. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Despike

Removal of data points that exceed the mean/median/threshold by selecting a window size of data points and replace by mean/median/threshold. Magnetic spikes can be caused iron objects on the surface or within the topsoil. Despike can improve the appearance of data and remove extreme readings that may affect further processing.

High Pass Filter

Removes low frequency anomalies within the data that are not considered to be archaeologically significant and may be natural in origin. A window passes over the data, the mean of all the data within the window is subtracted from the centre value. The size of the window is adjusted as is the weighting which may be uniform or Gaussian. The process is used to improve the visibility of anomalies of interest.

Low Pass Filter

Removes high frequency anomalies or 'noise' within datasets and provides a smoother output. A window passes over the data, the mean of all the data within the window is used to replace the centre value. The size of the window is adjusted as is the weighting. The process is used to improve the visibility of anomalies of interest.

Zero Median/Mean Traverse

The median (or mean) of data from each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the offset values of the gradiometer sensors. The process can remove archaeological features that run along a traverse but with the high resolution datasets created by the Sensys FGM650 sensors and the method of data collection this has not been a notable problem. In fact, the removal of offsets using software avoids carrying out a balancing procedure on site, which inevitably can never be done in magnetically clean conditions and results in improperly aligned fluxgate sensors and/or electronic adjustment values.

Appendix C – survey and data information

Area 1 minimally processed data
Filename: J834-mag-Area1-proc.xcp
Description: Imported as Composite from: J834-mag-Area1.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 407948.07 194235.67 m
Southeast corner: 408208.17, 194003.92 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 650100
Dimensions
Composite Size (readings): 1734 x 1545
Survey Size (meters): 260 m x 232 m
Grid Size: 260 m x 232 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.73
Mean: 0.00
Median: 0.01
Composite Area: 6.0278 ha
Surveyed Area: 3.549 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 1 filtered data
Filename: J834-mag-Area1-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.70
Mean: 0.00
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 201
5 Clip from -3.00 to 3.00 nT

Area 2 minimally processed data
Filename: J834-mag-Area2-proc.xcp
Northwest corner: 407915.04, 194104.23 m
Southeast corner: 408253.59, 193828.68 m
Source GPS Points: 628500
Dimensions
Composite Size (readings): 2257 x 1837
Survey Size (meters): 339 m x 276 m
Grid Size: 339 m x 276 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.87
Mean: 0.02
Median: 0.00
Composite Area: 9.3287 ha
Surveyed Area: 3.9505 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 2 filtered data
Filename: J834-mag-Area2-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.83
Mean: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 203
5 Clip from -3.00 to 3.00 nT

Area 3 minimally processed data
Filename: J834-mag-Area3-proc.xcp
Northwest corner: 407982.24, 193969.73 m
Southeast corner: 408276.54, 193754.63m
Source GPS Points: 471400
Dimensions
Composite Size (readings): 1962 x 1434
Survey Size (meters): 294 m x 215 m
Grid Size: 294 m x 215 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.93
Mean: 0.01
Median: 0.00
Composite Area: 6.3304 ha
Surveyed Area: 3.189 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 3 filtered data
Filename: J834-mag-Area3-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.89
Mean: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 201
5 Clip from -3.00 to 3.00 nT

Area 4 minimally processed data
Filename: J834-mag-Area4-proc.xcp
Northwest corner: 408059.68, 193837.29 m
Southeast corner: 408313.48, 193686.54 m
Source GPS Points: 247800
Dimensions
Composite Size (readings): 1692 x 1005
Survey Size (meters): 254 m x 151 m
Grid Size: 254 m x 151 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.23
Mean: -0.01
Median: 0.00
Composite Area: 3.826 ha
Surveyed Area: 1.6261 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 4 filtered data
Filename: J834-mag-Area4-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.17
Mean: 0.00
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 201
5 Clip from -3.00 to 3.00 nT

Area 5 minimally processed data
Filename: J834-mag-Area5-proc.xcp
Northwest corner: 408109.85, 193734.16m
Southeast corner: 408307.55, 193555.81 m
Source GPS Points: 317600
Dimensions
Composite Size (readings): 1318 x 1189
Survey Size (meters): 198 m x 178 m
Grid Size: 198 m x 178 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.89
Mean: 0.04
Median: 0.02
Composite Area: 3.526 ha
Surveyed Area: 2.0034 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 5 filtered data
Filename: J834-mag-Area5-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.83
Mean: 0.02
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 201
5 Clip from -3.00 to 3.00 nT

Area 6 minimally processed data
Filename: J834-mag-Area6-proc.xcp
Northwest corner: 408235.03, 193781.26m
Southeast corner: 408423.13, 193611.91 m
Source GPS Points: 320700
Dimensions
Composite Size (readings): 1254 x 1129
Survey Size (meters): 188 m x 169 m
Grid Size: 188 m x 169 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 3.32
Min: -3.30
Std Dev: 1.22
Mean: 0.03
Median: 0.00
Composite Area: 3.1855 ha
Surveyed Area: 1.9008 ha

Filename: J834-mag-Area6-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.12
Mean: 0.03
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 201
5 Clip from -3.00 to 3.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. 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.

A PDF copy will be supplied to the Wiltshire Historic Environment Record with greyscale images and abstraction layers made available on request. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

File type	Naming scheme	Description
Data	J834-mag-**[area number/name]**.asc J834-mag-**[area number/name]**.xcp J834-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J834-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J834-**[version number]**.dwg	CAD file in 2010 dwg format
Report	J834 report.odt	Report text in Open Office odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

The table below sets out Archaeological Surveys Ltd CAD layer names with associated colours and graphical content. Where CAD files are available layers may be extracted for further CAD/GIS use. Note: hatched polygon boundaries are contained within layers with the RGB colour code 254, 255, 255 (near white) in order to prevent their visibility.

Report sub-heading and associated CAD layer names	Colour with RGB index	Layer content
Anomalies with archaeological potential		
Anomalies with an uncertain origin		
AS-ABST MAG POS LINEAR UNCERTAIN	255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG NEG LINEAR UNCERTAIN	Blue 0,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN	255,127,0	Solid donut, point or polygon (solid)
Anomalies relating to land management		
AS-ABST MAG BOUNDARY	127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
Anomalies relating to former agricultural building		
AS-ABST MAG NEG LINEAR AGRICULTURAL	0,19,76	Line, polyline or polygon (solid)
AS-ABST MAG POS AGRICULTURAL	204,0,102	Line, polyline or polygon (solid)
Anomalies with an agricultural origin		

AS-ABST MAG RIDGE AND FURROW		0,127,63	Line, polyline or polygon (cross hatched ANSI37)
Anomalies associated with magnetic debris			
AS-ABST MAG DEBRIS		132, 132, 132	Polygon (cross hatched ANSI37)
AS-ABST MAG STRONG DIPOLAR		132, 132, 132	Solid donut, point or polygon (solid)
Anomalies with a modern origin			
AS-ABST MAG DISTURBANCE		132, 132, 132	Polygon (hatched ANSI31)

Table 3: CAD layering

Appendix F – copyright and intellectual property

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www.archaeological-surveys.co.uk
info@archaeological-surveys.co.uk
Tel: 01249 814 231

Survey location

N

Survey location

Site centred on OS NGR
SU 08165 93890

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

Archaeological Surveys
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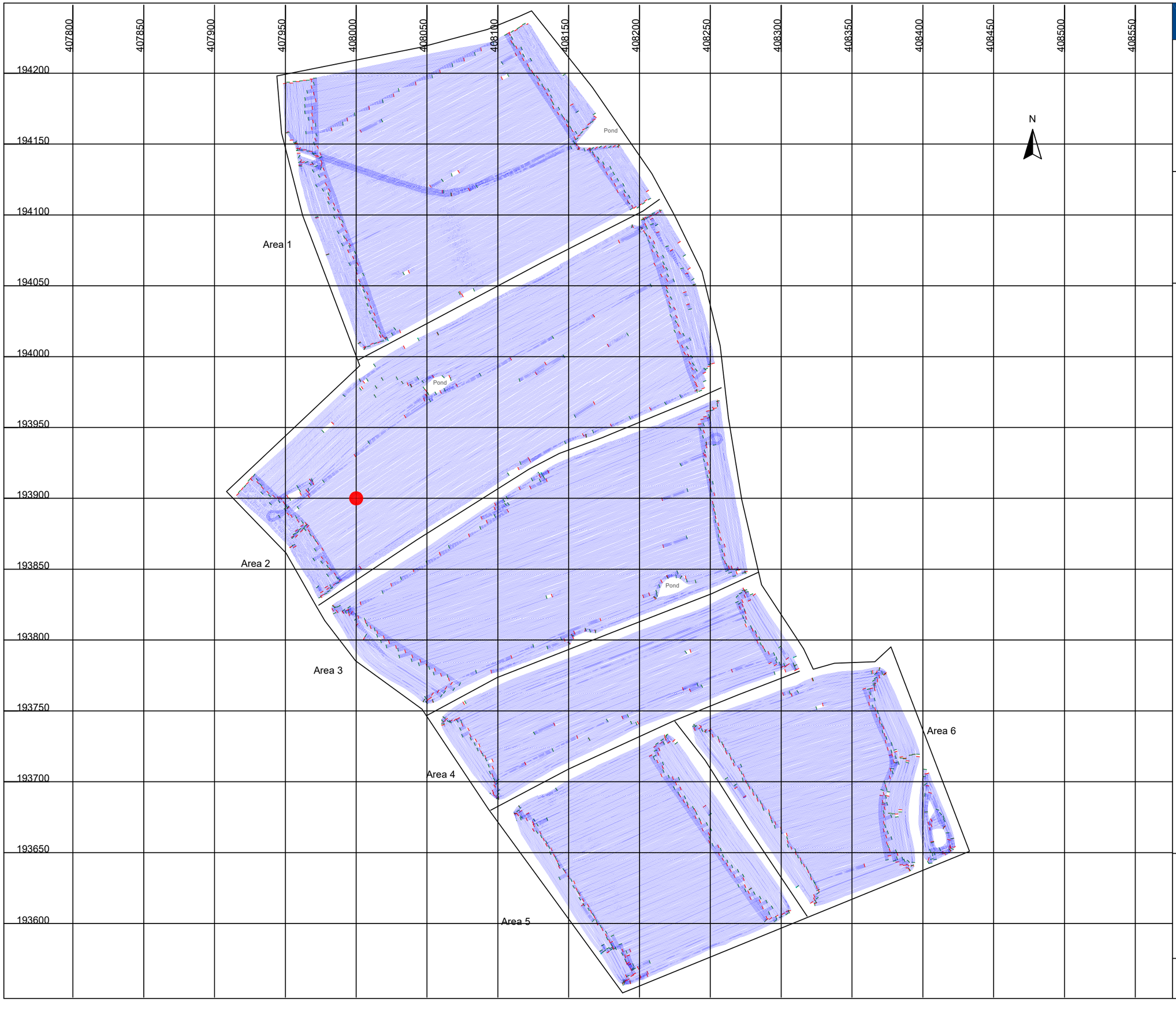
Cricklade
Wiltshire

Map of survey area

Archaeological Surveys
Specialist Geophysical Surveyors

Geophysical Survey
Malmesbury Road Solar Park
Cricklade
Wiltshire

Referencing information



Referencing grid to OSGB36 datum at 50m intervals

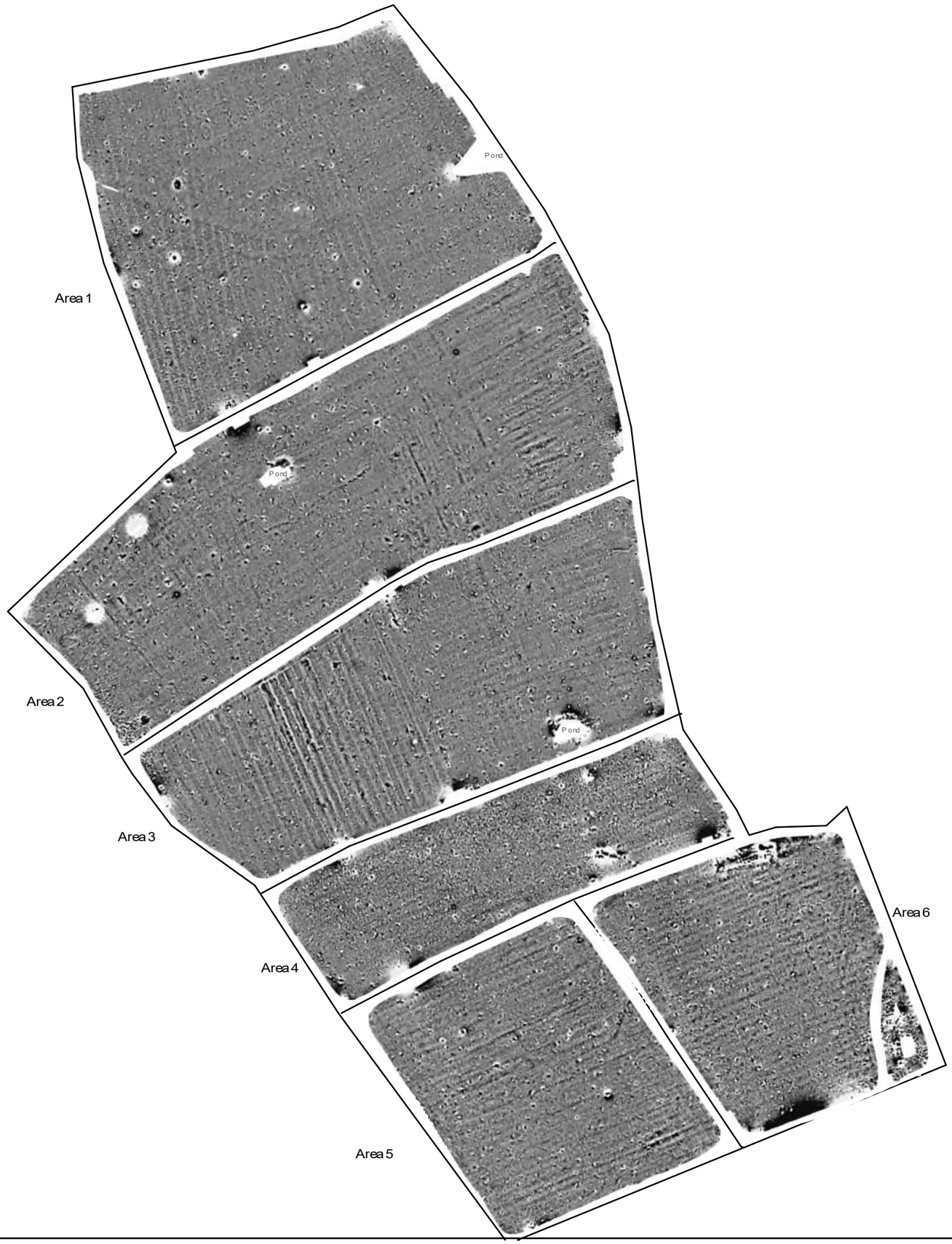
- 408000 193900
- Survey tracks
- Survey track start
- Survey track stop

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 02



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Wiltshire

Greyscale plot of minimally processed magnetometer data

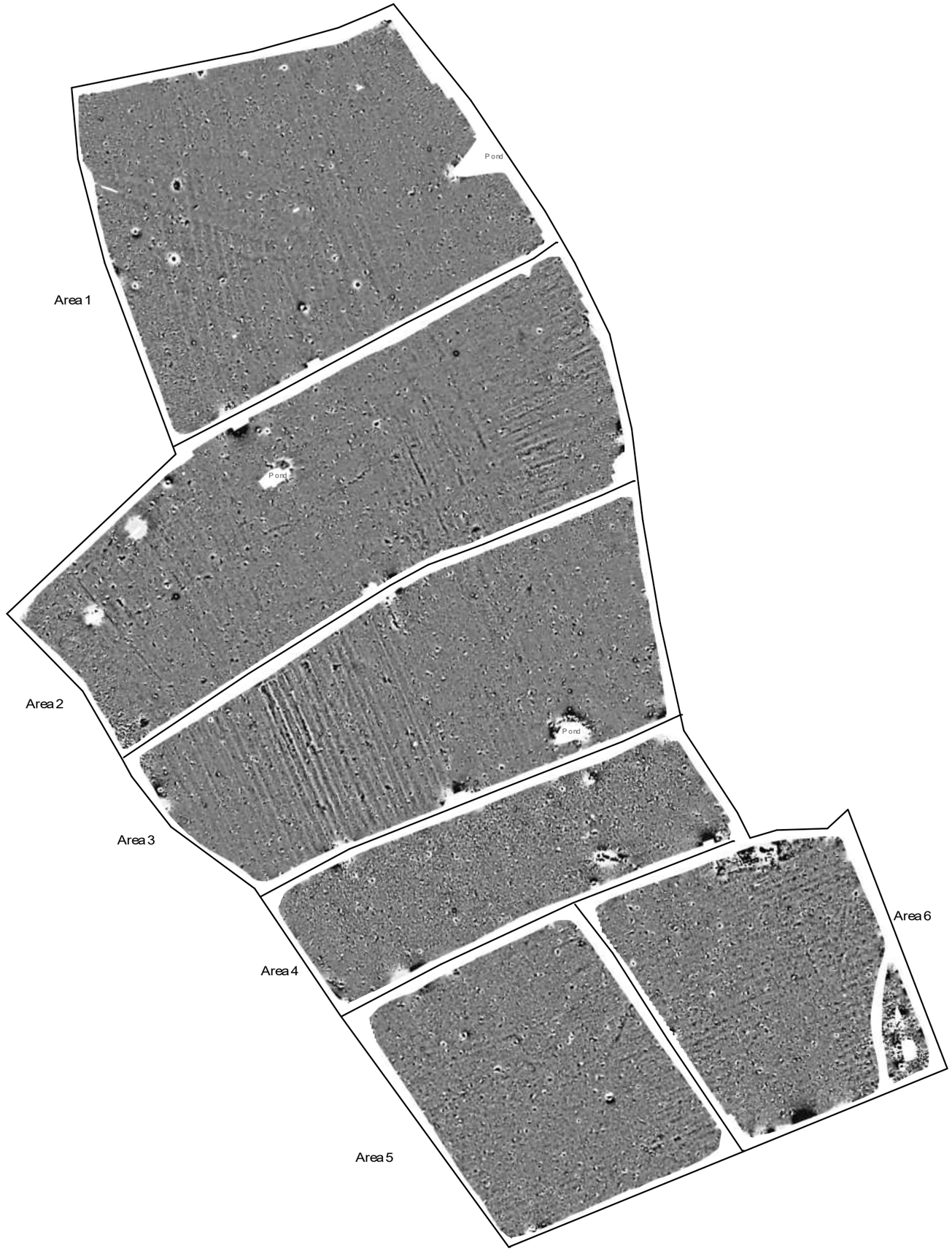
+3nT

-3nT

SCALE 1:2500

0m 50 100m

KTD	DJS	FIG 03



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Greyscale plot of filtered magnetometer data

+3nT

-3nT

SCALE 1:2500

0m 50 100m

KTD	DJS	FIG 04

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Abstraction and interpretation of magnetic anomalies

- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Positive linear anomaly - former field boundary
- Linear anomaly - ridge and furrow
- Negative linear anomaly - associated with former agricultural building
- Positive anomaly - associated with former agricultural building
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 05

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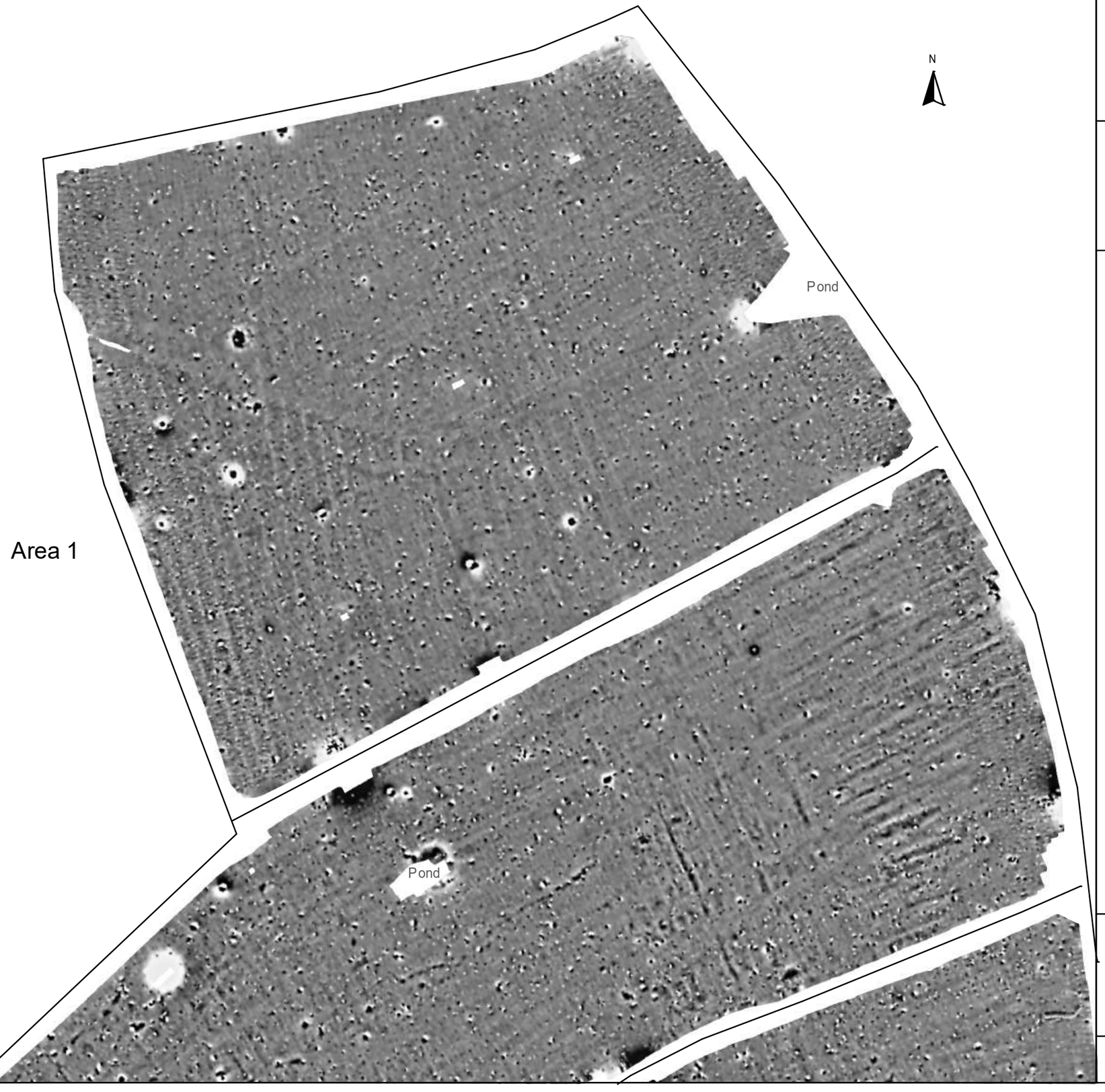
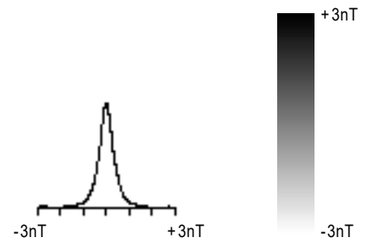
Greyscale plot of minimally processed magnetometer data - Area 1

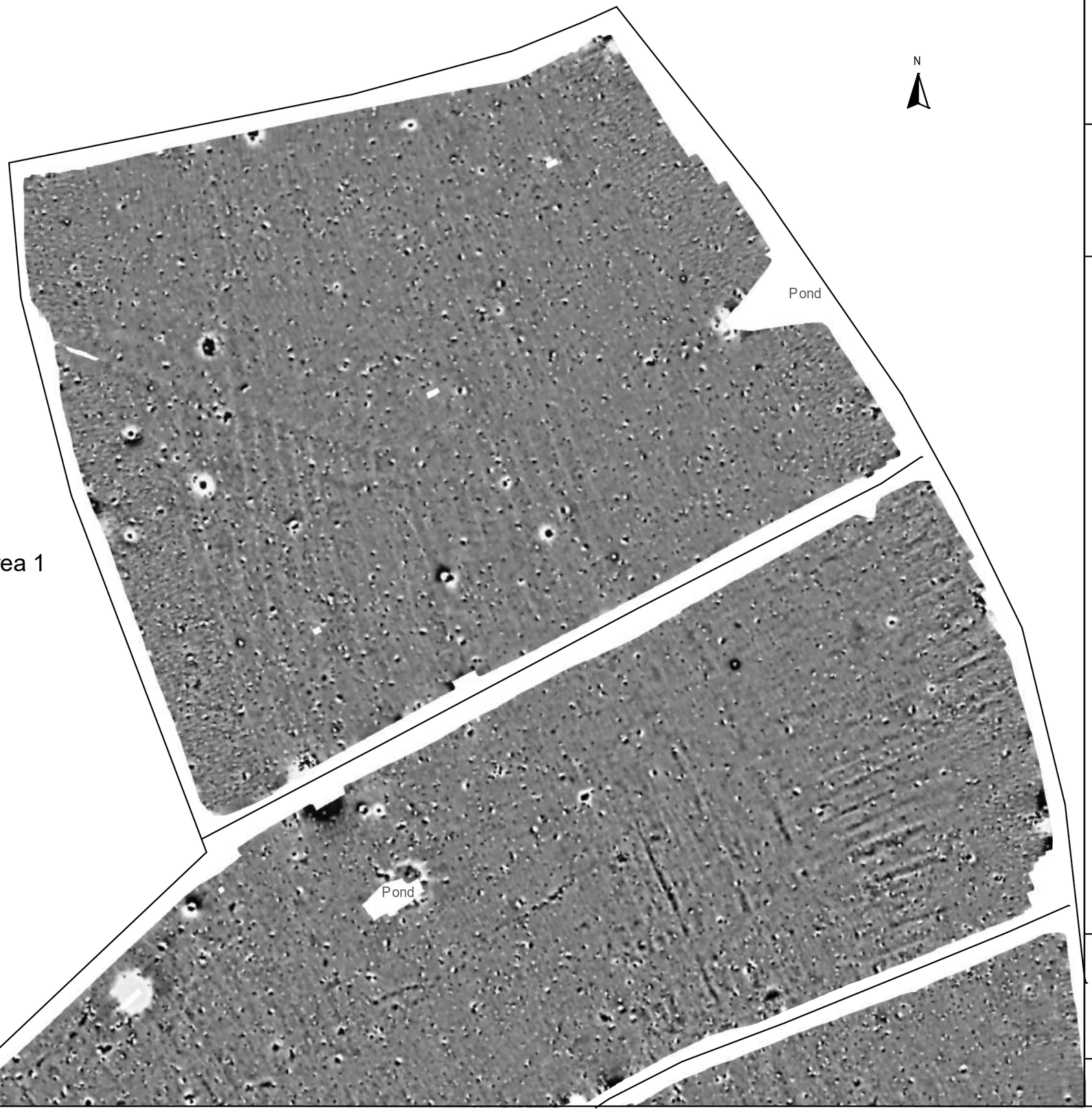




SCALE 1:1250

0m 10 20 30 40 50m

KTD	DJS	FIG 06



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Greyscale plot of filtered magnetometer data - Area 1

-3nT +3nT

+3nT
-3nT

SCALE 1:1250

0m 10 20 30 40 50m

KTD	DJS	FIG 07

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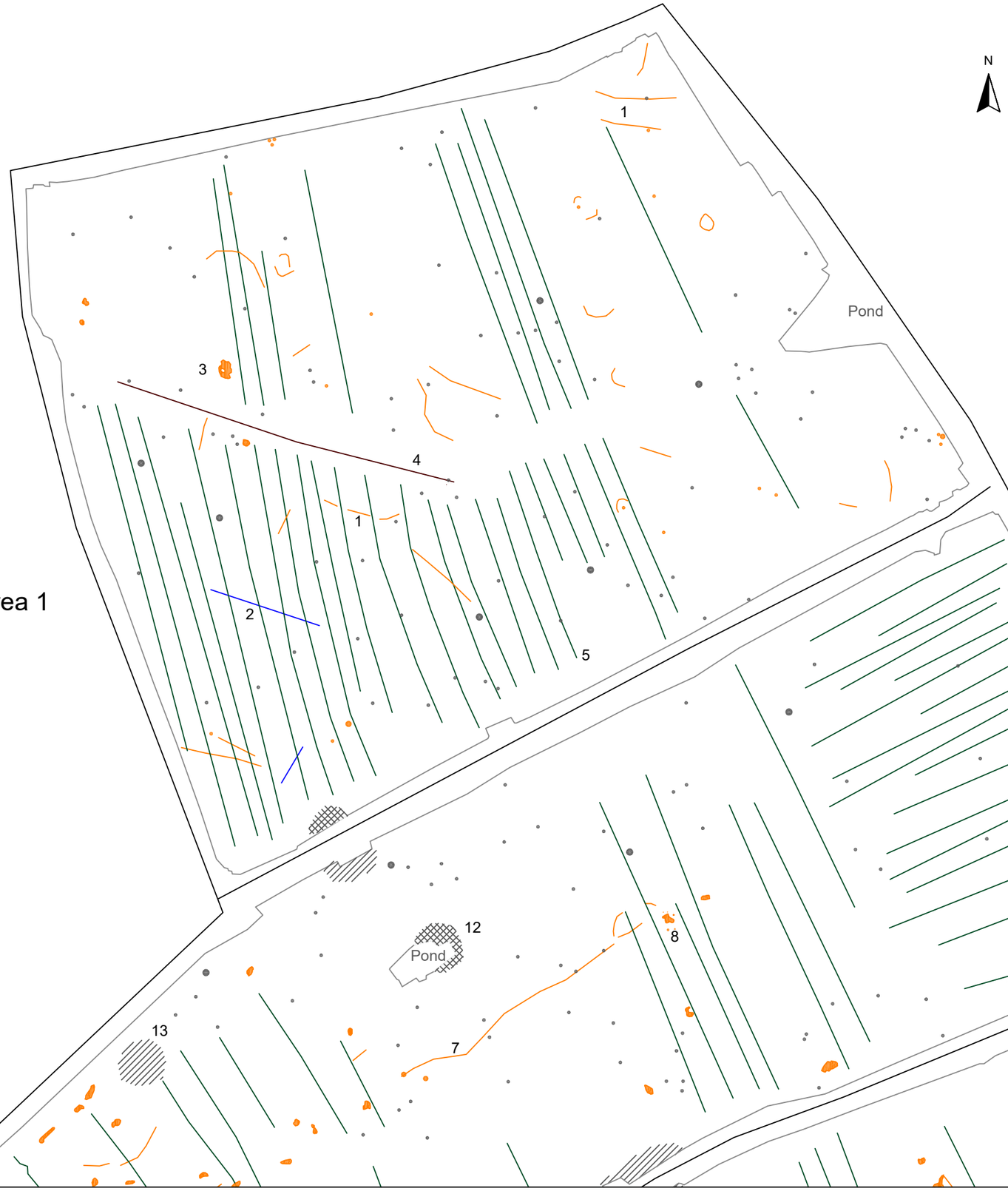
Abstraction and interpretation of magnetic anomalies - Area 1



- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Linear anomaly - former field boundary
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 08

Area 1

Area 2

Area 3

Pond

Pond

N

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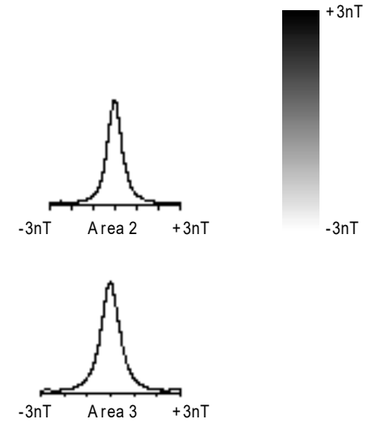
Greyscale plot of minimally processed magnetometer data - Areas 2 & 3



SCALE 1:1250

0m 10 20 30 40 50m

KTD	DJS	FIG 09

Area 1

Area 2

Area 3

Pond

Pond

N

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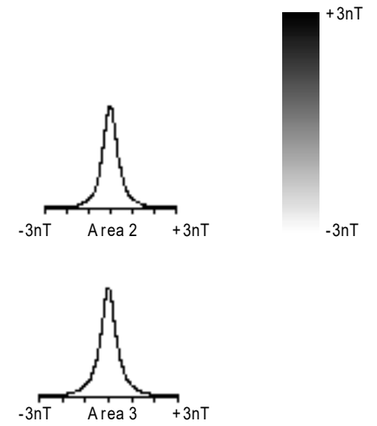
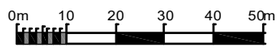
Wiltshire

Greyscale plot of filtered magnetometer data - Areas 2 & 3



SCALE 1:1250



KTD	DJS	FIG 10

Area 1

Area 2

Area 3

Pond

Pond

N

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Abstraction and interpretation of magnetic anomalies - Areas 2 & 3

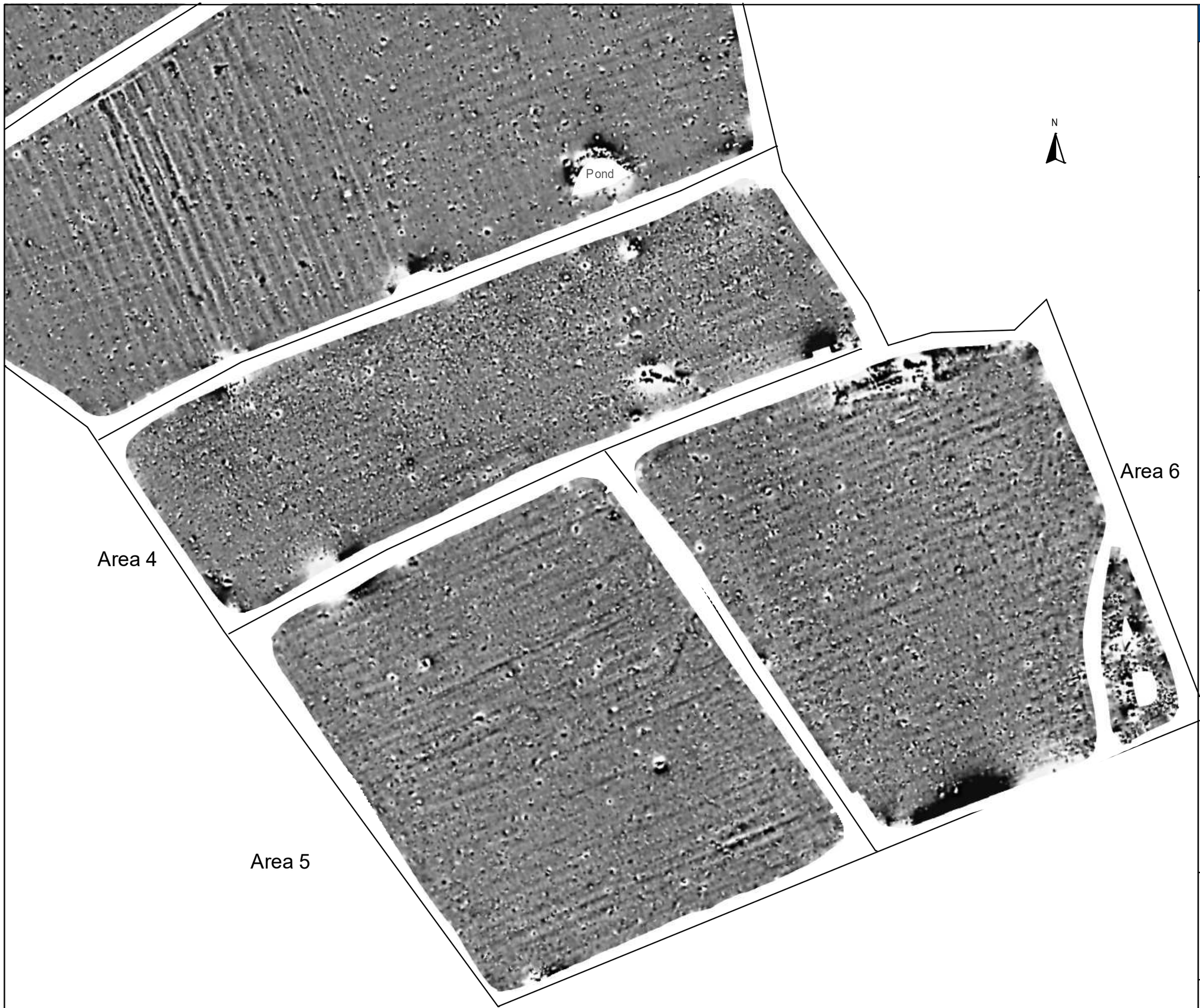
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Negative linear anomaly - associated with former agricultural building
- Positive anomaly - associated with former agricultural building
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 11



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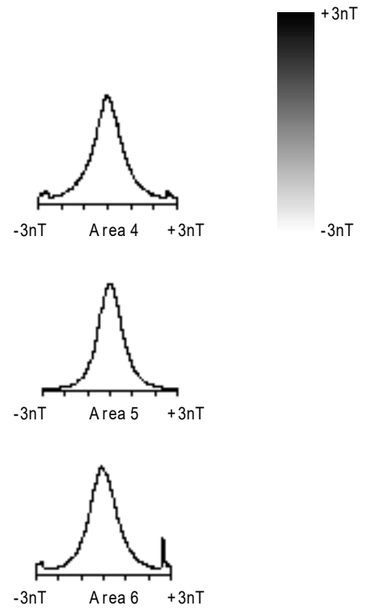
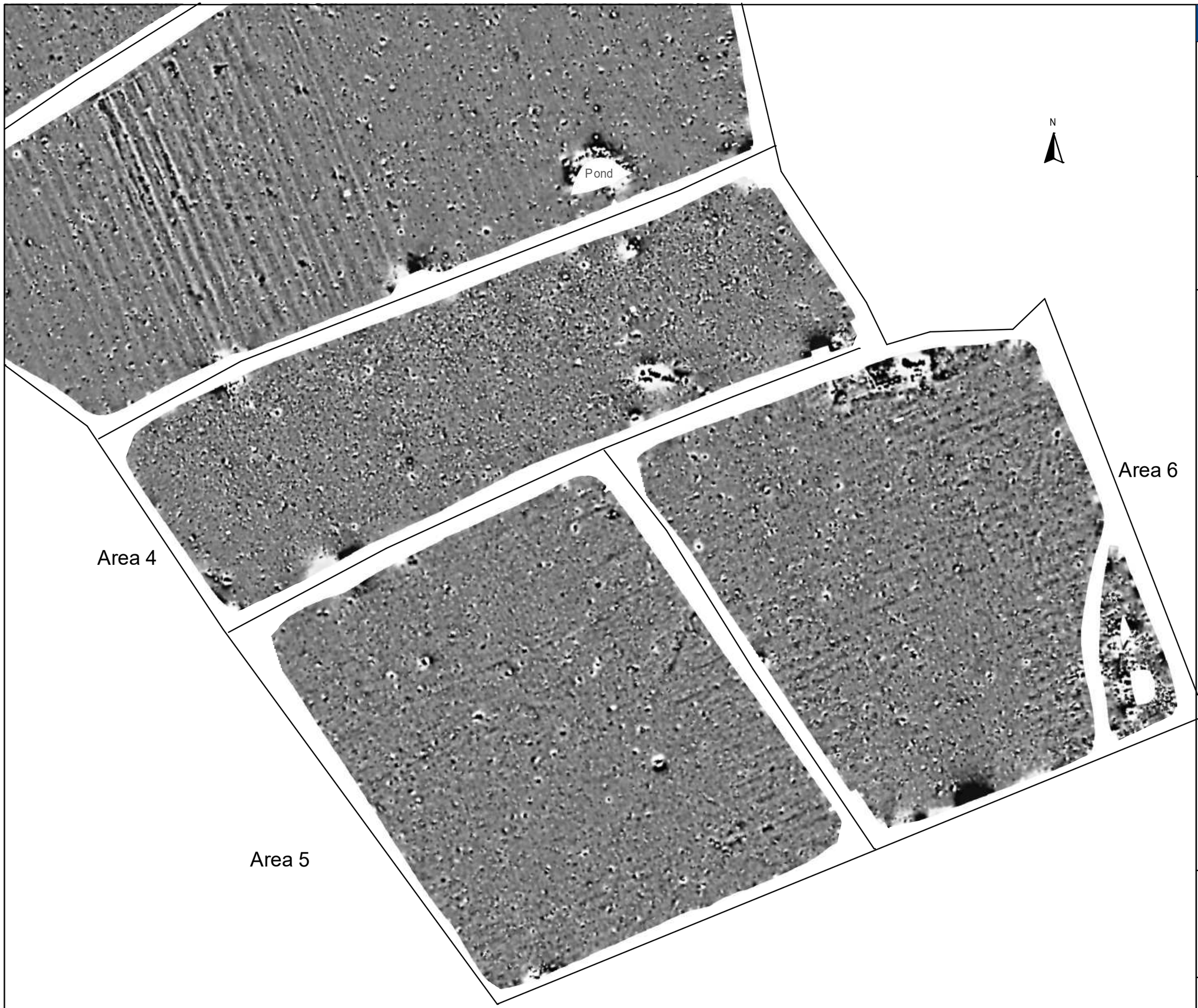
Greyscale plot of minimally processed magnetometer data - Areas 4, 5 & 6



SCALE 1:1250

0m 10 20 30 40 50m

KTD	DJS	FIG 12



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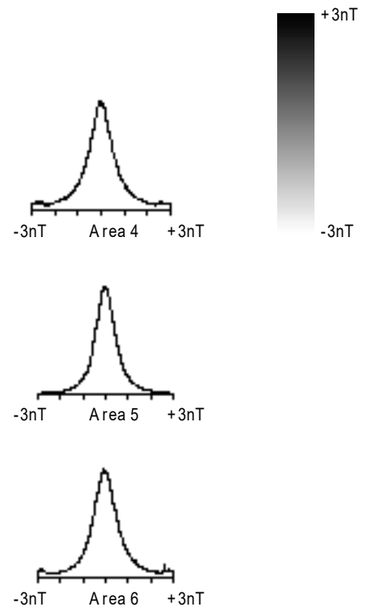
Greyscale plot of filtered magnetometer data - Areas 4, 5 & 6



SCALE 1:1250

0m 10 20 30 40 50m

KTD	DJS	FIG 13

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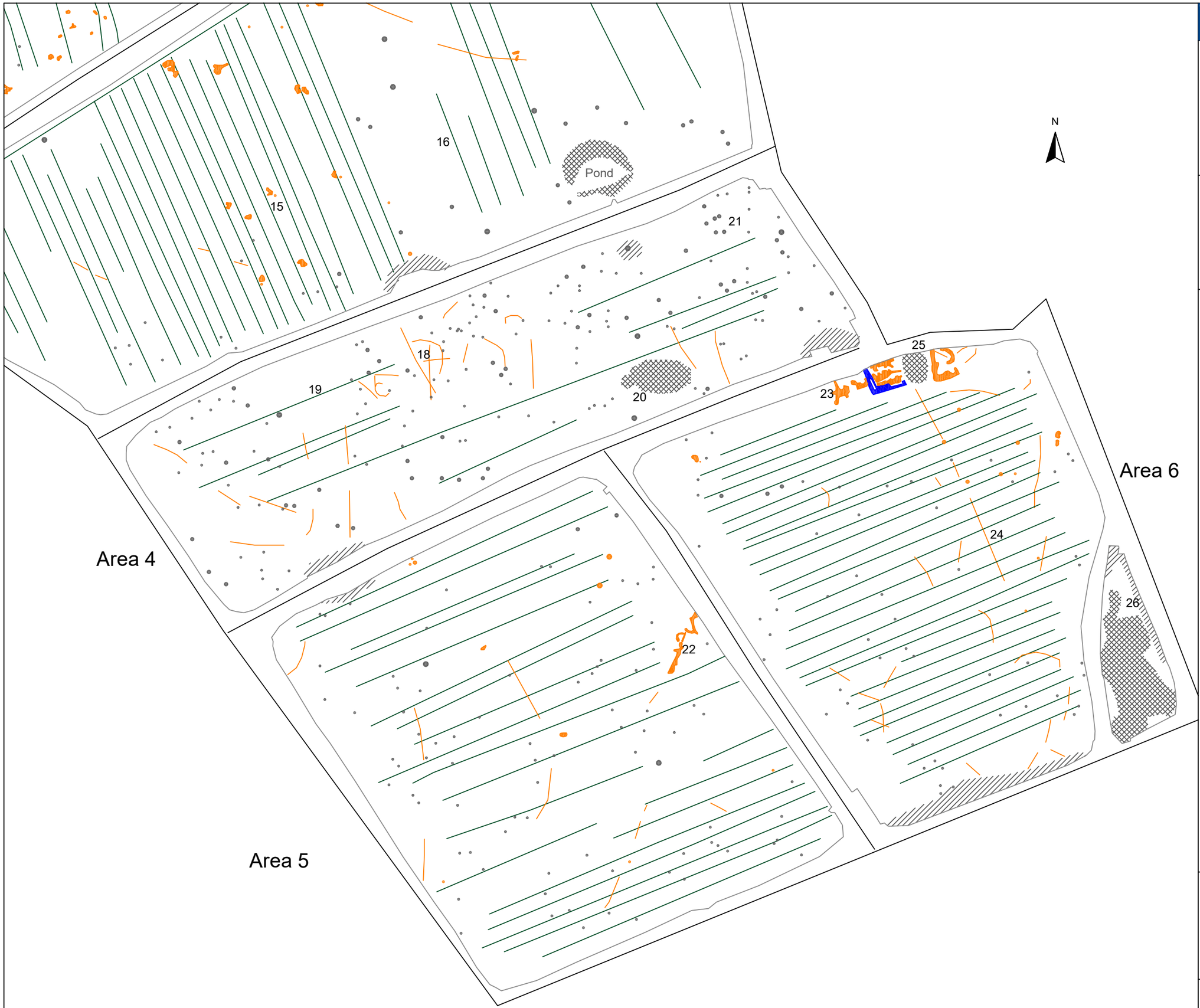
Abstraction and interpretation of magnetic anomalies - Areas 4, 5 & 6



- Positive linear anomaly - possible ditch-like feature
- Negative linear anomaly - material of low magnetic susceptibility
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1250

0m 10 20 30 40 50m

SCALE TRUE AT A3

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KTD	DJS	FIG 14