GEOPHYSICAL SURVEY REPORT G1387

Cliftongate, York: Geophysical Survey

Client:

On behalf of:

TW Fields, Hallam Land Management, Commercial Estates Group

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GSB Survey Report No. G1387

Clifton Gate, York

Contents

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Dates

Fieldwork:	16 December 2013 – 20 January 2014
Report:	05 February 2014

Report Approved: Dr John Gater MIfA FSA

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Background Project Details

NGR	SE 592 561
Location	The area under investigation lies some 2.5 km north of York, occupying several fields west of the B1363 Wigginton Road and north of the A1237 ring road.
HER/SMR	York HER
District	York (B)
Parish	Skelton CP
Topography	Flat
Current Land Use	Pasture & crop
Soils	Foggathorpe 2 (712i): slowly permeable seasonally waterlogged stoneless clayey and fine loamy over clayey soils (SSEW 1983).
Geology	Solid: Sherwood Sandstone group - sandstone. Superficial: Alne Glaciolacustrine formation - clay, silty (BGS 2014).
Archaeology	Possible Bronze Age barrows, Iron Age settlements, field systems and Medieval ridge and furrow (YAT *pers. comm.*)
Survey Methods	Detailed magnetometer survey (fluxgate gradiometer)
Study Area	*c.*100 ha

Aims

To locate and characterise any anomalies of possible archaeological interest within the study area. The work forms part of a wider archaeological assessment being carried out by **York Archaeological Trust** on behalf of **TW Fields, Hallam Land Management, Commercial Estates Group**.

Summary of Results

The results of the survey are dominated by magnetic responses associated with two pipelines and a network of land drains which occupy many of the fields. Several old field boundaries have also been detected, along with indications of earlier ploughing, including ridge and furrow cultivation.

In general, the remaining magnetic responses across the survey are weak, fragmented and poorly defined. Numerous anomalies have been given the interpretation category '*Uncertain Origin*' simply because they are equally likely to be agricultural or natural in origin, and even an archaeological cause cannot be entirely dismissed.

The data from Area 2 are perhaps the most perplexing to interpret. The linear and curvilinear trends appear to form patterns which could be archaeological but, if so, stronger responses would normally be expected. It is possible that features may be plough-damaged or even lacking in magnetic enhancement (hence the presence of both weak positive and negative anomalies). However, given that there are magnetic responses in the corner of Area 14 which appear to mark the edges of a soil mark visible from the air, there is no *a priori* reason why archaeological features, if present, would not show magnetically. More ephemeral features might not have been detected, but Iron Age or Romano-British settlement would be expected to result in clearer responses.

Method

Conventional: All survey grid positioning was carried out using Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS equipment. The geophysical survey areas are georeferenced relative to the Ordnance Survey National Grid by tying in to local detail and corrected to the mapping provided by the client. These tie-ins are presented in Figure T1. Please refer to this/these diagram(s) when re-establishing the grid or positioning trenches.

*Cart:*All survey data points had their position recorded using Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS equipment. The geophysical survey area is georeferenced relative to the Ordnance Survey National Grid.

Technique	Instrument	Traverse Interval	Sample Interval
1.Magnetometer	Bartington Grad 601-2	1m	0.25m
2.Magnetometer	CARTEASY^{N} cart system Bartington Grad 601sensors	0.75m	0.125m

All survey work is carried out in accordance with the current English Heritage guidelines (EH 2008).

Data Processing

Data processing was performed as appropriate using both in-house software packages (GeSuB & Carteasy) as outlined below.

Magnetic Data
Zero Mean Traverse (1&2), Step Correction (De-stagger) & Interpolation (on the Y axis) (1), Gridding (2)

Interpretation

When interpreting the results several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to very specific known features documented in other sources, this is done (for example: ***Abbey Wall***, ***Roman Road***). For the generic categories levels of confidence are indicated, for example: ***Archaeology*** – ***?Archaeology***. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification ***?Archaeology***. Details of the data plot formats and interpretation categories used are given in the Appendix: Technical Information at the end of the report.

General Considerations

Conditions were generally good for survey with the majority of the areas being flat and under pasture. A few areas were under low crop and subsequently the instrument was slowed down for ease of data collection in these fields. Isolated areas of waterlogging were present across the site.

1.0 Survey Results - Magnetometer Survey

1.1 At the outset it should be stated that there are no definite archaeological responses visible in the magnetic data. However, there are many poorly-defined, weak magnetic anomalies and trends which are difficult to interpret. The responses indicate a lack of enhancement which, in turn, could indicate a lack of anthropogenic activity on the site. Alternatively, it is just possible that any features originally present have been plough-damaged, or any magnetic enhancement has been leached away in the wet conditions. If Iron Age or Romano-British habitation ever occurred at the site, it would be expected that more evidence would be visible in the data. As they stand, the anomalies are little more than linear or curvilinear trends with no specific shapes or patterns. However, with this level of poor definition, interpretation does become more subjective, hence the use of the interpretation category *Uncertain Origin*. This is especially the case for the responses in Area 2 where the disjointed anomalies give the impression, visually, of being potentially interesting, but where the geophysical elements supporting an archaeological interpretation are lacking.

1.2 In the south-west corner of Area 14, two 'concentric' magnetic arcs are visible, but the definition is again poor. Analysis of Google Maps for this area shows a band of darker grass which also forms a sort of arc; it is believed that the magnetic responses could indicate magnetic variations at the edges of the broad, natural feature. Assuming this interpretation is correct, then if such variations are being detected, it adds weight to postulation above (in 1.1) that if archaeological features were present to any extent, there ought to be a better indication in the geophysical results.

1.3 When the overall magnetic results are reviewed first as a whole (Fig 3) and then second in more detail at individual field level (Figs 5, 7, 9, 11 and 13), it is apparent that there are massive networks of land drains throughout. A series of well-defined positive anomalies criss-cross Field 8 and dominate the results (apart from the ferrous pipe, see below 1.5). The responses follow a regular pattern, herringbone in shape, and as such indicate a series of drains, probably laid on magnetic gravels or other materials. In addition to these strong responses, the detailed view shows the presence of further drains on a variety of alignments throughout many of the fields. Although weaker in strength, they still form a clear pattern in the data. In this instance, it would seem that either more weakly-fired clay drains have been used, or non-magnetic materials have being employed to backfill any trenches. Alternatively, a mole-driver may have been employed to lay the drains. A third type of linear response, which comprises a series of linear small dipole (negative / positive) anomalies is also visible in the data. While these are fewer in number, the responses are typical of fired clay drain lengths. It would be interesting to compare the data with any recorded drainage plans for the land, to see if any known drains have been 'missed'.

1.4 There are other sets of parallel linear anomalies and trends visible in the data, which correspond with ploughing; narrower patterns are deemed to be recent in date, while more widely spaced anomalies are presumed to reflect medieval ridge and furrow cultivation.

1.5 The strongest magnetic anomalies are associated with two pipes. One crosses through Areas 5, 6 and 8, while the other runs through the middle of Area 1 and along the boundaries between Areas 2 and 3.

2.0 Conclusions

2.1 Several poorly defined, weak magnetic anomalies have been classified as having an uncertain origin. Those in Area 2 perhaps have greatest archaeological potential, but the geophysical evidence is at best tentative. Anomalies in Area 14 suggest that if the two curving arcs are indeed marking the edges of a natural curving band of differing soil, then if archaeological ditches or settlement were to be present, there ought to be better geophysical evidence for the former features. The possibility of plough damage or natural leaching away of any magnetic components cannot be dismissed.

2.2 Extensive magnetic survey has revealed a network of differing types of field drains and provided evidence of other agricultural practices, including ploughing plus ridge and furrow cultivation. Two old field boundaries have been recorded, as have two ferrous service pipes.

References

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EH 2008	*Geophysical Survey in Archaeological Field Evaluation.* English Heritage, Portsmouth.
OS 2014	http://www.old-maps.co.uk 1958,1:10,560 Post WWII Yorkshire, centred on SE 592 561. Accessed 23/01/2014
SSEW 1983	*Soils of England and Wales. Sheet 1, Northern England* Soil Survey of England and Wales, Harpenden.

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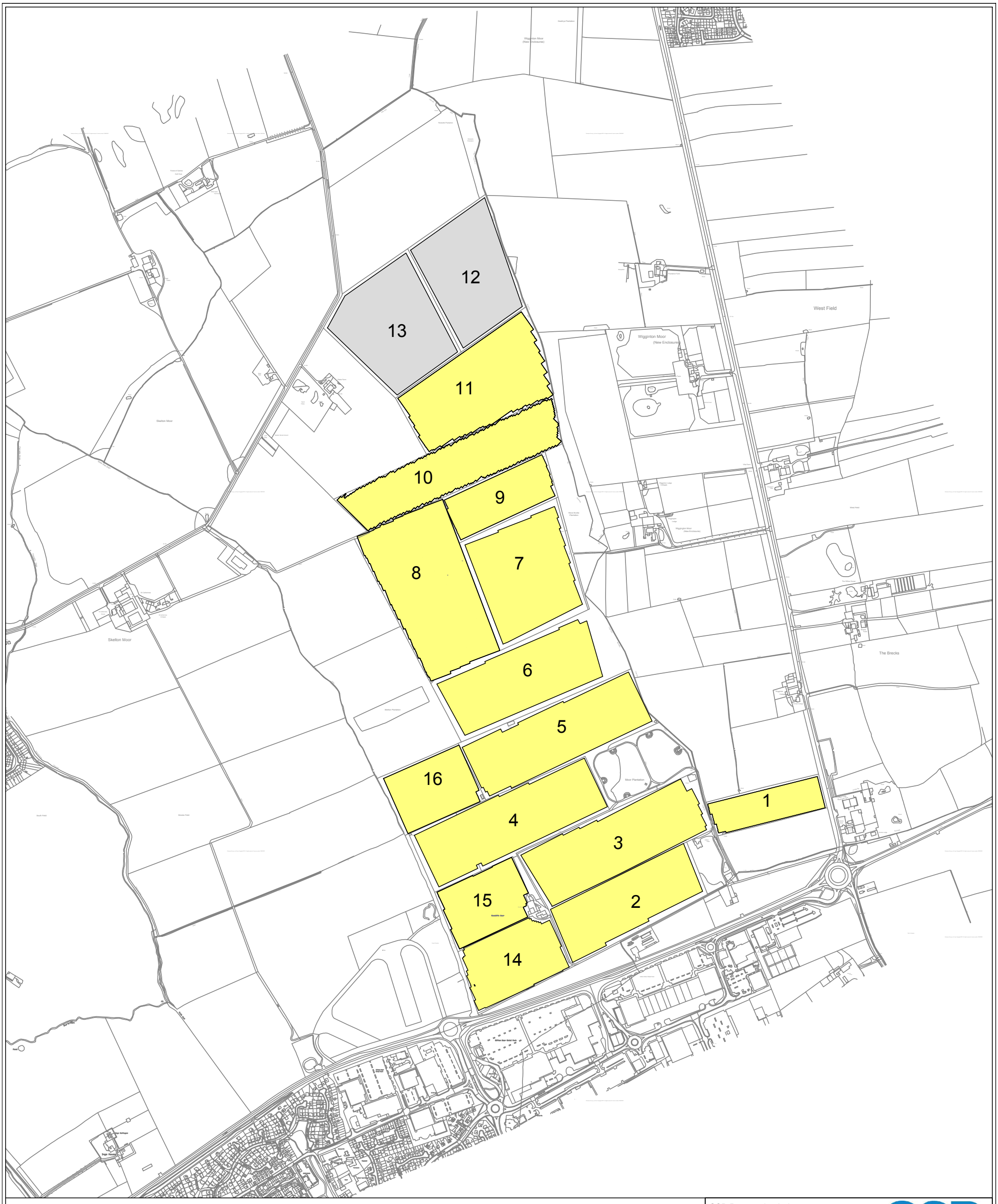
Project: G1387 Clifton Gate, York: Geophysical Survey

Title: Site Location Diagram

Drawn by: JMT

Figure 1



N

0 metres 400

1:10000 @ A3

Magnetometer survey - Areas complete

Magnetometer survey - Unsurveyable

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Title: Magnetometer Survey - Location of Survey Areas

Drawn by: ELWatson

Figure 2

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Title: Magnetometer Survey - Greyscale Plots [All Areas]

Drawn by: ELWatson

Figure 3

N

0 metres 400

1:10000 @ A3

Uncertain Origin
(discrete / trend)

Former Field Boundary

Agricultural
(ridge & furrow / ploughing)

Field Drain / Drain (trend) / Pipe

Ferrous / Magnetic Disturbance

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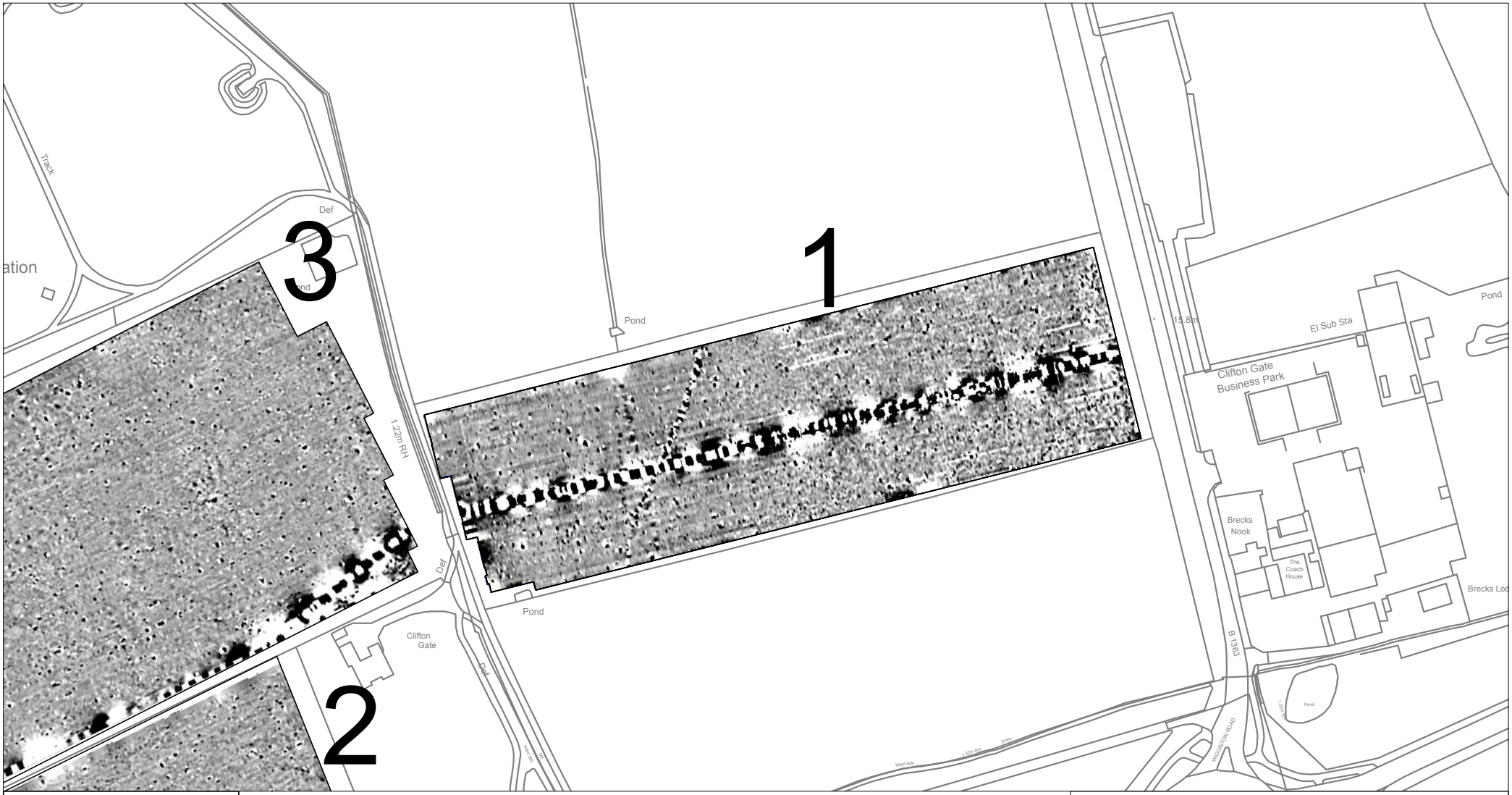
Title: Magnetometer Survey - Interpretation [All Areas]

Drawn by: ELWatson

Figure 4



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N

0 metres 100

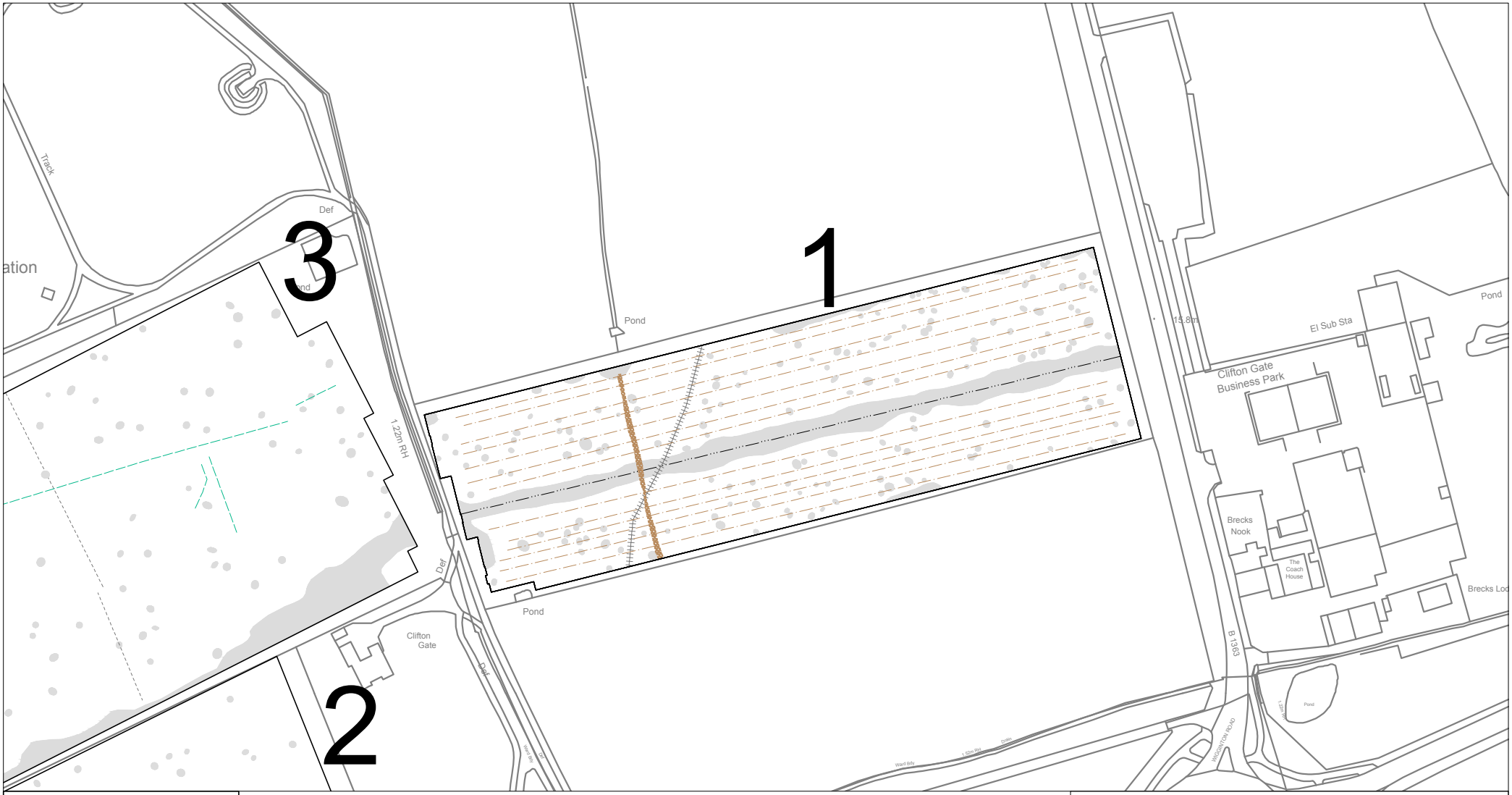
1:2500 @ A4

2
nT
-1

Project:	G1387 Clifton gate, York: Geophysical Survey
Title:	Magnetometer Survey - Area 1 Greyscale Plot

Drawn by: ELWatson

Figure 5



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N

0 metres 100

1:2500 @ A4

Uncertain Origin (discrete / trend)

Former Field Boundary

Agricultural (ridge & furrow / ploughing)

Field Drain / Drain (trend) / Pipe

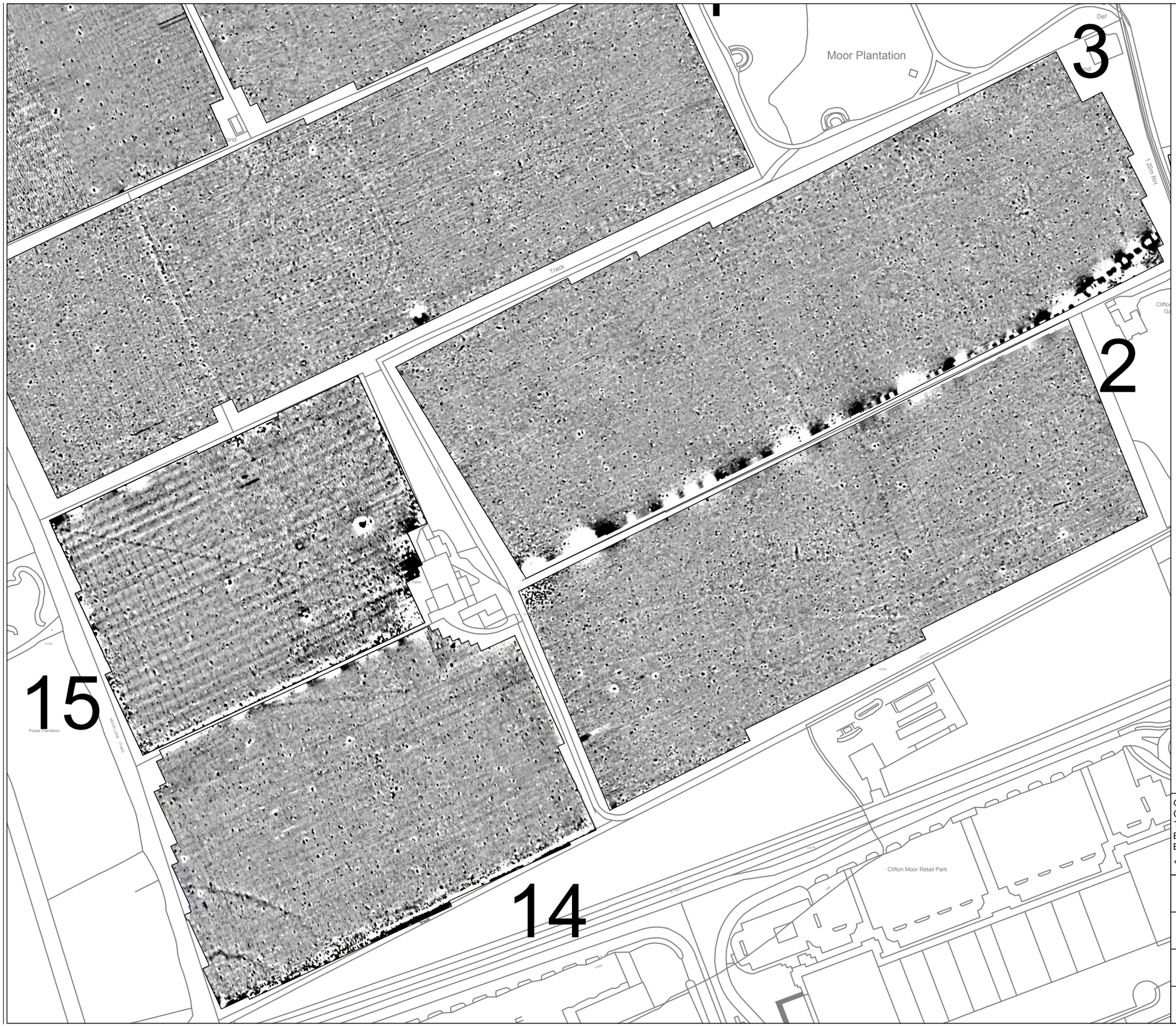
Ferrous / Magnetic Disturbance

Project: G1387 Clifton gate, York: Geophysical Survey

Title: Magnetometer Survey - Area 1 Interpretation

Drawn by: ELWatson

Figure 6



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-1

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Title: Magnetometer Survey - Areas 2, 3, 14 & 15 Greyscale Plot

Drawn by: ELWatson

Figure 7

N

0 metres 100

1:2500 @ A3

- Uncertain Origin (discrete / trend)
- Former Field Boundary
- Ploughing
- Field Drain / Drain (trend)
- Ferrous

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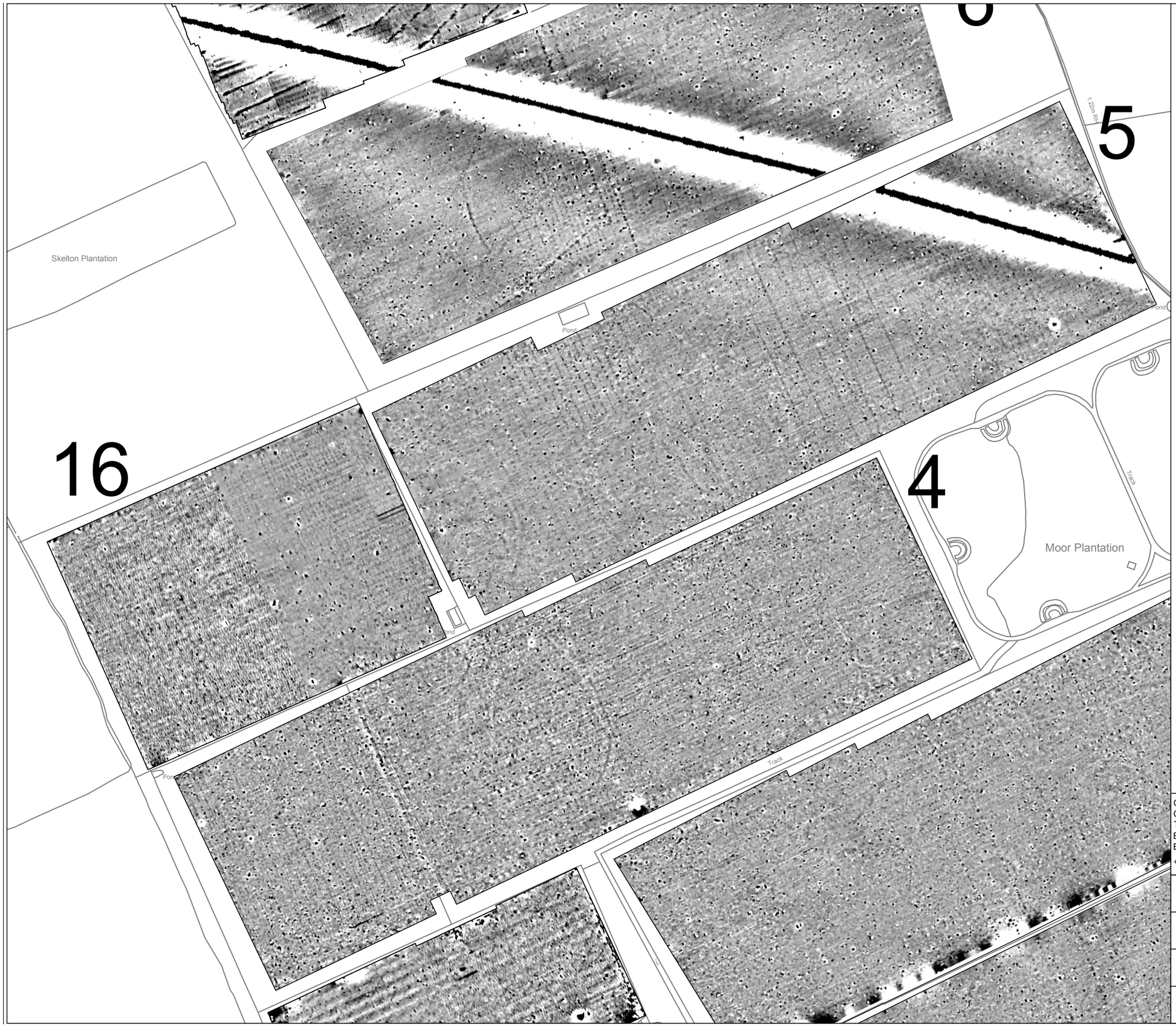
Title: Magnetometer Survey - Areas 2, 3, 14 & 15 Interpretation

Drawn by: ELWatson

Figure 8



N

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Title: Magnetometer Survey - Areas 4, 5 & 16 Greyscale Plot

Drawn by: ELWatson

Figure 9

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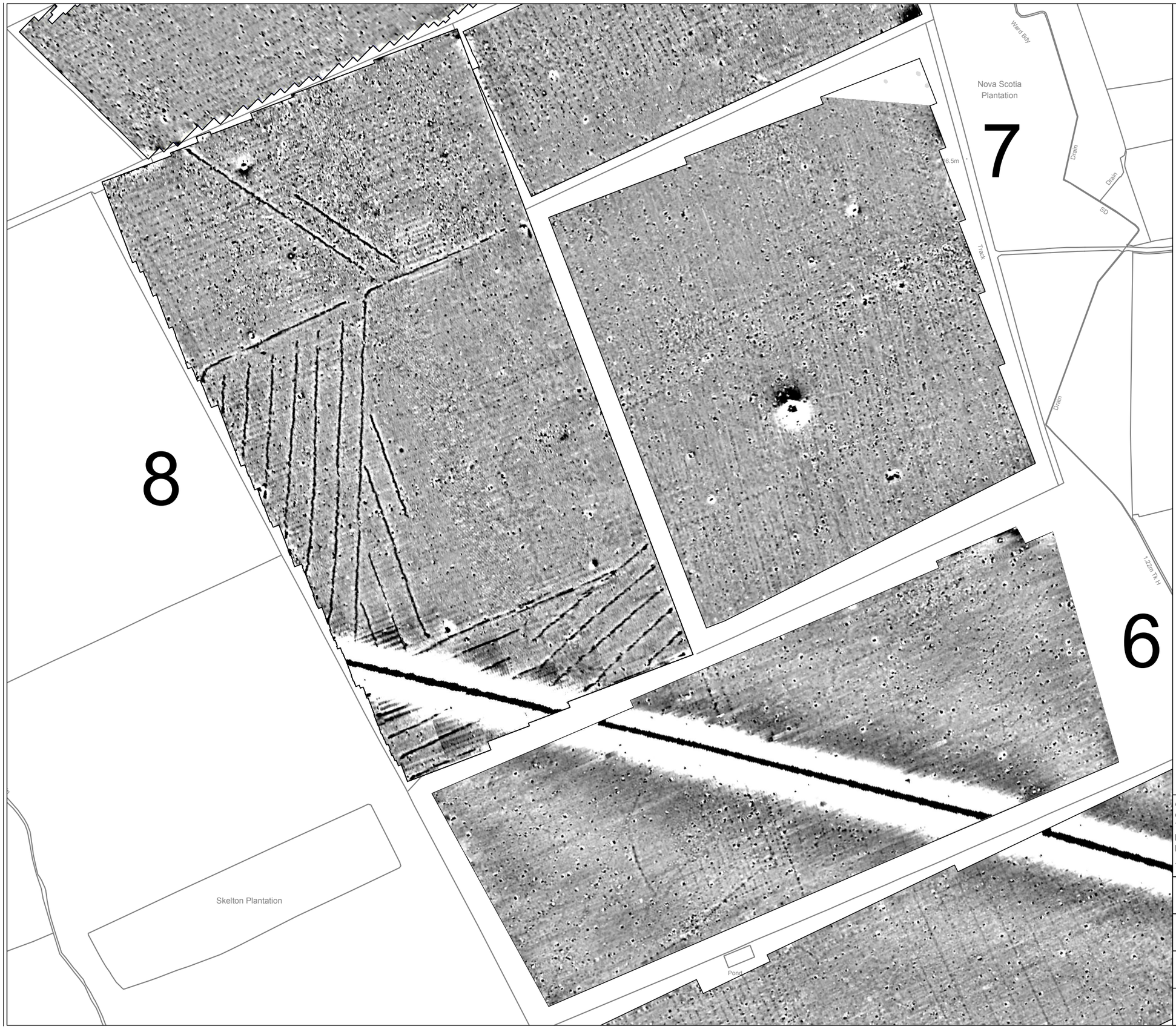
Title: Magnetometer Survey - Areas 4, 5 & 16 Interpretation

Drawn by: ELWatson

Figure 10



N

0 metres 100

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Title: Magnetometer Survey - Areas 6 - 8 Greyscale Plots

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Figure 11

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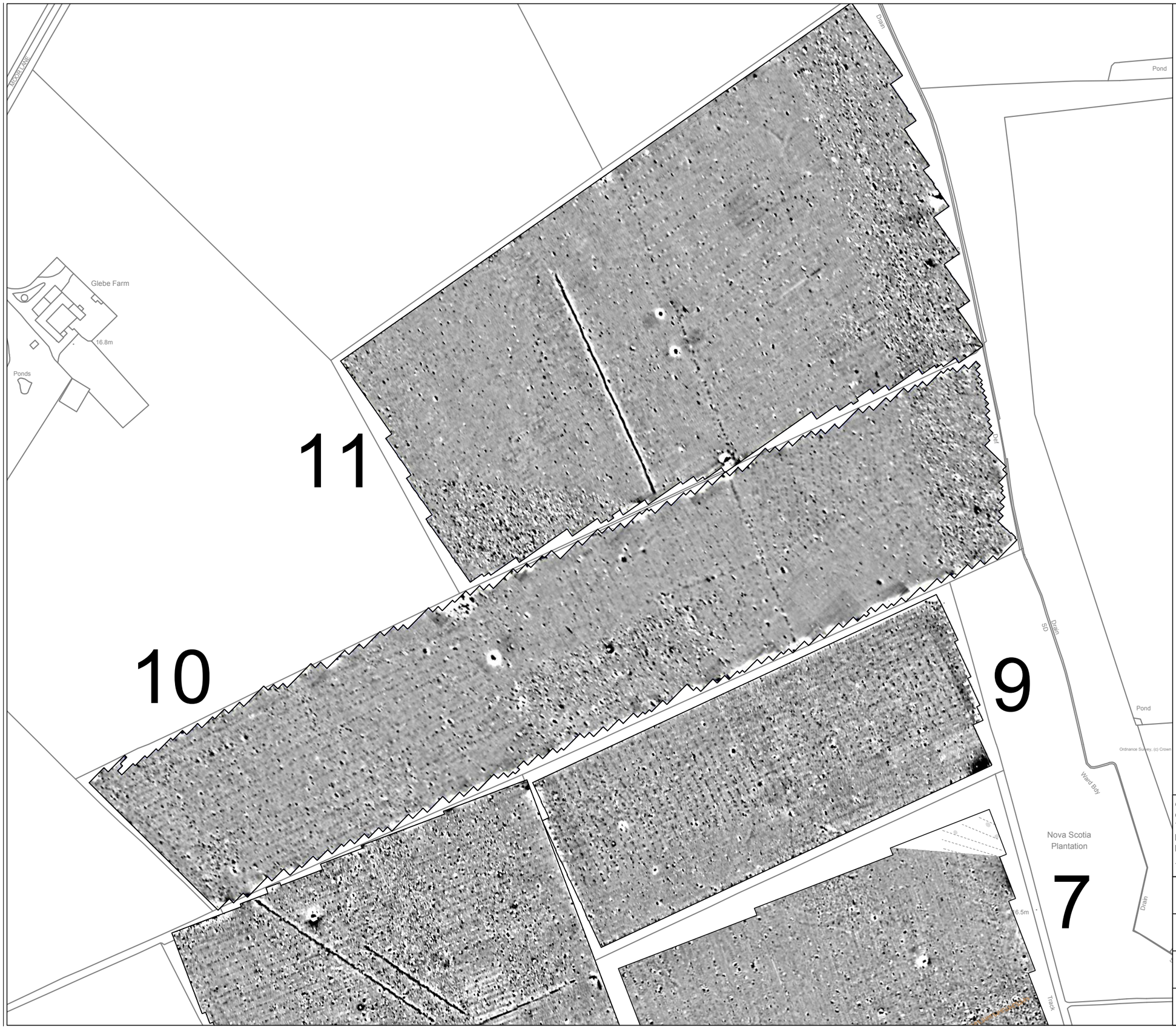
Project: G1387 Clifton gate, York: Geophysical Survey

Title: Magnetometer Survey - Areas 6 - 8 Interpretation

Drawn by: ELWatson

Figure 12



N

0 metres 100

1:2500@ A3

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Project: G1387 Clifton gate, York: Geophysical Survey

Title: Magnetometer Survey - Areas 9 - 11 Greyscale Plots

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Figure 13

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Project: G1387 Clifton gate, York:
Geophysical Survey

Title: Magnetometer Survey - Areas 9 - 11
Interpretation

Drawn by: ELWatson

Figure 14

Appendix - Technical Information: Magnetometer Survey

Instrumentation: Bartington *Grad*601-2 / GSB CARTEASY^{N} Cart system

Both the Bartington and CARTEASY^{N} instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The CARTEASY^{N} system has four gradiometer units mounted at 0.75m intervals across its frame – rather than working in grids, the cart uses an on-board survey grade GNSS for positioning. The cart system allows for the collection of topographic data in addition to the magnetic field measurements.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points along a traverse (the x axis) and/or between traverses (the y axis) and results in a smoother greyscale image.

Display

XY Trace Plot	This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane.
Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.
3D Surface Plot	This is similar to the XY trace, but in 3 dimensions. Each data point of a survey is represented in its relative position on the x and y axes and the data value is represented in the z axis. This gives a digital terrain, or topographic effect.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
?Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Increased Magnetic Response	An area where increased fluctuations attest to greater magnetic enhancement of the soils, but no specific patterns can be discerned in the data and no visual indications on the ground surface hint at a cause. They may have some archaeological potential, suggesting damaged archaeological deposits.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Old Field Boundary	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
Ploughing	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions. Smaller, isolated responses which do not form such obviously 'natural' patterns but which are, nonetheless, likely to be natural in origin may be classified as *?Natural*.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *?Archaeology* and *?Natural* or (in the case of linear responses) *?Archaeology* and *?Ploughing*; occasionally they are simply of an unusual form.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

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