magnitude surveys

Geophysical Survey Report of Whittlesey, Cambridgeshire

For

Pre-Construct Archaeology Ltd

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Abstract

Magnitude Surveys were commissioned to assess the subsurface archaeological potential of c. 12.6ha of land at Whittlesey, Cambridgeshire. A fluxgate gradiometer survey was carried out across the entire survey area and identified anomalies of an archaeological, agricultural, modern and undetermined origin. Modern interference is limited to the boundaries of the survey area and is caused by metal fencing. Archaeological activity has been identified in the form of probable trackways, a possible extension of a Roman causeway and additional linear cut features possibly indicative of former field systems. Historical agricultural activity has been identified in the form of ridge and furrow cultivation and modern agricultural activity has been identified in the form of drainage systems. A feature of a modern origin has been also identified, correlating with service covers visible on satellite imagery. Anomalies of an undetermined origin have been identified in the survey area that do not correspond to any features visible in historical OS maps or satellite images. Whilst they are likely to be agricultural or modern in origin, an archaeological origin cannot be excluded.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Pre-Construct Ltd to undertake a geophysical survey over a c. 12.6ha area of land at Whittlesey, Cambridgeshire (TL 28742 97468).

1.2. The geophysical survey comprised hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK due to its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken featured buildings (SFBs) and industrial activity (David *et al*., 2008).

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David *et al*., 2008), the Chartered Institute for Archaeologists (CIfA, 2020) and the European Archaeological Council (Schmidt *et al.,* 2015).

1.4. It was conducted in line with a WSI produced by MS (Wilkinson, 2023).

1.5. The survey commenced on 09/05/2023 and took two days to complete.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society for Archaeological Prospection).

2.2. The directors of MS are involved in cutting edge research and the development of guidance/policy. Specifically, Dr Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr Paul Johnson has a PhD in archaeology from the University of Southampton, is a Fellow of the Society of Antiquaries of London and a Member of CIfA, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.

2.3. All MS managers, field and office staff have degree qualifications relevant to archaeology or geophysics and/or field experience.

3. Objectives

3.1. The objective of this geophysical survey was to assess the subsurface archaeological potential of the survey area.

3.2. The survey has been carried out in accordance with the project brief created by the Cambridgeshire Historic Environment Team (CHET, 2023) in support of a forthcoming planning application on this site.

4. Geographic Background

4.1. The survey area is located c. 1.4km northeast from the centre of Whittlesey (Figure 1). The gradiometer survey was undertaken across an arable undulating field containing young wheat crop. The survey area is bordered by arable fields to the north and east, Eastrea Road to the south and housing to the west.

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of a flat arable field.	The field was bordered by a ditch to the north, road to the east and hedges to the south and west. Overhead cables and associated pylons ran along the eastern border.

4.3. The underlying geology comprises mudstone of the Oxford Clay Formation. Superficial deposits consist of sand and gravel of the March Gravels Member within the west and peat within the east (British Geological Survey, 2023).

4.4. The soils consist of freely draining, slightly acidic loamy soils (Soilscapes, 2023).

5. Archaeological Background

5.1. The following is a summary of a design brief for an archaeological evaluation produced by the Cambridgeshire Historic Environment team (2023) and provided by the client.

5.2. The projected route of a fen causeway of Roman origins runs through the centre of the survey area (Cambridgeshire Historic Environment Record, CB15033) and is likely in line with a field boundary shown on early editions of the OS mapping. An area of undated cropmarks indicative of settlement activity has also been identified within the northeast of the survey area (CHER 04155, MCB29298).

5.3. Approximately c. 650m east of the survey area lies the Scheduled Ancient Monument of the ring ditch and settlement site North of Eastrea (National Heritage List for England 1006853). This site encompasses cropmarks indicative of a Prehistoric Ring ditch as well as a possible Anglo-Saxon settlement. Further cropmarks indicative of a rectilinear enclosure and additional ring ditches have also been identified c. 450m east of the survey area (CHER 09393). Crop marks indicative of Saxon settlement have also been identified c. 300m northwest of the survey area (CHER ECB4093).

5.4. Investigations conducted at the site of the former Burdettes nursery, located c. 220m southwest of the survey area, identified evidence of Late Iron Age – Roman settlement activity with some human burials (CHER ECB3708, ECB4823, ECB5913). This Roman burial activity continues east, alongside a track heading northeast towards the projected route of the Fen Causeway (CHER ECB6845).

6. Methodology

6.1. Data Collection

6.1.1. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Therefore, a magnetometer survey should be the preferred geophysical technique unless its use is precluded by any specific survey objectives or the site environment. For this site, no factors precluded the recommendation of a standard magnetometer survey. Geophysical survey therefore comprised the magnetic method as described in the following section.

6.1.2. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.3. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.4. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

6.1.4.1. MS' hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.4.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.4.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to the EAC and Historic England guidelines for 'minimally enhanced data' (see Section 3.8 in Schmidt *et al.*, 2015: 33 and Section IV.2 in David *et al.,* 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen *et al*. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3. Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images of the gradient and total field at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 6). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historical maps, LiDAR data, and soil and geology maps. Google Earth (2023) was also consulted, to compare the results with recent land use.

6.3.3. Geodetic position of results – All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data.

7. Results

7.1. Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible, an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek

feedback on their reports, as well as reports from further work, in order to constantly improve our knowledge and service.

7.2.Discussion

7.2.1. The geophysical results are presented in combination with satellite imagery and historical maps (Figure 7).

7.2.2. A fluxgate gradiometer survey was successfully completed across c. 12.6ha of land at Whittlesey, Cambridgeshire. Anomalies of an archaeological, agricultural and natural origin have been identified. Modern disturbance is limited to the boundaries of the survey area caused by fencing.

7.2.3. Anomalies of probable and possible archaeological origin have been identified throughout the survey area (Figure 5). Three sets of parallel linear anomalies have been identified within the centre and south of the survey area, representative of possible double ditched trackways. A possible extension of a Roman Causeway has been identified in the east of the survey area (Figure 5). This linear anomaly appears to extend from the course of a causeway depicted in historical maps (Figure 7).

7.2.4. Numerous enhanced linear anomalies forming rectilinear morphologies have been identified throughout the survey area, possibly indicative of former field systems. However, the confidence of this interpretation is limited due to overlapping drainage systems, ridge and furrow cultivation and the overall weak enhancement of these anomalies. Due to these factors a possible archaeological categorisation has been ascribed.

7.2.5. Historical agricultural activity has been identified in the form of ridge and furrow cultivation within the north and evidence of modern agricultural activity has been identified by drainage systems present throughout the survey area.

7.2.6. A linear anomaly of a probable modern origin has been identified within the north of the survey area. The response of this anomaly has been crosscut by three areas of magnetic disturbance. These magnetic disturbances correlate with possible service covers visible on satellite imagery (Google Earth Pro 2023).

7.2.7. Several linear anomalies have been identified throughout the survey area, these anomalies lack key defining characteristics indicative of a specific feature. Thus, an undetermined categorisation has been ascribed.

7.3. Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Ferrous (Spike)** – Discrete dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.

7.3.1.3. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentration of multiple discrete, dipolar anomalies usually resulting from highly magnetic material such as rubble containing ceramic building materials and ferrous rubbish.

7.3.1.4. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.

7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally distinct from those caused by ferrous sources.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Archaeology Probable (Strong & Weak): Trackways** – Three sets of parallel, linear anomalies have been identified within the centre and south of the survey area running in an east-west and northeast-southwest orientation and are spaced roughly c. 6m apart [**1a**] (Figure 5). The morphology and strengths of these anomalies are indicative of possible double-ditched trackways.

7.3.2.2. **Archaeology Probable (Weak): Possible extension of Roman Causeway** – A broad linear, weak anomaly has been identified extending from the eastern border of the survey area [1b] (Figure 5). The broad signal of this anomaly is a-typical of an archaeological feature. However, this anomaly appears to extend from a Roman causeway depicted on historical maps (Figure 7).

7.3.2.3. **Archaeology Possible (Weak)** – Numerous weakly enhanced, linear anomalies running in a northeast to southwest alignment have been identified throughout the survey area (Figure 5). Some of these anomalies are best visible within the Total Field data (Figure 3). Much of these anomalies have clearly defined edges indicative of ditches containing magnetically enhanced infill. The morphology of these anomalies could be indicative of historical field systems. However, these anomalies are generally much weaker and are difficult to discern from

agricultural activity and natural variations, thus have been categorised as possible archaeology.

7.3.2.4. **Modern** – A broad weakly positive linear has been identified within the north of the survey area running in a northwest-southeast alignment [**1c**] (Figure 5). Three discrete dipolar anomalies run along this anomaly representative of magnetic disturbance. These magnetic disturbances correlate with what appears to be service covers identified on satellite imagery which could not be identified during the survey (Google Earth Pro, 2023).

7.3.2.5. **Ridge and Furrow (Trend)** – Several parallel, curvilinear anomalies have been identified within the west of the survey area running in a north to south orientation (Figure 5). These have a spacing of between c. 5m to 10m and are indicative of ridge and furrow cultivation.

7.3.2.6. **Drainage Features** – Multiple weak linear anomalies have been identified throughout the survey area in an east-west and northeast-southwest orientation (Figure 5). The properties of these anomalies are typical of drainage systems. These drainage features crosscut anomalies representing possible archaeological activity within the southwest, limiting the interpretation of the area (see section 7.2.2.3)

7.3.2.7. **Undetermined (Weak)** – Weakly enhanced linear anomalies have been identified within the north and south of the survey area (Figure 5). These anomalies do not exhibit characteristic morphologies of any specific feature. Because of this, they have been classified as undetermined. Whilst it is likely of agricultural or modern origin, an archaeological origin cannot be excluded.

8. Conclusions

8.1. A fluxgate gradiometer survey was successfully completed across the entire survey area and identified anomalies of an archaeological, agricultural, natural and undetermined origin. Modern interference Is limited to the boundaries of the survey area and is caused by overhead cables and metal fencing.

8.2. Probable and possible archaeological activity has been identified in the form of probable double ditched trackways, an extent of a mapped Roman Causeway. Further linear anomalies have been identified which may be indicative of former field systems. However, this interpretation has been limited by the weak enhancement of these anomalies and crosscutting of drainage systems.

8.3. Historical agricultural activity has been identified in the form of ridge and furrow regimes. Modern agricultural activity has been noted as drainage systems.

8.4. Anomalies of undetermined origins have been identified in the survey area and whilst they are likely to be agricultural or modern in origin, an archaeological origin cannot be excluded.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to any dictated time embargoes.

10. Copyright

10.1. Copyright and intellectual property pertaining to all reports, figures and datasets produced by Magnitude Services Ltd is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

11. References

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12. Project Metadata

MS Job Code	MSTL1567
Project Name	Whittlesey, Cambridgeshire
Client	Pre-Construct Archaeology Ltd.
Grid Reference	TL 28742 97468
Survey Techniques	Magnetometry
Survey Size (ha)	12.6
Survey Dates	2023-05-09 to 2023-05-10
Project Lead	Jake Dolan BSc FGS
Project Officer	Daniel Wilkinson BA (Hons)
HER Event No	ECB7125
OASIS No	N/A
S42 Licence No	N/A
Report Version	1.0

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	AW ZR DN	DW	16 May 2023
0.2	Corrections following Project Lead review	ED	DW	18 May 2023
0.3	Additional Comments from Project Lead	ED	JD	19 May 2023
0.4	Corrections following director review	DW	JD	24 May 2023
0.5	Additional corrections following director review	DW	DW	30 May 2023
1.0	Report issued as final	DW	JD	1 June 2023

MSTL1567: Whittlesey, Cambridgeshire
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

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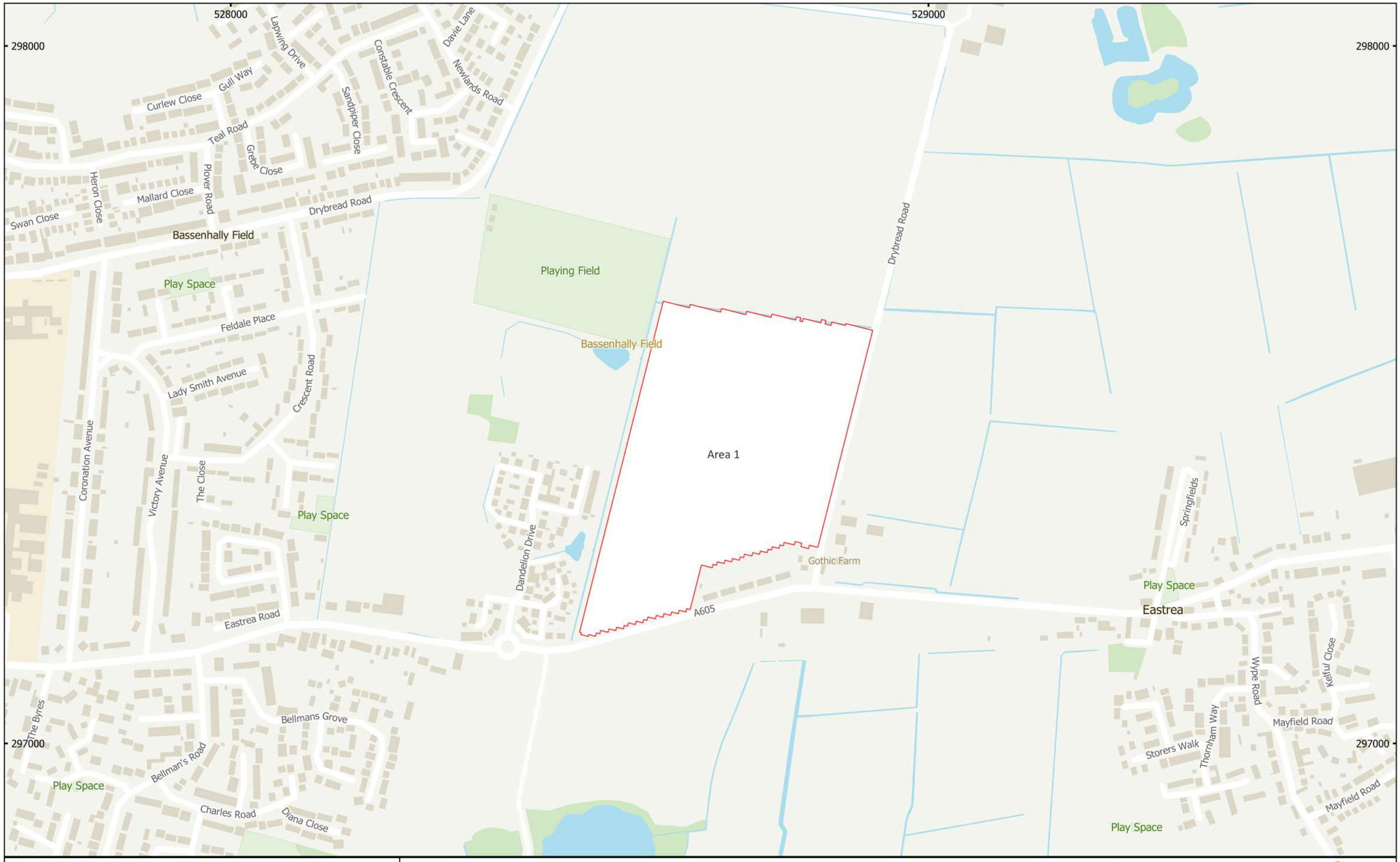
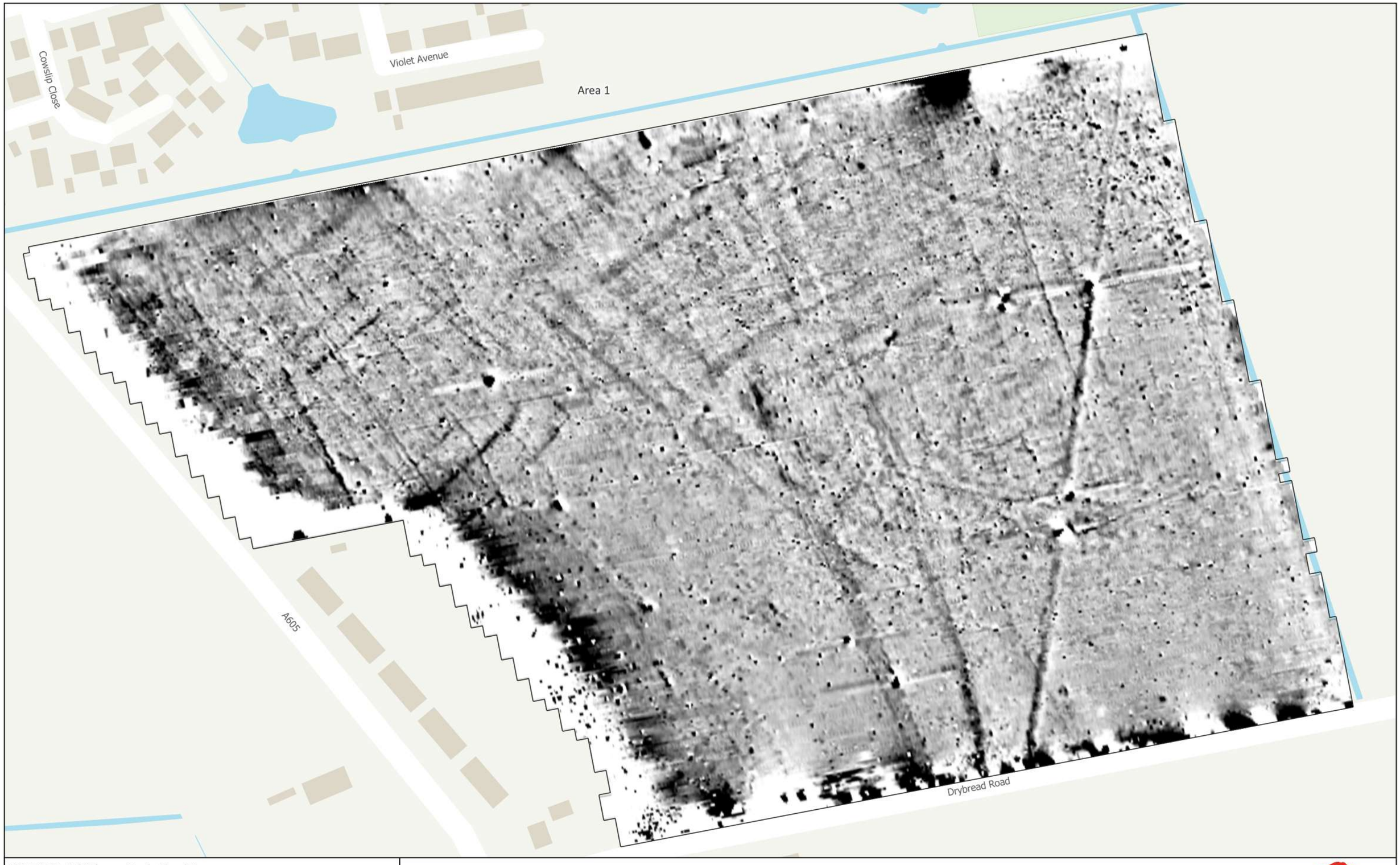


MSTL1567: Whittlesey, Cambridgeshire
Figure 2 - Location of Survey Area
1:5,000 @ A3

Survey Extent

magnitude surveys



MSTL1567: Whittlesey, Cambridgeshire
Figure 3 - Magnetic Total Field (Lower Sensor)
1:1,500 @ A3

48,997 nT 49,005

N

0 50 100 150 m

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Cowslip Close

Violet Avenue

Area 1

A605

Drybread Road

MSTL1567: Whittlesey, Cambridgeshire
Figure 4 - Magnetic Gradient
1:1,500 @ A3

-1 nT 2

N

0 50 100 150 m

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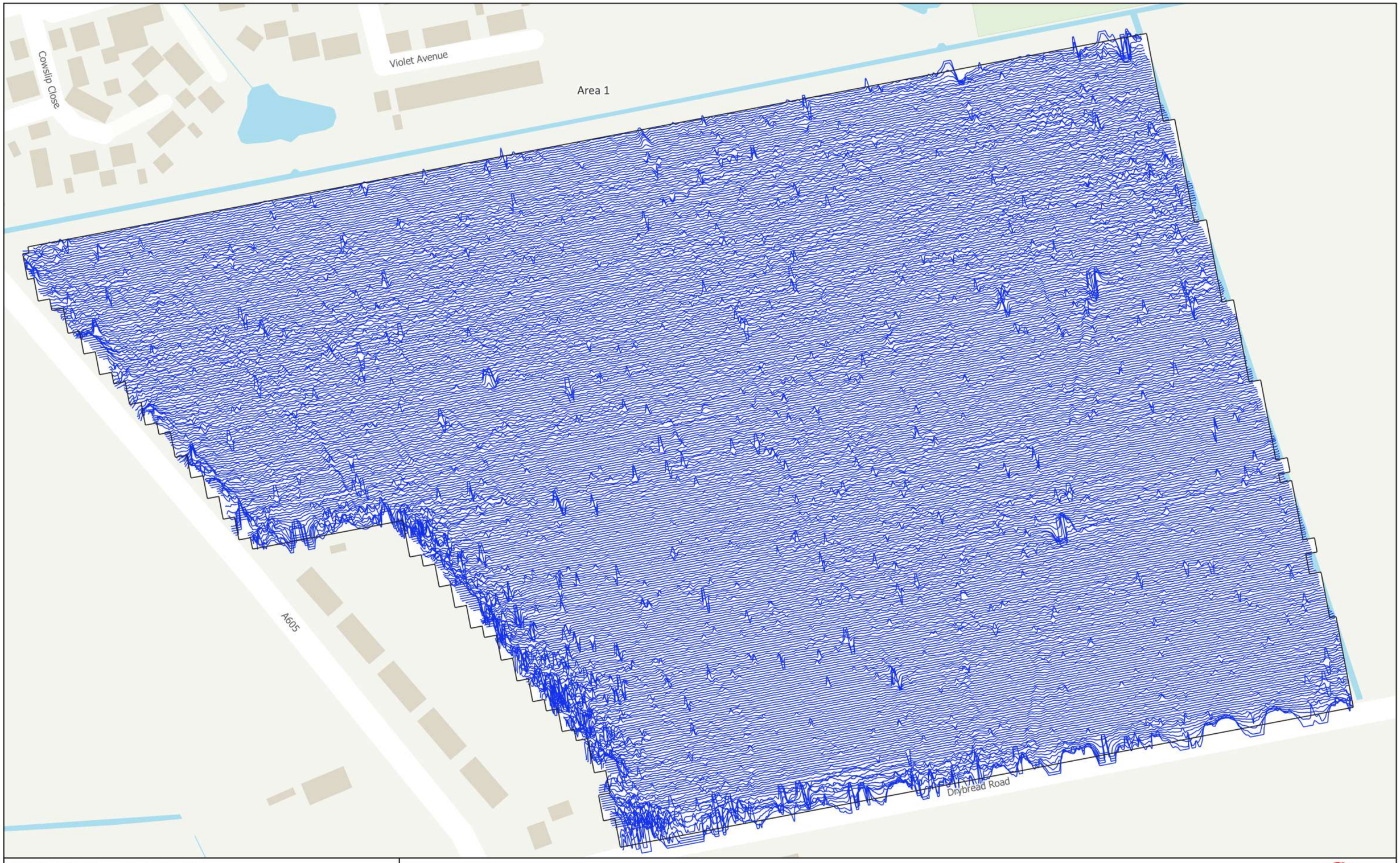
MSTL1567: Whittlesey, Cambridgeshire
Figure 5 - Magnetic Interpretation
1:1,500 @ A3

- Archaeology Probable (Strong)
- Archaeology Probable (Weak)
- Archaeology Possible (Weak)
- Modern
- Undetermined (Strong)
- Undetermined (Weak)
- Magnetic Disturbance
- Ridge and Furrow (Trend)
- Drainage Feature
- Ferrous (Spike)

N

0 50 100 150 m

magnitude surveys



MSTL1567: Whittlesey, Cambridgeshire
Figure 6 - XY Trace Plot
30nT/cm at 1:1,500 @ A3

N

0 50 100 150 m

magnitude surveys

MSTL1567: Whittlesey, Cambridgeshire
Figure 7 - Magnetic Interpretation Over Combined Historical Map and Satellite Imagery
1:3,000 @ A3

- Archaeology Probable (Strong)
- Archaeology Probable (Weak)
- Archaeology Possible (Weak)
- Modern
- Undetermined (Strong)
- Undetermined (Weak)
- Magnetic Disturbance
- Ridge and Furrow (Trend)
- Drainage Feature
- Ferrous (Spike)

N

0 100 200 300 m

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