



**magnitude
surveys**

**Geophysical Survey Report
of
Mepal Road
Sutton, Cambridge**

**For
RPS Group**

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Abstract

Magnitude Surveys was commissioned to access the subsurface archaeological potential of a c. 14.2ha area of land at Mepal Road, Sutton, Cambridge. A fluxgate gradiometer survey was successfully completed across the survey area. Probable and possible archaeological activity has been identified, with anomalies of curvilinear and linear morphology suggestive of ditches. Agricultural features including ridge and furrow cultivation, former mapped and unmapped field boundaries, modern ploughing and drains schemes have been identified. An area of possible extraction has also been detected. Some anomalies classified as 'Undetermined' were detected within the survey area and an archaeological interpretation for these cannot be excluded. The impact of modern activity on the site is limited to magnetic interference around field perimeters and that caused by bore hole covers and service line.

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1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS Group to undertake a geophysical survey over a c. 14.2ha area of land at Mepal Road, Sutton, Cambridgeshire (TL 44417 79609).
- 1.2. The geophysical survey comprised hand-pulled/quad-towed, cart-mounted and 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 (Garst, 2022) and carried out in accordance with the project brief created by the Cambridgeshire Historic Environment Team (CHET, 2021) in relation to planning reference 19/01707/OUM.
- 1.5. The survey commenced on 21st of March 2022 and continued the 22nd of April 2022 and took 4 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.

4. Geographic Background

4.1. The survey area was located c. 415m north of Sutton (Figure 1). Gradiometer survey was undertaken across four agricultural fields. The survey area was located to the west of the A142, with residential areas to the south and arable fields to the north and west (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of flat pasture.	The area was bordered by barbed wire to the south, north and west, and hedgerow and farm buildings to the east. Bore hole covers were present across the field, as well as hay bales in the south-eastern corner.
2	The survey area consisted of flat pasture.	The area was bordered by the barbed wire to the north and west, as well as buildings to the east and woodland to the south. A scrap pile was present in the northeastern part of the area.
3	The survey area consisted of flat arable field with young crop.	The area was bordered by hedges and trees to the east and west with ditches to the north and south.
4	The survey area consisted of flat scrubland.	The area was bordered by hedges to the east and west with wire fencing to the south and northwest. Areas 3 and 4 were separated by a ditch. Gravel and debris were present on the western edges of the survey area and a large ridge inhibited survey on the eastern edge.

4.3. The underlying geology comprises of mudstone of the Kimmeridge Clay Formation. Superficial deposits in the area include Oadby Member diamicton consisting of sedimentary deposits of glacial tills with glaciofluvial deposits of sand and gravel to the east (British Geological Survey, 2022).

4.4. The soils consist of a lime-rich loamy and clayey soils with impeded drainage (Soilscapes, 2022).

5. Archaeological Background

5.1. The following is a summary of an Archaeological and Heritage Desk Based Assessment produced by Prospect Archaeology (Field, 2019) and a Design Brief for Archaeological Evaluation (Hopper, 2021), which includes a search of the Cambridgeshire Historic Environment Record (CHER) both provided by RPS Group.

5.2. There is no evidence within the survey area of earlier prehistoric activity. Bronze Age discoveries are limited to poorly provenanced Middle Bronze Age and Bronze Age palstaves found c.480m and c.1km north of the survey area respectively. Later prehistoric activity is more substantial including a Middle Iron Age and Romano-British settlement, beyond the southwestern boundary of the survey area, north of The Brook. This included a watering hole for cattle which contained large quantities of domestic refuse including Middle Iron Age and early Romano-British pottery, animal bone and daub with wattle impressions, with environmental evidence showing that crop processing was taking place in the vicinity. Remains dating from the Iron Age

through to the medieval period were also identified c.750m to the north during two phases of archaeological investigations on land adjacent to Sutton Primary School.

- 5.3. There is some evidence for Romano-British activity around the survey area, predominantly around the centre of Sutton. A second century cremation in a jar was found c. 620m to the southeast of the survey area, and ditches and pottery were found c. 580m to the south.
- 5.4. Sutton was mentioned in the Domesday Survey of 1086 and was clearly a settlement during the Saxon period. Saxo-Norman and medieval features were excavated south of the survey area including a building with post-holes, and ditches c. 550m southeast of the survey area. Excavations also revealed drainage ditches and pond features of early medieval to post-medieval date c.640m south of the survey area.
- 5.5. A major complex of medieval earthwork remains are present near Burystead Farm c. 790m west of the survey area. The complex incorporates a late 13th to early 14th century chapel and burial ground, as well as an elongated rectangular medieval moat to the northeast and fishponds to the southwest.
- 5.6. The survey area appears to have functioned as part of the agricultural hinterland of Sutton during the medieval and post medieval periods. Evaluations undertaken to the southeast of the survey area have discovered agricultural activity in the form of ridge and furrow cultivation. Aerial photography assessment suggests that remains may be extant in the survey area.
- 5.7. Drainage of the fens around the Isle of Ely since 1630, transformed the surrounding area and during the 17th century Sutton was famous for growing fruit. Evidence of quarries have also been noted on historical maps within the immediate landscape.
- 5.8. Modern activity in the survey area includes the use of the land as the RAF Mepal Airfield from 1942 into the Cold War era. The survey area is situated towards the southwest corner of the former airfield's southern limit.

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-pulled/quad-towed cart system and hand-carried GNSS-positioned system.

6.1.4.1. MS' cart and 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 7 and 10). 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 (2022) 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 historical maps (Figure 4).

7.2.2.The fluxgate gradiometer survey has responded well to the environment of the survey area. The geophysical survey has detected a variation of anomalies related to probable and possible archaeological activity, as well as historical and modern agricultural schemes. The impact of modern activity on the results is generally limited to magnetic

interference from fencing and metal objects along the edges of survey areas, as well as modern service line and bore hole covers.

7.2.3. Probable archaeology has been identified in the eastern part of the survey area. This comprises a curvilinear anomaly indicative of discontinuous annular cut feature. These anomalies are characteristic of a ring ditch.

7.2.4. Several further linear and curvilinear anomalies have been identified that have been categorised as possible archaeology. This is due to their defined edges and morphology consistent with cut features such as ditches, as well as their location in the closest vicinity to probable archaeology. However, lack of distinctive shape or organisation means a more confident interpretation cannot be assigned.

7.2.5. Evidence of agricultural activity has been detected throughout the survey area in the form of ridge and furrow cultivation in multiple orientation, as well as mapped and unmapped field boundaries. The presence of ridge and furrow ploughing regimes indicate that the area has been under cultivation since at least the medieval/post-medieval period. Modern ploughing trends have also been detected across most of the survey area as well as drains.

7.2.6. In the eastern part of the survey area, a zone of possible extraction has been identified possibly demonstrating utilisation sand and gravel superficial deposits, that has naturally been backfilled.

7.2.7. Throughout the survey area anomalies that have been classified as 'Undetermined' have been detected. Some of these, characterised by a weak, positive signal might be representatives of ditches but have limited context or lack any clear pattern or morphology to enable a confident interpretation. Nevertheless, an archaeological origin cannot be excluded.

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. **Probable Archaeology (Weak)** – In Area 3, an annular anomaly has been identified [3a] (Figures 5 and 6). The feature measures c. 12m in diameter and is circular in form with breaks on the southeastern and northwestern sides. Magnetic enhancement is weak, typical of infilled ditch-type features. Given the more curved, continuous and distinct layout as well as defined edges of the anomaly, an 'Archaeology Probable' origin has been ascribed.

- 7.3.2.2. **Possible Archaeology (Weak)** - In the eastern part of Area 3, several positive, linear and curvilinear anomalies have been detected (Figures 5 and 6). These anomalies have a weak signal and are situated in the closest vicinity of probable archaeology; therefore a possible archaeological categorisation has been given. These anomalies could form part of a field system or enclosures, yet they lack characteristics that would allow for a more confident interpretation.

- 7.3.2.3. **Agricultural (Weak)** – Three linear anomalies have been identified exhibiting a positive weak magnetic signal, typical of a cut feature with anthropogenically enhanced fill [1a; 3b; 3e]. These anomalies correlate well with former field boundaries depicted on historic 1882-1918 OS mapping (Figures 5 and 6). Two further linear anomalies, with very similar morphology and signal have been identified within Area 3 [3c; 3f] but are not depicted on available historical mapping. Given their similarity, these have been classified as former unmapped field boundaries. Anomaly [3c], overlaps partially with a modern service, which could suggest reusage of the old field boundary for the service installation.

- 7.3.2.4. **Ridge and Furrow (Trend)** – Several groups of parallel linear anomalies have been detected throughout the survey area (Figures 5, 6, 8 and 9). Spacing between the anomalies is typically between 5-8m and is reflective of ridge and furrow ploughing schemes. Although the majority of the ridge and furrow are orientated in a roughly north to south alignment there is a distinct change towards the centre of Area 3 orientated roughly east to west (Figures 6 & 9). The ridge and furrow do not respect the identified former field boundaries suggesting that there were earlier field divisions in this area which predates available mapping.

- 7.3.2.5. **Agricultural (Trends)** – Across the survey area, a series of parallel linear anomalies have been detected which exhibit a weak magnetic signal. These are very closely spaced. A representative selection has been digitised to indicate

direction across the survey area (Figures 5, 6, 8 and 9). The orientation is well matched with modern cultivation visible in recent satellite imagery and are interpreted as agricultural trends caused by modern ploughing and headlands.

7.3.2.6. **Drain Features (Trend)** – Alignments of continuous linear, negative and positive anomalies are noted across the survey area (Figures 5, 6, 8 and 9). These types of signal could suggest ditch-like morphology.

7.3.2.7. **Possible Extraction** – In the northeastern edge of the survey area, a zone characterised by a change in background consistency has been identified (Figures 5 and 6). This mottled effect with distinctive strong enhancement at the edges is characteristic of areas of extraction that has been backfilled through natural processes.

7.3.2.8. **Undetermined** – Anomalies classified as “Undetermined” within the survey area have weak, positive magnetic signals (Figures 5, 6, 8 and 9). There is no corroborative evidence to confirm an agricultural or archaeological origin for these features: as they do not correspond with any mapped features on available historic maps (Figure 4). Whilst these do not present a clear layout, the defined edges of the anomalies suggest they should be considered to have anthropogenic potential; however, no confident interpretation can be provided.

8. Conclusions

- 8.1. A fluxgate gradiometer survey was successfully completed across the c. 14.2ha survey area. Magnetic disturbance was limited to haloes caused by fencing, bore hole covers and a service. The survey environment presented a relatively clear and consistent magnetic background against which weak small anomalies could be identified.
- 8.2. The geophysical results identified anomalies of probable and possible archaeological origin. These anomalies likely represent an infilled ditch features. Probable archaeological anomalies have been interpreted as representing a ring ditch, based on morphology and consistent magnetic signal. Possible archaeological anomalies appear to form part of a field system or enclosures.
- 8.3. The geophysical results reflect the long-term agricultural use of the survey area in the form of former mapped and unmapped field boundaries, ridge and furrow regimes, and drains. Modern ploughing was also identified across parts the survey area.
- 8.4. An area of localised extraction has been detected to the east of the survey area. This is a common practice in areas with sand and gravel.
- 8.5. Several anomalies throughout the site have been classified as undetermined as it has not been possible to definitively determine whether these anomalies are the result of archaeological, agricultural, or natural processes.

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

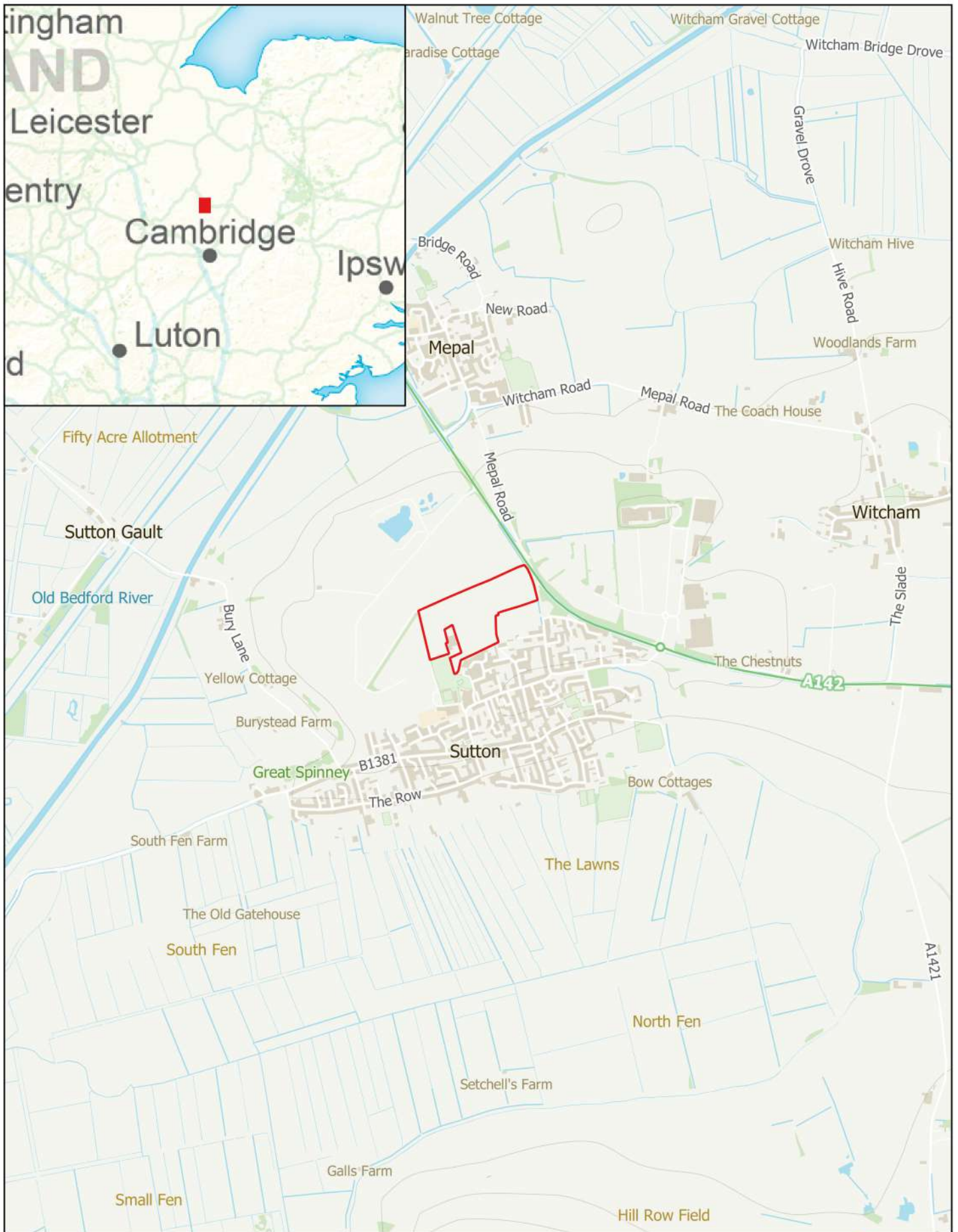
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12. Project Metadata

MS Job Code	MSTL1162
Project Name	Geophysical Survey Report of Mepal Road Sutton, Cambridge
Client	RPS Group
Grid Reference	TL 44417 79609
Survey Techniques	Magnetometry
Survey Size (ha)	14.2ha (Magnetometry), 1ha (Ground Penetrating Radar)
Survey Dates	2021-10-05 to 2021-10-15
Project Lead	Leigh A. Garst BFA MSc
Project Officer	Leigh A. Garst BFA MSc
HER Event No	ECB6860
OASIS No	magnitud1-506523
S42 Licence No	N/A
Planning Application	9/01707/OUM
Report Version	Final

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	AC	LG	27 April 2022
0.2	Corrections from Project Lead, draft for Director Approval	AC	LG	28 April 2022
Final	Final Report following comments from the client	LAG	LAG	04 May 2022



MSTL1162: Mepal Road, Sutton

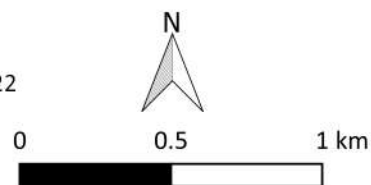
Figure 1 - Site Location

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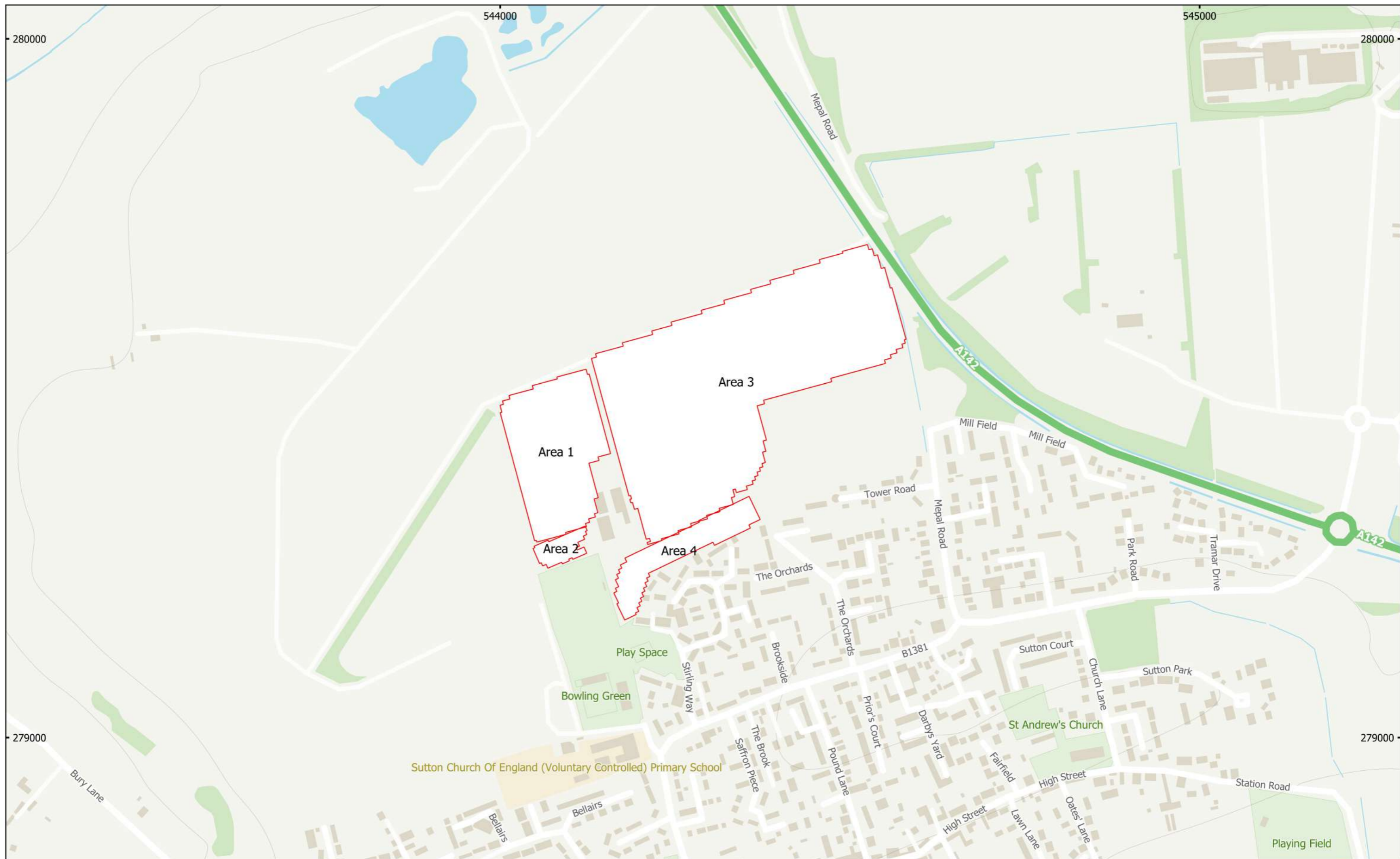
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 Site Boundary

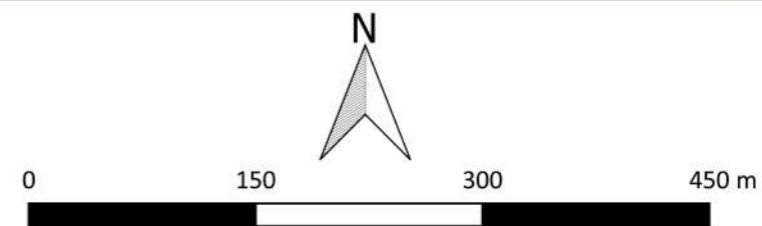


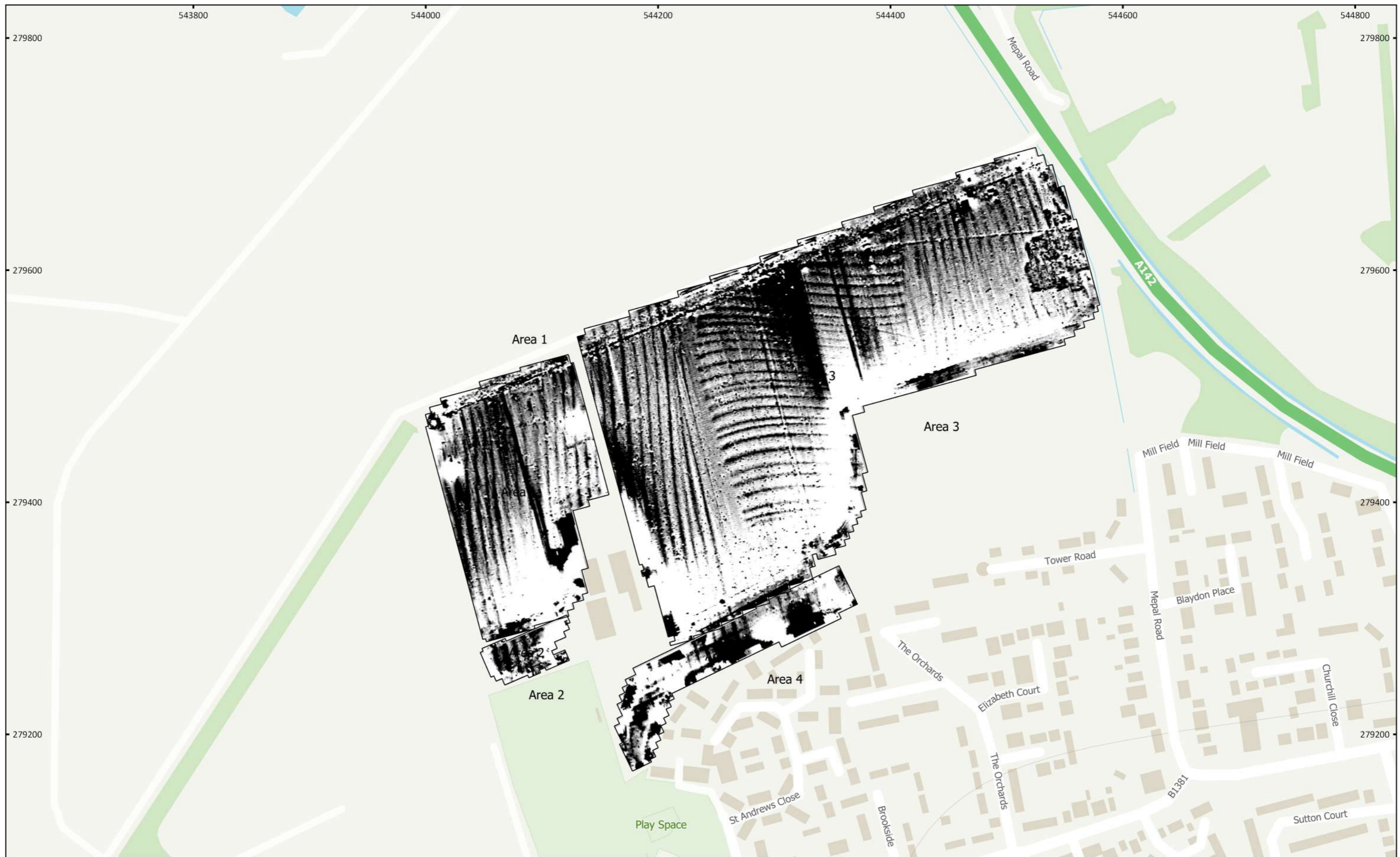
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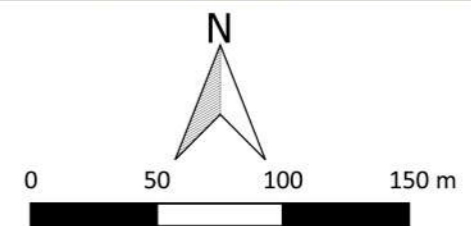
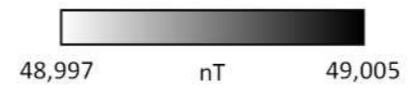
MSTL1162: Mepal Road, Sutton
 Figure 2 - Location of Survey Area
 1:5,000 @ A3
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 Survey Extent

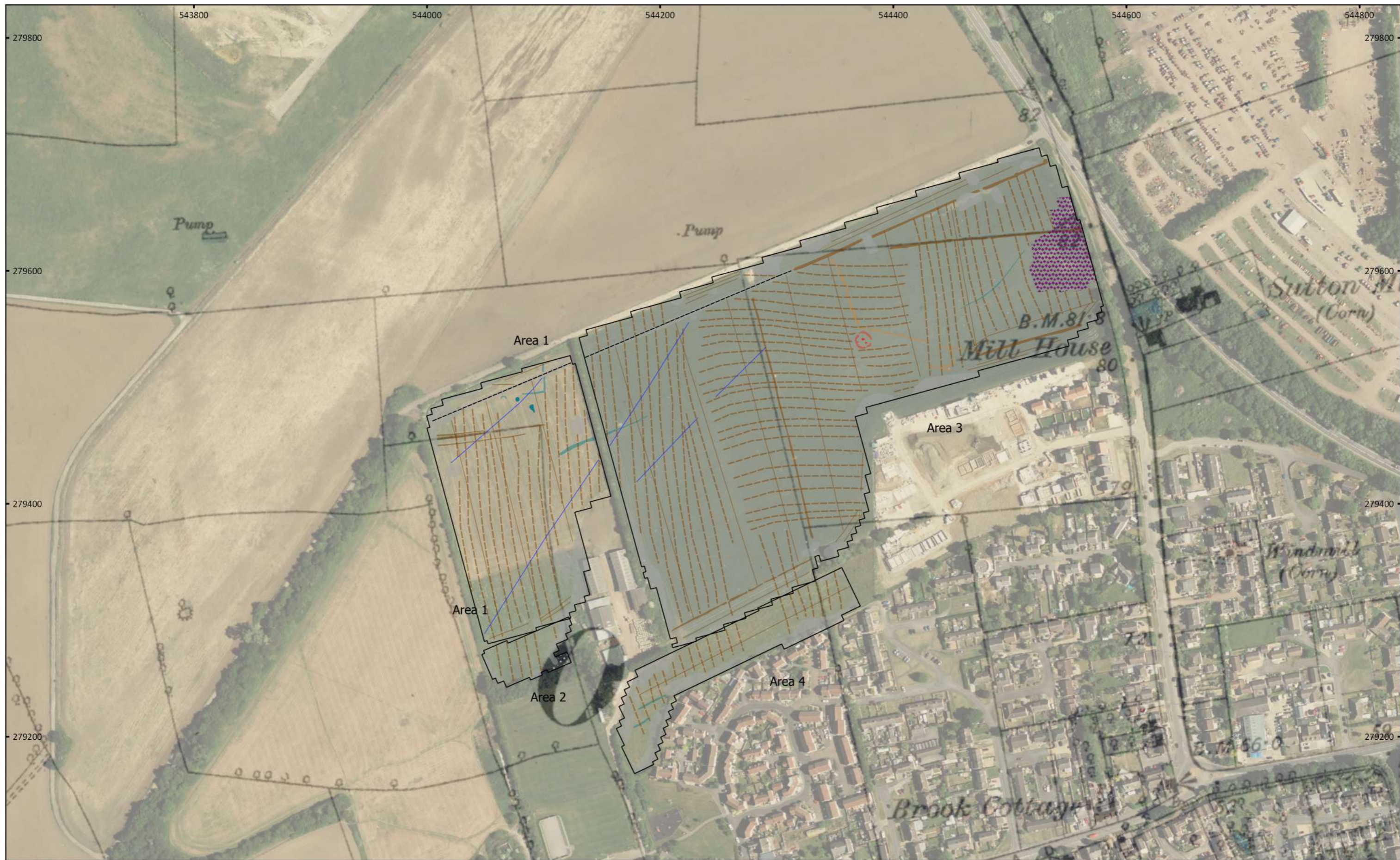




MSTL1162: Mepal Road, Sutton
 Figure 3 - Magnetic Total Field (Lower Sensor)
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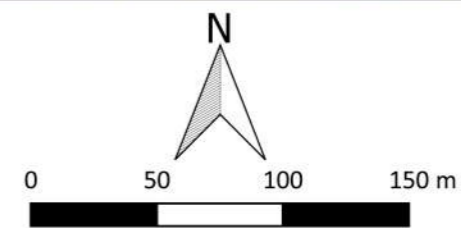


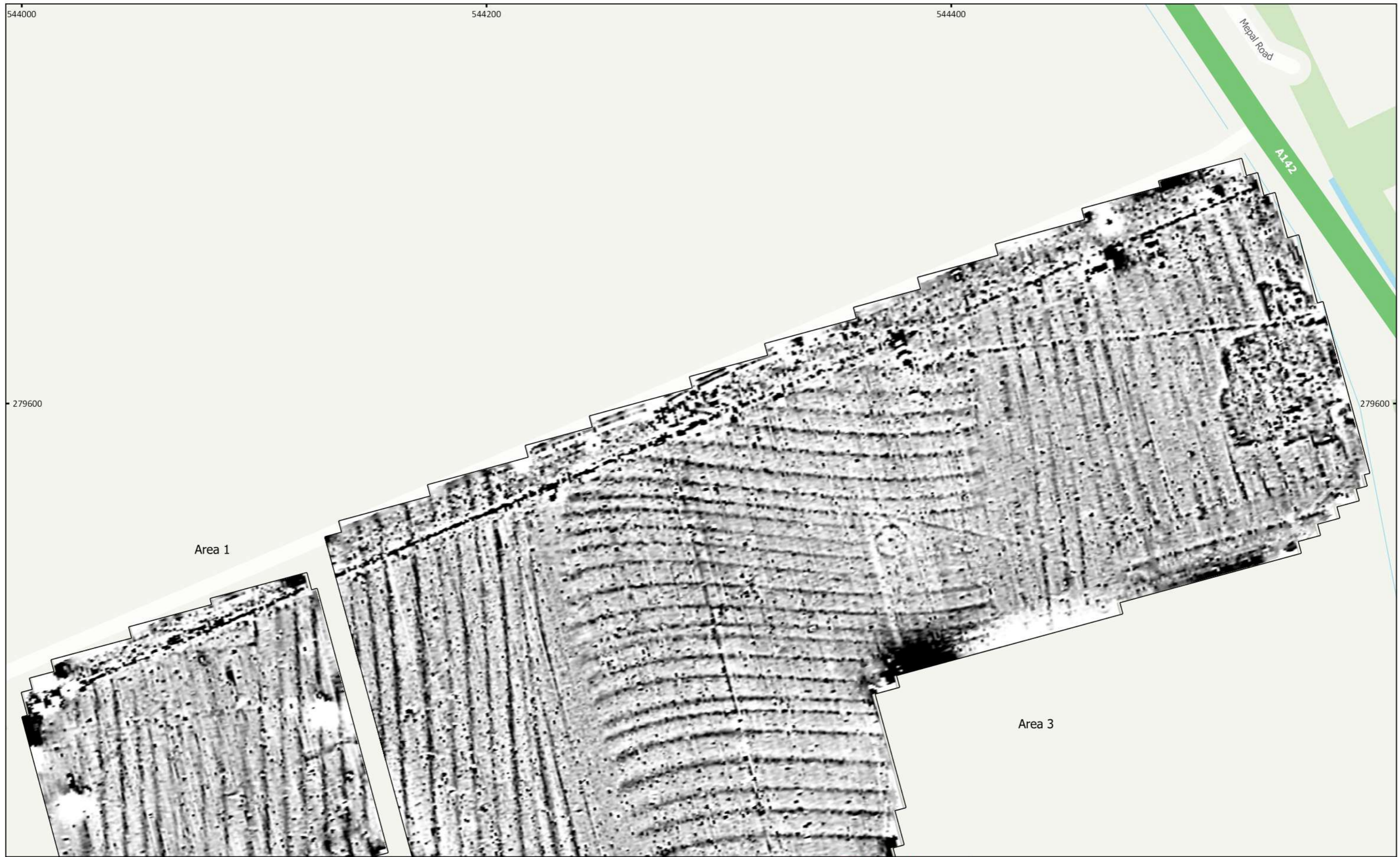
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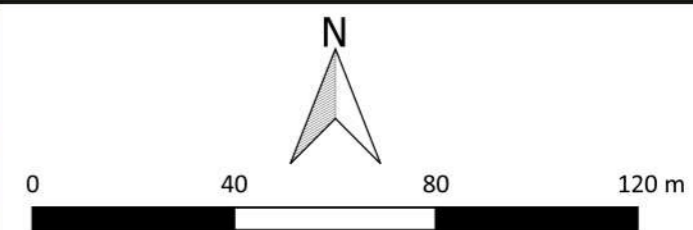
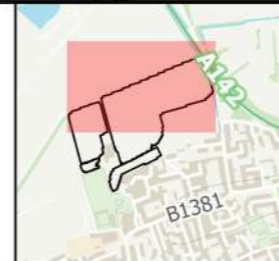
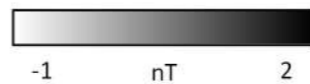
MSTL1162: Mepal Road, Sutton
 Figure 4 - Magnetic Interpretation Over Historical Maps and Satellite Imagery
 1:3,000 @ A3
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 Contains historical mapping © CLS Data 2022: Ordnance Survey, 6" 2nd
 edition c. 1882-1913
 Contains satellite imagery © Bing Satellite 2022

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|-------------------------------|------------------------------|--------------------------|
| Agricultural (Weak) | Ferrous/Debris (Spread) | Service |
| Archaeology Probable (Strong) | Undetermined (Strong) | Ridge and Furrow (Trend) |
| Archaeology Possible (Weak) | Undetermined (Weak) | Drainage Feature |
| Archaeology Probable (Weak) | Possible Extraction (Spread) | Ferrous (Spike) |
| Magnetic Disturbance | Agricultural (Trend) | |

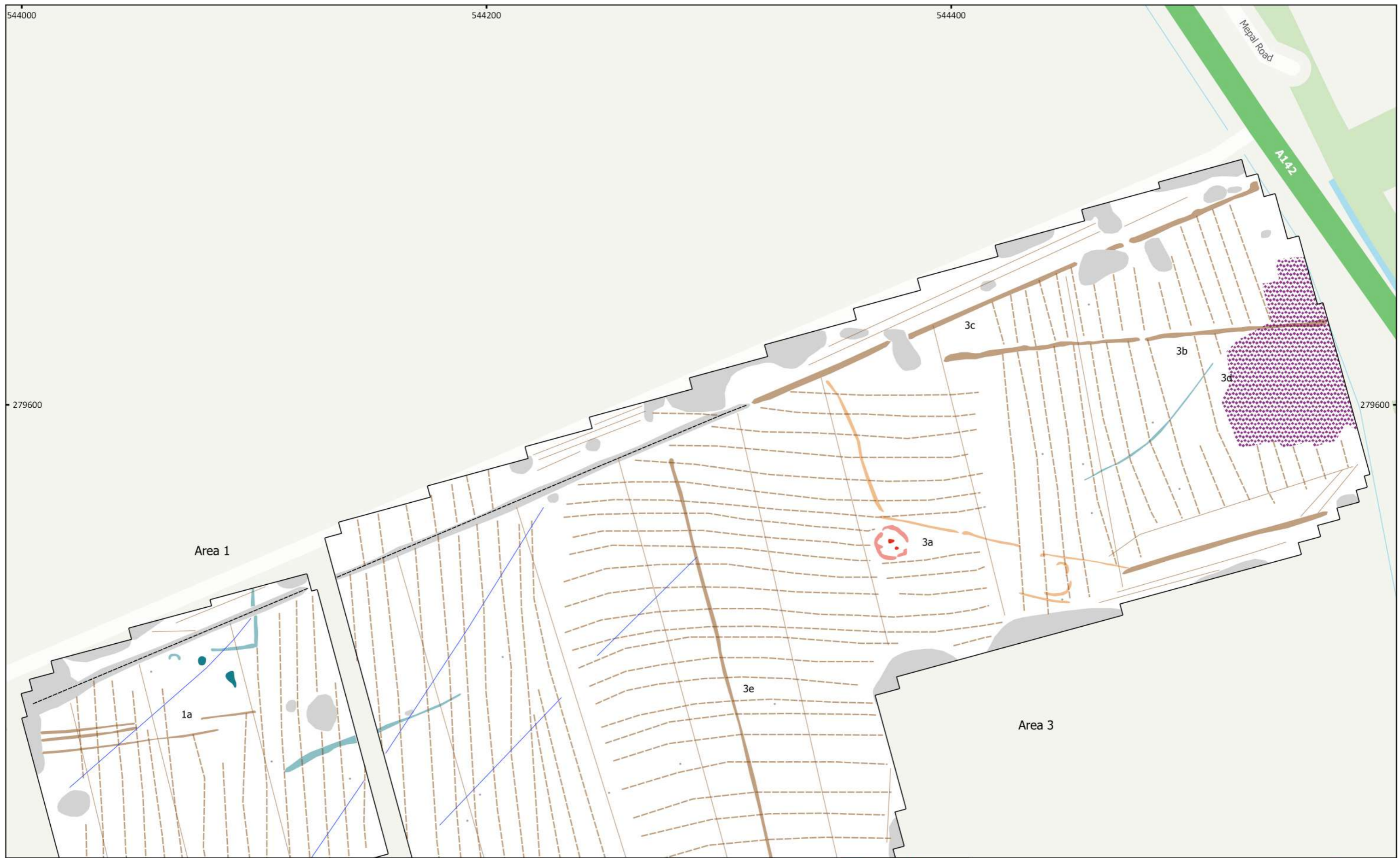




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 Figure 5 - Magnetic Gradient (Areas 1 and 3)
 1:1,500 @ A3
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 Figure 6 - Magnetic Interpretation (Areas 1 and 3)
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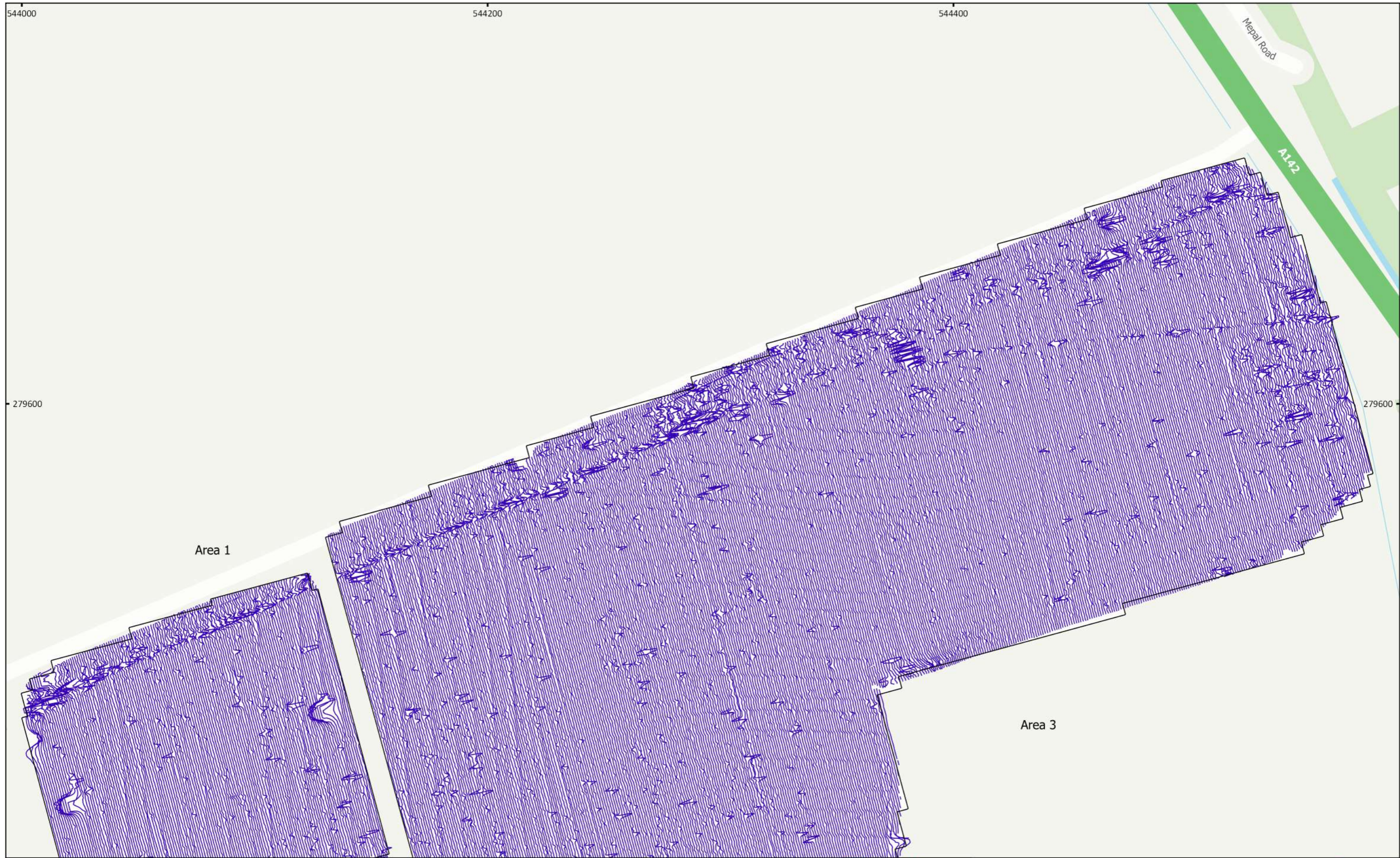
- | | | |
|-------------------------------|------------------------------|--------------------------|
| Archaeology Possible (Weak) | Magnetic Disturbance | Service |
| Archaeology Probable (Strong) | Undetermined (Strong) | Ridge and Furrow (Trend) |
| Archaeology Probable (Weak) | Undetermined (Weak) | Drainage Feature |
| Agricultural (Weak) | Possible Extraction (Spread) | Ferrous (Spike) |
| | Agricultural (Trend) | |



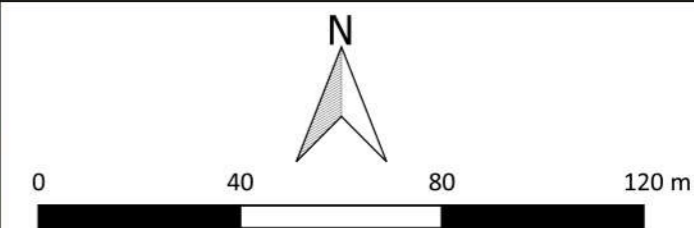
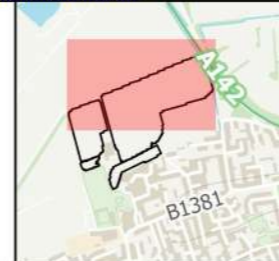
N

0 40 80 120 m

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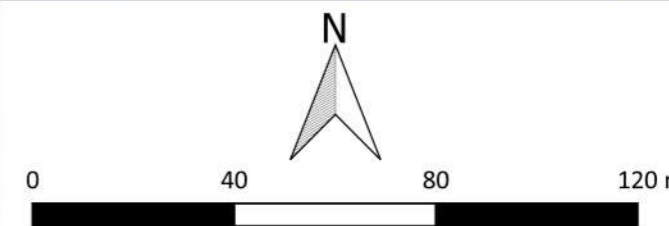
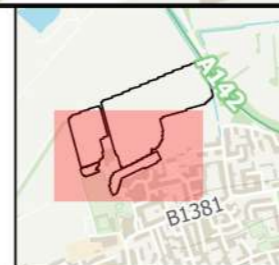
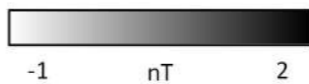


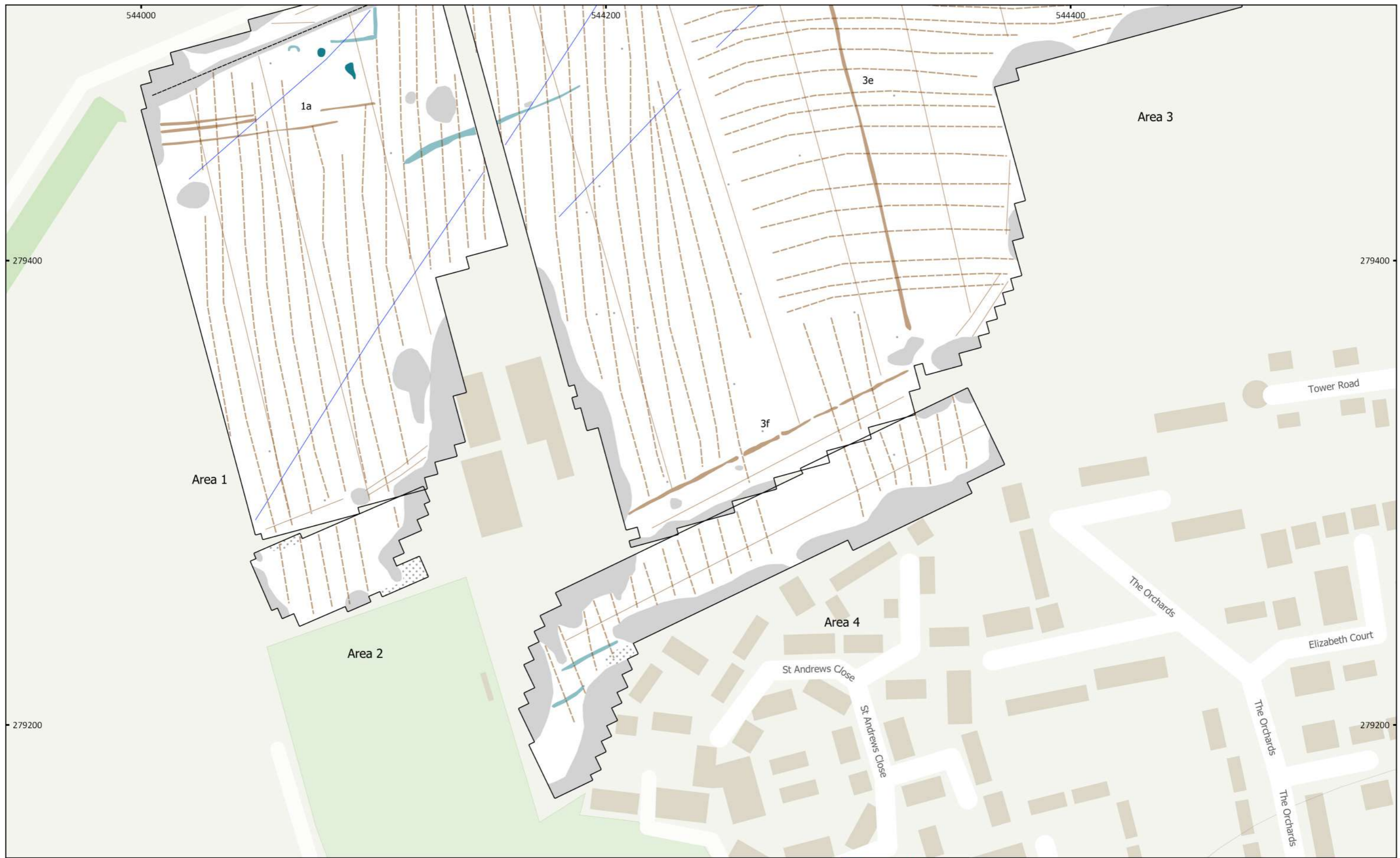
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 Figure 7 - XY Trace Plot (Areas 1 and 3)
 90nT/cm at 1:1,500 @ A3
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 Figure 8 - Magnetic Gradient (Areas 1, 2, 3 and 4)
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 Figure 9 - Magnetic Interpretation (Areas 1, 2, 3 and 4)
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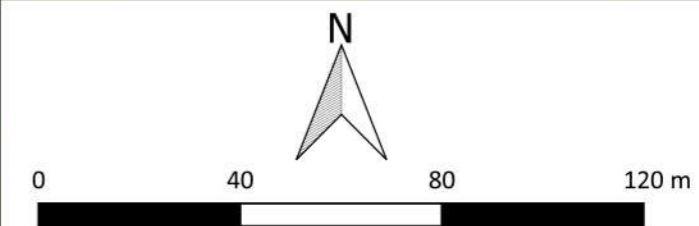
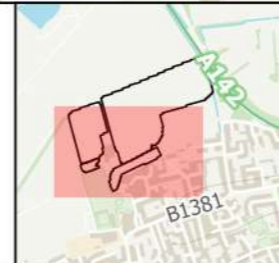
Agricultural (Weak)	Undetermined (Strong)	Ridge and Furrow (Trend)
Magnetic Disturbance	Undetermined (Weak)	Drainage Feature
Ferrous/Debris (Spread)	Agricultural (Trend)	Ferrous (Spike)
Service		



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 Figure 10 - XY Trace Plot (Areas 1, 2, 3 and 4)
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