



**magnitude**  
surveys

**Geophysical Survey Report  
of  
Farm Lane, Cheltenham**

**For  
Oxford Archaeology**

**On Behalf Of**

**Magnitude Surveys Ref: MSSO490**

**May 2019**



# magnitude surveys

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Draft 1.2	Corrections from line manager	Freddie Salmon BSc FGS	Freddie Salmon BSc FGS	Leanne Swinbank BA ACifA	24 May 2019
Draft 1.3	Corrections from project manager	Leanne Swinbank BA ACifA	Leanne Swinbank BA ACifA	Finnegan Pope- Carter BSc (Hons) MSc FGS	24 May 2019

## Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 5.5ha area of land off Farm Lane, Cheltenham. A fluxgate magnetometer survey was successfully completed across the site. All three survey areas within the site exhibit anomalies of probable or possible archaeological activity. A number of curvilinear anomalies in the north, have been classified as possible archaeology, however, they do not form a coherent archaeological pattern. The overlapping and intersecting of these anomalies may indicate a multiphase area of activity. An unmapped sunken driveway has been detected along the northern edge of Area 3, correlating to a topographic depression in the same area. Soil slip and erosion processes resulting from the extraction of sediment during the construction of the Driveway have resulted in amorphous natural anomalies surrounding the Driveway feature. Further, a possible un-mapped former field system along with varying orientations of ridge and furrow cultivation to the north, indicate widespread, continual agricultural activity.

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## 1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by Oxford Archaeology to undertake a geophysical survey on a c. 5.5ha area of land Farm Lane, Cheltenham, Gloucestershire (SO 937 198).
- 1.2. The geophysical survey comprised hand-pulled, cart-mounted and hand-carried GNSS-positioned fluxgate magnetometer survey.
- 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, 2014) and the European Archaeological Council (Schmidt et al., 2015).
- 1.4. Survey was conducted in line with a Written Scheme of Investigation written by Magnitude Surveys (2019).
- 1.5. The survey commenced on 02/05/19. Due to the presence of livestock on this date a second visit was made, with survey re-commencing 22/05/19 taking a total of 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 of Archaeological Prospection).
- 2.2. Director Dr. Chrys Harris is a Member of CIfA, has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of ISAP. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Reporting Analyst Dr. Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is the Vice Conference Secretary and Editor of ISAP News for ISAP, and is the UK Management Committee representative for the COST Action SAGA.
- 2.3. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

## 3. Objectives

- 3.1. The geophysical survey aimed to assess the subsurface archaeological potential of the survey area.

## 4. Geographic Background

4.1. The site is located c. 0.5km south-west of Leckhampton and c. 3km south-west of the centre of Cheltenham (Figure 1). Survey was undertaken across three fields, bounded by Farm Lane, a house and a field to the west, Kidnappers Lane to the north, residential housing to the east, and further fields to the south (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Scrubland. Sloping gently down from east to west in the south of the area, and a slope north to south in the north-east corner.	Bounded by trees on all sides, with a ditch running along the eastern boundary. A metal gate and shed were present in the south-west corner, with a further metal gate on the southern boundary.
2	Pasture. Short, grazed grassland. Gentle downward slope eastwards c.50m from eastern boundary.	Bounded by an electric fence to the north, east, south and west. A metal gateway was noted to the south-west of this area.
3	Scrubland. A slight depression around the north and east of the site. Areas of unsurveyable brambles around the boundaries of the site.	Bounded by a metal fence to the north and west, and a treeline to the east and south, with a ditch running along the eastern boundary. A compound of buildings was situated in the north-eastern corner of the survey area.

4.3. The site is located over an interbedded Jurassic mudstone bedrock, part of the Charmouth mudstone formation (British Geological Survey, 2019). Formed in a shallow shelf-sea environment a partial carbonate content locates within the upper to mid layers of this bedding feature. Superficial deposits surrounding the survey area identify quartz rich river terrace deposits remaining from previous flooding events of nearby waterways. Overlaid by a lime-rich loamy and clayey soil with impeded drainage (Soilscapes, 2019).

## 5. Archaeological Background

5.1. The following section provides a summary of the Desk- Based Assessment (DBA) (Hunter,2001), and a previous excavation report (Oxford Archaeology, 2015) both provided by Oxford Archaeology.

5.2. Evidence for the Prehistoric period includes a Bronze Age beaker found c. 740m to the east of the survey area.

5.3. A prior watching brief identified Roman pottery sherds, coins, a brooch and a ring c. 620m to the east of the survey area, along with two possible ditches or pits and a possible line of stones which may have been the remains of a wall.

5.4. Medieval activity includes a moated site and fish ponds of Scheduled Monument 32363 c. 250m to the south-east of the survey area. Excavations in the 1930's revealed that the site was occupied from the 12<sup>th</sup> to the 16<sup>th</sup> Centuries. An earthwork complex was identified c. 500m to the south-east of the survey area and has been interpreted as boundaries of fields or the manor

grounds. Leckhampton Court is a Grade II listed building containing a 14<sup>th</sup> Century hall and doorway and is located c. 700m south-east from the survey area.

- 5.5. An excavation was conducted c. 60m to the east of Area 3 and identified a number of areas of activity dating to the Iron Age and Roman periods, with pottery suggesting use of the site dating to between the 1<sup>st</sup> Century BC and the 3<sup>rd</sup> Century BC.
- 5.6. Evidence for Prehistoric activity included a small flint scatter, dating to the late Mesolithic, and a large oval enclosure, probably Bronze Age in date, both identified to the north of the excavation area. A possible cremation discovered near to these may also be Bronze Age in date.
- 5.7. An enclosure of probable late Iron Age date, along with a number of ditches and smaller enclosures that are thought to be from the early Roman period were identified toward the centre of the excavation area. Large amounts of Roman pottery were also discovered. A number of Roman agricultural boundaries were identified, along with a group of three burials, thought to date to the 1<sup>st</sup> or 2<sup>nd</sup> Century AD. Two roundhouses were also identified in the north, along with a large granary structure. Relatively high-status copper alloy finds from the 1<sup>st</sup> and 2<sup>nd</sup> Century AD, were recovered to the south-east of the excavation area. Four burials were discovered in the same area, with three buried in a fully crouched position, all dating to the mid-1<sup>st</sup> Century AD.
- 5.8. A ditched enclosure from the 10<sup>th</sup> or 11<sup>th</sup> Century was identified to the north of the excavation area. Remnants of medieval ridge and furrow were also identified across much of the excavation area.

## 6. Methodology

### 6.1. Data Collection

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

6.1.2. 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

6.1.3. The magnetic data were collected using MS' bespoke hand-pulled cart system and hand-carried GNSS-positioned system.

- 6.1.3.1. 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.

- 6.1.3.2. 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.
- 6.1.3.3. 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 Historic England's standards for "raw or minimally processed data" (see sect 4.2 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 upper and/or 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 at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figures 8 & 11). XY trace plots visualise the magnitude and form of the geophysical response, aiding in 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, historic maps, LiDAR data, and soil and geology maps. Google Earth (2019) was consulted as well, to compare the results with recent land usages.

- 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 will be 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 of further work in order to constantly improve our knowledge and service.

### 7.2. Discussion

7.2.1. The geophysical results are presented in consideration with contours (Figure 4), historic maps (Figure 5) and XY Traces (Figures 8 & 11).

7.2.2. The fluxgate magnetometer survey has responded well to the survey area's environment and survey was completed across three fields (see 4.2). The site is characterised by a relatively quiet natural background. Area 1 exhibits a much more widespread natural variation compared to both Areas 2 and 3. Resulting from the seasonal flooding of Hatherley Brook; deposition of a predominantly sand and gravel river terrace deposit provides a less enhanced superficial layer. Hatherley Brook is subducted below the surface adjacent to Area 1, meaning any less magnetically enhanced flood water deposits are confined to Areas 2 & 3 within site. Magnetic disturbance from modern sources is mostly limited to the western boundaries (Figures 8 & 11) of site, produced by fencing on the perimeter of the field. Ferrous spread anomalies, often representing modern debris are associated with a 20th century path located at the north-eastern end of Area 1 (see 7.3.2.4) and also with ground levelling activities following the removal of a number of trees in the eastern half of Area 1 (1954-1974 OS County series map) and across Area 3 (Google Satellite imagery 2007).

7.2.3. Anomalies of both possible and probable archaeological origin have been identified throughout the survey area. A potential driveway has been identified to the northeast of Area 3, corresponding to a topographical depression in the survey area's landscape. Surrounded by a number of amorphous natural anomalies it is possible that the excavation during the construction of the driveway caused the erosion of the soils surrounding the feature.

7.2.4. Throughout Area 2, a number of positively enhanced linear anomalies have been identified, together these form a rectilinear system possibly reflecting a former field

system. None of the anomalies identified correlate with field boundaries recorded on historic maps, it is therefore likely that the detected field system predates available mapping. The magnetic signal of the anomalies become weaker and more ephemeral further east in Area 2, making the identification of their full extent and layout more difficult.

7.2.5. Two ephemeral anomalies within Area 2 have been classed as being of possible archaeological origin. Despite their proximity to areas of probable archaeology, the weaker magnetic signal strength and relative isolation makes the classification of these anomalies more difficult. Additional anomalies of possible archaeological origin have been detected in Area 1, with a range of magnetic enhancements. While the anomalies in Area 1 are grouped within the western half of the area they do not form a coherent pattern, unlike the field system in Area 2. Instead, the anomalies appear to overlap and intersect suggesting different phases of anthropogenic activity.

7.2.6. Widespread ridge and furrow cultivation trends have been noted throughout the site. Overlapping alignments of these trends indicates a shift in field layout overtime, with some correlating closely to former field boundaries, identified on historic mapping figures (Figure 5).

## 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. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures along the edges of the field have been classified as ‘Magnetic Disturbance’. These magnetic ‘haloes’ will obscure the response of any weaker underlying features, should they be present, often over a greater footprint than the structure they are being caused by.
- 7.3.1.3. **Ferrous (Spike)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of isolated modern metallic debris on or near the ground surface.
- 7.3.1.4. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentrated deposition of discrete, dipolar ferrous anomalies and other highly magnetic material.
- 7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant 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 not ferrous in nature.

### 7.3.2. Magnetic Results - Specific Anomalies

- 7.3.2.1. **Archaeology Probable** - A single, broad negatively enhanced anomaly has been identified in the northeast corner of Area 3, [3a] (Figure 10). Measuring c.74m long, on a general northwest–southeast orientation and c.5m wide, this probable driveway feature corresponds directly with a depression in the site’s topography. Surrounding nearby natural disturbance [3b] has resulted from soil slip and erosion caused by the loosely compacted sand and gravel geology on the banking of the driveway.
- 7.3.2.2. **Archaeology Probable** – A series of linear anomalies extend eastwards from the northwest corner of Area 2, together these form a long linear anomaly, [2a] c.120m in length, with abutting extensions extending north towards Area 1, [2b], c.20m in length. The anomalies within Area 2 may form a rectilinear former field system. Additional fragmented anomalies abutting the south of [2a] may represent a small livestock enclosure, [2c], measuring c.13m x 6m, which has been fragmented by subsequent ridge and furrow cultivation.
- 7.3.2.3. **Archaeology Possible** –To the south of Area 1 a number of overlapping linear anomalies [1a, 1b, 1c & 1d] have been identified. A linear anomaly, [1a] has been detected in the west of Area 1, oriented on a north-south alignment measuring 57m in length. A separate linear anomaly [1b], c.30m west of [1a], shares a similar alignment and has a more greatly enhanced positive magnetic signature (Figure 6 & 7). Adjoining the east of [1b], a discontinuous possible enclosure, [1c], measures c.14m x 23m. A second discontinuous curvilinear anomaly [1d] intersects [1c] to the north. Together these anomalies form a grouping of anthropogenic features, the origins of which are unclear. However, the magnetic signals have the positive, continuous form typical of ditch anomalies.
- 7.3.2.4. **Archaeology Possible** – Two ephemeral, curvilinear anomalies within Area 2, [2d & 2e], (Figure 7) have been detected with only slightly increased enhancement than the quiet natural background. Approximately 12m from the eastern boundary of Area 2 a curvilinear anomaly [2d] measures c. 5m in width, and 8m in length, contained within the curve of [2d], a single pit-like feature measuring c. 3m. A much larger curvilinear anomaly [2e] has been identified approximately 65m south west of [2d]. Open sided on its eastern face the anomaly measures c.18m from north to south. The ephemeral nature of these anomalies makes any clear relationship to nearby boundary or enclosure features difficult to determine.
- 7.3.2.5. **Ferrous/Debris (Spread)** – An elongated highly ferrous anomaly identified in the north east of Area 1 relating to a former trackway (1923 OS County series: Gloucestershire.) through the site oriented along a general north – south alignment, measures approximately 93m long. Scattered enhancement has occurred from the removal of this pathway and any possible detritus relating from its usage during the 20<sup>th</sup> century.

## 8. Conclusions

- 8.1. A fluxgate gradiometer survey has been successfully undertaken across the site identifying anomalies of both probable and possible archaeological origin. Widespread agricultural activity has also been identified, continuing across numerous survey areas within the site. Multiple phases of ridge and furrow cultivation, on differing alignments suggests long and continuous agricultural utilisation of the land.
- 8.2. Within Area 3, a topographic depression coincides with the location of negatively enhanced anomalies, indicating the potential location of a droveway feature. The construction of associated banking has resulted in the development of an area of natural disturbance around the droveway.
- 8.3. In the north of site, a number of overlapping positively enhanced linear anomalies indicate a possible multiphases area of activity within the site; although very weak, these linear anomalies appear to extend southwards into Area 2. Within Area 2, the anomalies form a more coherent former field system with an adjoining possible livestock enclosure. Two very weak curvilinear anomalies of possible archaeological origin have been detected in Area 2, the magnetic signal of these anomalies is difficult to discern from the surrounding natural background. Despite this a possible archaeological origin has been interpreted from the form and orientation when compared to nearby archaeological and agricultural features.
- 8.4. Positively enhanced, isolated ferrous anomalies correlate to the removal of trees within Area 1 during the 20<sup>th</sup> century, occurring at in the same period as the removal of a trackway running from north to south through Area 1 a resulting widespread magnetic disturbance has been identified proximal to the eastern boundary of the survey area.

## 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 the any dictated time embargoes.

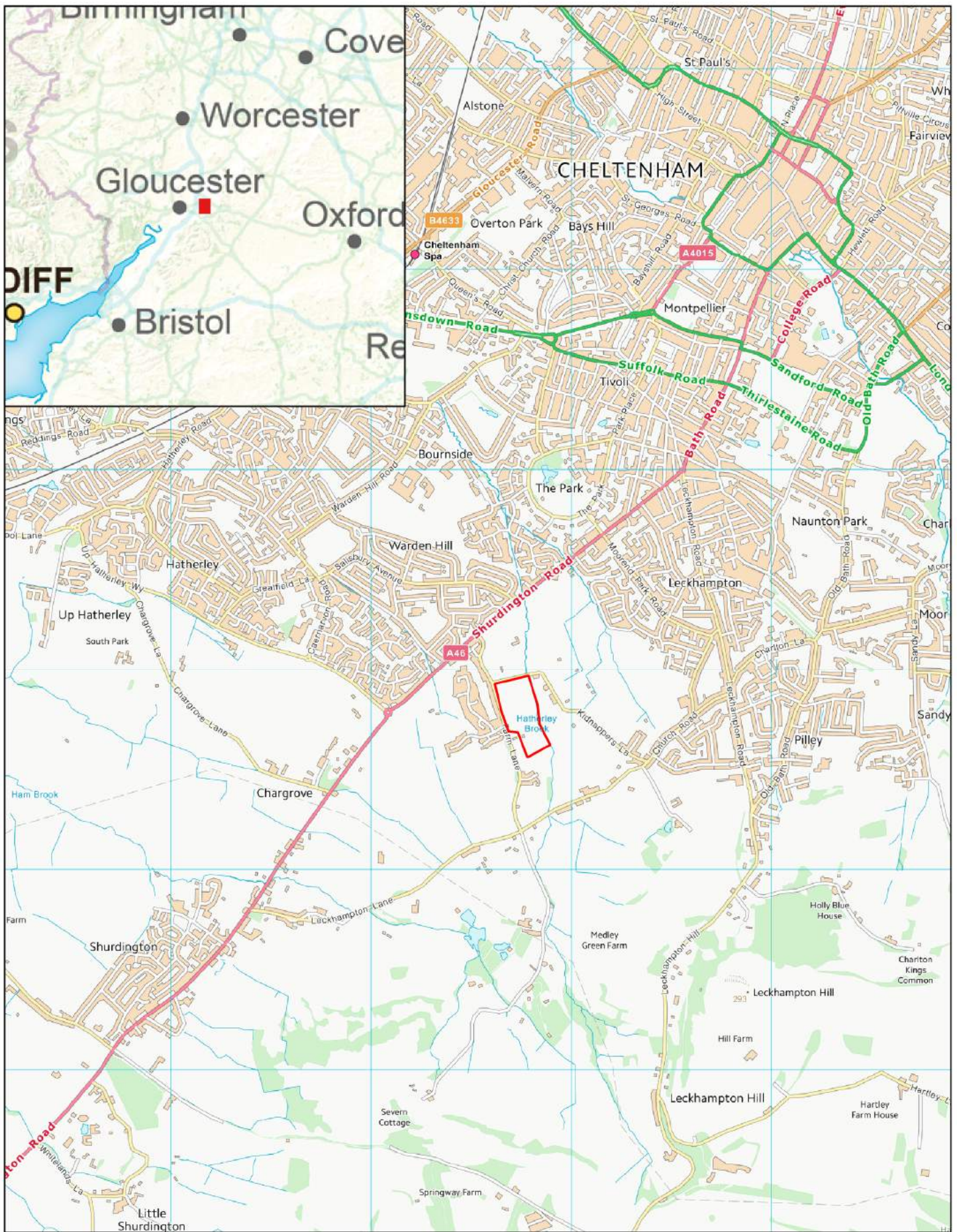
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- 10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be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

## 11. References

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MISO490 - Farm Lane, Cheltenham

Figure 1 - Site Location

1:25,000 @ A4

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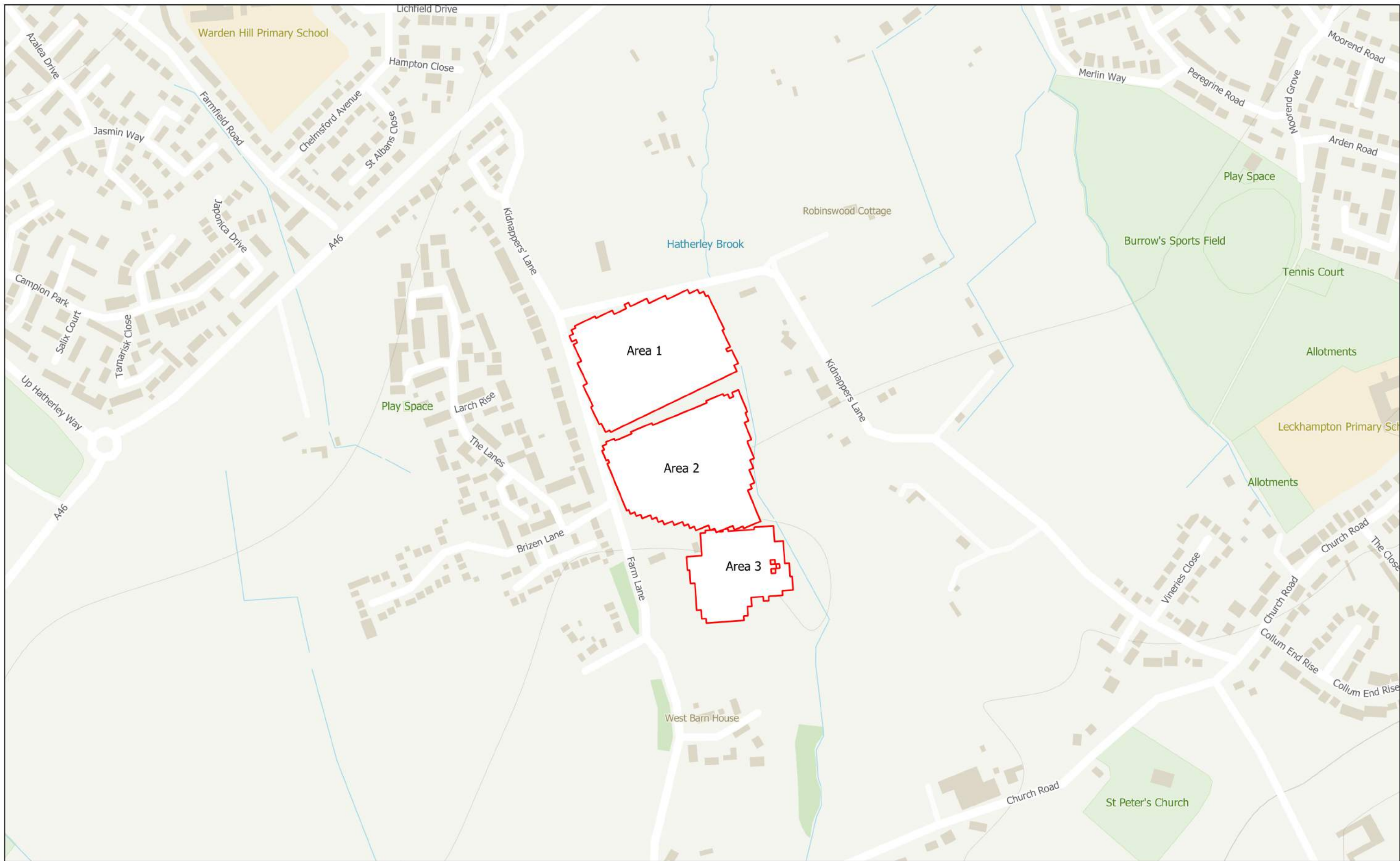
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 Site Boundary



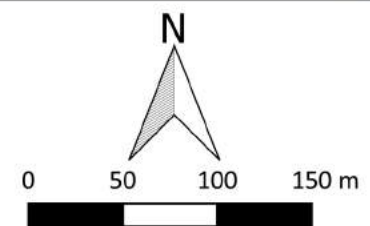
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MSSO490 - Farm Lane, Cheltenham  
 Figure 2 - Location of Survey Areas  
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 Survey Extent

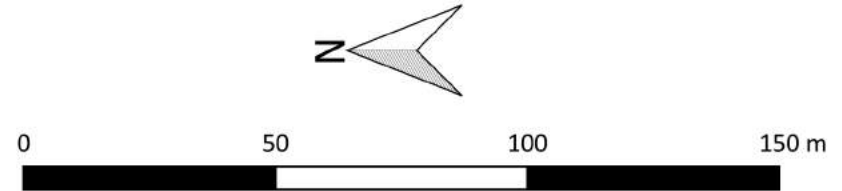
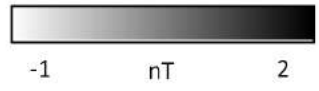


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MSSO490 - Farm Lane, Cheltenham  
Figure 3 - Magnetic Gradient  
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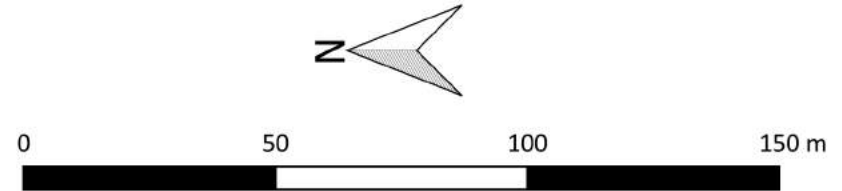
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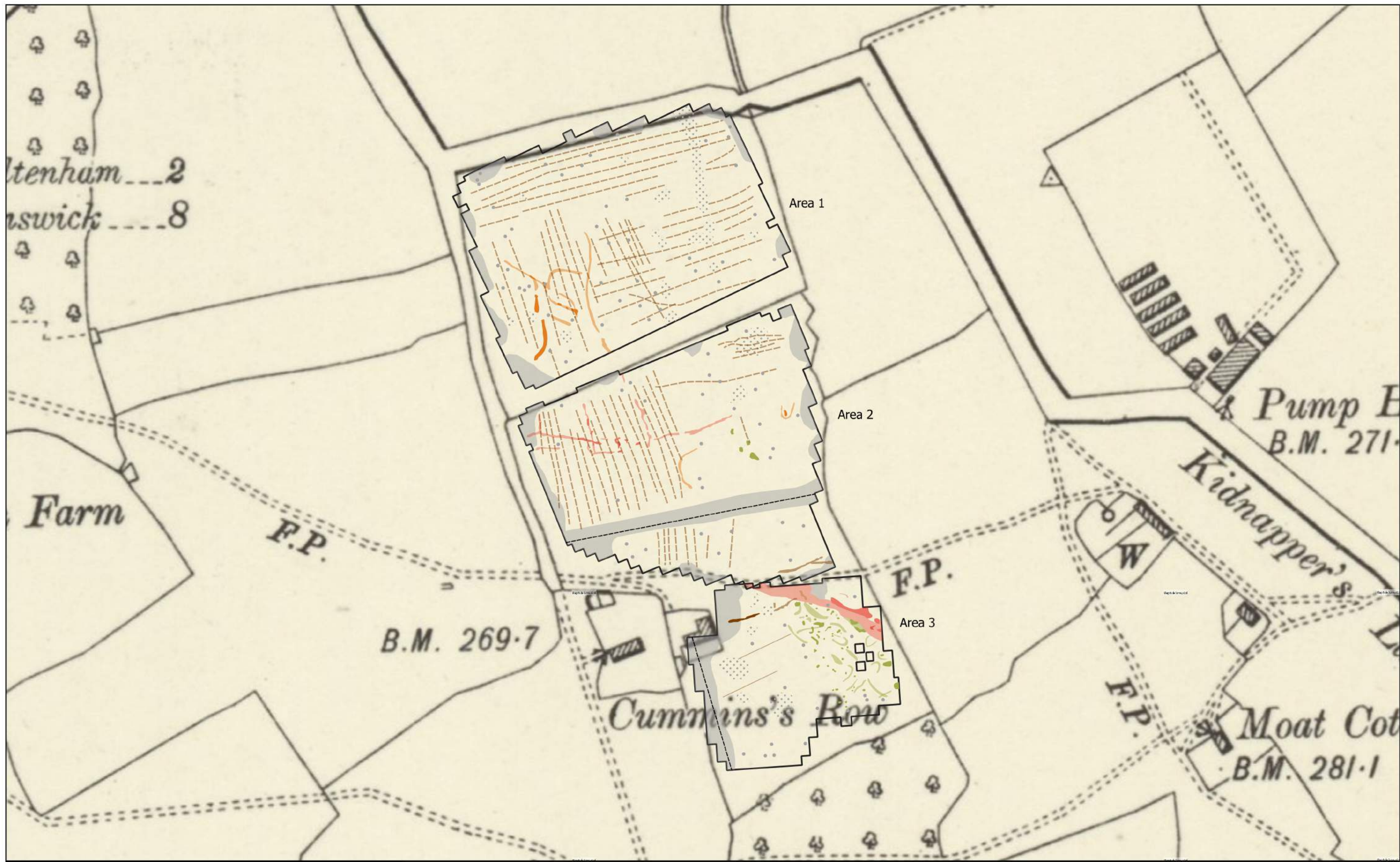


MSSO490 - Farm Lane, Cheltenham  
 Figure 4 - Magnetic Interpretation with contours  
 1:1,500 @ A3  
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- |                                 |                              |                    |
|---------------------------------|------------------------------|--------------------|
| ■ Archaeology Probable (Strong) | --- Ridge and Furrow (Trend) | ■ Natural (Strong) |
| ■ Archaeology Probable (Weak)   | --- Agricultural (Trend)     | ■ Natural (Weak)   |
| ■ Archaeology Possible (Strong) | ■ Magnetic Disturbance       |                    |
| ■ Archaeology Possible (Weak)   | ● Ferrous/Debris (Spread)    |                    |
| ■ Agricultural (Strong)         | ● interpretation_point       |                    |
| ■ Agricultural (Weak)           | --- Service                  |                    |

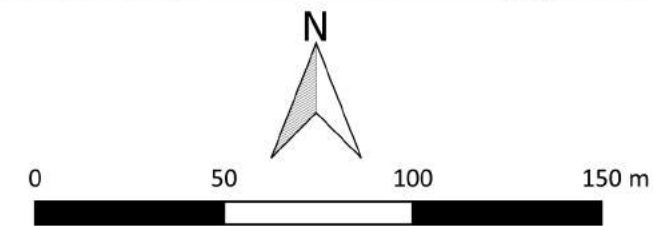






MSSO490 - Farm Lane, Cheltenham  
 Figure 5 - Magnetic Interpretation Over Historic Mapping (Overview)  
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 Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 ©  
 National Library of Scotland

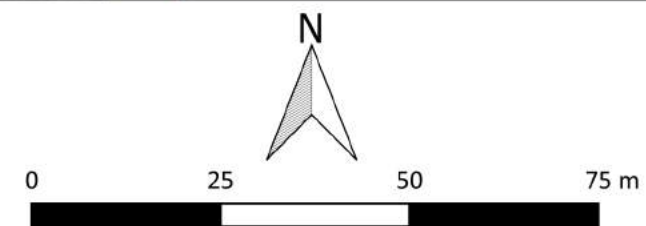
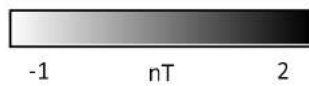
- |                                 |                              |                    |
|---------------------------------|------------------------------|--------------------|
| ■ Archaeology Probable (Strong) | --- Ridge and Furrow (Trend) | ■ Natural (Strong) |
| ■ Archaeology Probable (Weak)   | --- Agricultural (Trend)     | ■ Natural (Weak)   |
| ■ Archaeology Possible (Strong) | ■ Magnetic Disturbance       |                    |
| ■ Archaeology Possible (Weak)   | ● Ferrous/Debris (Spread)    |                    |
| ■ Agricultural (Strong)         | ● interpretation_point       |                    |
| ■ Agricultural (Weak)           | --- Service                  |                    |







MSSO490 - Farm Lane, Cheltenham  
Figure 6 - (North) Magnetic Greyscale  
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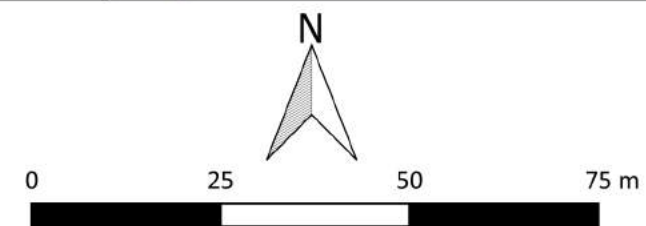




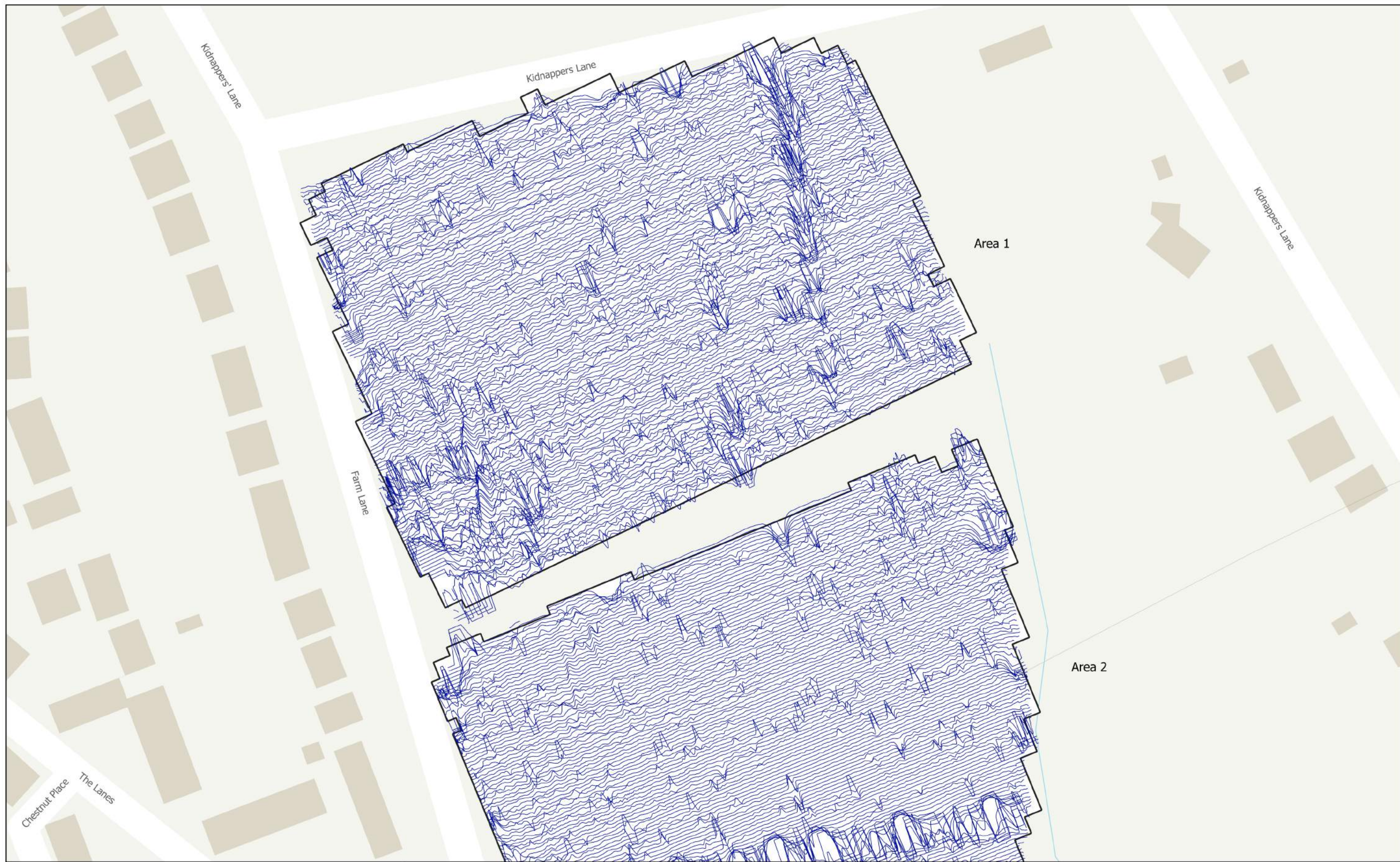


MSSO490 - Farm Lane, Cheltenham  
 Figure 7 - (North) Magnetic Interpretation  
 1:1,000 @ A3  
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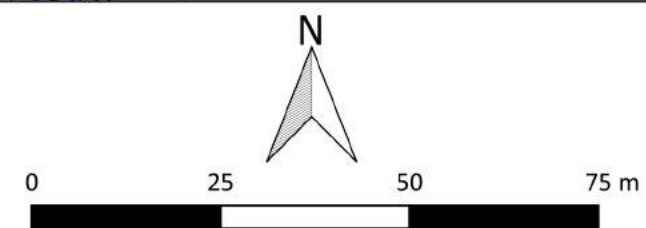
- |                                 |                              |                        |
|---------------------------------|------------------------------|------------------------|
| ■ Archaeology Probable (Strong) | --- Ridge and Furrow (Trend) | --- Service            |
| ■ Archaeology Probable (Weak)   | ■ Magnetic Disturbance       | ■ Natural (Strong)     |
| ■ Archaeology Possible (Strong) | ● Ferrous/Debris (Spread)    | ● interpretation_point |
| ■ Archaeology Possible (Weak)   |                              |                        |







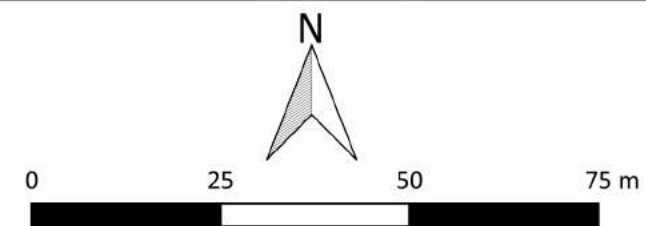
MSSO490 - Farm Lane, Cheltenham  
Figure 8 - (North) XY Trace plot  
20nT/cm at 1:1,000 @ A3  
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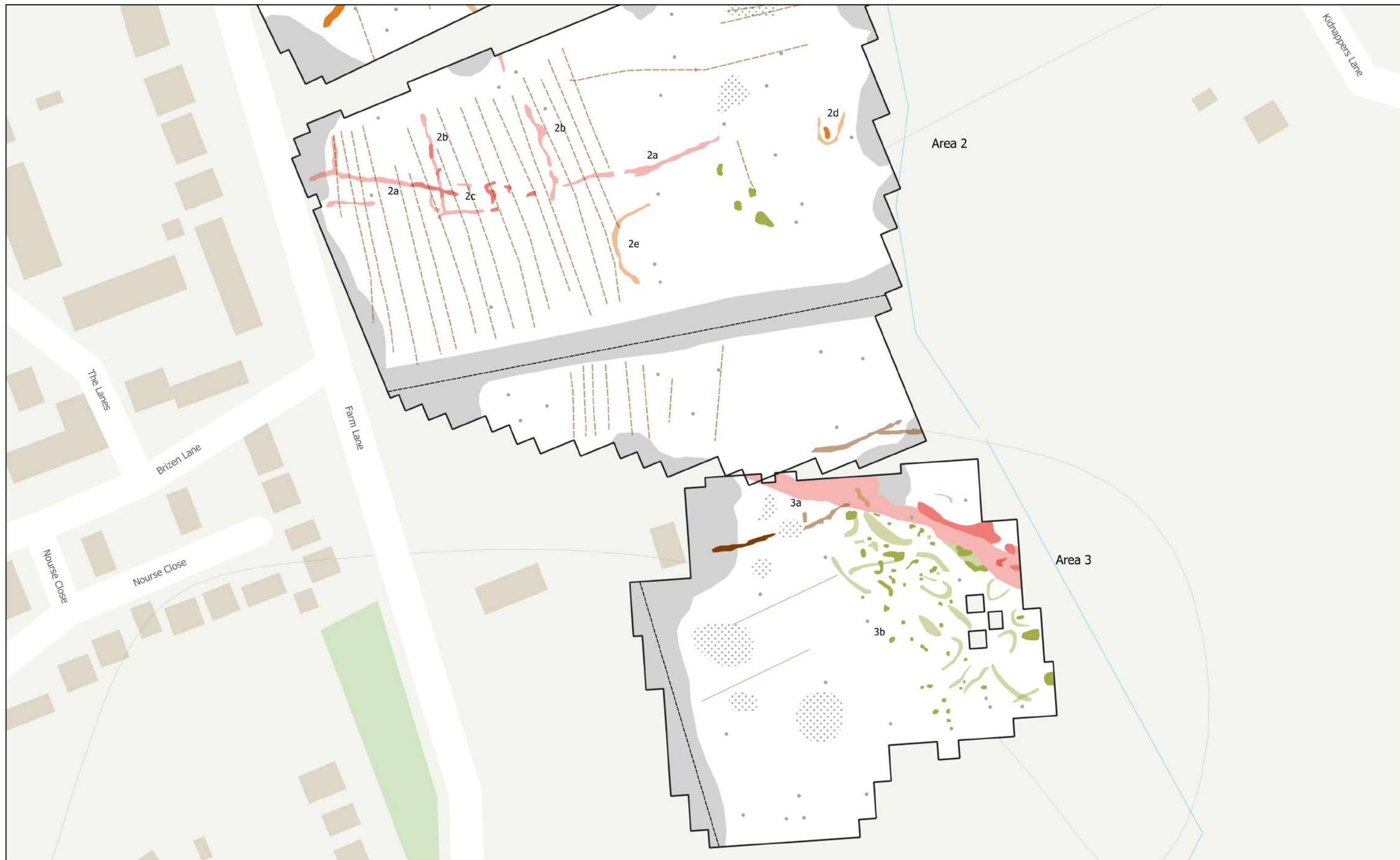




MSSO490 - Farm Lane, Cheltenham  
Figure 9 - (South) Magnetic Greyscale  
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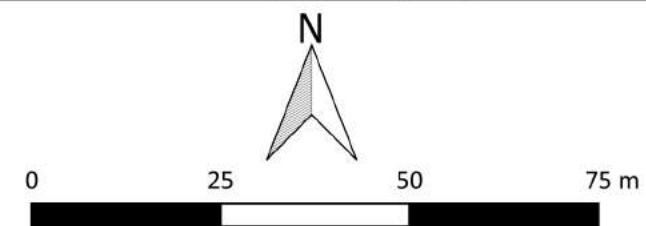




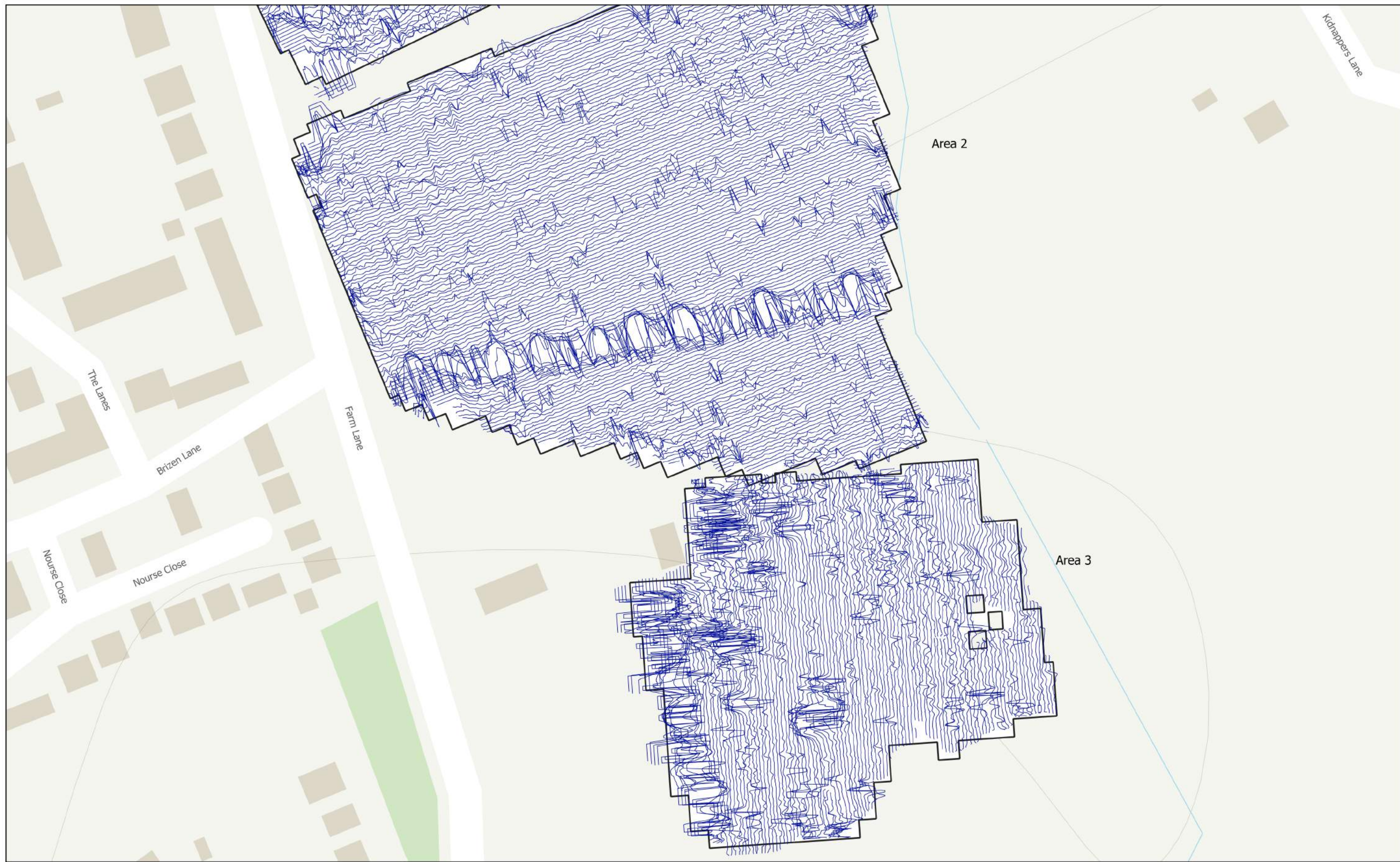


MSSO490 - Farm Lane, Cheltenham  
 Figure 10 - (South) Magnetic Interpretation  
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- |                                 |                              |                    |
|---------------------------------|------------------------------|--------------------|
| ■ Archaeology Probable (Strong) | --- Ridge and Furrow (Trend) | ■ Natural (Strong) |
| ■ Archaeology Probable (Weak)   | --- Agricultural (Trend)     | ■ Natural (Weak)   |
| ■ Archaeology Possible (Strong) | ■ Magnetic Disturbance       |                    |
| ■ Archaeology Possible (Weak)   | ● Ferrous/Debris (Spread)    |                    |
| ■ Agricultural (Strong)         | ● interpretation_point       |                    |
| ■ Agricultural (Weak)           | --- Service                  |                    |







MSSO490 - Farm Lane, Cheltenham  
Figure 11 - (South) XY Trace plot  
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