



**magnitude
surveys**

Geophysical Survey Report

**of
Land at Leicester Lane, Desford
Leicester**

**For
RPS Consulting**

Magnitude Surveys Ref: MSSK1884

HER No: TBA

OASIS No: magnitud1-528627

October 2024



**magnitude
surveys**

3 Captain Street

Bradford

BD1 4HA

01274 926020

info@magnitudesurveys.co.uk

Report By:

Daniel Wilkinson BA (Hons)

Report Approved By:

Dr Paul S. Johnson FSA MCIfA

Issue Date:

09 October 2024

Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of c. 3.7ha of land at Desford, Leicester. A magnetometer survey was undertaken, green waste or similar scattered ferrous debris was present across the majority of the survey area, inhibiting the identification of other anomalies. No anomalies suggestive of archaeological activity were identified. Agricultural trends associated with modern ploughing regimes and drainage systems were recorded. Modern interference is also present along the edges of the survey area, caused by standing buildings and a trackway.

Contents

Abstract.....	2
List of Figures	4
1. Introduction	5
2. Quality Assurance	5
3. Objectives.....	5
4. Geographic Background.....	6
5. Archaeological Background.....	6
6. Methodology.....	7
6.1. Data Collection	7
6.2. Data Processing	7
6.3. Data Visualisation and Interpretation	8
7. Results.....	9
7.1. Qualification	9
7.2. Discussion	9
7.3. Interpretation	9
7.3.1. General Statements	9
7.3.2. Magnetic Results - Specific Anomalies.....	10
8. Conclusions	10
9. Archiving	10
10. Copyright.....	10
11. References	11
12. Project Metadata	12
13. Document History.....	12

List of Figures

Figure 1:	Geophysical Survey Location	1:25,000 @ A4
Figure 2:	Geophysical Survey Area	1:5,000 @ A3
Figure 3:	Magnetic Total Field (Lower Sensor)	1:1,500 @ A3
Figure 4:	Magnetic Gradient	1:1,500 @ A3
Figure 5:	Magnetic Interpretation	1:1,500 @ A3
Figure 6:	XY Trace Plot	1:1,500 @ A3
Figure 7:	Magnetic Interpretation Over Combined Historical Maps and Satellite Imagery	1:3,000 @ A3
Figure 8:	GNSS Trace Plot	1:1,500 @ A3

1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS Consulting to undertake a geophysical survey over a c. 3.7ha area of land at Desford, Leicester (SK 48647 03723).
- 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 (Curtis, 2024).
- 1.5. The survey commenced 20/09/2024 and was completed the same day.

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 has served as 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 Chair of the Archaeological Prospection Community 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. 800m southwest from the centre of Desford (Figure 1). A gradiometer survey was undertaken across an arable field. The survey area was bordered to the north and west by housing and to the east and south by arable fields (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The area consisted of an arable field containing cereal crop stubble, sloping down from the west to the east. A deep trough was located within the northeastern corner of the survey area and could not be surveyed.	The survey area was bordered to the north and west by hedges and a metal fence, to the east by trees and to the south by an embankment.

4.3. The underlying geology comprises mudstone of the Gunthorpe Member across the majority of the survey area, with sandstone of the Cotgrave Member within the northwestern corner of the survey area. No superficial deposits have been recorded within the survey area. (British Geological Survey, 2024).

4.4. The soils consist of slightly acid loamy and clayey soils with impeded drainage (Soilscapes, 2024).

5. Archaeological Background

5.1. The following is a summary of a heritage statement produced and provided The RPS Group (Behrendt, 2024).

5.2. A geophysical survey, trial trenching and excavation was conducted, adjacent to the southwest of the survey area. A single, very abraded sherd of a possible Late Neolithic or Bronze Age date was identified in a pit (MLE25694). The heavily abraded condition of the pottery may indicate this to be a residual find, rather than in-situ. An early Bronze Age thumbnail scraper and piercer (MLE9266) was found during trial trenching c. 600m southwest of the survey area.

5.3. A Roman occupation site originating in the Late Iron Age comprising pits, ditches and intercutting features as well as pottery (mostly dating to the Roman period) is recorded c. 500m in an unspecified location through trenching. Another Roman site and enclosure (MLE2721 and MLE2727) are located c. 700 – 800m east of the survey area and two pottery kilns (MLE2742) were found c. 850m southwest of the survey area.

5.4. The 1886 OS map shows the site as part of a larger, irregular shaped field, with the western and southern site boundaries established. The 1916 map shows a small enclosure within the east of the survey area containing two tanks. The enclosure containing the tanks was removed after 1994. However, the tanks appear to be located within the eastern edge of the survey area based on LiDAR imagery provided within the DBA. They were not observed during the recent site visit and are not visible on satellite imagery.

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 (2024) was also consulted, to compare the results with recent land use.

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. The fluxgate gradiometer survey was conducted over the entirety of the survey area and detected scattered, dipolar noise likely related to greenwaste fertilisation. The presence of this noise has resulted in reduced confidence in the visibility of any anomalies resulting from any other features that may be present. The geophysical survey is characterised by this disturbance, although anomalies of a modern agricultural origin were discernable. Magnetic disturbance was identified along the edges of the field, caused by extant buildings and a trackway.

7.2.3. Anomalies indicative of modern agricultural practices were recorded throughout the survey area and correspond with modern ploughing regimes and drainage systems (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. **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.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural (Trends)** – Weakly enhanced, linear anomalies were recorded throughout the survey area, a representative sample of which have been drawn (Figure 5). These trends run on multiple different orientations, indicative of opposing modern ploughing regimes which are noted in previous satellite images (Google Earth Pro, 2024).

7.3.2.2. **Drainage Systems** – Several linear anomalies exhibiting a weakly enhanced, dipolar magnetic signal have been detected and interpreted as ceramic drainage features (Figure 5).

8. Conclusions

- 8.1. A fluxgate gradiometer survey was successfully completed across the survey area. The survey identified scattered greenwaste across the entirety of the survey area. This has reduced confidence in the ability of the survey to discern anomalies relating to any subsurface features that may be present. Despite this, anomalies of a modern agricultural origin were identified. Modern interference was also caused by the edges of the survey area by extant buildings and a trackway.
- 8.2. Modern agricultural practices were detected across the survey area as linear anomalies related to modern ploughing trends and drainage systems.

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

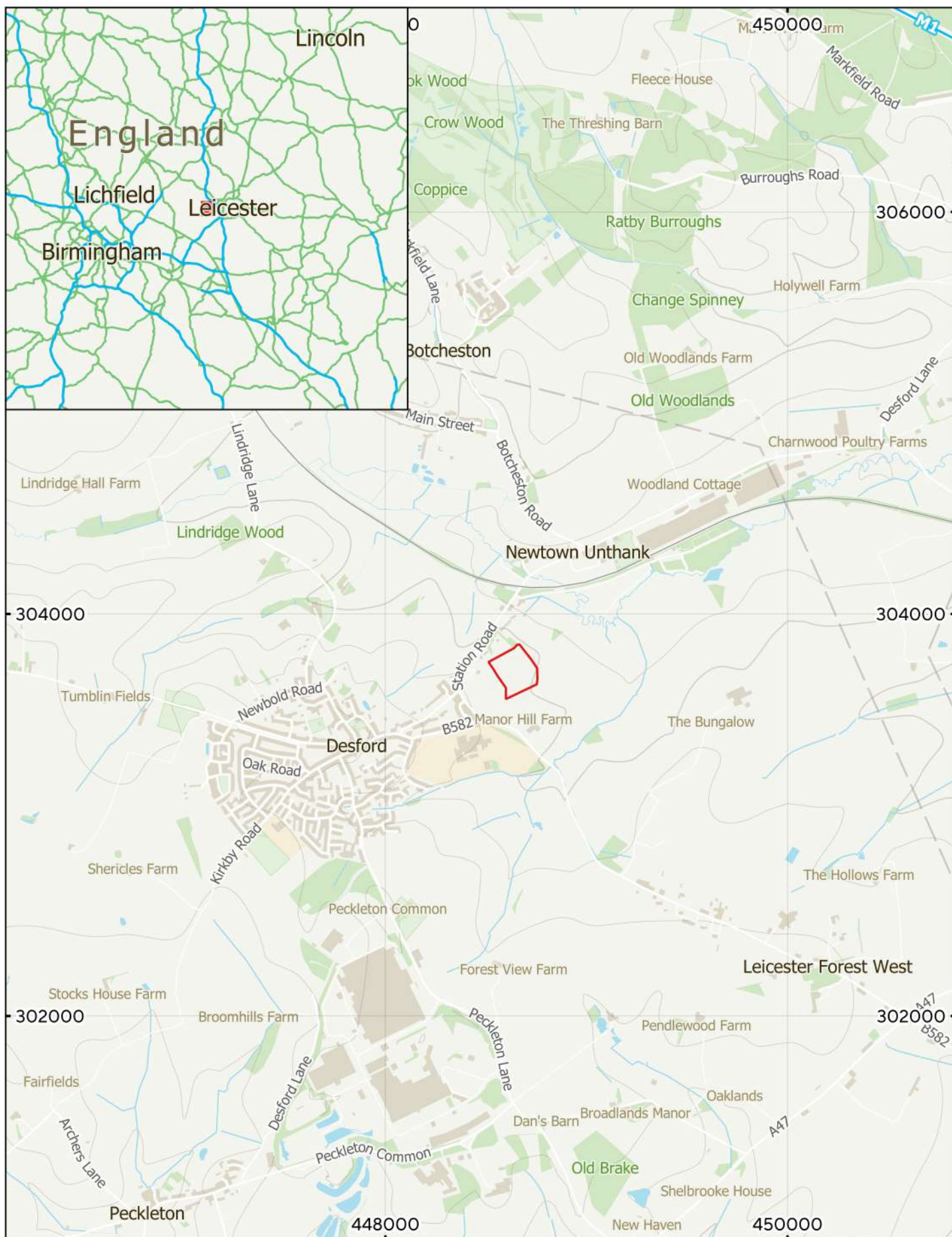
- Behrendt, A. 2024. Heritage Statement: Leicester Lane, Desford, Leicestershire. RPS Group.
- British Geological Survey, 2024. Geology of Britain. Desford, Leicester.
[<http://mapapps.bgs.ac.uk/geologyofbritain/home.html/>]. Accessed 20/09/2024.
- Chartered Institute for Archaeologists, 2020. Standards and guidance for archaeological geophysical survey. ClfA.
- Curtis, H., 2024. Written Scheme of Investigation for a Geophysical Survey of Desford, Leicester. Magnitude Surveys.
- David, A., Linford, N., Linford, P. and Martin, L., 2008. Geophysical survey in archaeological field evaluation: research and professional services guidelines (2nd edition). Historic England.
- Google Earth, 2024. Google Earth Pro V 7.1.7.2606.
- Olsen, N., Toffner-Clausen, L., Sabaka, T.J., Brauer, P., Merayo, J.M.G., Jorgensen, J.L., Leger, J.M., Nielsen, O.V., Primdahl, F., and Risbo, T., 2003. Calibration of the Orsted vector magnetometer. Earth Planets Space 55: 11-18.
- Schmidt, A. and Ernenwein, E., 2013. Guide to good practice: geophysical data in archaeology (2nd edition). Oxbow Books: Oxford.
- Schmidt, A., Linford, P., Linford, N., David, A., Gaffney, C., Sarris, A. and Fassbinder, J., 2015. Guidelines for the use of geophysics in archaeology: questions to ask and points to consider. EAC Guidelines 2. European Archaeological Council: Belgium.
- Soilscapes, 2024. Desford, Leicester. Cranfield University, National Soil Resources Institute.
[<http://landis.org.uk>]. Accessed 20/09/2024.

12. Project Metadata

MS Job Code	MSSK1884
Project Name	Desford, Leicester
Client	RPS Consulting
Grid Reference	SK 48647 03723
Survey Techniques	Magnetometry
Survey Size (ha)	3.7ha (Magnetometry)
Survey Dates	2024-09-20
Project Lead	Daniel Wilkinson BA (Hons)
Project Officer	Daniel Wilkinson BA (Hons)
HER Event No	TBA
OASIS No	Magnitud1-528627
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	HR	DW	20 September 2024
0.2	Secondary draft following Director Review	DW	PSJ	26 September 2024
0.3	Third draft following Director Review	DW	PSJ	26 September 2024
0.4	Fourth draft following Client Corrections	IT, IC	PSJ	4 October 2024
1.0	Final draft issued	DW	KD	9 October 2024



MSSK1884 - Land at Leicester Lane, Desford, Leicester

Figure 1 - Geophysical Survey Location

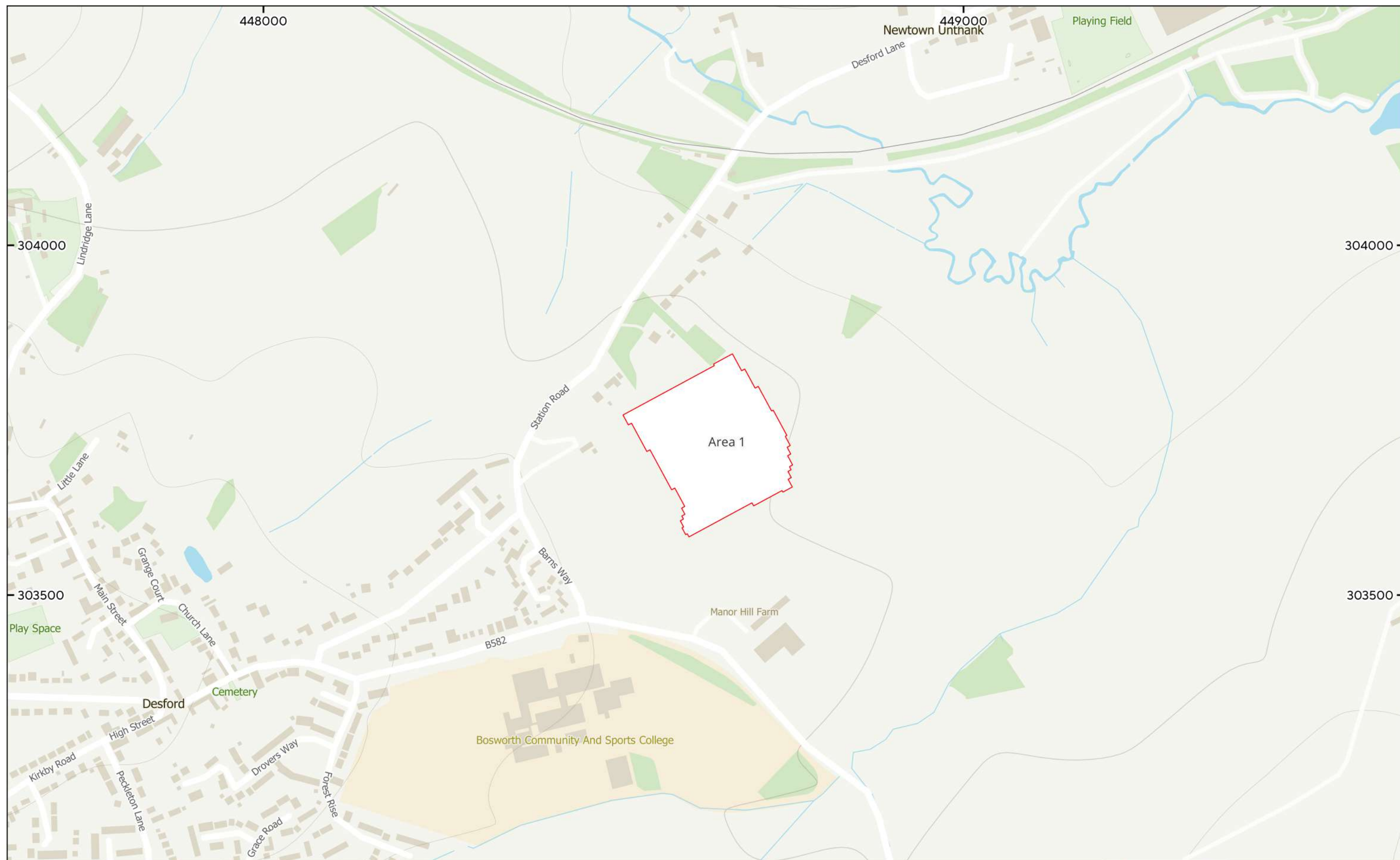
1:25,000 @ A4

© Magnitude Surveys Ltd 2024

Contains OS data © Crown Copyright and database right 2024

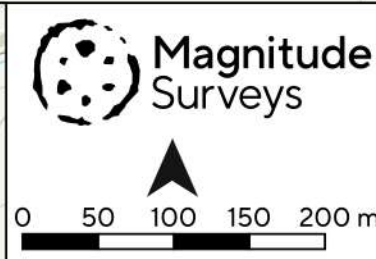
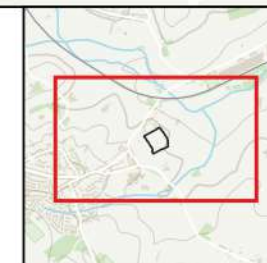
 Geophysical Survey Location

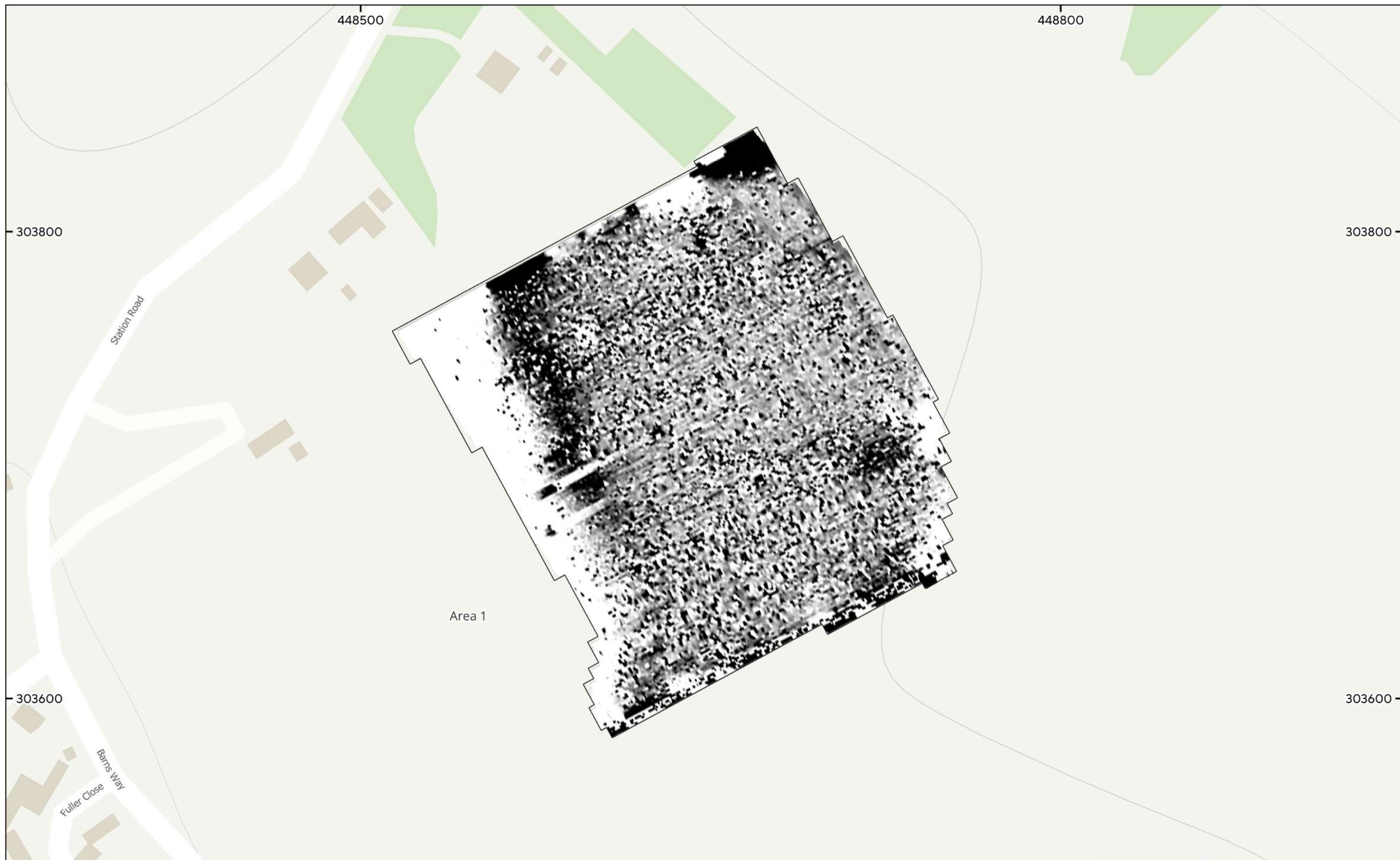




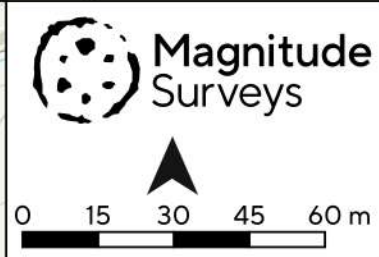
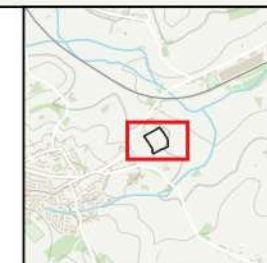
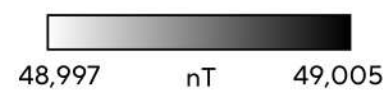
MSSK1884 - Land at Leicester Lane, Desford, Leicester
Figure 2 - Geophysical Survey Area
1:5,000 @ A3
© Magnitude Surveys 2024
Contains Ordnance Survey data © Crown Copyright and
database right 2024

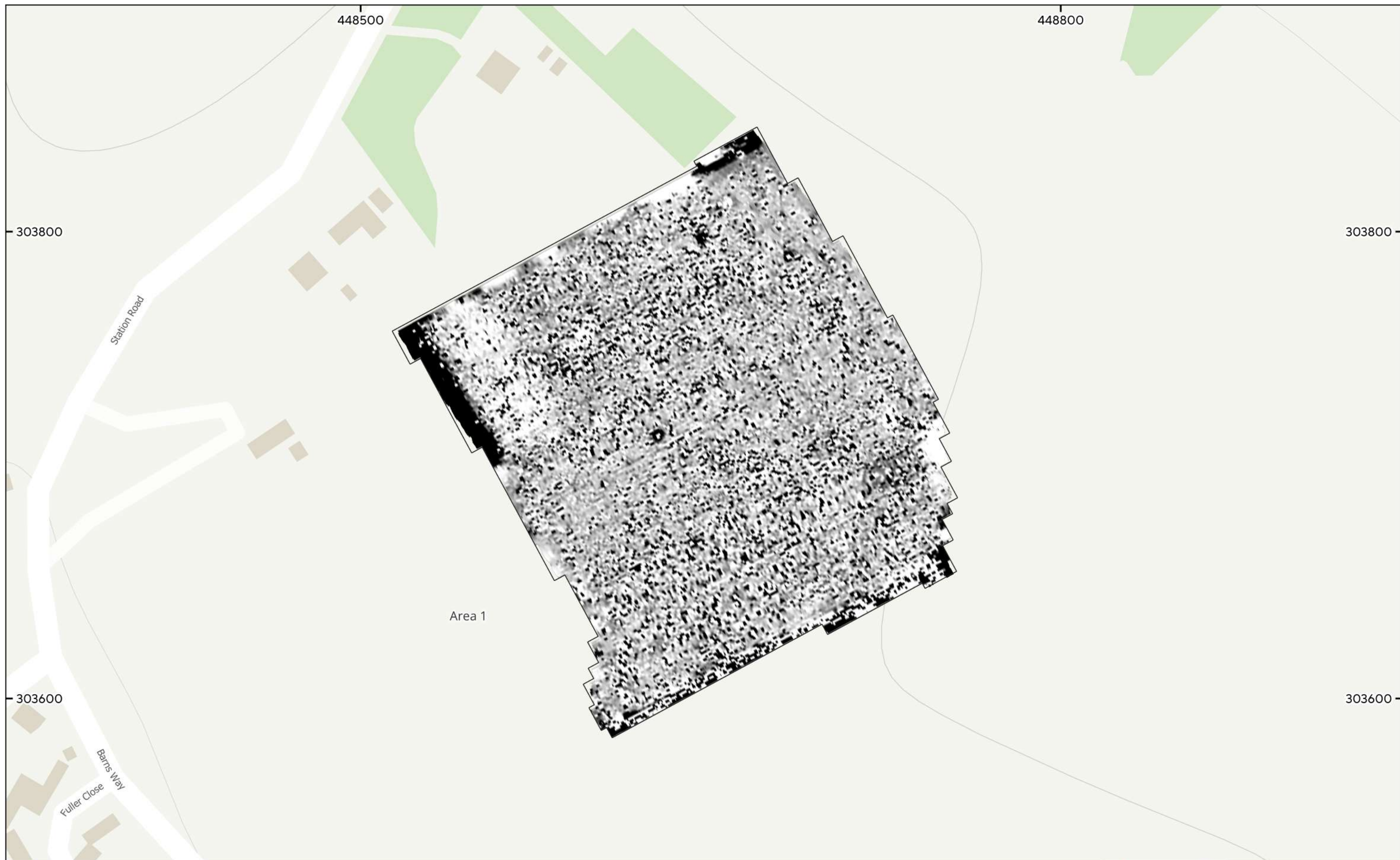
 Survey Extent



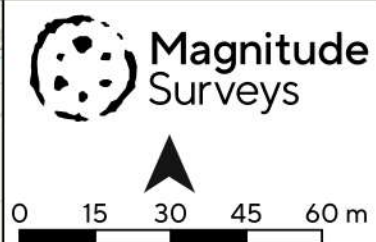
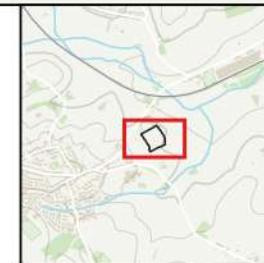
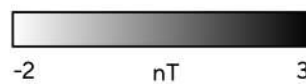


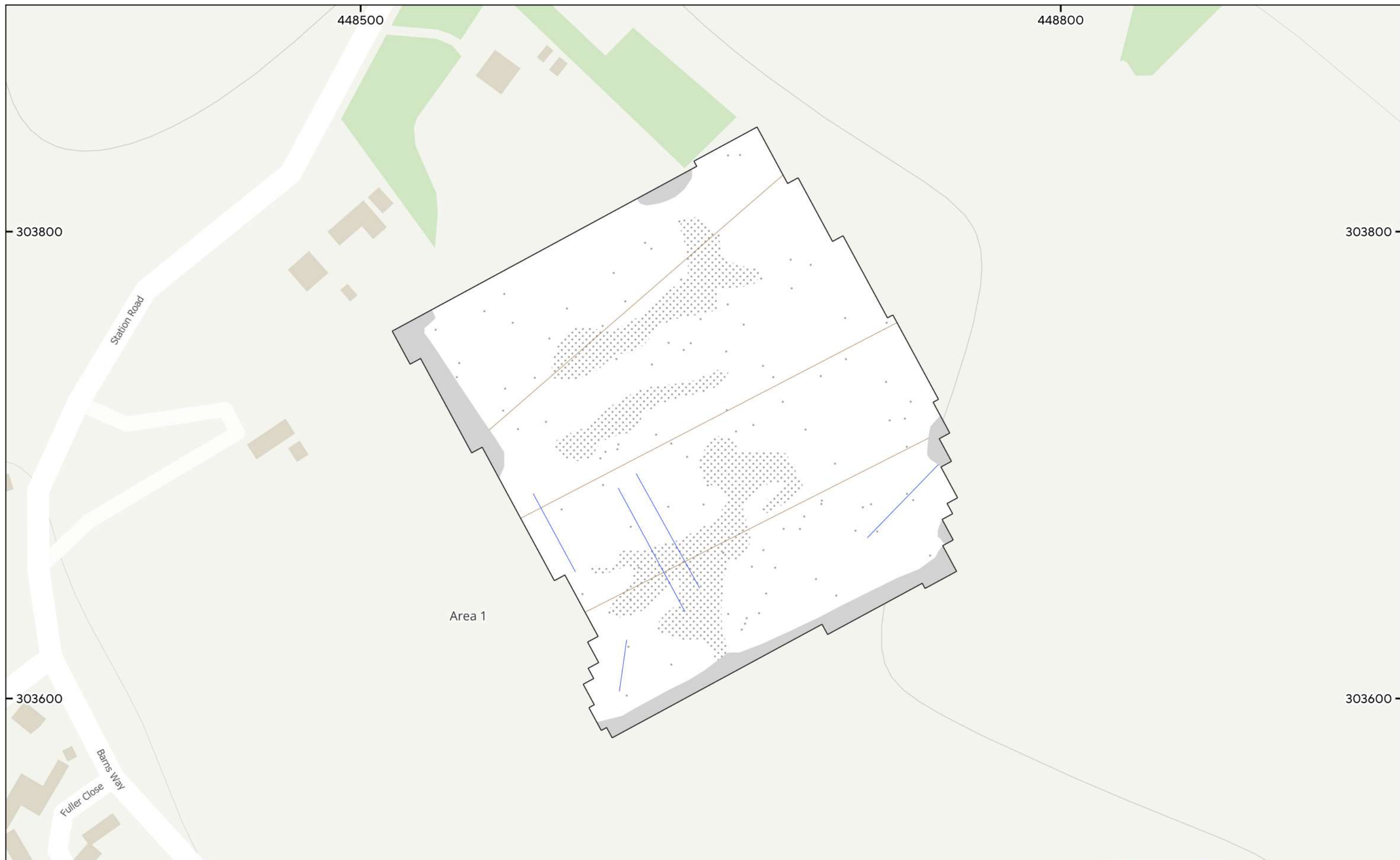
MSSK1884 - Land at Leicester Lane, Desford, Leicester
Figure 3 - Magnetic Total Field (Lower Sensor)
1:1,500 @ A3
Contains Ordnance Survey data © Crown Copyright and
database right 2024





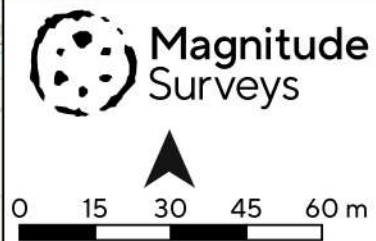
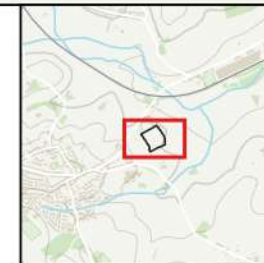
MSSK1884 - Land at Leicester Lane, Desford, Leicester
Figure 4 - Magnetic Gradient
1:1,500 @ A3
Contains Ordnance Survey data © Crown Copyright and
database right 2024

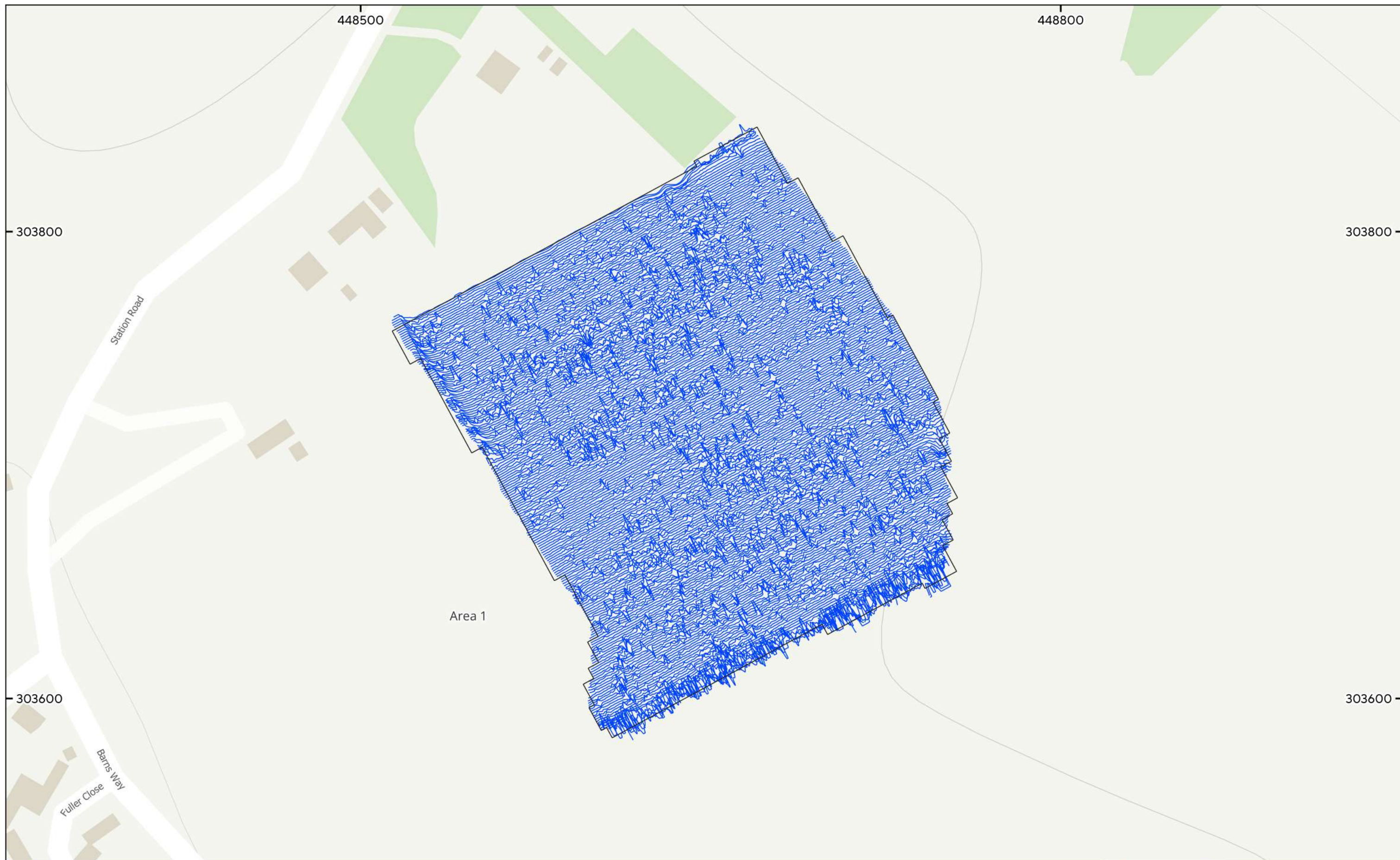




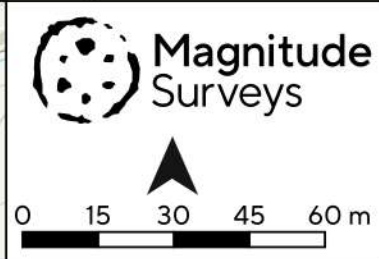
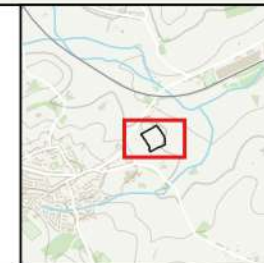
MSSK1884 - Land at Leicester Lane, Desford, Leicester
Figure 5 - Magnetic Interpretation
1:1,500 @ A3
Contains Ordnance Survey data © Crown Copyright and
database right 2024

- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Agricultural (Trend)
- Drainage Feature
- Ferrous (Spike)





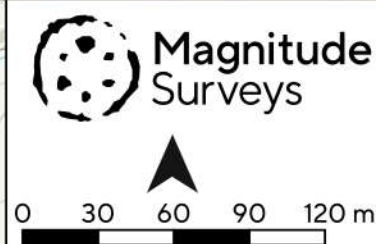
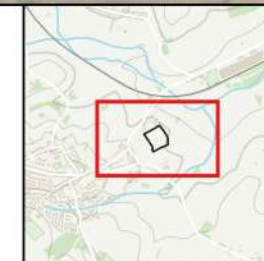
MSSK1884 - Land at Leicester Lane, Desford, Leicester
Figure 6 - XY Trace Plot
90nT/cm @ 1:1,500 @ A3
Contains Ordnance Survey data © Crown Copyright and
database right 2024

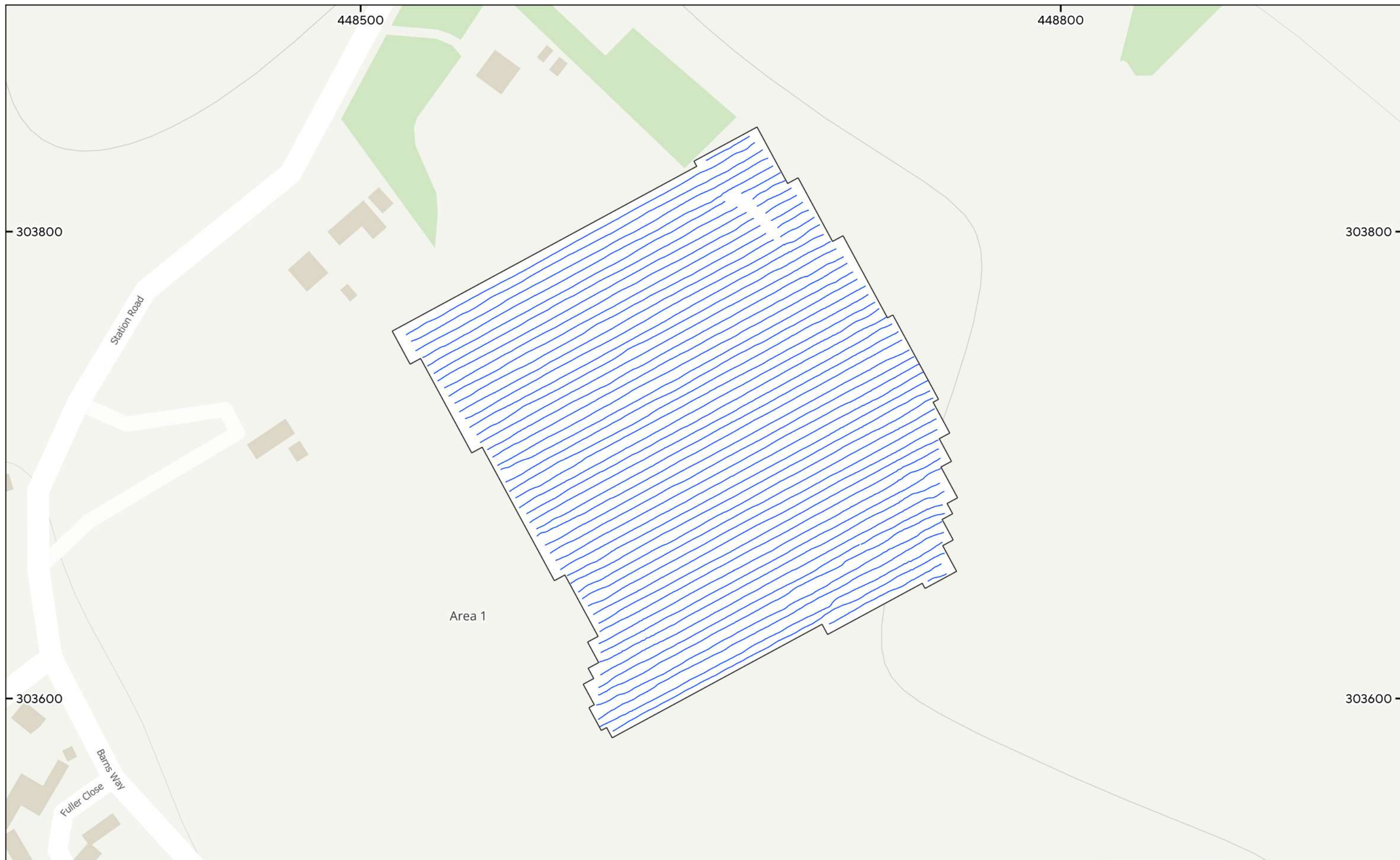




MSSK1884 - Land at Leicester Lane, Desford, Leicester
 Figure 7 - Magnetic Interpretation Over Combined Historical Maps and Satellite Imagery
 1:3,000 @ A3
 Contains Ordnance Survey data © Crown Copyright and database right 2024
 Contains © CLS Data (2024): Ordnance Survey, c. 1882-1950
 Contains © Bing Satellite (2024)

- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Agricultural (Trend)
- Drainage Feature
- Ferrous (Spike)





MSSK1884 - Land at Leicester Lane, Desford, Leicester
Figure 8 - GNSS Trace Plot
1:1,500 @ A3
Contains Ordnance Survey data © Crown Copyright and
database right 2024

