Tillbridge Solar

Tillbridge Solar Project
EN010142

Volume 6
Environmental Statement
Appendix 8-5-2: Cable Route Corridor Geophysical Survey Report
Document Reference: EN010142/APP/6.2

Regulation 5(2)(a)
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

April 2024
Revision Number: 00

@: info@tillbridgesolar.com T: 0800 046 9643

This report presents a survey of a larger area which was considered for the Scheme during the application and assessment process. As such there are areas surveyed and presented in this report which are no longer within the Order limits. This does not impact on the conclusions of this report.

Geophysical Survey Report

Tillbridge Solar Scheme, Cable Route,

Willingham-by-Stow, Lincolnshire

For

Aecom

Magnitude Surveys Ref: MSSK1393C

HER Event Number: TBC

OASIS Number: TBC

December 2023

3 Captain Street

Bradford

BD1 4HA

01274 926020

info@magnitudesurveys.co.uk

Report By:

[redacted]

Report Approved By:

[redacted]

Issue Date:

12 December 2023

Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of the Tillbridge Solar Scheme, Cable Route in Lincolnshire. A fluxgate gradiometer survey was successfully completed on a 46.4ha area of land, with approximately 29.84ha unable to be surveyed due to waterlogged ground conditions and access difficulties. No anomalies clearly suggestive of archaeological activity were identified. Numerous undetermined objects displaying signals indicative of ferrous material were identified. Multiple mapped former field boundaries have been detected in the survey area in addition to evidence of ridge and furrow cultivation, drainage features, and linear anomalies likely relating to modern ploughing. Anomalies classified as 'undetermined' have been detected and although these are likely to be a result of natural processes or agricultural activities, an archaeological origin cannot be ruled out completely. The impact of modern activity on the site is visible in magnetic interference caused by perimeter fencing, troughs, and buried services.

Contents

List of Figures

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Aecom to undertake a geophysical survey over a c. 76.24ha area of land near Willingham-by-Stow, Gainsborough, Lincolnshire (SK 87577 84499).

1.2. The geophysical survey comprised 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 (Stoddart, 2023).

1.5. The survey commenced on 18/10/2023 and took six days, over a period of two weeks to [redacted]

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, [redacted] as 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); [redacted] 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); [redacted] as 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 areas that had not previously been surveyed along the proposed cable route, which will be shared with other potential solar schemes.

3.2. The survey results will accompany a forthcoming application for a cable route for the proposed Tillbridge Solar Scheme.

3.3. The survey results will aim to provide evidence to support an outline recommendation for further works (if necessary), such as by identifying areas of archaeological potential to be targeted by trial trench evaluation.

4. Geographic Background

4.1. The survey area was located c. 1km south of Willingham-by-Stow, at its closet point (Figure 1). Gradiometer survey was undertaken across 13 fields under arable cultivation and pasture. The survey area is spread out over an area from Cow Lane in the north to the A150 in the south. The survey area is bounded by Cow Lane in the north, the village of Normanby-by-Stow in the centre, and Marton Grange Barn in the south. (Figure 2). Approximately 29.83ha of the 76.24ha area was unable to be surveyed due t

4.2. o waterlogged ground conditions and access issues.

4.3. Survey considerations:

Survey Area	Ground Conditions	Further Notes
2	Flat field under arable cultivation	The northern and western borders consisted of hedgerows and the eastern and southern border [redacted]
13	Flat pasture	The northern, eastern, and western borders consisted of hedgerows, and the southern border consisted of a house and fruit trees. A line of trees was orientated north to south along the western half of the survey area. Metal troughs were located along the eastern border of the survey area.
14	Pasture field sloping down to the northwest	The northern, southern, and western borders consisted of hedgerows, the eastern border consisted of a hedgerow and farm buildings on the southern half of the border. An area in the northwest was unable to be surveyed due to waterlogged ground.
1401	Flat field under arable cultivation	The northern and southern borders had no physical boundary, the eastern border consisted of a hedgerow and ditch and the western border consisted of a hedgerow.
1402	Flat field under arable cultivation	The northern and eastern borders consisted of hedgerows, the southern border consisted of a farm track and the western border had no physical boundary.
16	Flat field under arable cultivation	The survey areas northern and southern border had no physical boundary, and the eastern and western borders consisted of hedgerows.
1601	Field under arable cultivation, sloping down to the west	The survey area was surrounded by ditches and hedgerows. A partial hedgerow was located in the southeastern corner of the survey area. A collapsed brick structure was located in the centre of the survey area.

1602	Flat pasture	The northern border had no physical boundary and the southern and western borders consisted of a hedgerow, ditch and metal wire fence.
1603	Flat pasture	The northern, eastern, and southern border consisted of a hedgerow, ditch and metal wire fence and the western border had no physical boundary.
1604	Field under arable cultivation, sloping down to the southeast	The northern border had no physical boundary, the eastern border consisted of hedgerow and metal fence, the southern border consisted of a hedgerow and ditch, and the western border consisted of a hedgerow. A railway line was orientated north to south just beyond the western border.
17	Flat field under arable cultivation	The northern border consisted of a ditch, the eastern border consisted of a hedgerow, and the southern and western borders had no physical boundary. A railway line was orientated north to south just beyond the eastern border.
18	Flat pasture [redacted]	The northern and southern borders had no physical boundary, the eastern border consisted [redacted]rn border consisted of a ditch and hedgerow. A railway line was orientated north to south just beyond the eastern border.
1801	Flat pasture	The survey area had no physical boundary on its northern, southern, and western borders and the eastern border consisted of a ditch and hedgerow.

4.4. The bedrock geology of the survey area is largely composed of interbedded mudstone and limestone of the Scunthorpe Mudstone Formation, with a small band of Charmouth Mudstone Formation mudstone in the northeast. Superficial deposits in the survey area consist of Mid Pleistocene – diamicton Till, in the northeast, bands of alluvial clay, silt, sand, and gravel in the northeast and centre, and a small area of sand and gravel of the Holme Pierrepont Sand and Gravel Member in the southwest (British Geological Survey, 2023).

4.5. The soils across the majority of the survey area consist of slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, with loamy and clayey floodplain soils with naturally high groundwater in the northeast and centre of the survey area and a small area of naturally wet very acid sandy and loamy soils in the southwest of the survey area. (Soilscapes, 2023).

5. Archaeological Background

5.1. The following archaeological background has been provided by AECOM (2023) and is informed by a review of Lincolnshire Historic Environment Record (HER) data. The DBA will be issued in support of the DCO application for the Tillbridge Solar Scheme.

5.2. Prehistoric evidence is primarily limited to find spots of stone tools and lithic scatters found in the topsoil. The survey area is located to the east of the river Trent, which has been known to produce evidence of prehistoric remains given the past exploitation of the resource and the survival potential of archaeological remains.

5.3. During the Romano-British period, there is a significant amount evidence for occupation in the vicinity of the survey area, including a Scheduled Roman town and fort. The fort, located to the south of Littleborough Lane, c. 1.8km west of the survey area consists of archaeological deposits of a first century fortification, visible as cropmarks. These cropmarks (MLI54200) have been recorded to the south of Littleborough Lane with a ditched enclosure recorded marking the boundary of the fort. The fort consists of a sub-rectangular plan enclosure with rounded corners, defined by two parallel ditches. A possible second Roman fort has also been identified at Gate Burton (MLI50544) c. 1.5km northwest of the survey area. The site is visible on aerial photographs, thought to represent several enclosures, although it has also been interpreted as being agricultural in nature.

5.4. The Roman town of Segelocum is a Scheduled Ancient Monument located c. 2.6km west of the survey area, near the current village of Littleborough. The site is visible on aerial photographs and is thought to extend over an area of approximately c. 400m by c. 300m. Geophysical survey [redacted] a number of by linear and rectilinear anomalies which conform to a town grid. The features indicate a high level of planned development within the core of the Roman town, and also suggests significant roadside settlement in the direction of Sturton-le-Steeple.

5.5. Immediately to the south of the survey area is the approximate site of the Roman Till Bridge Lane (MLI50575). Till Bridge Lane (MLI50575) was a Roman road which ran from Ermine Street to the north of Lincoln to the crossing of the Trent at Marton. Till Bridge Lane branches from Ermine Street to the north-west, approximately 4.5km from Lincoln and crosses the Trent to reach Segelocum. Evidence of the road includes a metalled surface which was uncovered during an archaeological watching brief, and remains of possible paving of the Roman road have also been recorded approximately 1km to the west of the survey area at Marton (MLI52462). The geophysical survey around the Roman road c. 1.3km west of the survey area recorded evidence of settlement to either side of it (MLI51369). This settlement is thought to be a ribbon development and stretched along the road towards the Trent crossing near Segelocum.

5.6. There is evidence of development of the landscape through the Early Medieval (A.D. 409 – 1066) period. Early Medieval activity is attested by a small number of findspots chiefly focused around Torksey (MLI507489). Torksey was the site of the winter camp of the Viking Great Army in 872 (A.D 872-873) and is located approximately 2.2km southwest of the survey area (MLI25067). The camp sat on a prominent bluff partially surrounded by marshes and with the river Trent on its western boundary. By the end of the Early Medieval period the landscape within the study area was characterised by small agricultural settlements, as indicated by the records in the Domesday Book. Evidence of the later medieval period includes a number of shrunken, or deserted, medieval villages and their associated open field systems evidenced by the presence of ridge and furrow cultivation in proximity to the survey area – including scheduled remains at Normanby by Stow (MLI52445).

5.7. The historical mapping of the study area highlights the agricultural nature of the landscape during the post-medieval period. Much of the land was enclosed in the 18th century, with the establishment of numerous farms across the landscape. The 19th century OS mapping also show that the agricultural fields and the settlements have remained fairly unchanged in size until the modern period.

5.8. During the modern period, a military airfield (RAF Sturgate) was located approximately 450m northwest of the survey area. The airfield opened in 1944 and was originally used for training two operational Lancaster bomber squadrons. In 1953 the station was allocated for use by the United States Air Force Strategic Air Command.

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 [redacted]owing 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 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.

[redacted]

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 (Figures 5, 7, 9, 11 and 13). 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 (Figures 17, 20, 23, 26, 29, 32, 35, 38, 41, and 44). 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 (Figures 6, 8, 10, 12 and 14).

[redacted]

7.2.2. A fluxgate gradiometer survey was carried out along the proposed route of the Tillbridge Solar Scheme, Cable Route, Lincolnshire. An area of approximately 46.4ha was surveyed with c. 27.5ha unable to be surveyed due to waterlogged ground conditions and access difficulties (Figures 2, 4 and 5). The survey has generally responded well to the environment of the survey area. Areas of magnetic disturbance from modern activity are present at the edges of the survey areas. Further interference is present from troughs and along the routes of buried services. The effect on the data caused by this interference is limited but locally significant. No anomalies clearly suggestive of archaeological activity were identified. Anomalies of an agricultural and undetermined origin were identified.

7.2.3. Numerous anomalies were detected in Areas 1601 and 1604, that were identified as undetermined ferrous objects (Figures 25 to 37). These anomalies do not correspond with any known features on historical mapping, available HER information, or satellite imagery. It has not been possible to provide a confident interpretation of these features from the geophysical data alone. It is possible these anomalies are a result of burning activity, kilns, UXOs, or agricultural/modern activity.

7.2.4. Evidence of historical agricultural activity has been identified throughout the survey area in the form of a series of former field boundaries which correspond with those depicted on historical OS mapping (Figures 6, 8, 10, 12 and 14). Ridge and furrow regimes have been detected in the south of the survey area, indicating the area has been under cultivation since at least the medieval/post-medieval period (Figures 10, 12 and 14). Linear anomalies indicating the presence of drainage features and modern ploughing regimes have been detected across the survey area (Figures 5 to 44).

7.2.5. Anomalies of an undetermined origin have been identified throughout the survey area. Whilst these anomalies are likely of agricultural, natural, or modern origin, an archaeological origin cannot be ruled out.

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. **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.

7.3.1.4. **Undetermined** – Anomalies are classified as Undetermined when the origin of [redacted]upporting 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. **Undetermined Ferrous Object** – Located throughout Areas 1601 and 1604 a multitude of discrete anomalies displaying a strong dipolar magnetic signal have been detected (Figures 25 to 37). These anomalies are widespread throughout these two areas, and do not display uniform organisation or any discernible alignment. The signal of these anomalies is undiagnostic, and they may represent the presence of kilns, or UXOs (unexploded ordnance). The UXO threat level for this area is, however, considered to be low. It is also possible these anomalies are a result of agricultural practices/modern activity. As such it has not been possible to confidently interpret the sources of these anomalies, and they have been categorised as undetermined ferrous objects.

7.3.2.2. Agricultural (Weak/Spread) – Located in Areas 2, 13, 1402, 17, 18 and 1801 multiple and weak linear anomalies and linear spreads of ferrous material have been identified. (Figures 6, 8, 12 and 14). The majority of these roughly correspond with field boundaries recorded on 2nd Edition Ordnance Survey (OS) mapping.

7.3.2.3. **Ridge and Furrow –** Arrangements of regularly-spaced weak linear and curvilinear anomalies have been identified in Areas 1601, 1602, 1603, 1604, 17 and 18 (Figures 28, 31, 34, 37, 40 and 43). These anomalies are indicative of ridge-and-furrow regimes following numerous different alignments, that for the most part do not align with modern field boundaries and crop directions. In some areas it is difficult to distinguish between ploughing trends and ridge and furrow, however, those anomalies exhibiting a characteristic parallel-S-shaped curvilinear morphology and consistent positive magnetic signal have been given a ‘ridge and furrow’ categorisation.

7.3.2.4. **Agricultural (Trend) –** Weak linear trends have been identified across the survey area. These anomalies correspond with modern ploughing visible on satellite imagery (Figures 5 to 44).

7.3.2.5. **Drainage Feature –** Multiple linear anomalies, on various alignments throughout the survey area have been detected. Three types of magnetic responses have been recorded. The first type of response consists of strong, positive, linear signals. The second kind of anomalies consist of weak positive linear signals. The third type of anomalies have a weak, dipolar signal indicative of modern ceramic drains (Figures 5 to 44). The drainage features are arranged on a variety of alignments, ranging from the typical closely spaced herringbone pattern to wide rectilinear organisation terminating at the field edges.

[redacted] linear, and discrete anomalies have been identified across the survey area (Figures 4 to 87). These anomalies do not have any supporting contextual evidence. These anomalies are likely to be the result of geological or agricultural processes, but in these cases an archaeological origin cannot be entirely ruled out. Located In Areas 16 and 1603 two discrete anomalies with a strong dipolar signal have been detected (Figures 25 and 34). These discrete anomalies, characterised by strong, dipolar signals may be representative of high-temperature in-situ burning activity.

7.3.2.7. **Service (Trend) -** Buried services have been in Areas 14, 1601, 17, 18 and 1801 (Figures 22, 25, 28, 40 and 43). These linear anomalies, comprising repeating strong dipolar anomalies, are characteristic of buried services; their strength and spread has contributed to obscuring weaker anomalies if present.

8. Conclusions

8.1. A fluxgate gradiometer survey was successfully completed across c. 46.4ha of the survey area with 27.5ha unable to be surveyed due to waterlogged ground conditions and access difficulties. The survey technique responded well to the environment of the survey area, detecting anomalies relating to the historical and agricultural nature of the survey area.

8.2. A multitude of discrete anomalies have been classified as Undetermined Ferrous Objects, due to a lack of clear supporting contextual information.

8.3. Evidence of agricultural use of the land has been detected across the survey area in the form of former mapped field boundaries, ridge and furrow regimes, drainage features and linear anomalies likely related to modern ploughing regimes.

8.4. Several anomalies have been classified as Undetermined due to lack of context, or any clear pattern or morphology which would enable a confident interpretation. Nevertheless, an archaeological origin for these cannot be excluded.

[redacted]

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

11. References

AECOM 2023. Tilbridge Solar, Cultural Heritage and Desk-Based Assessment (Draft). Internal Client document.

British Geological Survey, 2023. Geology of Britain. Willingham-by-Stow, Lincolnshire. [redacted].

Chartered Institute for Archaeologists, 2020. Standards and guidance for archaeological geophysical survey. CIfA.

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, 2023. 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, 2023. Willingham-by-Stow, Lincolnshire. Cranfield University, National Soil Resources Institute. [redacted]. Accessed 09/11/2023.

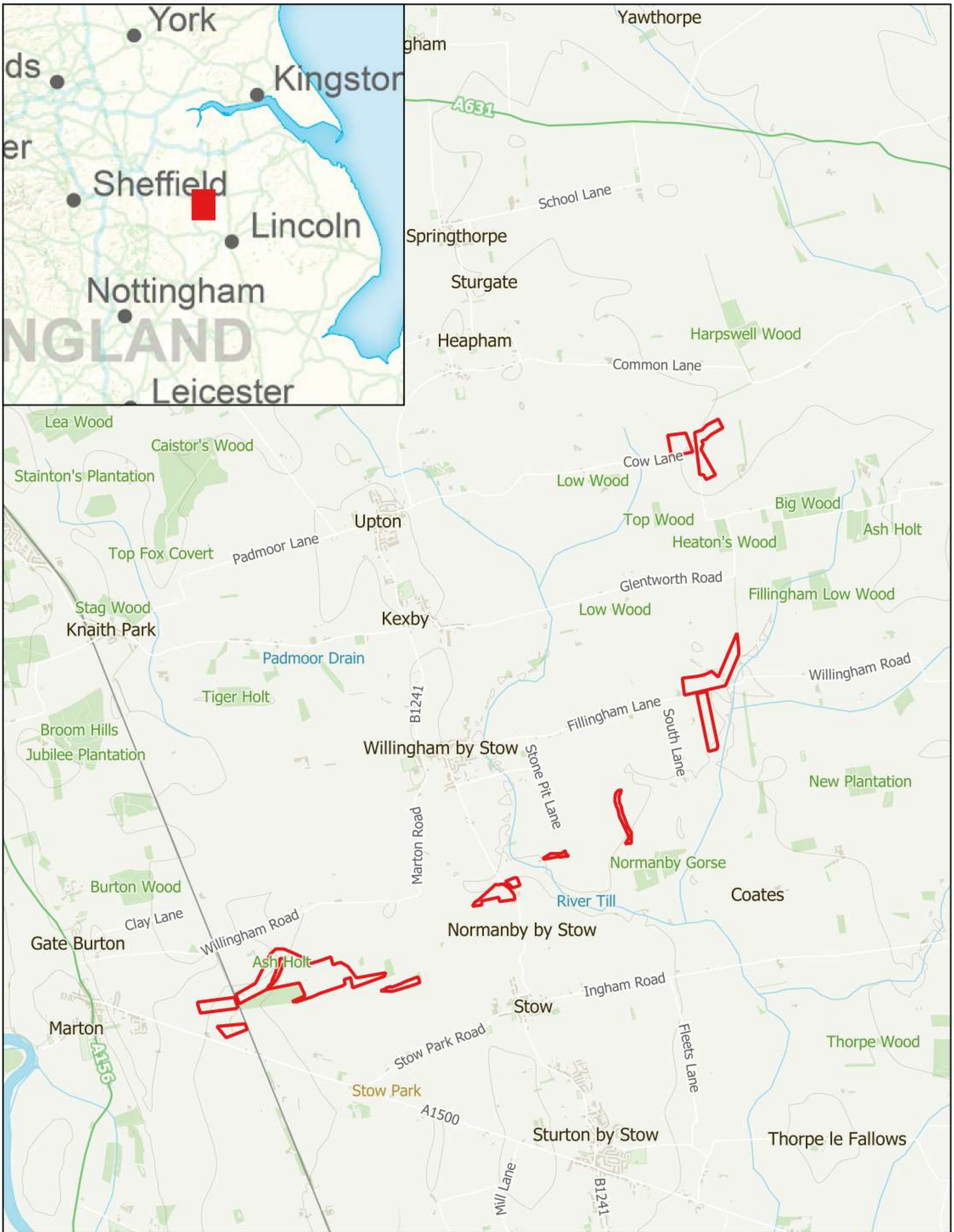
Stoddart, A, C., 2023. Written Scheme of Investigation For a Geophysical Survey of Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire. Magnitude Surveys Ltd.

12. Project Metadata

MS Job Code	MSSK1393C
Project Name	Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Client	Aecom
Grid Reference	SK 87577 84499
Survey Techniques	Magnetometry
Survey Size (ha)	76.24ha (Magnetometry)
Survey Dates	2023-10-16 to 2023-10-25
Project Lead	Dr Paul S. Johnson FSA MCIfA
Project Officer	Krasimir Dyulgerski BA MRes Alexander C Stoddart BA
HER Event No	TBC
OASIS No	TBC
S42 Licence No	N/A
Report Version	1.0

13. Document History

Version	Comments	Author	Checked By	Date
[redacted]	to Review			09 November 2023
0.2	Changes Following Review	ACS	AL	09 November 2023
0.3	Changes Following Director Review	ACS	PSJ	10 November 2023
1.0	Client Corrections	KD	KD	12 December 2023

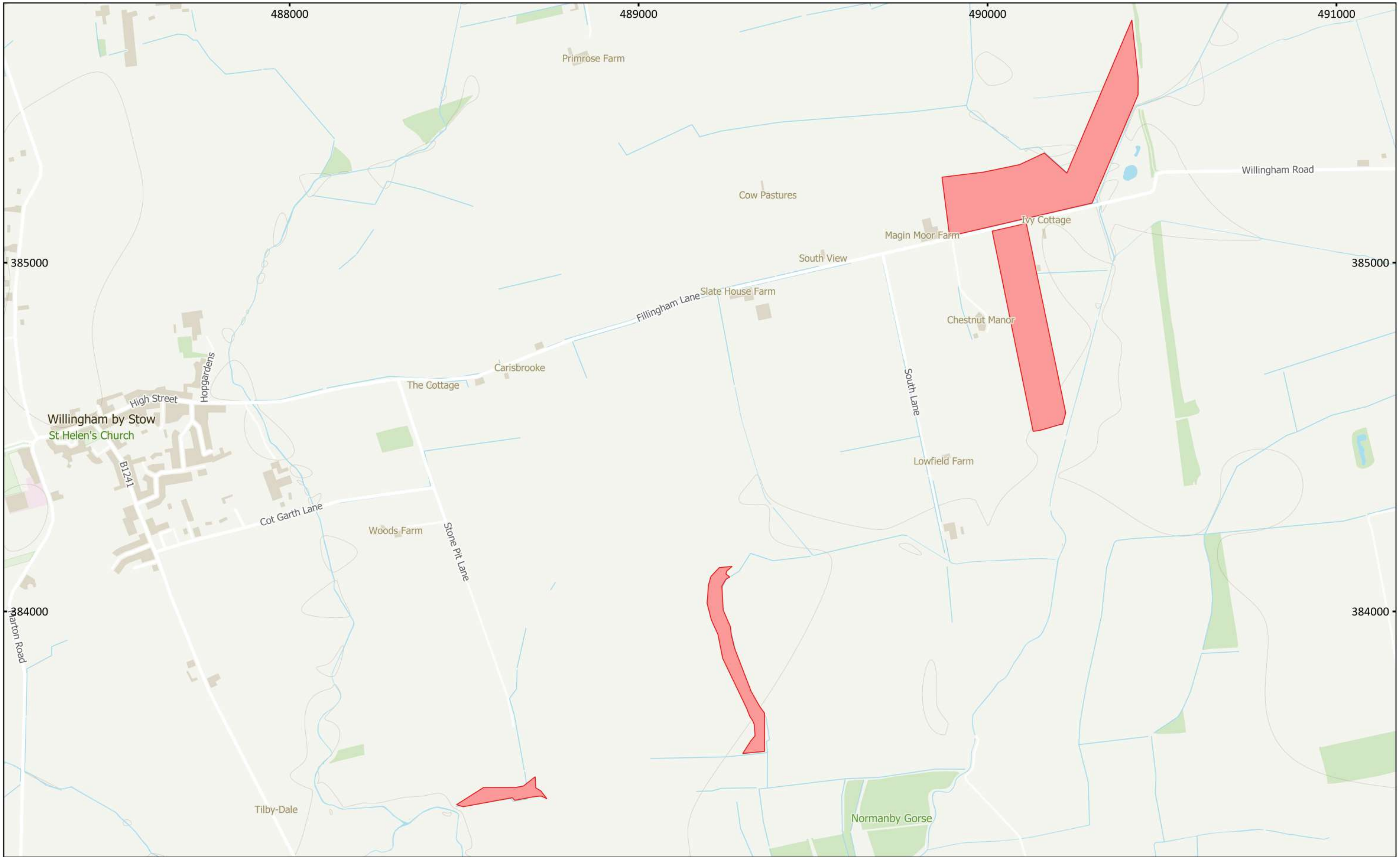


MSSK1393: Tillbridge Solar Scheme, Lincolnshire
Figure 1 - Site Location
1:50,000 @ A4

Site Boundary

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 2 - Location of Survey Areas (North)
1:10,000 @ A3

magnitude surveys



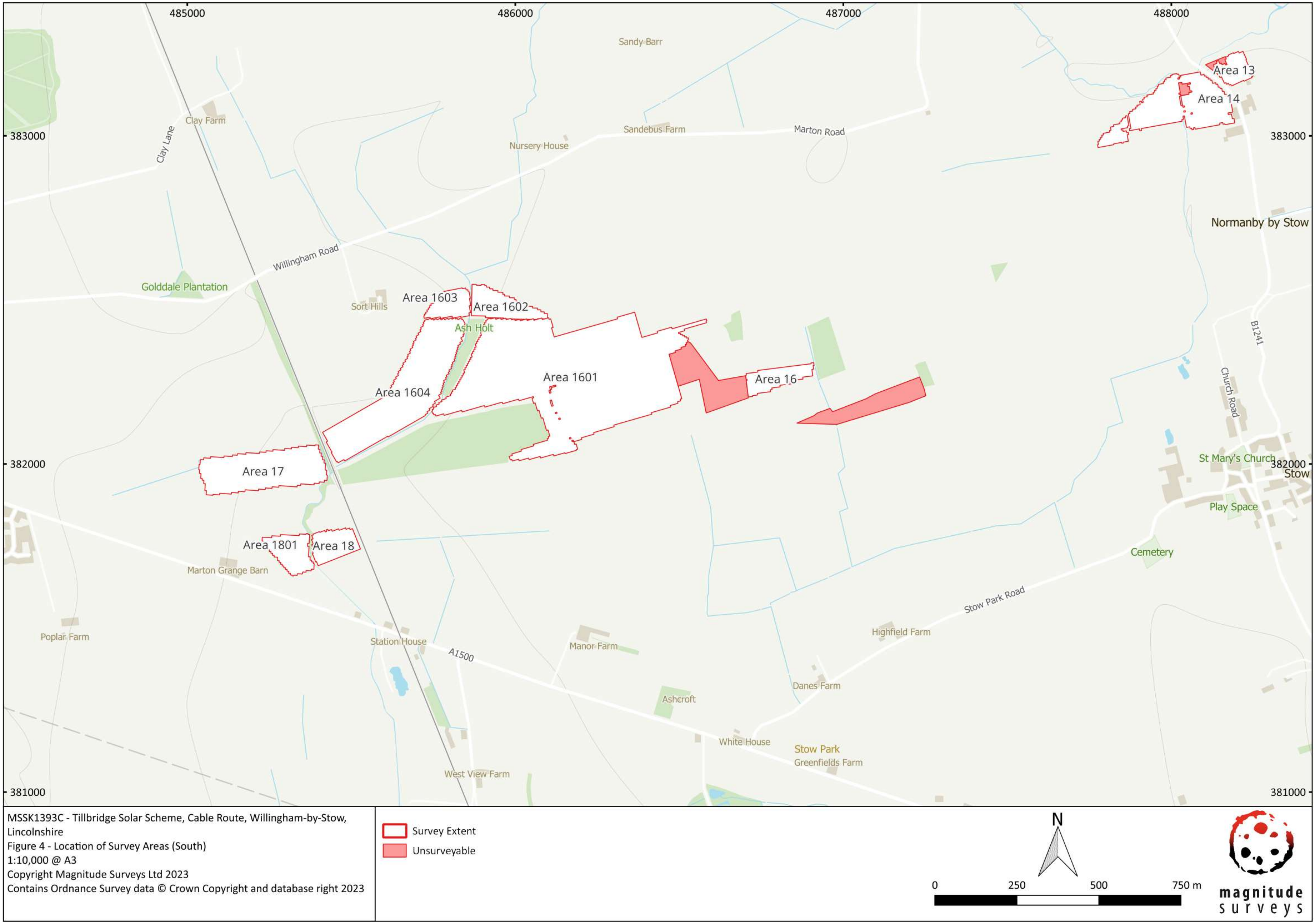
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 3 - Location of Survey Areas (Centre)
1:10,000 @ A3

Survey Extent
Unsurveyable

N

0 250 500 750 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire

Figure 4 - Location of Survey Areas (South)

1:10,000 @ A3

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 5 - Magnetic Total Field (Lower Sensor) (Overview) (Area 2)
1:3,000 @ A3

48,998 nT 49,003

N

0 80 160 240 m

magnitude surveys

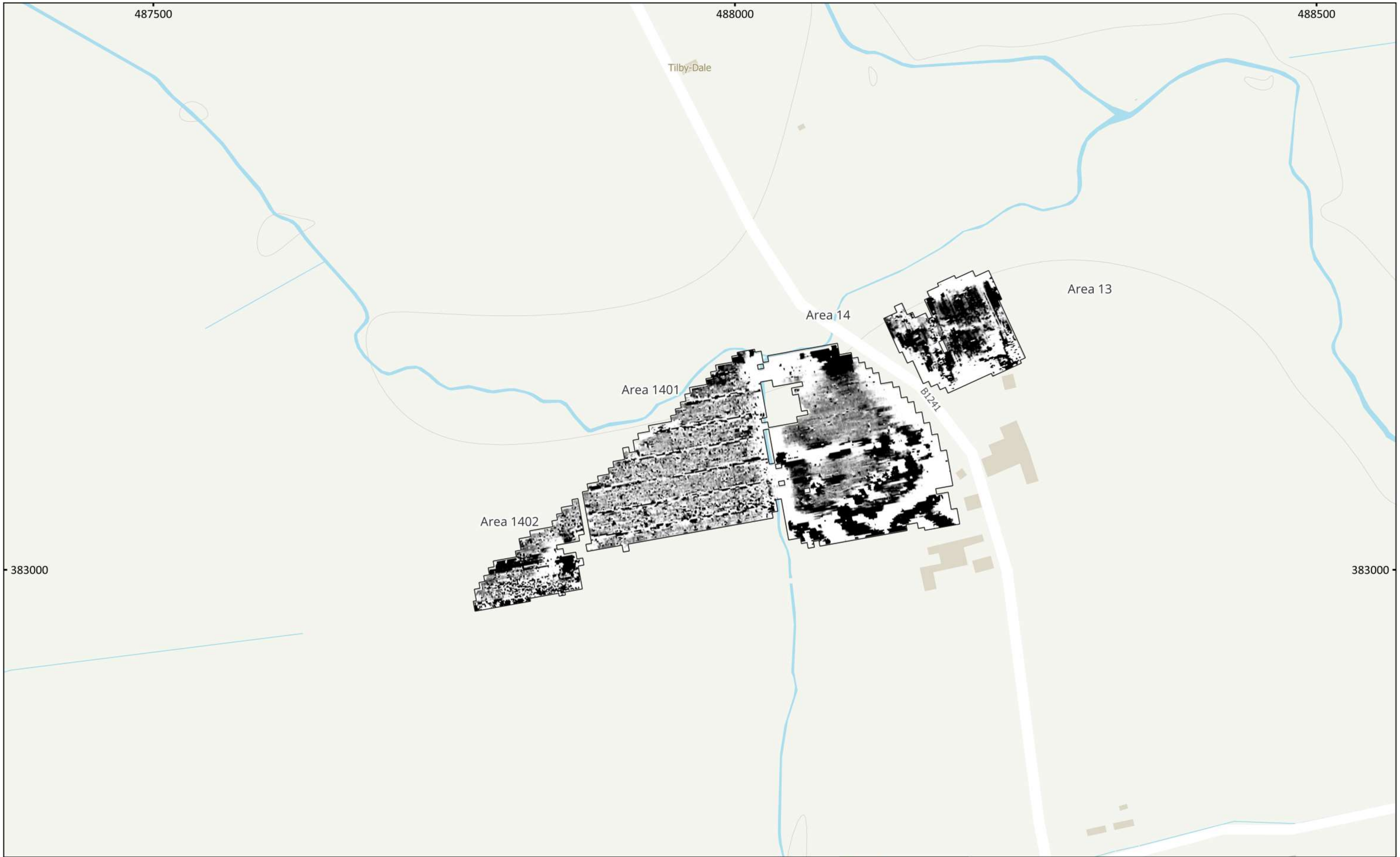
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 6 - Magnetic Interpretation Over Historical Maps and Satellite Imagery (Overview) (Area 2)
1:3,000 @ A3

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

N

0 80 160 240 m

magnitude surveys

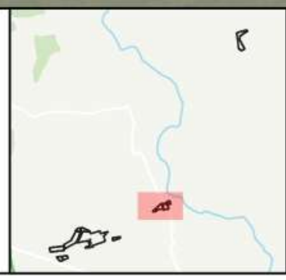


MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 7 - Magnetic Total Field (Lower Sensor) (Overview) (Areas 13 & 14)
1:3,000 @ A3

magnitude surveys

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 8 - Magnetic Interpretation Over Historical Maps and Satellite Imagery (Overview) (Areas 13 & 14)
1:3,000 @ A3

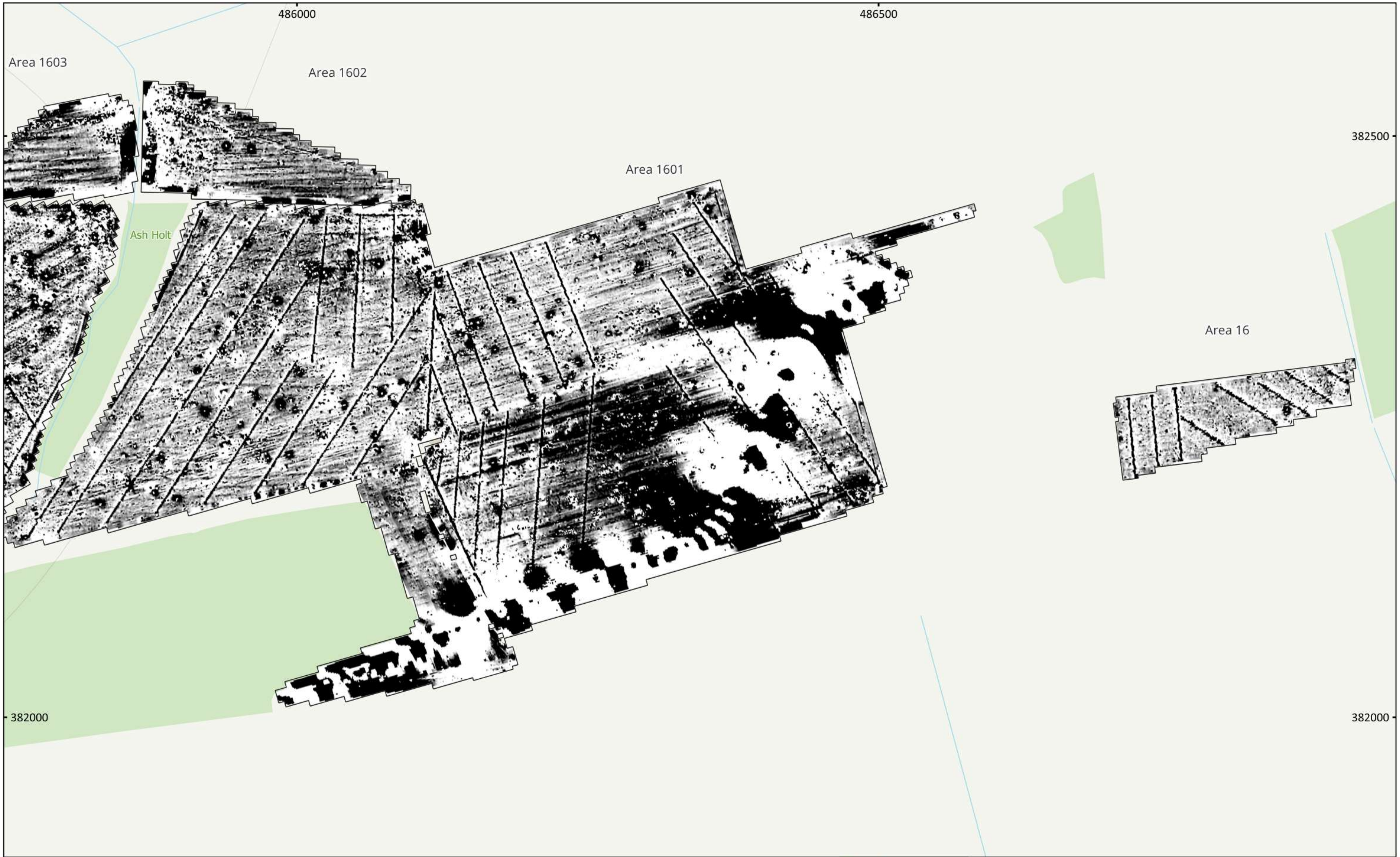
- Agricultural (Spread)
- Agricultural (Weak)
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Weak)
- Service
- Drainage Feature
- Ferrous (Spike)



N

0 80 160 240 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 9 - Magnetic Total Field (Lower Sensor) (Overview) (Areas 16, 1601 & 1602)
1:3,000 @ A3

48,998 nT 49,003

N

0 80 160 240 m

magnitude surveys

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 10 - Magnetic Interpretation Over Historical Maps and Satellite Imagery (Overview) (Areas 16, 1601 & 1602)
1:3,000 @ A3

Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Strong)
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)

N

0 80 160 240 m

magnitude surveys

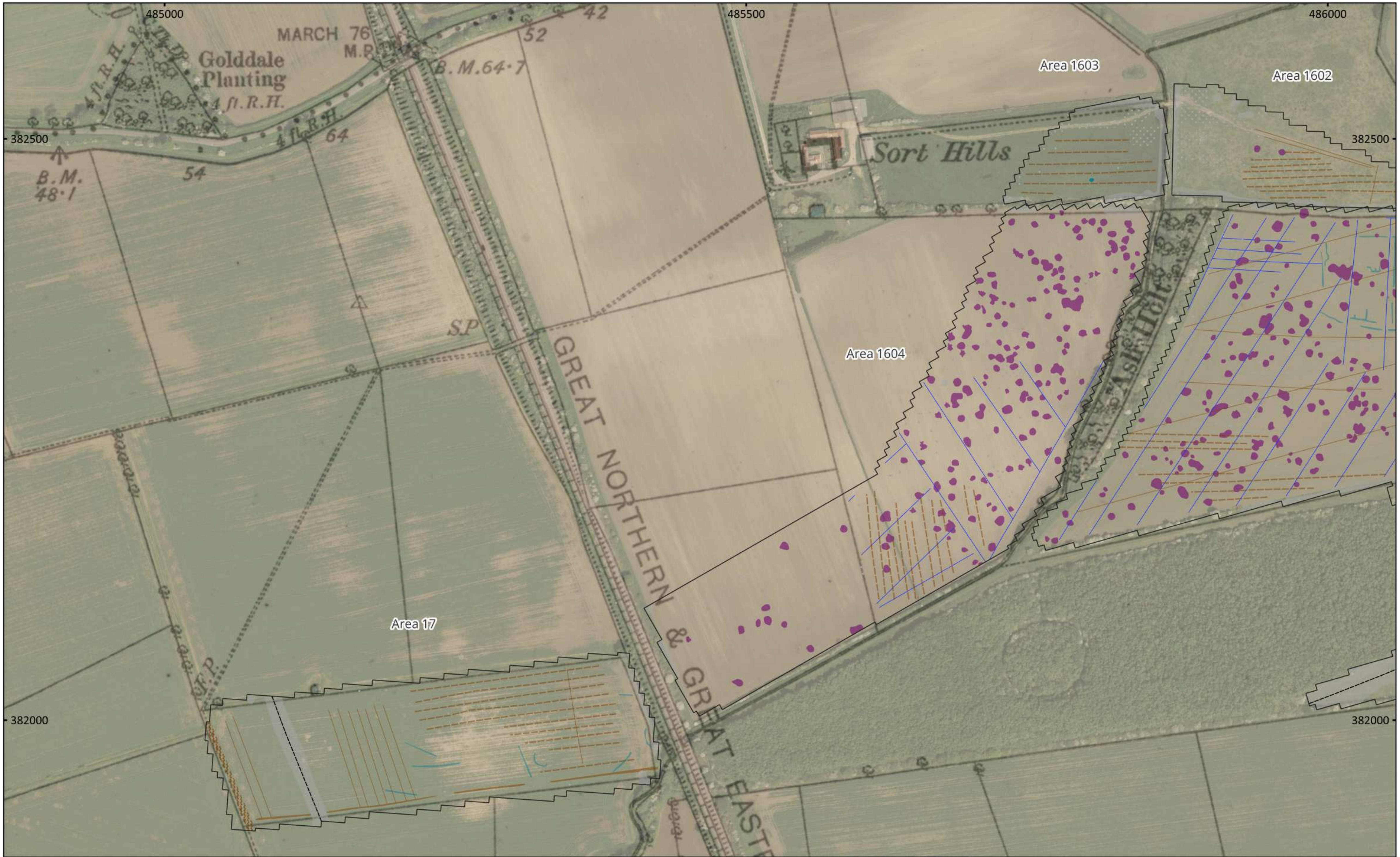
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 11 - Magnetic Total Field (Lower Sensor) (Overview) (Areas 1603, 1604 & 17)
1:3,000 @ A3

48,998 nT 49,003

N

0 80 160 240 m

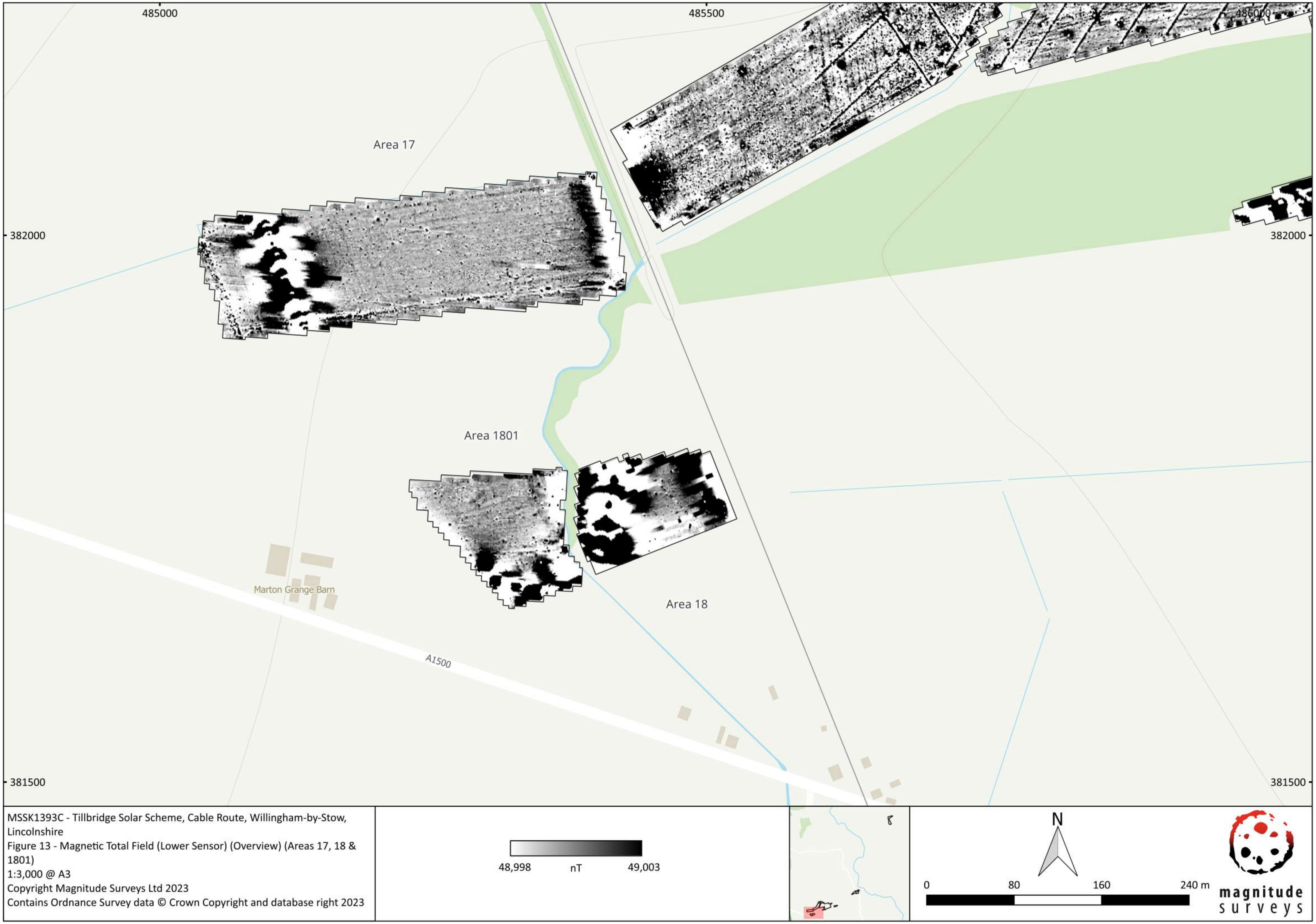
magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 12 - Magnetic Interpretation Over Historical Maps and Satellite Imagery (Overview) (Areas 1603, 1604 & 17)
1:3,000 @ A3

Agricultural (Spread)
Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Strong)
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Ridge and Furrow (Tr
Drainage Feature
Ferrous (Spike)

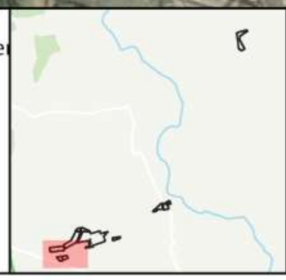
magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 13 - Magnetic Total Field (Lower Sensor) (Overview) (Areas 17, 18 & 1801)
1:3,000 @ A3

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 14 - Magnetic Interpretation Over Historical Maps and Satellite Imagery (Overview) (Areas 17, 18 & 1801)
1:3,000 @ A3

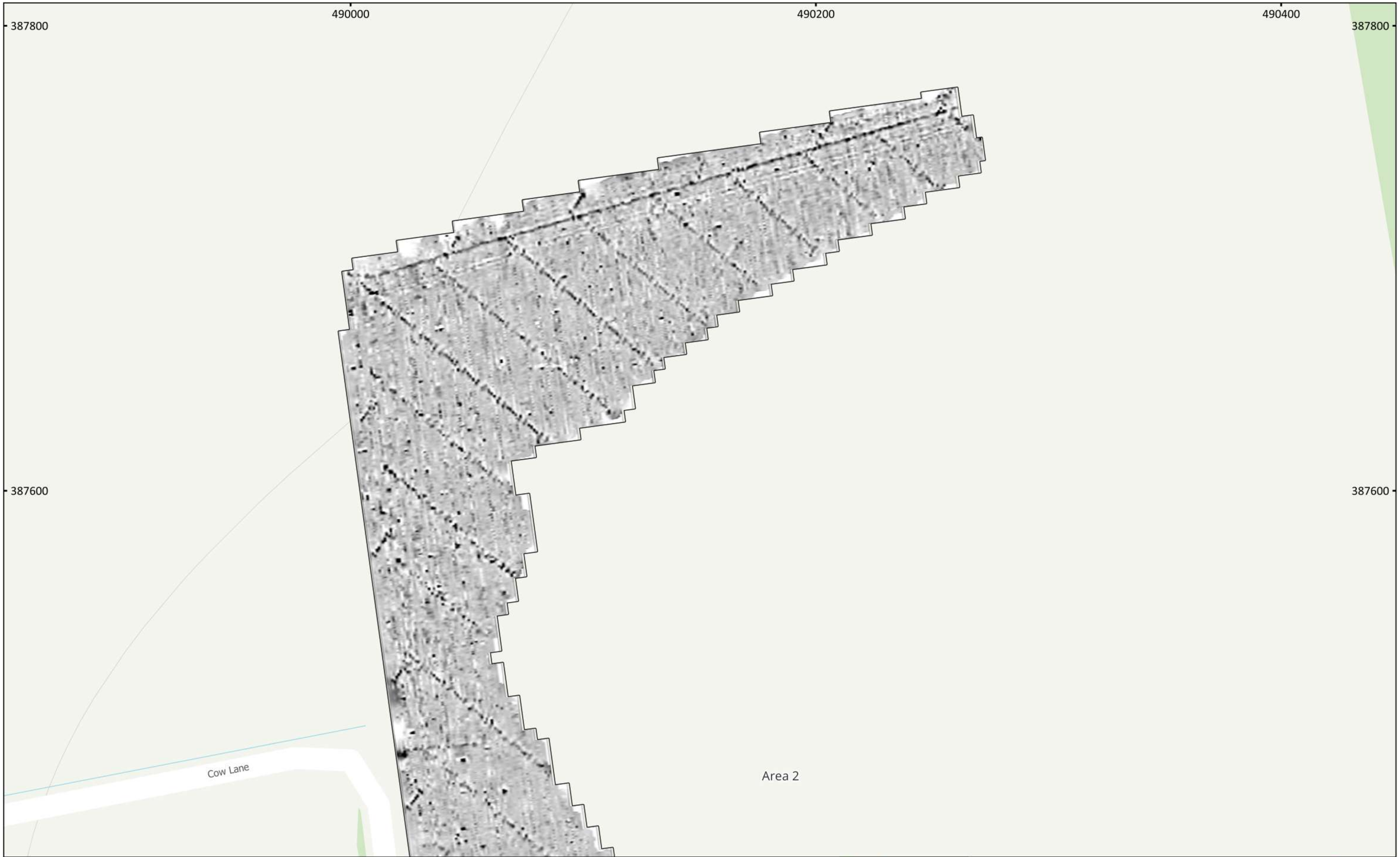
Agricultural (Spread)
Agricultural (Weak)
Magnetic Disturbance
Natural (Spread)
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Ridge and Furrow (Tre
Drainage Feature
Ferrous (Spike)



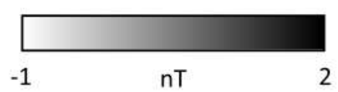
N

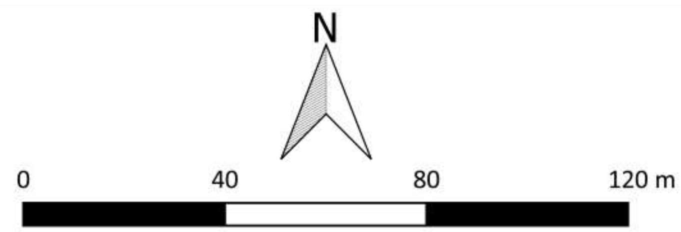
0 80 160 240 m

magnitude surveys

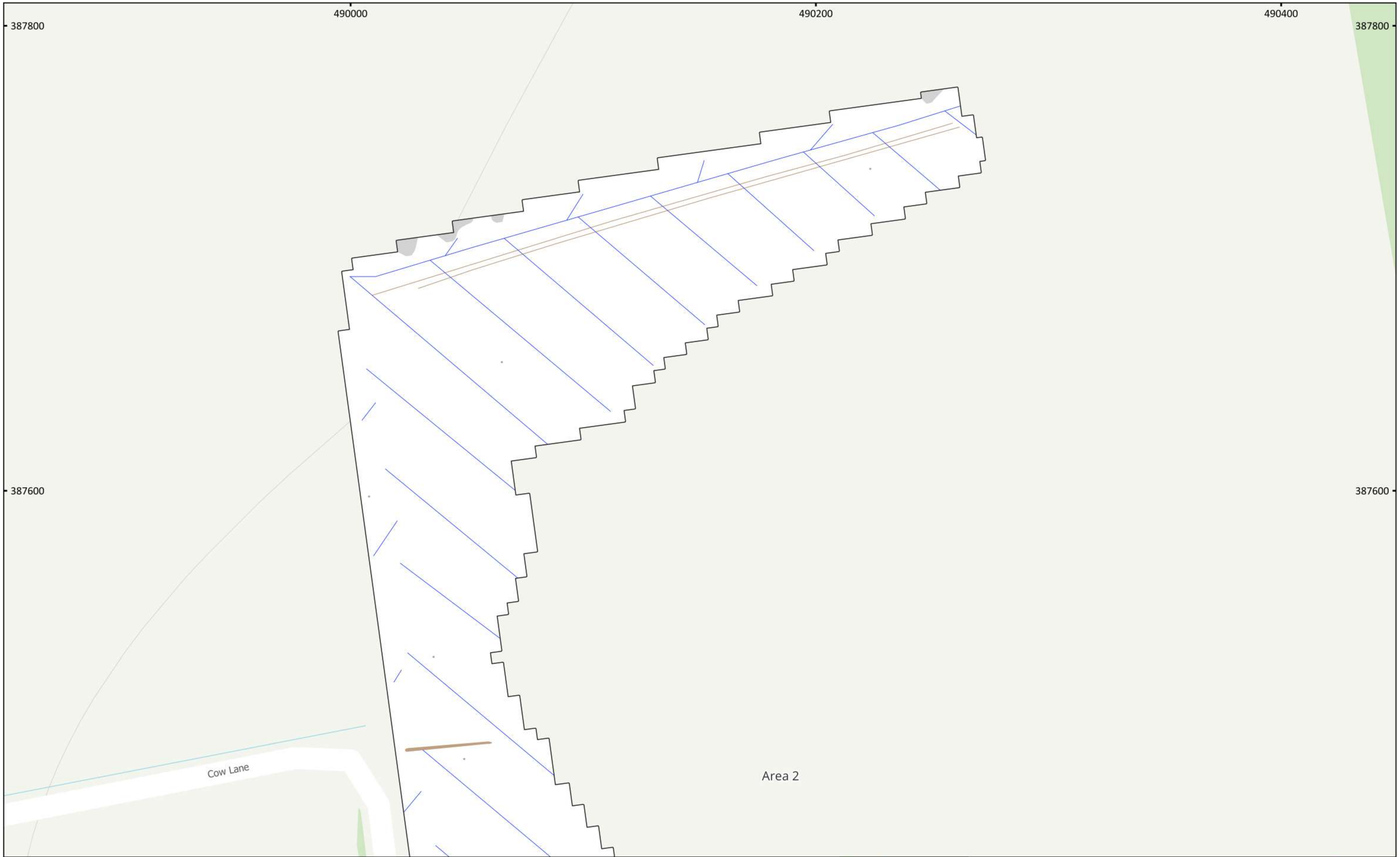


MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 15 - Magnetic Gradient (Area 2 (North))
1:1,500 @ A3





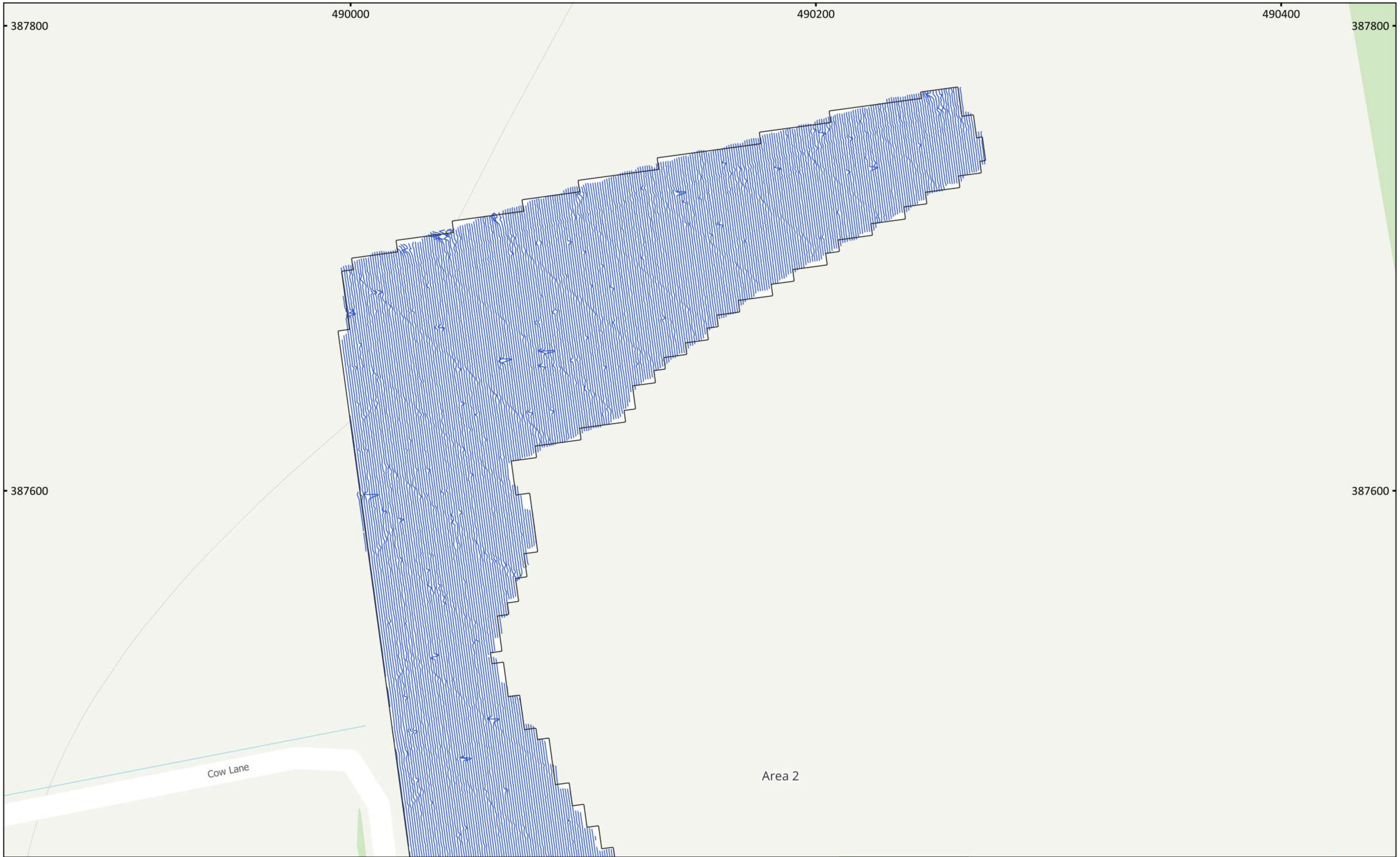
magnitude surveys



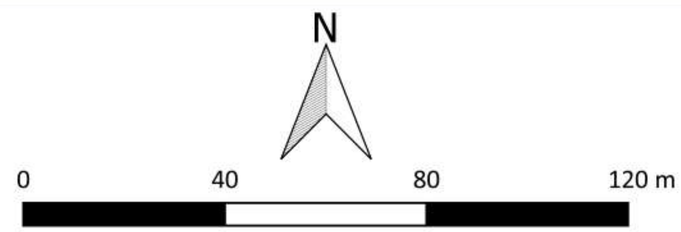
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 16 - Magnetic Interpretation (Area 2 (North))
1:1,500 @ A3

Agricultural (Weak)
Magnetic Disturbance
Agricultural (Trend)
Drainage Feature
Ferrous (Spike)

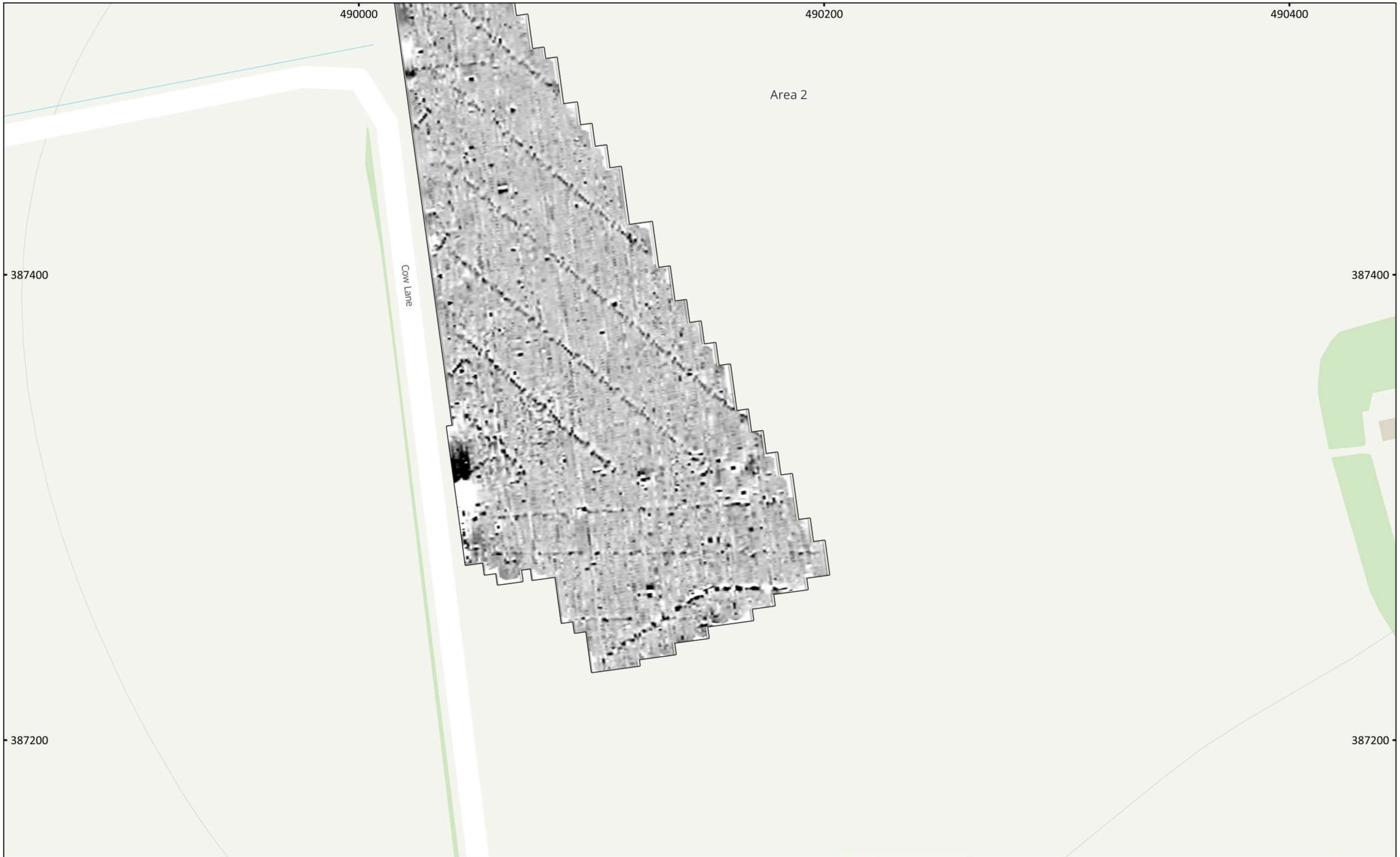
magnitude surveys



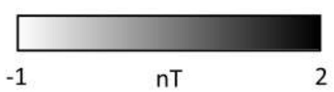
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 17 - XY Trace Plot (Area 2 (North))
30nT/cm at 1:1,500 @ A3

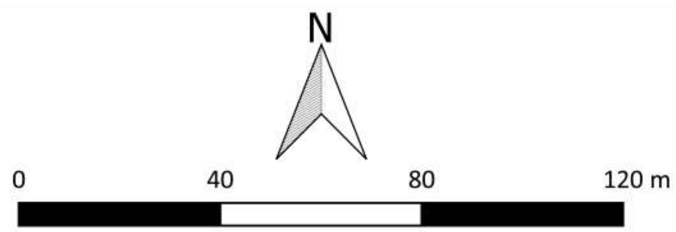


magnitude surveys

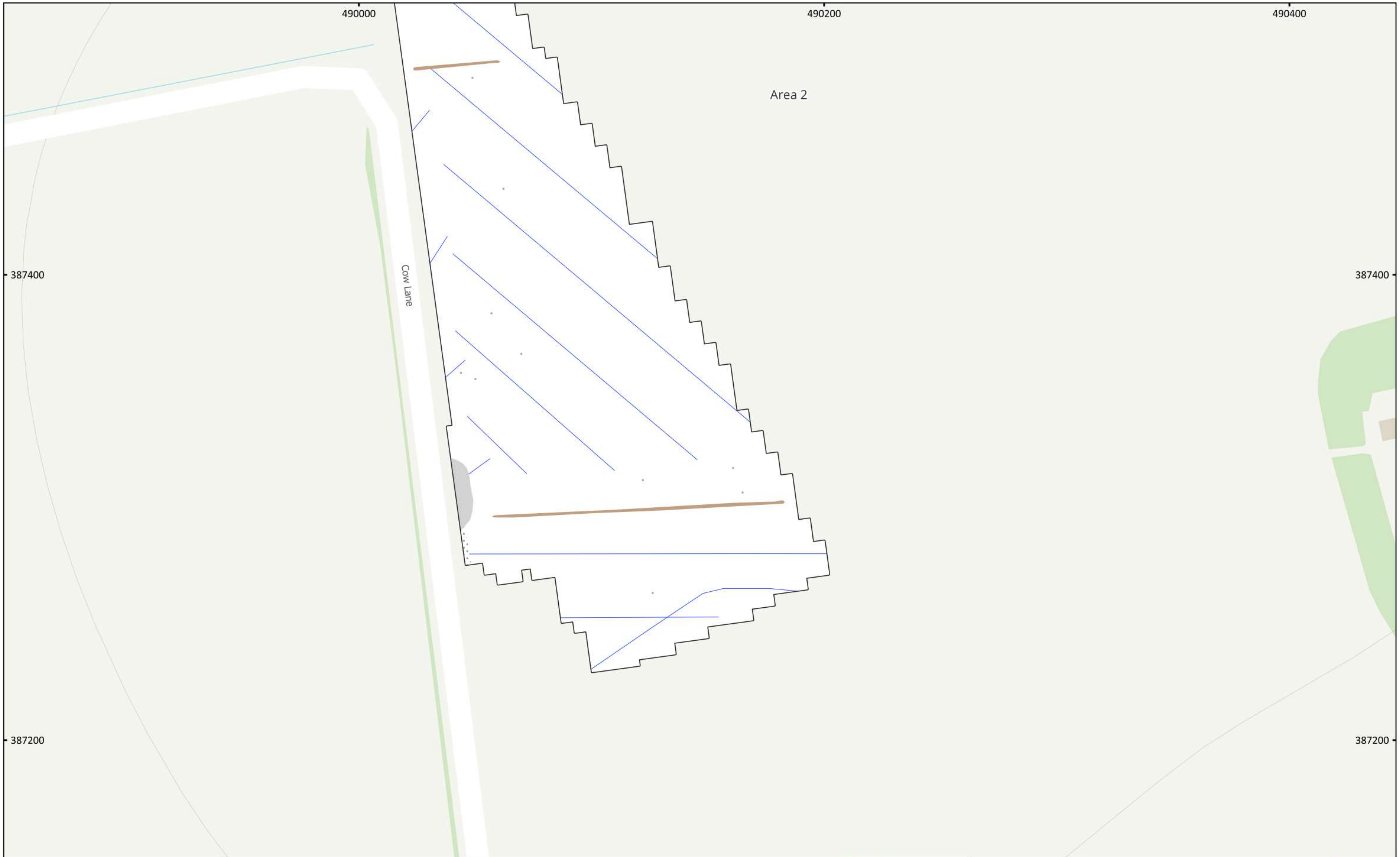


MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 18 - Magnetic Gradient (Area 2 (South))
1:1,500 @ A3





magnitude surveys



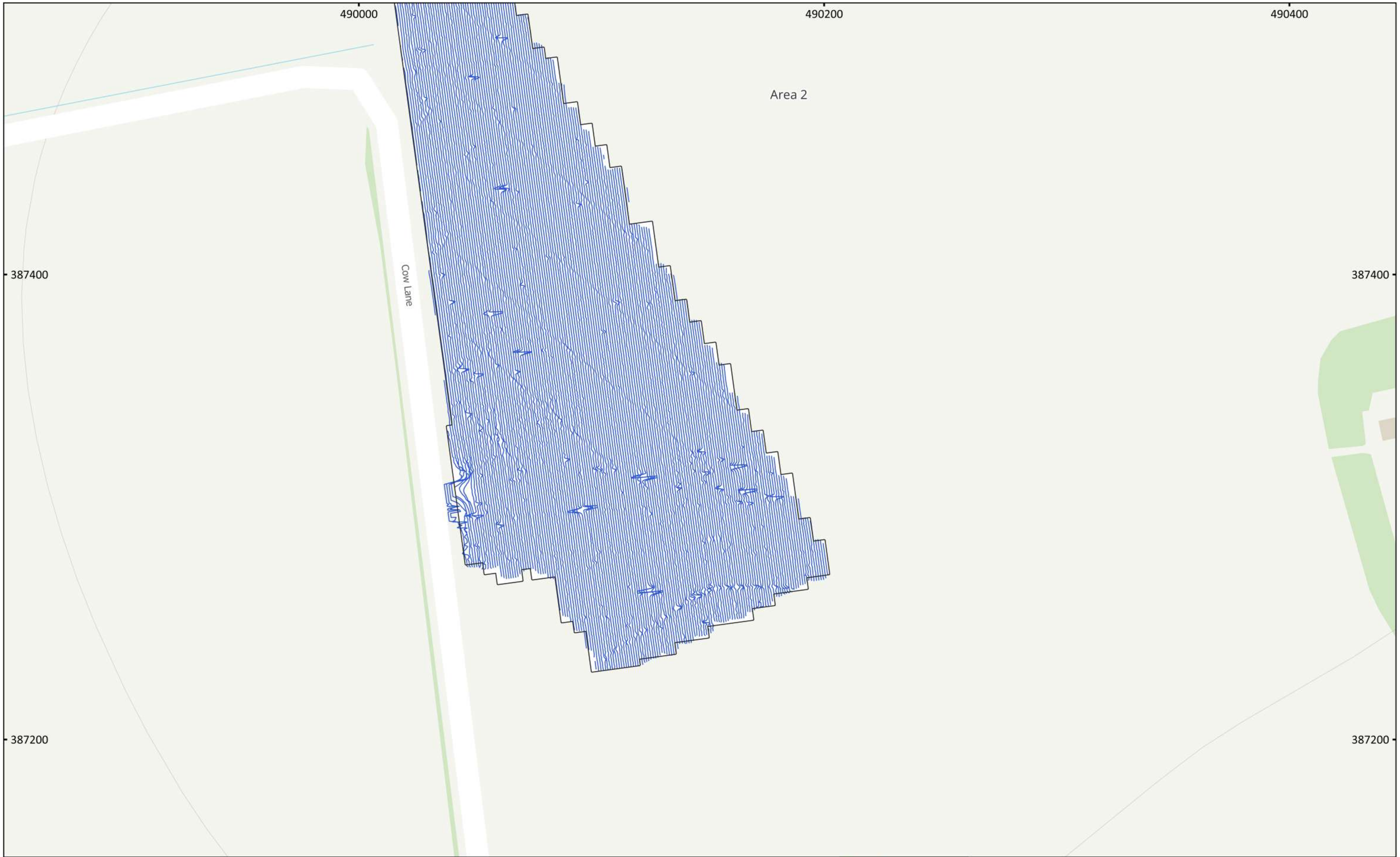
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 19 - Magnetic Interpretation (Area 2 (South))
1:1,500 @ A3

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

N

0 40 80 120 m

magnitude surveys

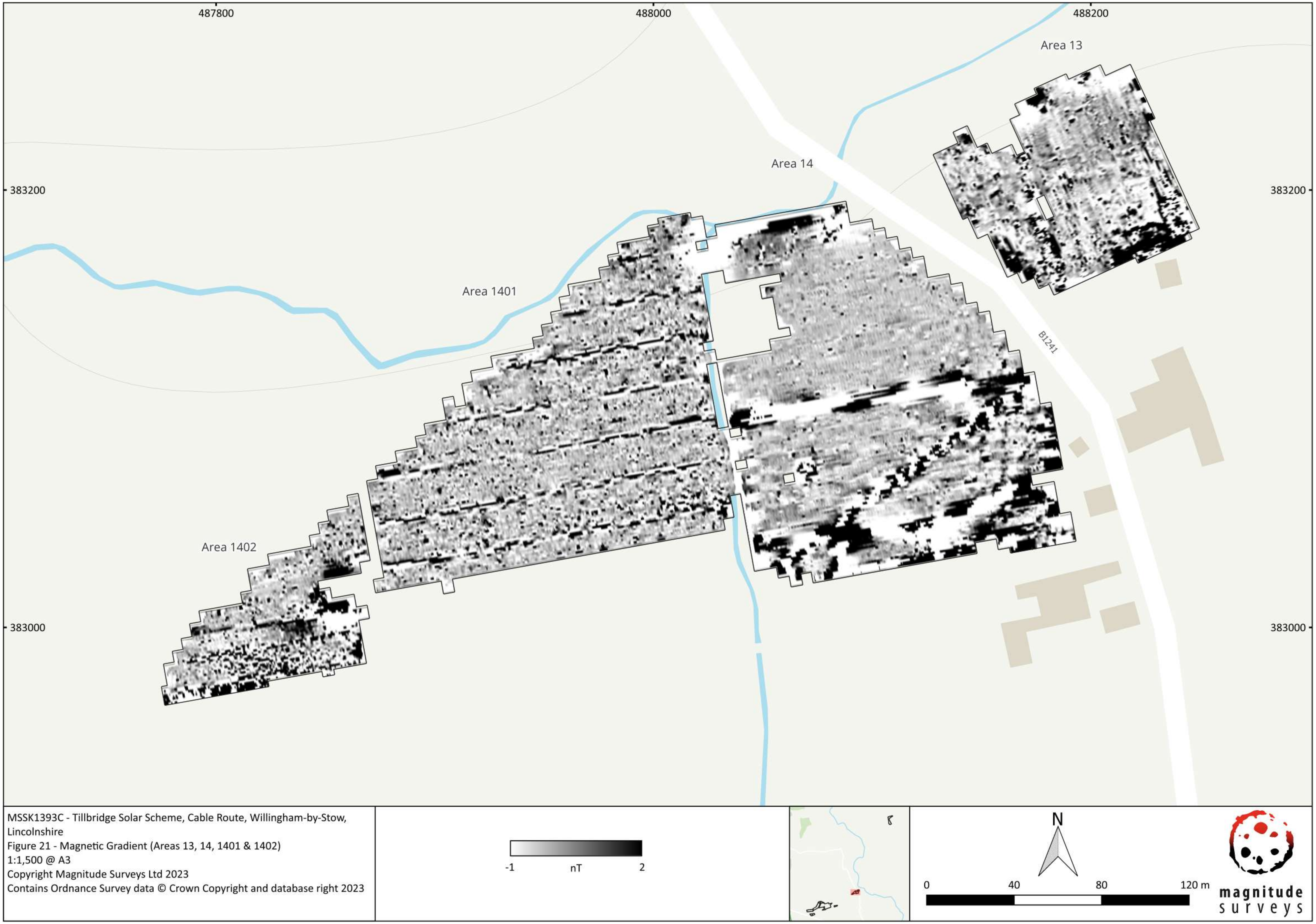


MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 20 - XY Trace Plot (Area 2 (South))
30nT/cm at 1:1,500 @ A3

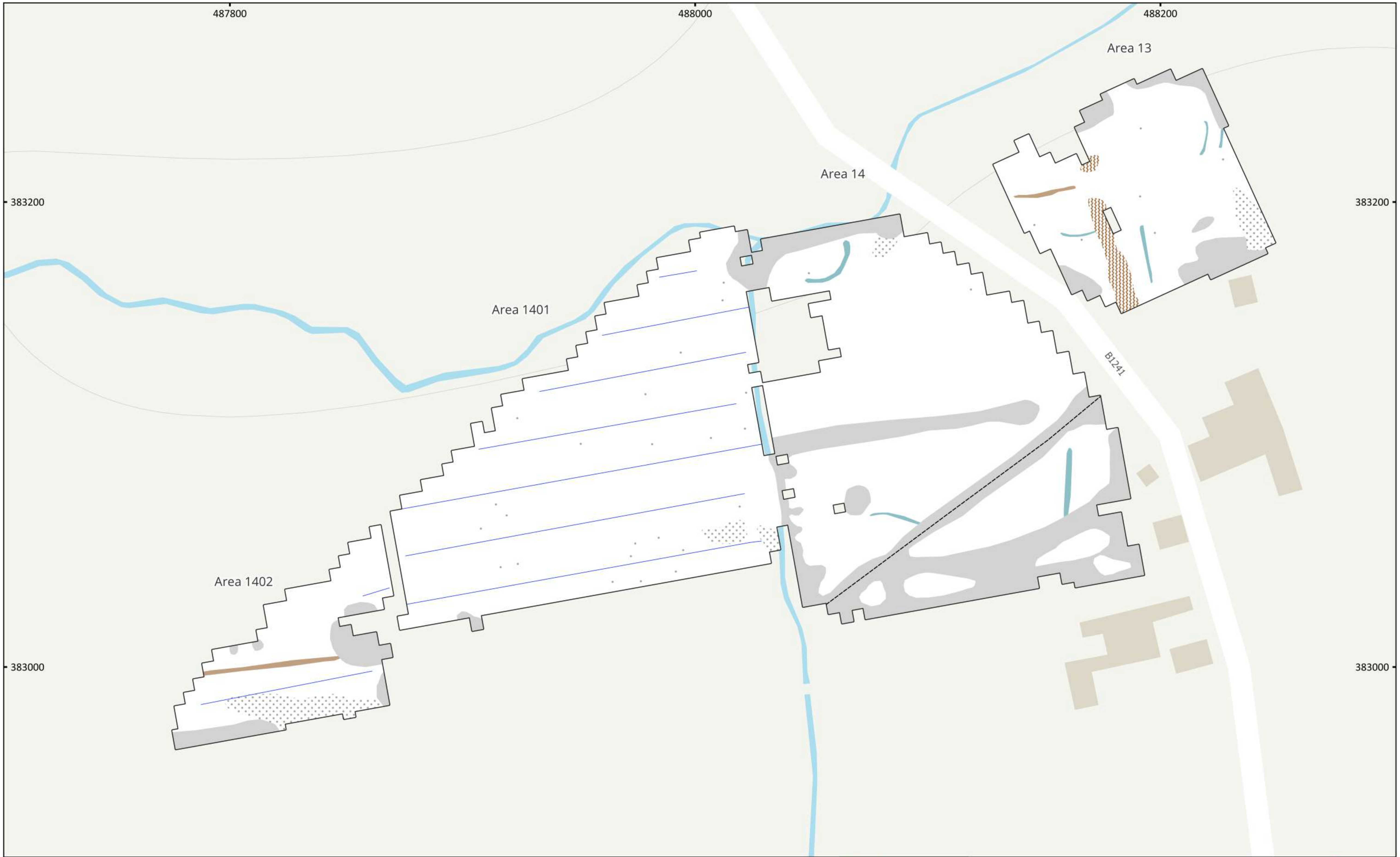
N

0 40 80 120 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 21 - Magnetic Gradient (Areas 13, 14, 1401 & 1402)
1:1,500 @ A3

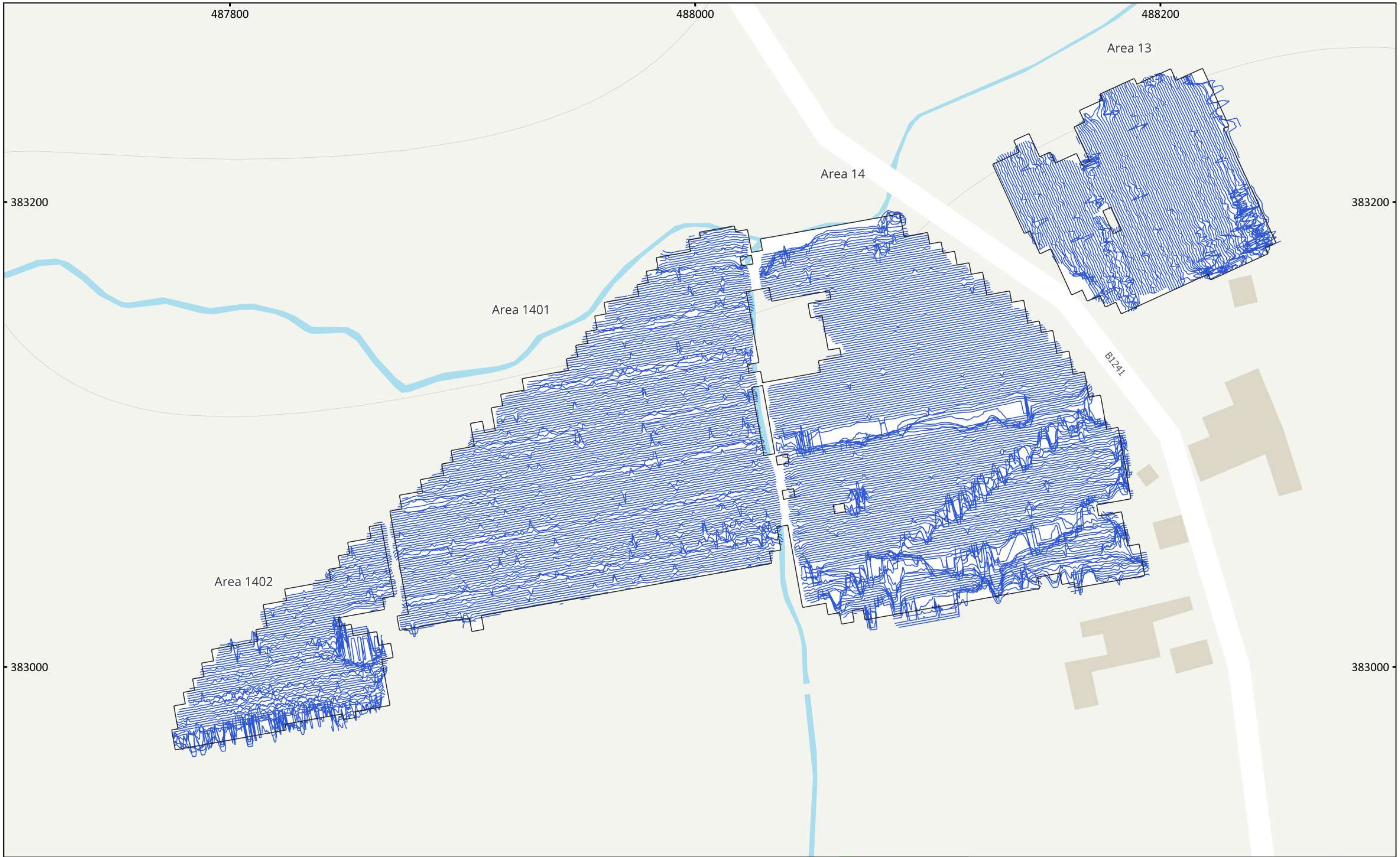


MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 22 - Magnetic Interpretation (Areas 13, 14, 1401 & 1402)
1:1,500 @ A3

Agricultural (Spread)
Agricultural (Weak)
Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Weak)
Service
Drainage Feature
Ferrous (Spike)

N
0 40 80 120 m

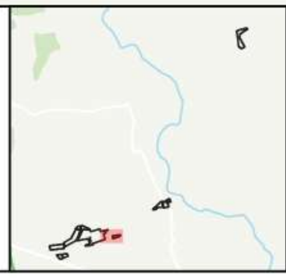
magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 23 - XY Trace Plot (Areas 13, 14, 1401 & 1402)
30nT/cm at 1:1,500 @ A3

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 24 - Magnetic Gradient (Area 16)
1:1,500 @ A3

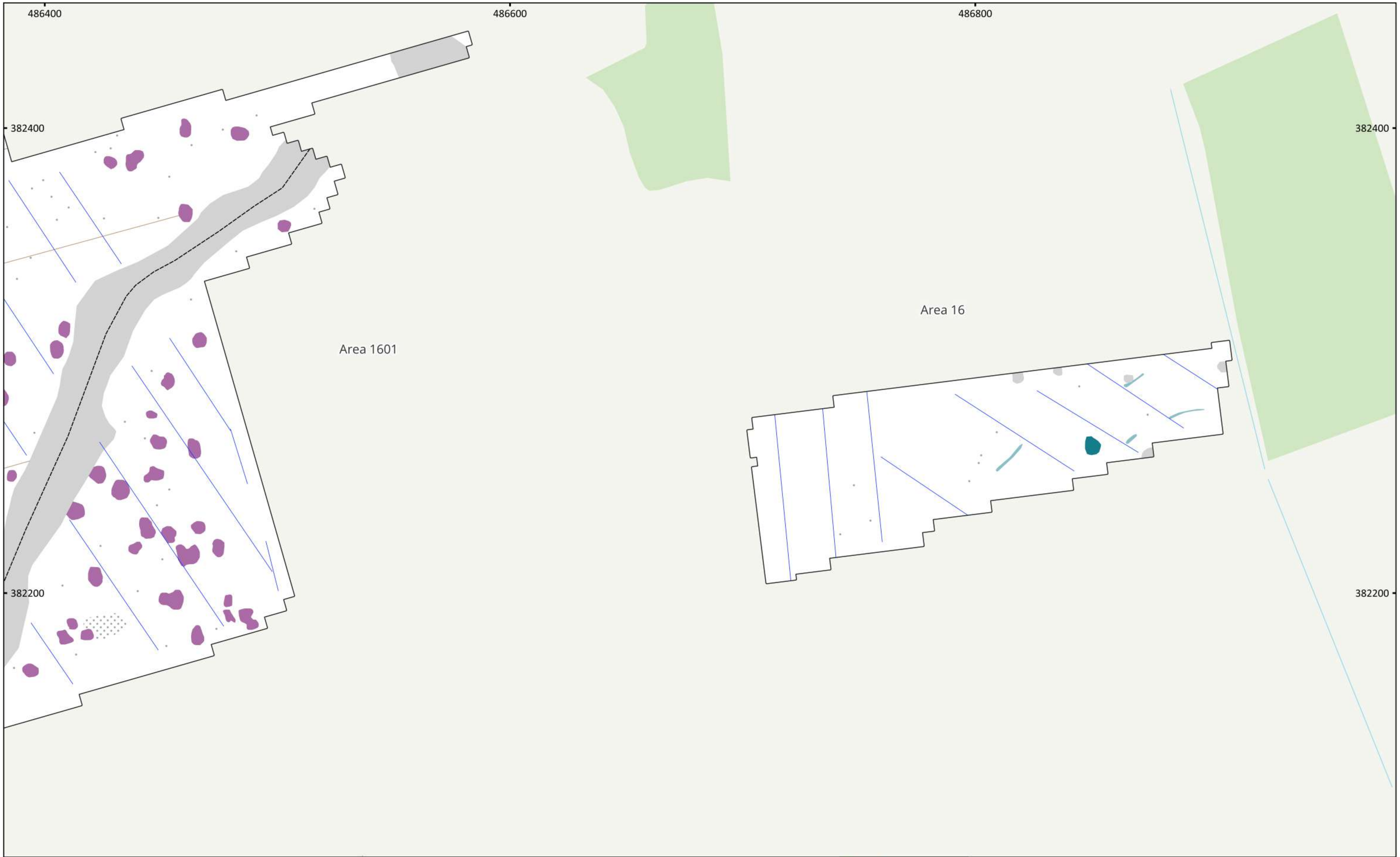
-1 nT 2



N

0 40 80 120 m

magnitude surveys



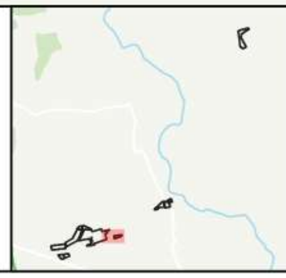
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 25 - Magnetic Interpretation (Area 16)
1:1,500 @ A3

Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Strong)
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Drainage Feature
Ferrous (Spike)

N

0 40 80 120 m

magnitude surveys

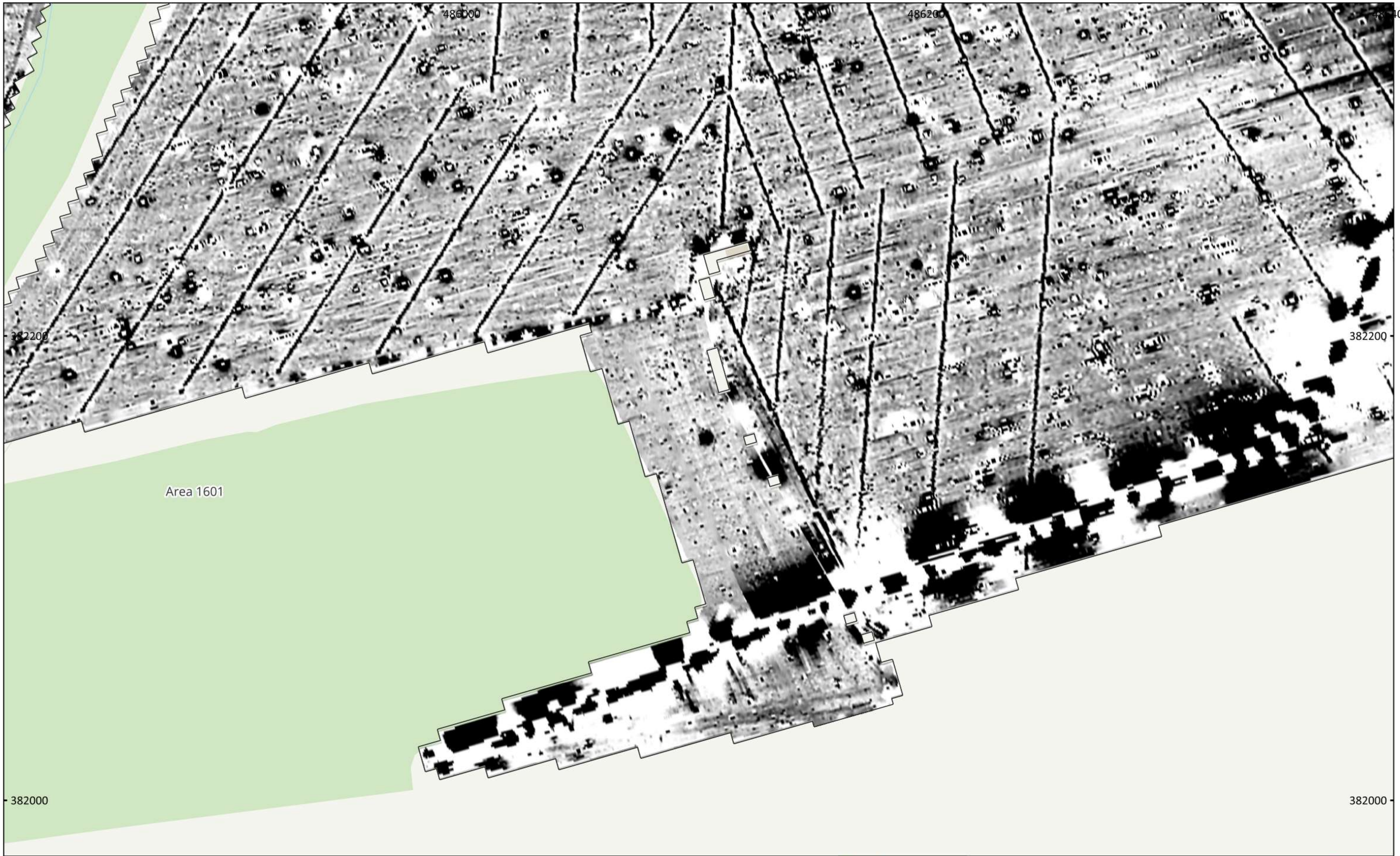


MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 26 - XY Trace Plot (Area 16)
30nT/cm at 1:1,500 @ A3

N

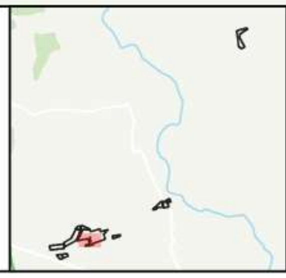
0 40 80 120 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 27 - Magnetic Gradient (Area 1601 (South))
1:1,500 @ A3

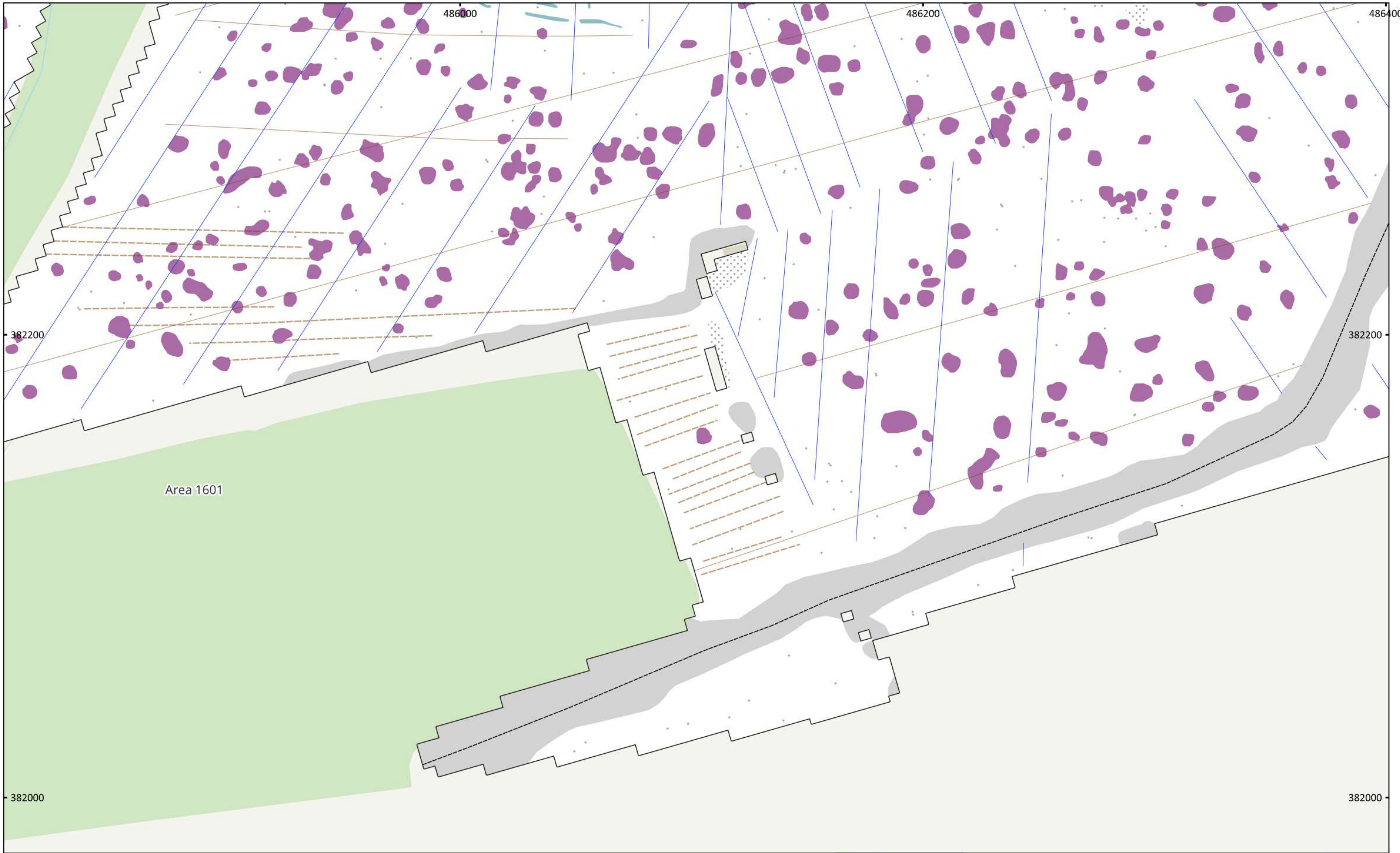
-1 nT 2



N

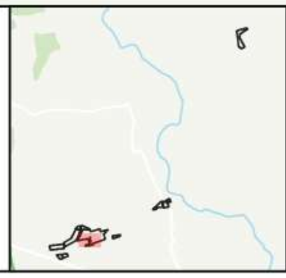
0 40 80 120 m

magnitude surveys



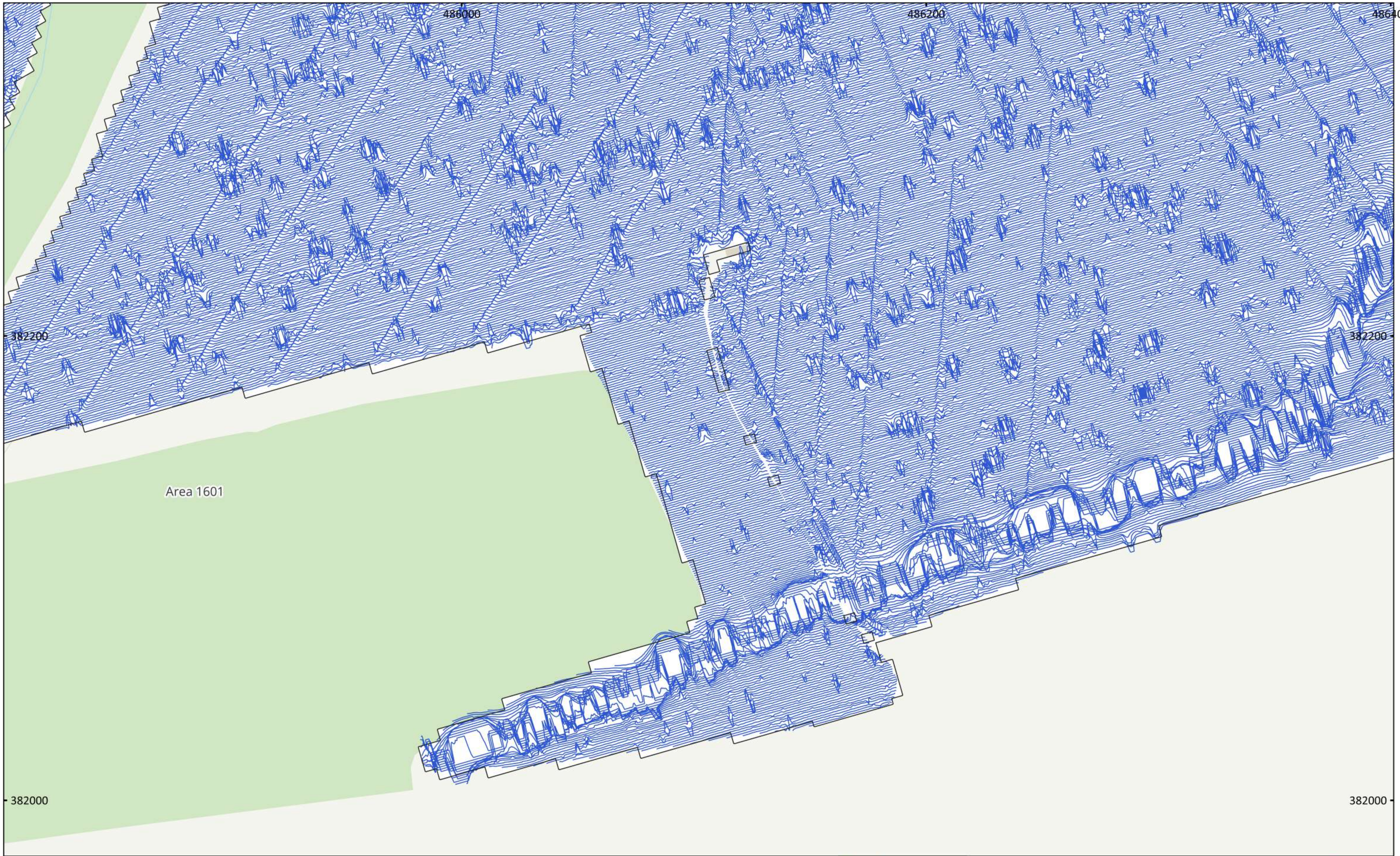
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 28 - Magnetic Interpretation (Area 1601 (South))
1:1,500 @ A3

Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)

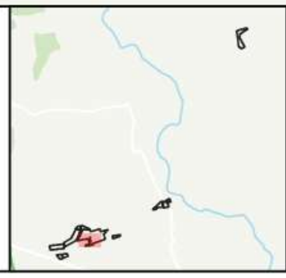


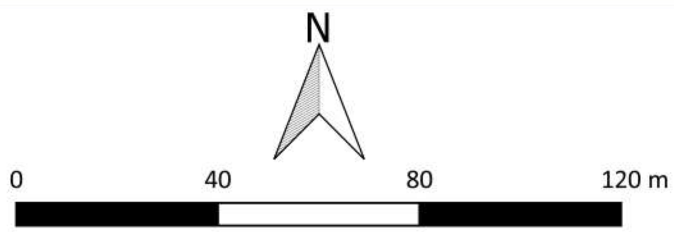
N
0 40 80 120 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 29 - XY Trace Plot (Area 1601 (South))
30nT/cm at 1:1,500 @ A3





magnitude surveys

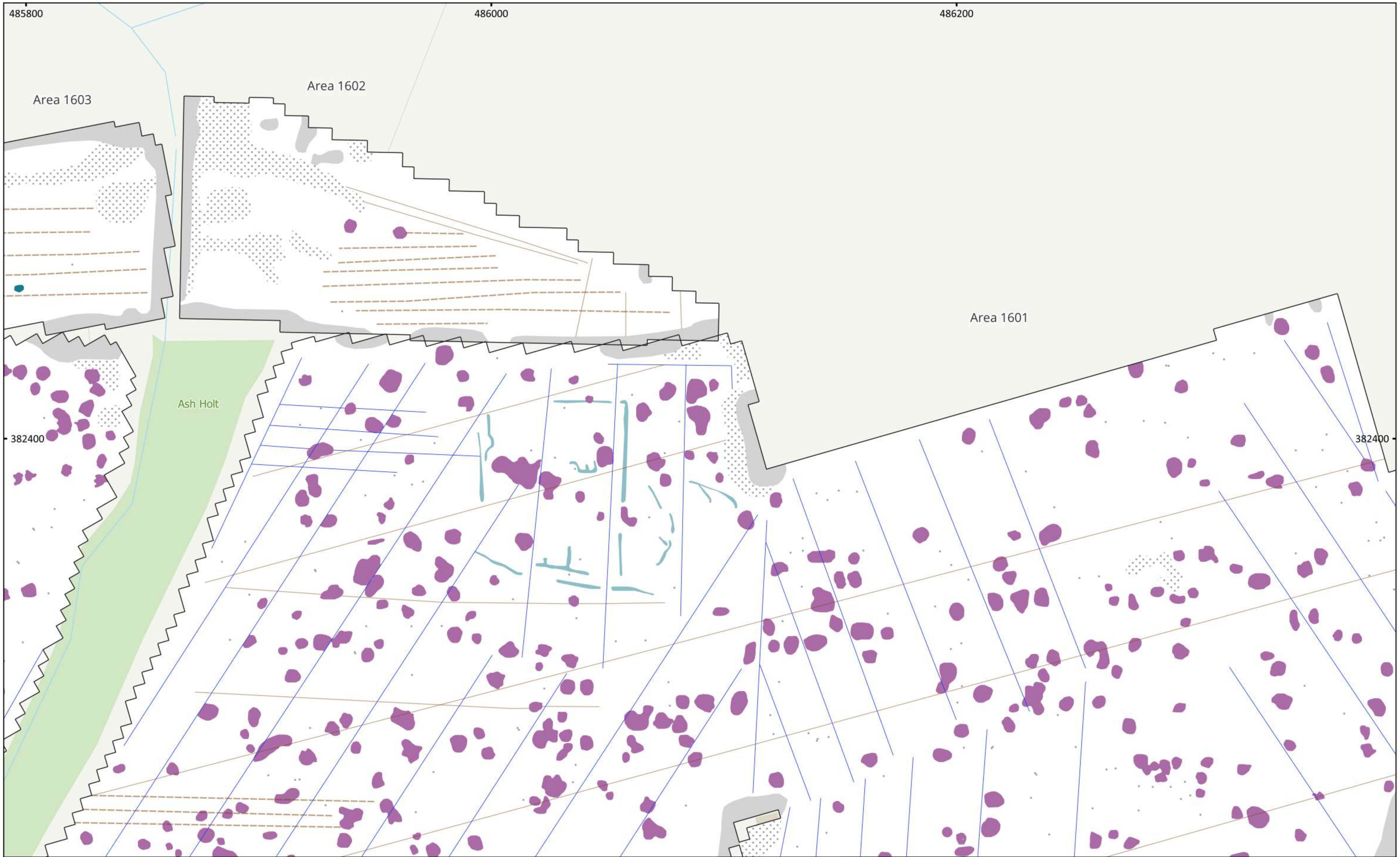
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 30 - Magnetic Gradient (Area 1601 (North) and 1602)
1:1,500 @ A3

-1 nT 2

N

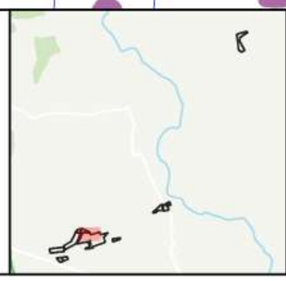
0 40 80 120 m

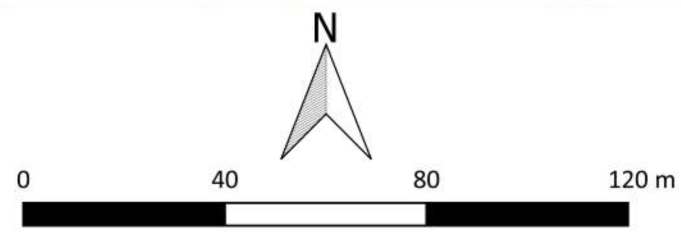
magnitude surveys



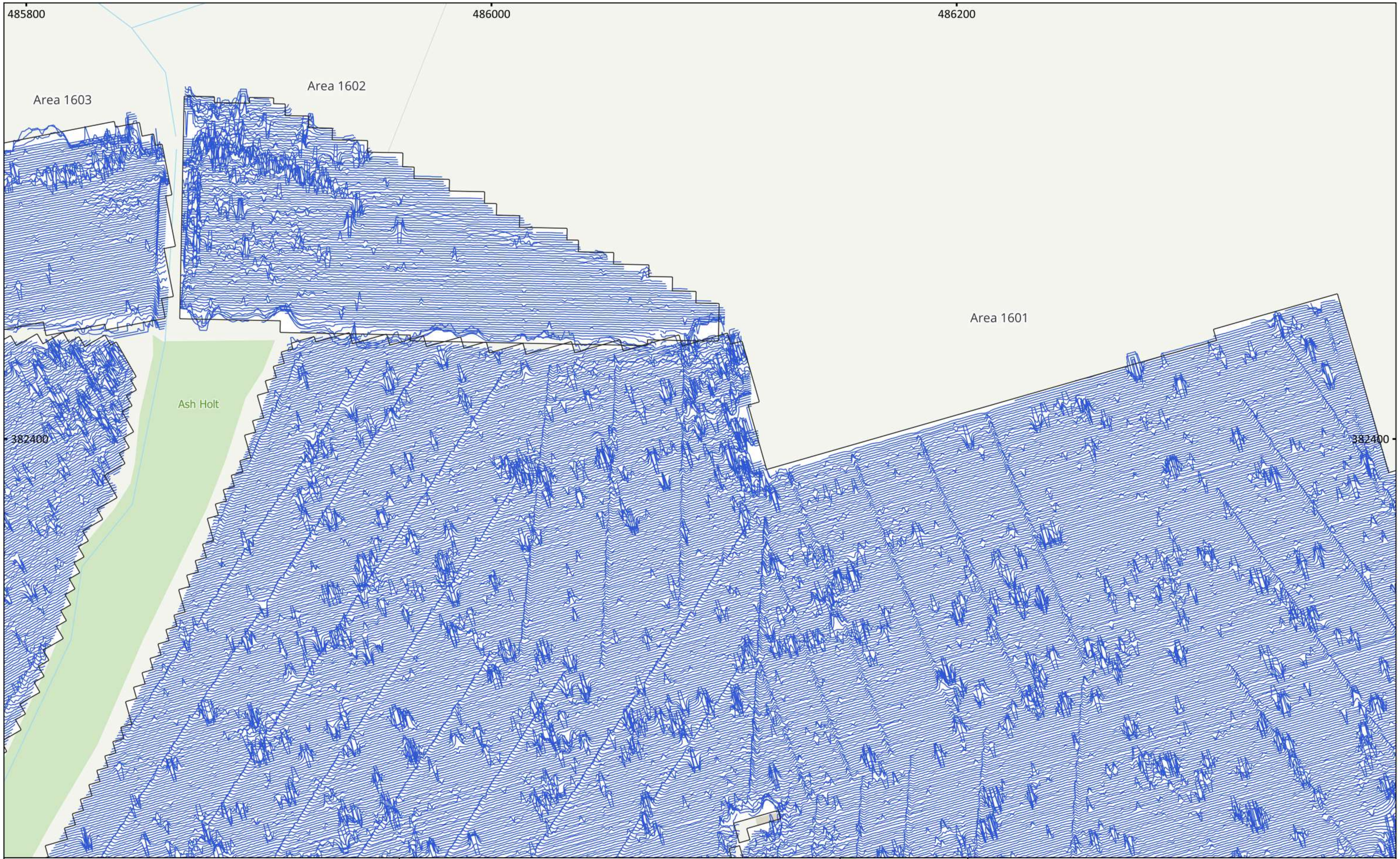
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 31 - Magnetic Interpretation (Area 1601 (North) and 1602)
1:1,500 @ A3

Magnetic Disturbance
Ferrous/Debris (Spread)
Undetermined (Strong)
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)





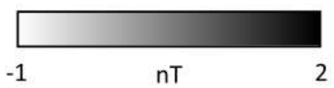
magnitude surveys

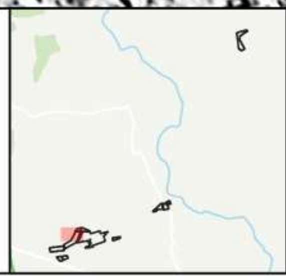


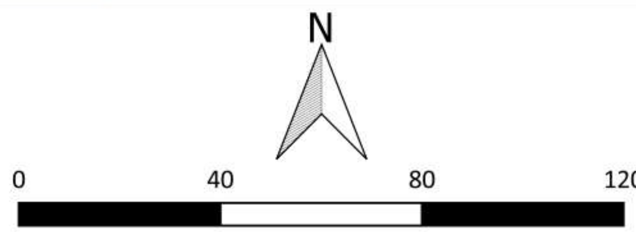
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 32 - XY Trace Plot (Area 1601 (North) and 1602)
30nT/cm at 1:1,500 @ A3

magnitude surveys

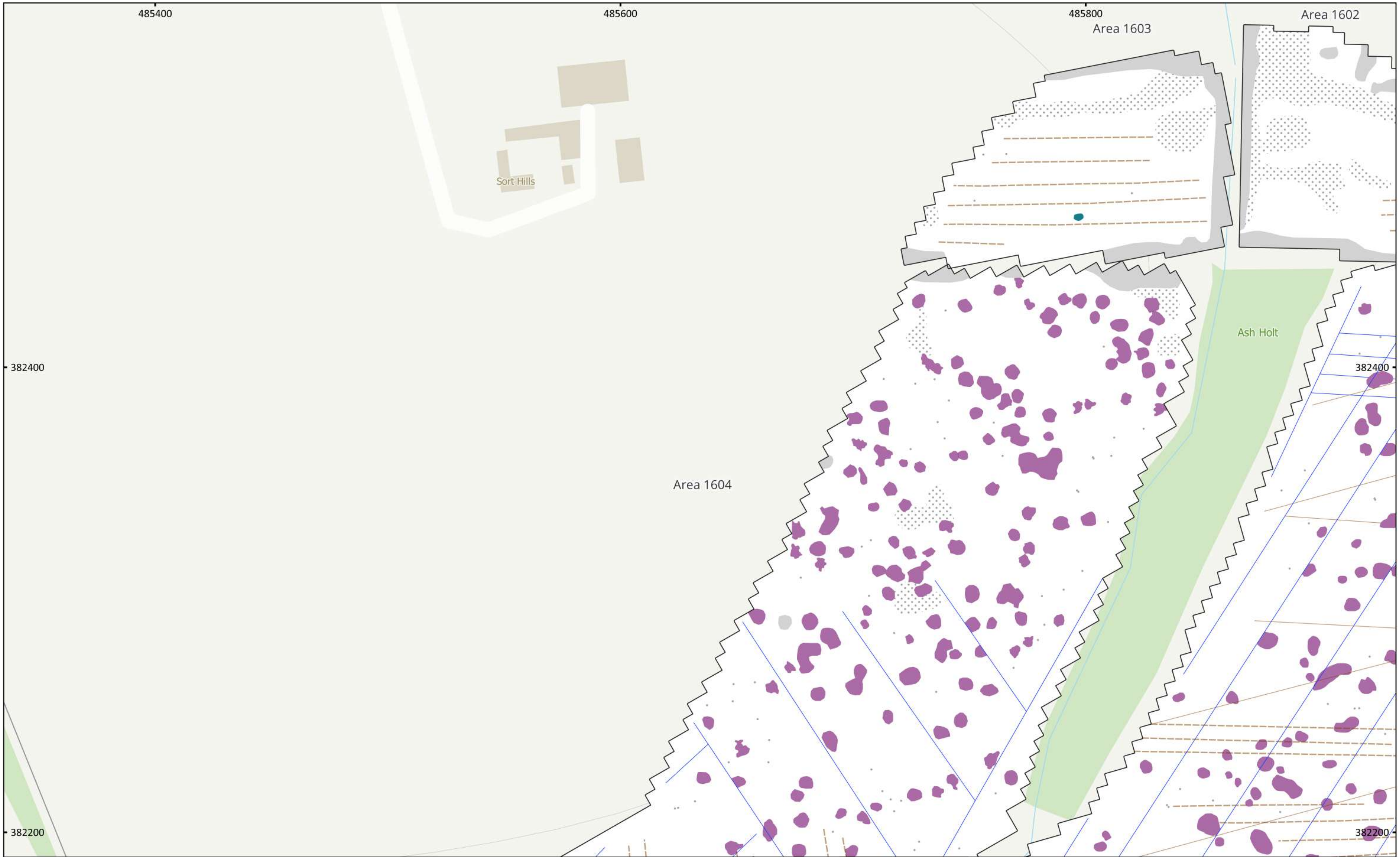
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 33 - Magnetic Gradient (Area 1603 & 1604 (North))
1:1,500 @ A3





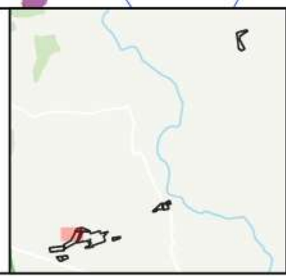


magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 34 - Magnetic Interpretation (Area 1603 & 1604 (North))
1:1,500 @ A3

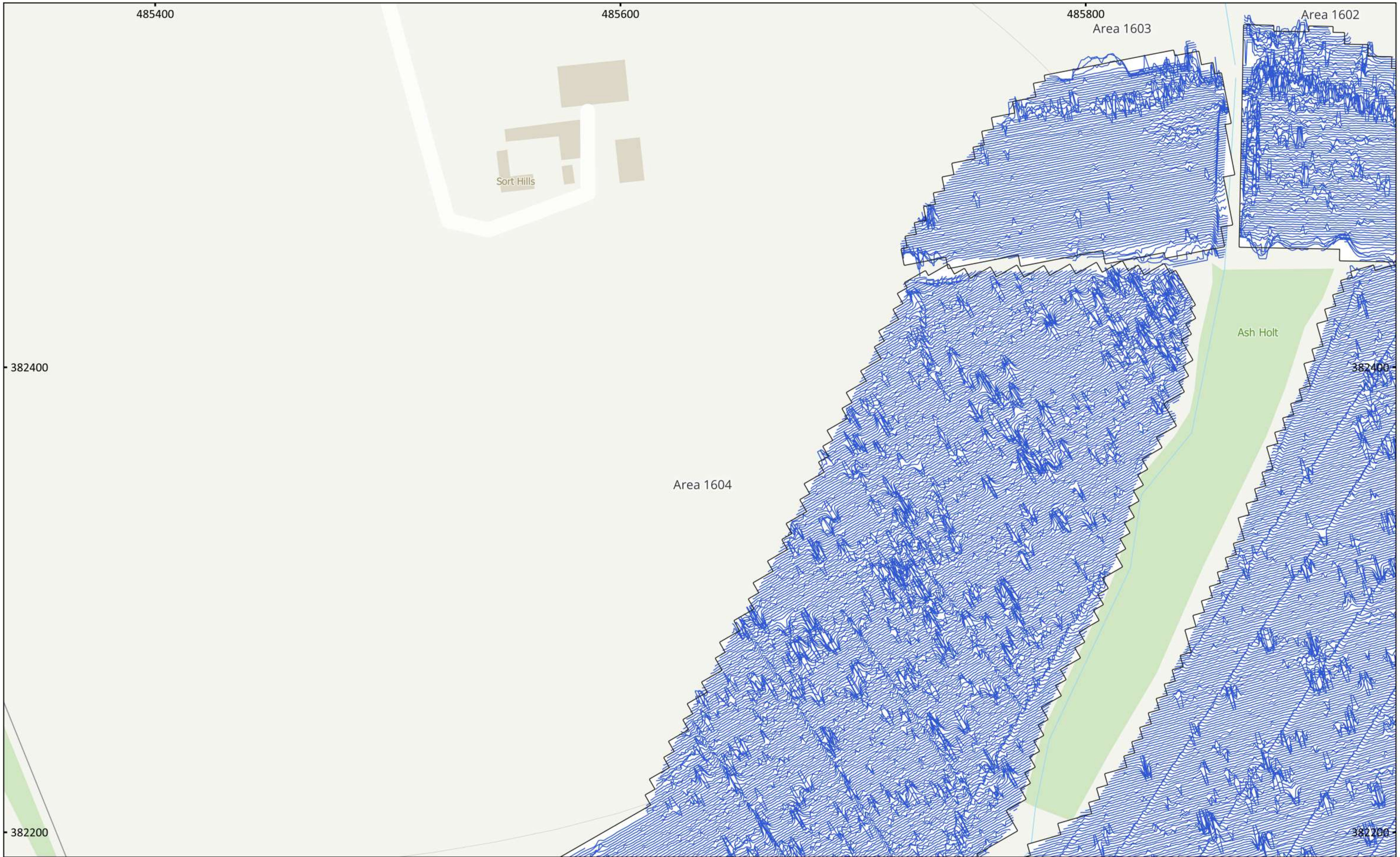
- Magnetic Disturbance
- Ferrous/Debris (Spread)
- Undetermined (Strong)
- Undetermined Ferrous Object
- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Drainage Feature
- Ferrous (Spike)



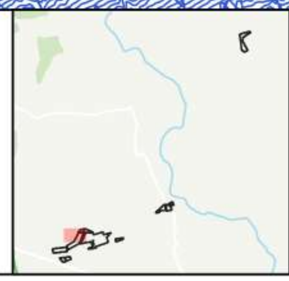
N

0 40 80 120 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 35 - XY Trace Plot (Area 1603 & 1604 (North))
30nT/cm at 1:1,500 @ A3

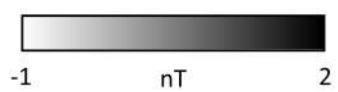


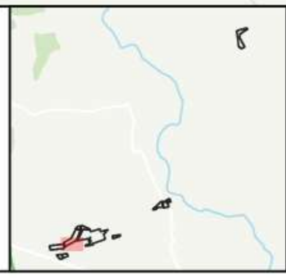
N

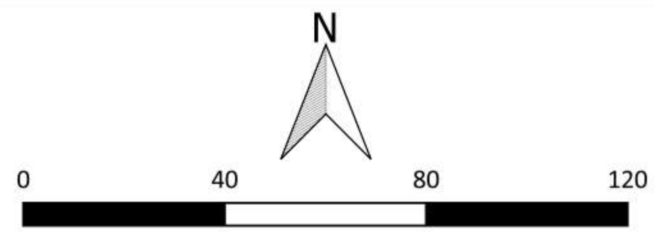
0 40 80 120 m

magnitude surveys

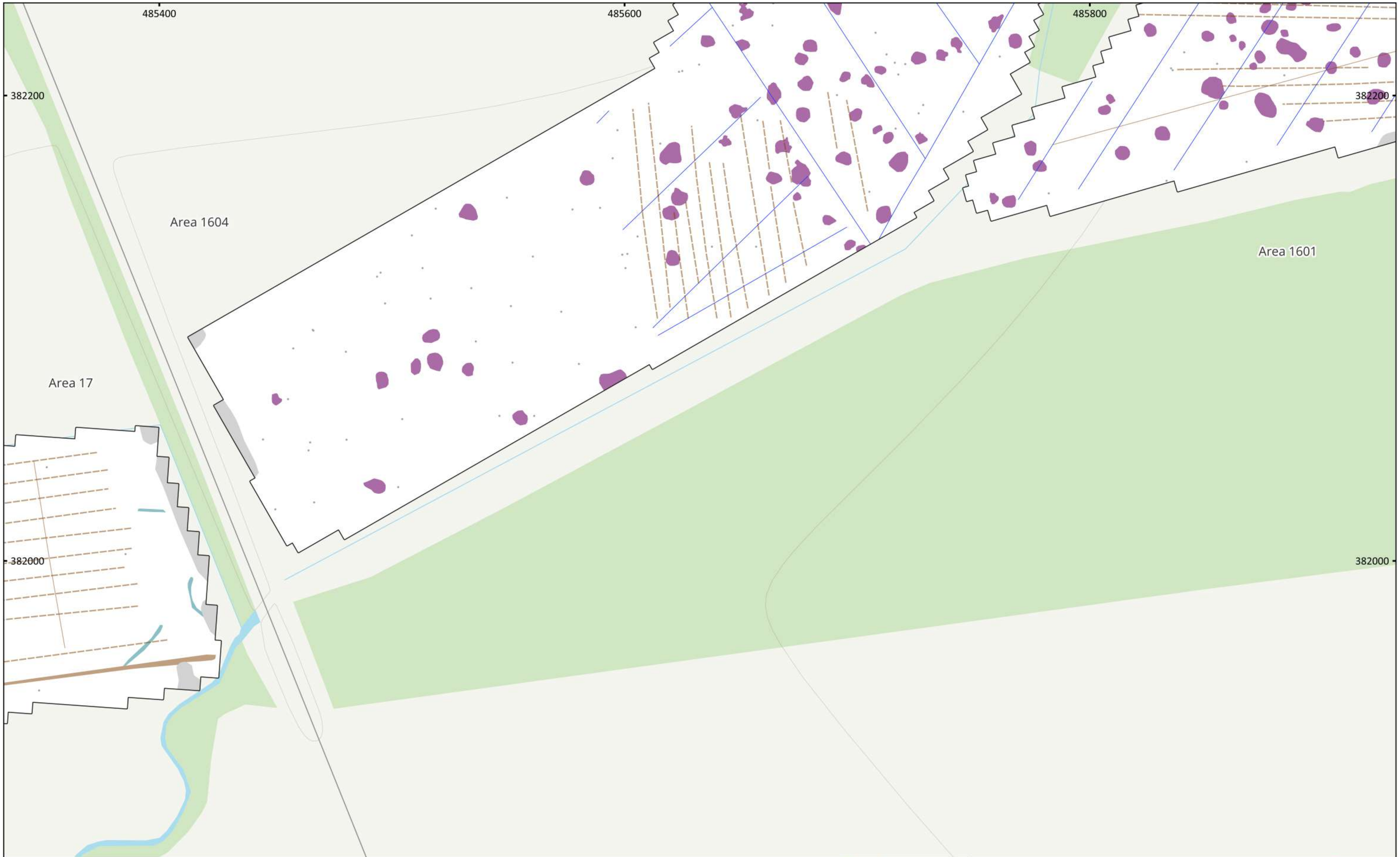
MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 36 - Magnetic Gradient (Area 1604 (South))
1:1,500 @ A3





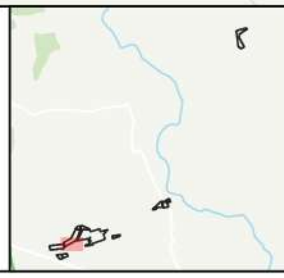


magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 37 - Magnetic Interpretation (Area 1604 (South))
1:1,500 @ A3

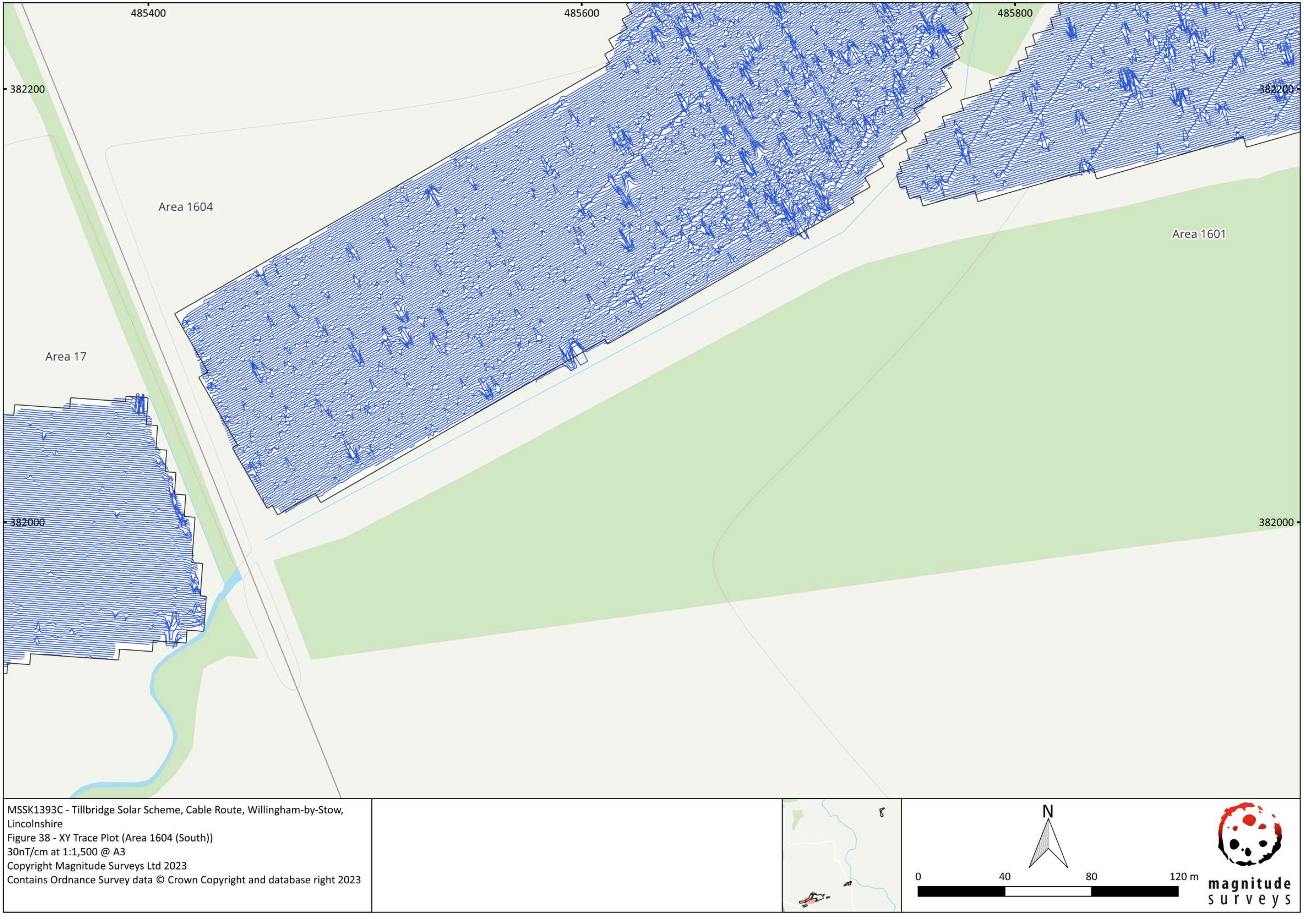
Agricultural (Weak)
Magnetic Disturbance
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)



N

0 40 80 120 m

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 38 - XY Trace Plot (Area 1604 (South))
30nT/cm at 1:1,500 @ A3

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 39 - Magnetic Gradient (Area 17)
1:1,500 @ A3

-1 nT 2

N

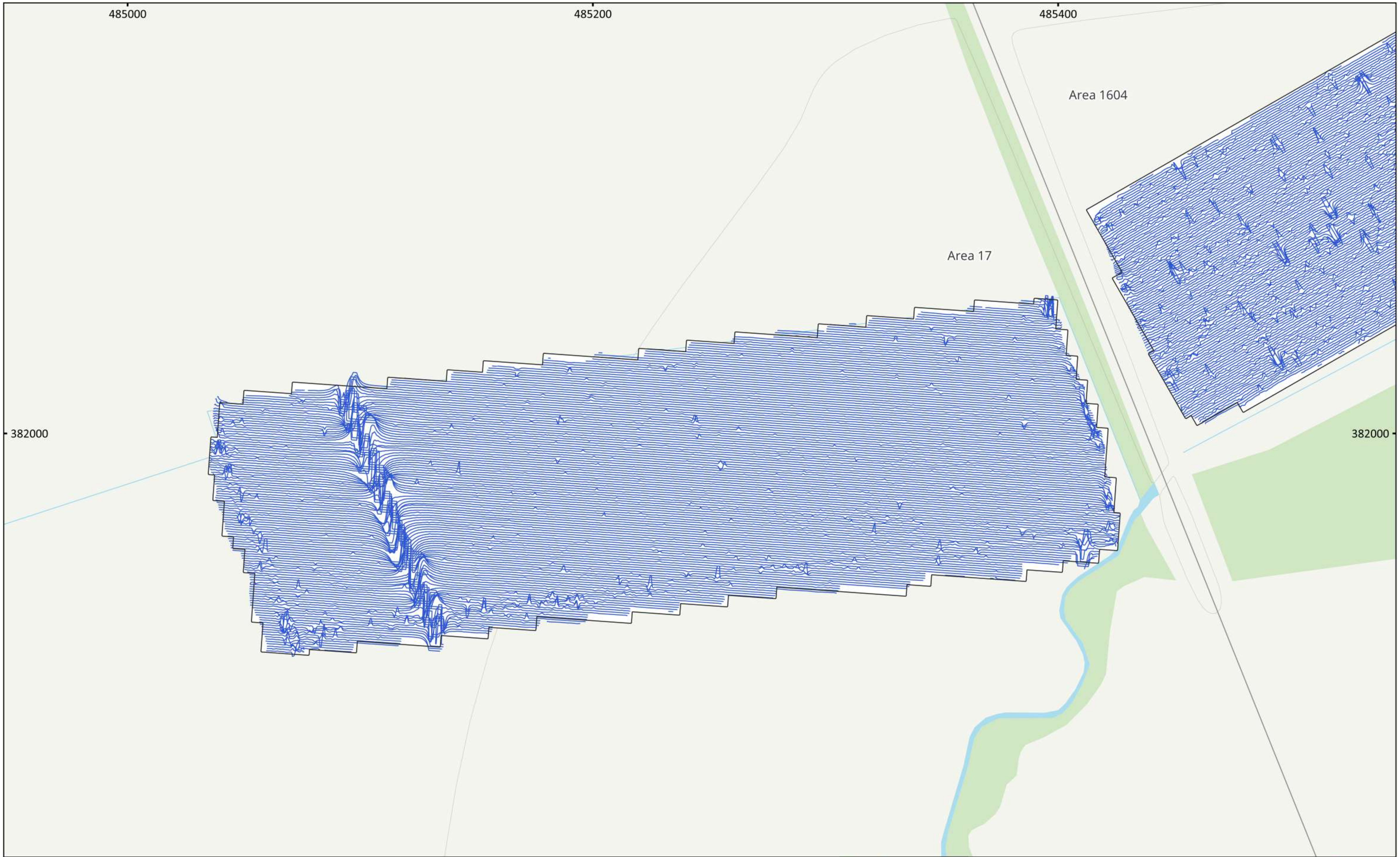
0 40 80 120 m

magnitude surveys

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 40 - Magnetic Interpretation (Area 17)
1:1,500 @ A3

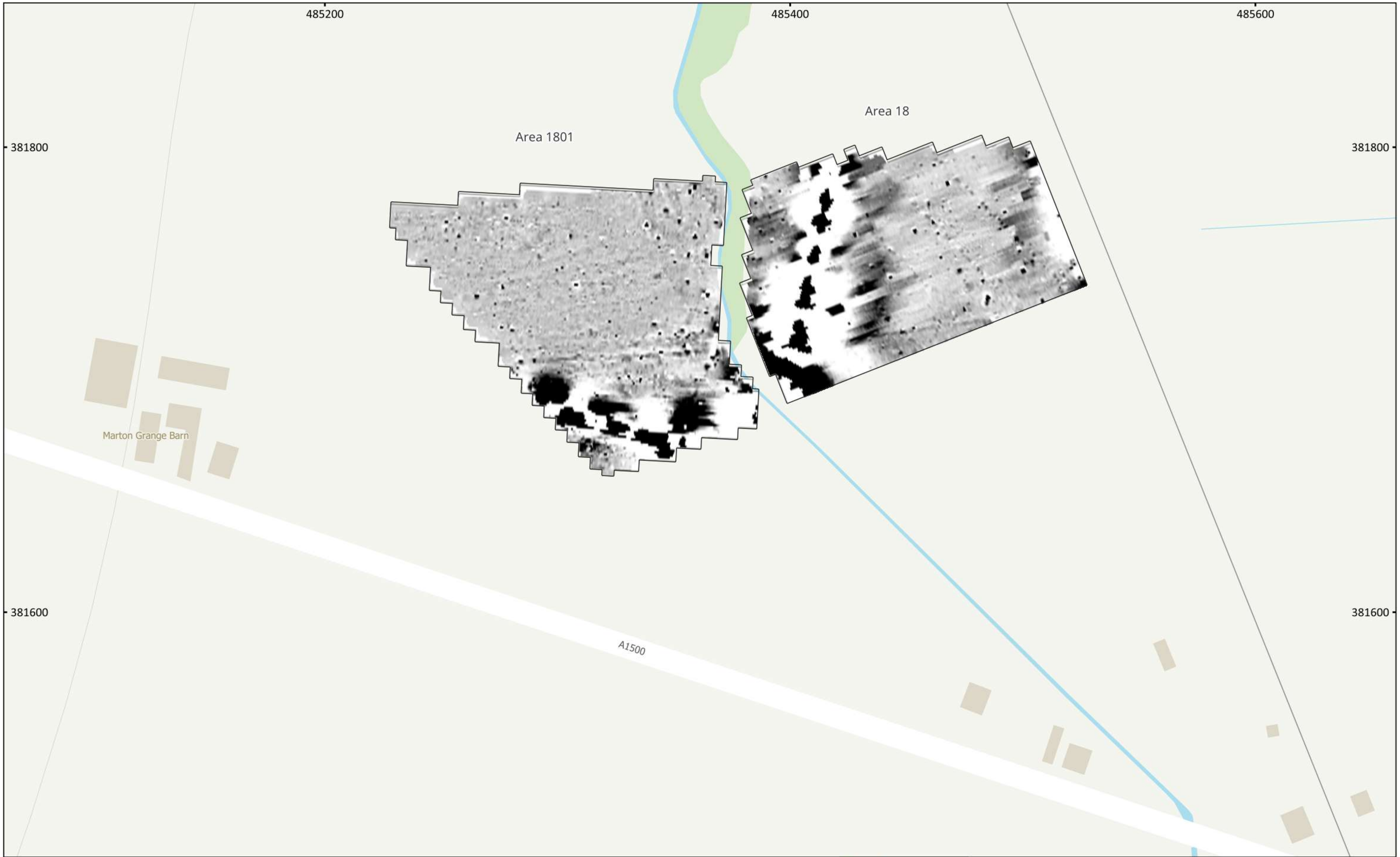
Agricultural (Spread)
Agricultural (Weak)
Magnetic Disturbance
Undetermined (Weak)
Undetermined Ferrous Object
Agricultural (Trend)
Service
Ridge and Furrow (Trend)
Ferrous (Spike)

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 41 - XY Trace Plot (Area 17)
30nT/cm at 1:1,500 @ A3

magnitude surveys



MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 42 - Magnetic Gradient (Areas 18 & 1801)
1:1,500 @ A3

-1 nT 2

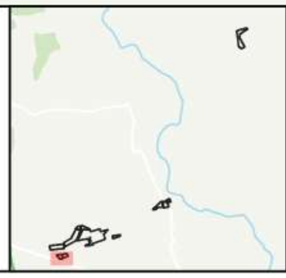
N

0 40 80 120 m

magnitude surveys

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 43 - Magnetic Interpretation (Areas 18 & 1801)
1:1,500 @ A3

Agricultural (Weak)
Magnetic Disturbance
Natural (Spread)
Undetermined (Weak)
Service
Ridge and Furrow (Trend)
Drainage Feature
Ferrous (Spike)



N

0 40 80 120 m

magnitude surveys

MSSK1393C - Tillbridge Solar Scheme, Cable Route, Willingham-by-Stow, Lincolnshire
Figure 44 - XY Trace Plot (Areas 18 & 1801)
30nT/cm at 1:1,500 @ A3

magnitude surveys