

Appendix 13B: Geophysical Survey Report

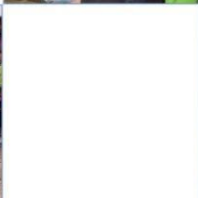
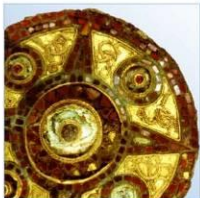
Eggborough, Combined Cycle Gas Turbine (CCGT), North Yorkshire

Archaeological Geophysical Survey

National Grid Reference Number: SE 58232 24594 to SE 57888 28035

AOC Project No: 51669

Date: February 2017



ARCHAEOLOGY

HERITAGE

CONSERVATION

Eggborough, Combined Cycle Gas Turbine (CCGT)

North Yorkshire

Archaeological Geophysical Survey

On Behalf of: Annie Calder
AECOM
One Trinity Gardens
Quayside
Newcastle upon Tyne,
NE1 2HF

National Grid Reference (NGR): SE 58232 24594 to SE 57888 28035

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Prepared by: James Lawton

Illustrations by: Kimberley Teale

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Author: James Lawton

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Enquiries to: AOC Archaeology Group
The Raylor Centre
James Street
York
YO10 3DW

Tel. 01904 413404
e-mail. york@aocarchaeology.com

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Non-Technical Summary

AOC Archaeology Group was commissioned by AECOM to undertake an archaeological geophysical (gradiometer) survey to investigate the potential for buried archaeological remains along the route of a proposed combined cycle gas turbine from Eggborough Power Station.

The route of the proposed development runs from the western edge of the village of Burn (SE 58232 24594) south east to Eggborough Power station where it terminates (SE 57888 28035). The proposed development route covers approximately 26 hectares across seventeen fields. The survey areas consisted of predominately agricultural land although some areas of pasture were included. The land was for the most part generally flat throughout.

The results of the survey located two areas of likely archaeological remains in locations where previously noted HER records exist. However, only a couple of the anomalies identified in the geophysical results fully match the cropmark evidence recorded in the HER. It is thought that a combination of the natural soil and geological variations coupled with significant ploughing may have either destroyed any remains which were hoped to be located in these areas, or that any remains have been buried by alluvium from flooding, masking the remains from geophysical detection.

Several other discrete trends of possible archaeological origin were recorded in a number of areas along the scheme. A further number of possible archaeological trends that were more likely to be of geological or agricultural origins were also detected. None of the detected anomalies were clear or well defined enough to confirm the presence of a previous settlement or monument, and with a lack of records such as HER data or aerial photography in these locations, the results can only be described as being potentially archaeological.

The effects of the local geology and low-lying topography is evident in the results with the presence of a considerable amount of drainage patterns throughout all areas, as well as a number of flood deposits. Ploughing trends of both modern and older ridge and furrow schemes are also recorded in most fields along the proposed development route. Both the drainage patterns and ploughing trends are clear throughout all of the areas surveyed along the scheme, suggesting that any archaeology that once was present has been severely truncated and destroyed. However only further intrusive investigation will confirm these results.

1 Introduction

- 1.1 AOC Archaeology Group was commissioned by AECOM to undertake an archaeological geophysical survey for the proposed Combined Cycle Gas Turbine (CCGT) pipeline, from Eggborough Power Station, North Yorkshire, as part of a wider scheme of archaeological assessment.
- 1.2 The survey was carried out to provide information on the extent and significance of potential buried archaeological remains on the site.

2 Site Location and Description

- 2.1 The survey area is located to the north west of Eggborough Power Station in North Yorkshire, close to the village of Chapel Hadlesey. The pipeline route runs from the Eggborough Power station (SE 58232 24594) to the east of the village of Chapel Hadlesey before turning north west towards the village of Burn (SE 57888 28035) (see Figure 1).
- 2.2 The proposed development route covers approximately 26 hectares, running through seventeen fields which are currently under a mixture of pasture and arable cultivation. Area 13 was largely overgrown vegetation at about chest height and was deemed unsurveyable. Area 12 was under a bean crop and was not surveyed, and Area 14 contained dense scrub that was for the most part also unsurveyable apart from a small section in the north of the area.
- 2.3 The development route is generally level and is situated at a height of approximately 5-10m above Ordnance Datum (OD) and crosses numerous drainage ditches and the River Aire.
- 2.4 The site is located on bedrock geology of Sherwood Sandstone with superficial geology of Hemingbrough Glaciolacustrine Formation, Clay and Silts and Brighton Sand Formation – Sand (BGS 2017). The soils are made up of a combination of freely draining slightly acid sandy soils, loamy soils with naturally high groundwater, slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, and loamy and clayey floodplain soils with naturally high groundwater (Soilscapes 2017).
- 2.5 Gradiometer survey is suggested to provide a good response to this type of geology, although results can vary depending on the formation of the geology (David *et al.* 2008, 15).

3 Archaeological Background

- 3.1 The archaeological background below is drawn from the PEIR preliminary environment information report produced for the proposed development by AECOM (AECOM 2016). It shows their current archaeological baseline, although this is only at a draft stage (References, Photographs and Site codes e.g. HER numbers not included in this WSI). A more detailed assessment is currently about to be produced by AECOM but at this current time no other information is available.

Scheduled Monuments

- 3.2 There are four Scheduled Monuments within the 5km study area. These consist of the following:
- 3.3 The buried remains of a Roman fort are located approximately 1km north-west of the proposed development (1017822). The fort, and associated features, is located on a sandstone promontory on the south side of the River Aire flood plain. There are no known Roman roads leading to the fort and the garrison is believed to have been supplied by the river, which is relatively rare and contributes to the value of the monument.

- 3.4 There are also a number of non-designated assets that relate to the fort at Roall that are included for completeness, comprising the auxiliary fort (MNY12278), the vicus (MNY12279/919950) and the bath house (MNY12280).
- 3.5 The fort would originally have been located directly adjacent to the River Aire when it ran along its original course which is now indicated by the crescent shaped pond named Old Hee, visible along the northern boundary of the scheduled area. The fort is orientated north-east to south-west on its long axis and the main gate faces the river, on the north-east side. The fort is surrounded by a double ditch and given the typical shape and in comparison with other forts in the locality is thought to date to the 1st century AD, specifically the Flavian period (69 AD – 96AD). Geophysical survey and intensive aerial photograph analysis has been carried out at this site which has identified internal features and associated linear features beyond the defences. These include a possible bathhouse, an associated vicus located to the southeast and southwest and paddocks. It is likely that there will be waterfront type features located near the Old Hee pond and the relict course of the River Aire, including possible wharfs, bridge footings or boats themselves.
- 3.6 The setting of the fort is defined principally by the extent of its buried remains, and, if it was supplied by the Aire, by its topographical location and relationship with the former course of the river, although it does not flow in the same location as during the Roman period, as indicated by the location of the Old Hee pond. The fort occupies a level area which would have been directly on the banks of the river with extensive views in all directions. The setting of the fort has altered, with the introduction of large, modern elements such as the existing power station.
- 3.7 There is evidence for Roman military activity at Castleford to the west and Brough to the east with major road networks running to the east and west. In closer proximity, there are a number of non-designated cropmarks which have been tentatively dated to the Roman period indicating further activity in the study area.
- 3.8 Whitley Thorpe moated Templar grange site is located approximately 3.8 km south-west of the proposed development (1017458). A monastic grange was run by a monastic community, to provide food and materials for the parent monastic house, independent of the secular manorial system. The site occupies an area of slightly raised ground; however long-range views do not form part of its setting. The setting of the monastic grange is defined primarily by the extent of its buried and extant remains, which include infilled fishponds and denuded ridge and furrow, as well as its association with the surrounding lands which formed the manor of Whitley, held by the Knights Templar from before 1248.
- 3.9 Another scheduled monastic grange is located to the north, approximately 7km north of the existing power station and 4km north of the northern extent of the proposed cable connection. Thorpe Hall moated monastic grange (1017460) was originally a grange of the Benedictine abbey at Selby and includes a number of slight earthworks and extensive buried remains. The setting of the site is defined by the extent of the buried and extant remains and also by its historical association with the remnants of medieval agriculture in the surrounding area.
- 3.10 A World War Two (WW2) bombing decoy control building (1020499) is located approximately 4.8km north of the northern extent of the proposed cable connection, and 7.8km north of the proposed development. The monument includes the standing remains of a control building for a dummy aerodrome, and the primary purpose of the site was to act as a decoy to divert enemy aircraft from attacking the RAF fighter station at Church Fenton, located 6.5km to the north-west. The location of the decoy forms an integral component of its setting, and contributes to its significance as a feature which formed part of the chain of defence of Britain during WW2. It is located on the anticipated flight

path that enemy aircraft would have taken towards the Church Fenton parent station, which would have seen them follow a course along the Humber Estuary and River Ouse before swinging north towards Church Fenton. The original function of the asset can only really be appreciated from the air and at night.

Listed Buildings

- 3.11 There are 82 listed buildings within the study area. These consist of four grade I, three grade II* and 75 grade II assets. A significant number of buildings are located within settlements or are similar in terms of their type and setting; these are grouped together accordingly for the purpose of this report.
- 3.12 (The details of these listed buildings are found in the full version of the AECOM report but for the purpose of this WSI have been excluded as they have little or no impact from the survey).

Non-designated assets

- 3.13 There are 71 non-designated heritage assets within the 1km study area. The principal heritage assets within close proximity to the proposed development (main site and gas pipeline corridor) are summarised below.
- 3.14 There is known prehistoric activity in the 1km study area. Cropmarks that are likely to be associated with an Iron Age or Roman ditched enclosure are located approximately 500 m to the east of the southern end of the proposed gas pipeline corridor (1315714).
- 3.15 Cropmark evidence has identified a trackway (MNY10008) and field system (MNY10003) of potential late prehistoric or early Roman date 450 m to the north of the gas pipeline corridor.
- 3.16 Cropmark evidence has also identified an undated enclosure and possible trackway on the western edge of the gas pipeline corridor (MNY24129). A medieval find is also recorded in this location (MNY10013). There is no evidence to suggest that the features extend to the east into the gas pipeline corridor.
- 3.17 The remains of a double-ditched enclosure (1318872) and field system (1318895) are recorded on the southwestern edge of the gas pipeline corridor at the point it crosses the existing A19 carriageway. An undated enclosure, also been identified from cropmark evidence, is located approximately 220 m to the north-west of the double-ditched enclosure (MNY10018).
- 3.18 An undated enclosure has also been identified from cropmark evidence approximately 650 m east of the gas pipeline corridor (MNY17090/1318742) and may be of prehistoric or medieval origin. MNY24130 is located approximately 150 m west of the gas pipeline corridor on the north bank of the River Aire. The feature was recorded during a watching brief on a gas pipeline and comprises a ditch and bank that may be part of a dyke system that went out of use in 1789 (On Site Archaeology, 1999).
- 3.19 Within the footprint of the existing Eggborough power station is the site of Sherwood Hall (MNY17093/MNY9849). Associated with this former asset are the cropmarks of three ponds and a possible drain (1315781). The remains of a metalled trackway (MNY34131) recorded during a watching brief in 1998 may also be associated with the hall. Sherwood Hall was occupied by William Morritt Esq. in the 1820s (www.geunki.org.uk). The date of construction of this hall is unknown, but was previously known as Potterlawe and is claimed to have been a grange of the Templar Preceptory located at Temple Hirst to the north of the River Aire (Worsfold 1894). The hall was demolished in the 1960s to make way for Eggborough power station.
- 3.20 There are a number of non-designated assets relating to the medieval Hall Garth moated site (56177/MNY9969). The site is non-designated but has been identified through consultation as being

of potential national importance. The known extent of the site has been defined primarily by cropmark evidence and map regression, and the gas pipeline corridor has been designed to avoid remains associated with the site.

- 3.21 The double moated site was constructed by the Basset family in the 12th century. The earliest structures included a hall with the moat added in the 13th century. Rescue excavation undertaken during the 1960s also found evidence of Roman and Saxon activity. Timber buildings were replaced with stone structures in the mid-13th century, and further alterations were made in the 14th century with the construction of a kitchen followed by the remodelling of the manor and construction of a gatehouse and bridge over the moat in the 15th and 16th centuries.
- 3.22 Hall Garth appears on the Ordnance Survey maps from the 1849 1st edition until the 1973 edition when it is no longer shown. The mapping shows the extent of the moat, showing that all four arms were visible as earthworks until the mid-20th century. The 1849 Ordnance Survey map shows the moat in detail, indicating that the western section of the moat may still have contained water, or at least be heavily waterlogged.
- 3.23 The disappearance of Hall Garth from the Ordnance Survey mapping may have occurred as a result of the construction of flood defences in the 1960s, which prompted the rescue excavation. The excavation, led by Mrs. J Le Patourel, recorded the extensive preservation of the asset and the chronology of the site's development. The existence of the moated site, along with the monastic granges and number of settlements in the study area suggests that this area was a relatively well-populated and utilised rural landscape during the medieval period.
- 3.24 The setting of Hall Garth is defined primarily by the extent of its buried remains. The shared historical association with remnant medieval field systems in the wider study area also contribute to the setting of Hall Garth.
- 3.25 Evidence of medieval agricultural activity has also been identified at the northern limit of the gas pipeline corridor, located to the west of the settlement of Burn abutting West Lane on its eastern side. Cropmark evidence suggests ridge and furrow and field boundaries (1309762). The site of a medieval windmill is recorded approximately 460 m east of the gas pipeline corridor on the south side of the River Aire (MNY17065).
- 3.26 Findspot evidence, which can provide a background signature on the type of activity in an area, includes two findspots of late Iron Age and Roman pottery (MNY10002, MNY10001) and also medieval finds (MNY10000) (MNY9999).
- 3.27 Burn Airfield is located approximately 600 m north-east of the gas pipeline corridor (MNY1063). The airfield opened in November 1942 as a base for Wellington Bombers of the RAFs 4 Group, Bomber Command, 578 Squadron, and had three concrete runways, associated hangars and accommodation buildings. The squadron was disbanded in 1946 and the runway closed in September 1946, although the airfield and surrounding area was used as a Prisoner of War camp for German soldiers until 1948. The airfield's last military use was during the Korean War and Suez Crisis, when it was used as a tank park.
- 3.28 Eggborough Power Station is a non-designated heritage asset (1316287). This coal-fired power station was constructed in the 1960s and opened in 1970, and was capable of producing enough electricity to meet the needs of two million households.

Potential for previously unknown heritage assets

- 3.29 The existing baseline evidence suggests the proposed development is located within an archaeological landscape with the potential to contain multi-period archaeological remains, in particular, late prehistoric, Roman, medieval and post-medieval remains. The archaeological investigations during the construction of a gas pipeline to the immediate west of the proposed gas pipeline corridor (On Site Archaeology 1999) identified several features that are now recorded in the HER. The gas pipeline route was excavated through floodplain deposits, and the watching brief report notes that one of the features, a ditch and bank (MNY24130) was sealed by sandy clay alluvium. The course of the River Aire has deviated over time, and there is a high potential that river silts may have masked prehistoric, Roman, and later deposits and features associated with water-edge activities.

4 Aims

- 4.1 The aim of the geophysical survey was to identify any potential archaeological anomalies that would enhance the current understanding of the archaeological resource within the proposed development site.
- 4.2 Specifically the aims of the gradiometer survey were;
- To locate, record and characterise any surviving sub-surface archaeological remains within the site
 - To help determine the next stage of works as part of the current planning application
 - To provide an assessment of the potential significance of any identified archaeological remains in a local, regional and (if relevant) national context
 - To produce a comprehensive site archive and report.

5 Methodology

- 5.1 Parameters were selected that were suitable for the prospective aims of the survey and in accordance with recommended professional good practice (David *et al.* 2008, 8).
- 5.2 The gradiometer survey was carried out using Bartington Grad601-2 fluxgate gradiometer (see Appendix 1 and 2). Data was collected on an east-west alignment using zig-zag traverses, with a sample interval of 0.25m and a traverse interval of 1m.
- 5.3 A total of 369 full or partial 30m by 30m grids were surveyed within the proposed site, totalling a surveyed area of approximately 26ha (including unsurveyable areas). Attention was taken to attempt to avoid metal obstacles present within the survey area. Gradiometer survey is affected by 'above-ground noise' and therefore avoiding metallic objects improves the overall data quality and results obtained.
- 5.4 All geophysical survey work was carried out in accordance with recommended good practice specified in guideline documents published by English Heritage (David *et al.* 2008), and the Chartered Institute for Archaeologists *Standard and Guidance for archaeological geophysical survey* (2014). Data processing, storage and documentation were carried out in accordance with the good practice specifications detailed in the guidelines issued by the Archaeology Data Service (Schmidt and Ernenwein 2011).
- 5.5 The gradiometer data were downloaded using Bartington Grad601 PC Software v313 and processed using Geoscan Geoplot v3.0. The details of these processes can be found in Appendices 3 and 4.

- 5.6 Interpreted point, polyline and polygon layers were created as layers in AutoCAD and technical terminology used to describe identified features can be found in Appendix 5.

6 Results and Interpretation

- 6.1 Gradiometer survey results have been visualised as greyscale plots with the raw data plotted at -1nT to 2nT (Figures 3, 5, 8, 11, 14, 17, 20, 23, 26 and 29). The processed data has also been plotted at -1nT to 2nT (Figures 6, 9, 12, 15, 18, 21, 24, 27 and 30). An interpretation of each area has also been completed (Figures 4, 7, 10, 13, 16, 19, 22, 25, 28 and 31). An individual characterisation of identified anomalies can be found in Appendix 6.

Area 1 (Parcel 900) Figures 5 - 7

- 6.2 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.
- 6.3 A number of discrete linear trends have been recorded in the data which although faint could be archaeological in origin (**E1**). These do not form any clear shape or pattern but they could be associated with former field systems or settlement. The most northerly of these trends could be an old field boundary (**E2**) which is shown on an Ordnance Survey Map of 1853 in a similar location running west to east (Old Maps, 2017).
- 6.4 A number of pit-like anomalies have been recorded which could be archaeological in origin, in particular when associated with the other potential archaeological features in the area (**E3**).
- 6.5 Possible drainage patterns are seen in the data and these predominantly run north to south across the area (**E4**).
- 6.6 A large pipe anomaly is seen running east to west in the far north of the area (**E5**).
- 6.7 Closely spaced parallel modern ploughing trends are seen running north west to south east across the data (**E6**).
- 6.8 Two negative linear responses are seen in the dataset (**E7** and **E8**) which most likely represent agricultural headlands. One of these runs east to west along the southern boundary of the field (**E7**). The second one is observed on the eastern boundary of the area and runs north to south (**E8**).
- 6.9 A number of isolated dipolar anomalies / iron spikes have been identified (example **E9**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 2 (Parcel 895) Figures 5 - 7

- 6.10 No remains of a definitive archaeological nature are noted within this area. The small size of the survey area means it is difficult to put any context to features observed in the data.
- 6.11 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.
- 6.12 Faint linear trends of a possible archaeological or geological origin are visible within the data (**E10**).
- 6.13 The faint outline of a possible agricultural headland is also visible in the data along the northern edge of the field (**E11**).
- 6.14 A possible pit like anomaly has been detected but it is most likely to be associated with a variation in soil rather than an archaeological origin, as there is very little in associated activity in the area (**E12**).
- 6.15 A number of isolated dipolar anomalies / iron spikes have been identified (example **E13**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil

of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 3 (Parcel 885) Figures 5 - 7

- 6.16 A number of discrete linear and curvilinear trends are visible in the results and although they don't form a coherent pattern they could be suggestive of an archaeological origin (**E14**). These run east west in direction and are located in the western half of the area.
- 6.17 A number of pit like anomalies have been recorded and these could also be archaeological in origin (**E15**).
- 6.18 A number of parallel trends are noted running north to south in the eastern part of the survey area and these could well be the remains of a former ridge and furrow agricultural scheme (**E16**). Although similar to trends representing drainage patterns, they would appear to be more comparable to ridge and furrow seen elsewhere along the development route.
- 6.19 Other more discrete tentative trends running in different directions are seen in the western part of the area (**E17**). Again these could be field drains, but at present they are thought to also be former ridge and furrow ploughing trends due to their width and spacing.
- 6.20 A former field boundary visible on first edition Ordnance Survey mapping from 1853 (Old Maps, 2017) is seen running north south through the centre of the dataset (**E18**). This also corresponds with field divisions recorded in the HER.
- 6.21 A set of faint possible field drains are located in the east of the area running west to east (**E19**).
- 6.22 Two possible agricultural headlands are seen in the data as very faint linear trends (**E20** and **E21**). These are formed by modern ploughing and are seen on the western edge of the area (**E20**) and the south eastern edge of the area (**E21**).
- 6.23 A large modern ferrous anomaly is seen in the data and is most likely reflective of modern disturbance (**E22**).
- 6.24 A number of isolated dipolar anomalies / iron spikes have been identified (example **E23**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 4 (Parcel 810) Figures 5 - 7

- 6.25 No definitive archaeological anomalies have been recorded within Area 4 and the majority of responses would appear to be agricultural in origin.
- 6.26 The only discrete linear trend that could be archaeological is a large curvilinear response slightly broader compared to others running roughly east to west across the data (**E24**). Although this could be archaeological it is most likely to be the result of an agricultural headland caused by ploughing. The reason for this opinion is that it is very reflective of the edge of the field and the other ploughing trends within the area. It would appear to respect the shape and direction of these other ploughing responses.
- 6.27 Two other trends of a potential archaeological origin are recorded in the east of the field. One anomaly is adjacent to the eastern field edge, however it is likely the result of geological soil variations or modern activity (**E25**). The second is a very faint curvilinear trend also located in the east of the field (**E26**).

- 6.28 A linear trend running south west to north east across the centre of the area could represent a former field boundary (**E27**). However it is not observed on first edition Ordnance Survey mapping of the area from 1853 and therefore must be characterised as possible archaeology.
- 6.29 A number of curvilinear trends in the area represent agricultural activity, possibly a former ridge and furrow ploughing scheme (**E28**). These anomalies could also be field drainage patterns, but they would appear to be rather curvilinear for drains. One of these anomalies corresponds with cropmarks recorded in the HER which may be a former field division system.
- 6.30 A number of pit like anomalies have been detected (**E29**). However these could also be isolated dipolar anomalies / iron spikes (example **E30**), which are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site. It is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 5 (Parcel 835) Figures 8 - 10

- 6.31 Area 5 contains the remains of two known archaeology assets; MNY10018 (parallel linear ditches and an enclosure of an uncertain date) and Monument 1318872 (possible Romano-British double ditched enclosure, seen as cropmarks). The geophysical results do indicate that several discrete trends and anomalies correlate with those of Monument 1318872 (**E31**), however they do not fully represent the assets observed through aerial photography. This may be due to the effects of agriculture having ploughed out the features over time.
- 6.32 A number of pit-like features have been detected in the data and these could be archaeological in origin (**E32**, **E33**, **E34** and **E35**).
- 6.33 A number of tentative linear trends have been observed in the area but nothing that looks to be definitively archaeological has been recorded (**E36** and **E37**). These could be related to the nearby asset MNY10018.
- 6.34 A larger number of linear features have been clearly recorded in the data running in multiple directions, all of which relate to agricultural drainage (**E38**, **E39**, **E40** and **E41**). These are likely to be multiphase and were put in over a significant number of years, hence their multiple directions.
- 6.35 One clear positive linear trend runs north west to south east across the data with two further less defined linears adjoining it, running north and north east (**E42**). These linear anomalies correlate with three old field boundaries marked on First Edition Ordnance Survey mapping of 1853 (Old Maps, 2017). In particular the stronger north west to south east anomaly corresponds with old field divisions recorded in the HER data.
- 6.36 Ridge and furrow ploughing (**E43**) has been recorded in the west of the area running west to east before terminating just before the former field boundary **E42**. These trends indicate that previously this field had a significant ridge and furrow ploughing scheme before both the ridge and furrow and former field boundary were removed and ploughed out.
- 6.37 A number of modern ploughing trends are seen running north east to south west through the rest of the data (**E44**).
- 6.38 Along the eastern edge of the dataset a spread of modern disturbance is seen and is likely related to landscaping for the road embankment (**E45**).
- 6.39 A former woodland named Whiteings Wood is visible of first edition 1853 Ordnance Survey mapping (Old Maps, 2017), and a triangular anomaly representing the boundary of the woodland is visible in the dataset as two linear trends along the eastern extents of the area (**E46**).

- 6.40 The southern boundary is also affected by modern disturbances which are related to the farm and garden fencing located just south of the survey area (**E47**).
- 6.41 A number of isolated dipolar anomalies / iron spikes have been identified (example **E48**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 6 (Parcel 875) Figures 8 - 13

- 6.42 The data contains no anomalies that would indicate obvious archaeological activity. A former area of woodland known as Whiteings Wood is visible on first edition Ordnance Survey mapping of 1853 (Old Maps, 2017) which covers nearly all the area surveyed.
- 6.43 The clearest magnetic responses in this area are drains which are visible as positive anomalies running north west to south east across the dataset (**E49**).
- 6.44 A faint linear trend is seen running south west to north east which is most likely to be a field drain, but could also be a former boundary (**E50**). This is not visible on any available historic mapping, and therefore could be a boundary that is archaeological in origin. This does not correspond with any known cropmarks in the HER data.
- 6.45 A pipe anomaly is seen running south west to north east along the north western edge of this data set (**E51**). This large highly magnetic anomaly affected the data significantly in this part of the site and was added to by the presence of a modern tarmacked track running parallel to it on the very northern and western edge of the survey boundary (**E52**).
- 6.46 A further track and drain is seen on the southern boundary between Area 6 and Area 7 (**E53**). This is visible on first edition Ordnance Survey mapping of 1853 called Whiteings Lane (Old Maps, 2017).
- 6.47 This area unlike other survey areas is particularly noisy in terms of ferrous spikes / isolated dipolar anomalies. They have been identified throughout this field and in particular in the north (example **E54**) which is most likely as a result of disturbance from the laying of the pipe or tarmac track, or fly tipping which was observed at the time of survey. These spikes are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 7 (Parcel 705) Figures 11 - 13

- 6.48 No anomalies of a definitive archaeological origin have been recorded in Area 7.
- 6.49 The most obvious and clear responses recorded are related to modern drainage (**E55**). These drains run west to east with one central drain joining them all together running from north to south.
- 6.50 A further set of drains observed with a weaker magnetic response run north east to south west (**E56**).
- 6.51 Agricultural headlands at the field edges are seen in both the north and south of the area (**E57**) and a track is seen following the boundary along the northern edge of the field (**E58**). This track runs west to east between Areas 6 and 7 and represents the former Whiteings Lane visible on the first edition Ordnance Survey mapping of 1853 (Old Maps, 2017).
- 6.52 A number of large ferrous anomalies representing telegraph poles are seen in the data and were visible in the field at the time of survey (**E59**).

6.53 Unlike other survey areas this field is particularly noisy in terms of ferrous / isolated dipolar anomalies, particularly in the north of the field where a spread of magnetic disturbance is located (example **E60**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site. These ferrous anomalies correlate with the location of a section of Burn Airfield (MNY1063) which is for the most part located north east of the pipeline corridor, and the spread of magnetic disturbance most likely relates to the remnant infrastructure of this airfield.

Area 8 (Parcel 705) Figures 14 - 16

6.54 Area 8 interestingly appears to be much quieter in comparison to other areas along the proposed development route. The reason for this is unclear but the author speculates that it could be down to an agricultural process known as de-stoning for crops such as carrots. This may have led to less material of magnetic contrast being present, such as stones and metal remains such as plough sherds. Another possibility is that the area is more susceptible to flooding which has led to alluvium build up over time, burying any magnetic responses.

6.55 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.

6.56 The only discrete linear trend located in the field is related to a possible former field boundary visible on the first edition Ordnance Survey mapping of 1853 (Old Maps, 2017) running north south through the dataset (**E61**).

6.57 Two possible areas of flooding / waterlogging are visible in the data as wide anomalies (**E62**) possibly as a result of where sediments have pooled during flooding creating a magnetic response notably different to the surrounding background response.

6.58 Tentative ploughing trends are visible running west to east through the data but again these are less clear compared to those observed in the data from other adjacent areas (**E63**).

6.59 An area of magnetic disturbance is seen in the southern part of the area and is related to an area of rubble and CBM visible on the surface at the time of survey (**E64**).

6.60 A number of pit like anomalies are located in the survey area, however these are not thought to be archaeological on this occasion and are much more likely to be due to modern soil variations in the area (**E65**).

6.61 A number of isolated dipolar anomalies / iron spikes have been identified (example **E66**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 9 (Parcel 665) Figures 14 - 19

6.62 There would appear to be no definitive archaeological remains located in this area.

6.63 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.

6.64 Several tentative discrete linear and curvilinear trends are present in the data which might indicate possible archaeological activity (**E67**, **E68** and **E69**). These are only tentative and form no clear shape of form but are potentially archaeological in origin.

6.65 A linear trend running west to east centrally through the dataset would appear to be an old field boundary (**E70**) which is visible on historic Ordnance Survey mapping of 1853 of Yorkshire (Old Maps, 2017).

- 6.66 Several parallel drainage or former ridge and furrow ploughing patterns run west to east throughout the area (**E71**). These are only faint compared to other areas along the development route and are mostly located in the northern half of the area.
- 6.67 There are two negative trends (white) running west to east in the north of the data (**E72** and **E73**), two in the south of the data (**E74** and **E75**) and two along the western edge of the data (**E76** and **E77**) that represent agricultural headlands.
- 6.68 A number of isolated dipolar anomalies / iron spikes have been identified (example **E78**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 10 (Parcel 665) Figures 17 - 22

- 6.69 There would appear to be no definitive archaeological remains located within Area 10.
- 6.70 Even though cropmarks have been observed to the west of the area, none of the anomalies identified in the results correspond to those recorded in the HER data.
- 6.71 Several tentative discrete linear and curvilinear trends within the data indicate at possible archaeological activity (**E79** and **E80**). These are only tentative and form no clear shape of form but potentially could have archaeological origins.
- 6.72 A linear trend running west-east centrally through the dataset (**E81**) is likely to be an old field boundary which is visible on historic Ordnance Survey mapping of 1853 (Old Maps, 2017).
- 6.73 Modern ploughing trends are visible in the data with a number running west to east in the south of the area (**E82**) however most run predominantly north to south throughout; and are seen as narrow parallel linear trends (**E83**).
- 6.74 Two significant negative linear features (white) are visible running west-east in both the north of the area (**E84**) and the south (**E85**). These represent agricultural headlands formed by ploughing visible on the surface, and represent where the plough is lifted from the ground to change direction or at the edge of the cultivated area.
- 6.75 Several parallel drainage patterns run west to east throughout the area (**E86**). These are less clear than the modern ploughing trends but are approximately 10m apart and run parallel to one another.
- 6.76 A number of possible pit like features and geological variations have been identified in the results of this area (**E87** and **E88**). An archaeological origin cannot be dismissed, however, it is much more likely that these are geological in origin due to their size and shape and the lack of associated features in the area.
- 6.77 Magnetic disturbance caused by a wooden electric pole holding cables is seen in the data set (**E89**).
- 6.78 A number of isolated dipolar anomalies / iron spikes have been identified (example **E90**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 11 (Parcel 675) Figures 20 - 22

- 6.79 A discrete rectilinear trend of a possible archaeological origin has been observed in the data (**E91**). This potential archaeological feature includes a rectilinear anomaly in the centre of the dataset. Though not recorded in the HER cropmark data, this anomaly might be related to the manor and moat of Hall Garth situated to the east of the survey area (MNY9969).

- 6.80 In the south of the area a number of positive responses are seen that are most likely of an archaeological origin (**E96**) which are most likely related to Hall Garth to the east (MNY9969). Not all of the cropmarks recorded in the HER data are observed in the geophysical data, however the linear trends do correlate. However in this area the ground was saturated and boggy at the time of survey, and coupled with the proximity to the river, a couple of these responses may reflect geological variations rather than archaeological origins.
- 6.81 A number of old field boundaries also meet at this location as observed on historic Ordnance Survey mapping of 1853 (Old Maps, 2017) which have potentially been recorded in the data (**E92**).
- 6.82 Clear modern ploughing trends are seen running in parallel lines in a north to south direction across the dataset (**E93**).
- 6.83 Agricultural headlands caused by ploughing are also seen as a negative trend (white) in the north of the area running west to east (**E94**).
- 6.84 Several drains have also been detected running north west to south east across the area (**E95**). These are seen as tentative discrete linear trends and are less clear compared to the modern ploughing trends **E93**.
- 6.85 A number of isolated dipolar anomalies / iron spikes have been identified (example **E97**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

Area 12 (Parcel 615)

- 6.86 Area 12 was unavailable for survey due to a winter crop of beans being present within the field, which was too dense for survey.

Area 13 (Parcel 590)

- 6.87 Area 13 contained significantly high scrub and vegetation which was possibly Japanese Knotweed and was therefore avoided.

Area 14 (Parcel 590) – Figures 23 - 25

- 6.88 This area is located in an oxbow of the River Aire and was only partially surveyed in the far north. This was mainly due to the area being severely overgrown as well as being mostly covered in high levels of alluvium and rubbish from recent flood events.
- 6.89 The effect of both of these issues has been clearly seen in the small amount of data that was collected. It was felt that after scanning the small available area that was vegetation free, it was not worthwhile to survey any more of the area. The combination of alluvium and rubbish made the data significantly magnetically noisy and any archaeological remains would not be recorded through this noise, and so the survey in this field was abandoned.
- 6.90 In the small area that was surveyed, no archaeological anomalies have been detected.
- 6.91 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.
- 6.92 The only anomaly recorded was a strong negative curvilinear trend on the northern edge of the area which correlates with the base of the flood defence which is situated as an upstanding earthwork (**E98**).

Area 15 (Parcel 550) Figures 26 - 28

- 6.93 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.
- 6.94 A discrete anomaly running east to west in the north of the area is likely to be the remains of a former field boundary to the River Aire to the north (**E99**). This was visible in the field at the time of survey as a headland and flood defence banking but may have been more substantial in the past.
- 6.95 A number of tentative possible archaeological trends are located within the survey area (**E100**). These trends however are difficult to interpret due to a lack of patterning and cannot be definitively described as archaeological in origin.
- 6.96 North of the former field boundary **E99** a strong geophysical anomaly of a large pipe is identified (**E101**). This anomaly also runs west to east through the area parallel to **E99**.
- 6.97 A large amount of modern ferrous disturbance runs down the western edge of this area and is the result of a modern trackway which is significantly more magnetic in comparison to the surrounding magnetic background (**E102**).
- 6.98 The effects of a large high voltage electricity pylon is observed in the south of the dataset (**E103**). The effects of the live electricity and the large scale of the pylon has affected the results of the survey in this area creating a strange halo effect which continues into Area 16.
- 6.99 A number of isolated dipolar anomalies / iron spikes have been identified in the dataset (example **E104**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set, as well as a spread of material from historical flowing events.

Area 16 (Parcel 540) Figures 26 - 31

- 6.100 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.
- 6.101 A number of very weak tentative linear and curvilinear trends are located in the data in this area (**E105**). These potentially could be possible archaeological remains but alluvium in this area has weakened the anomaly strength and made interpretation difficult.
- 6.102 A linear anomaly is detected running north south which is likely to connect to Area 17 (**E106**). This anomaly potentially could be archaeological in origin however it might be a response of a field drain which is low lying in topography and close to the river to the north.
- 6.103 The response of high voltage electricity wires have caused a strange magnetic disturbance response in the northern part of the dataset (**E107**). These run east west and it is likely that the electricity running through the cables affected the machines causing the strange halo effect in the data.
- 6.104 Magnetic disturbance is observed running down the western edge of the survey area and is the result of a modern trackway (**E108**). The surrounding geology is quite quiet and the trackway in contrast is significantly magnetic which has accentuated the geophysical response.
- 6.105 Geological variations have been detected in the area and these would indicate the presence of alluvium in high quantities. The alluvium has given the area the data a smooth appearance in comparison to the data from other areas (**E109**).
- 6.106 A number of isolated dipolar anomalies / iron spikes have been identified (example **E110**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set. In this area there would

appear to be fewer and most likely due to the amount of alluvium in the area masking many of these spikes.

Area 17 (Parcel 540) Figures 29 - 31

- 6.107 None of the anomalies identified in the results correspond with cropmarks recorded in the HER data.
- 6.108 A number of discrete linear and curvilinear trends have been detected in the area and these have the potential to be archaeological in origin (**E111**). A further set of anomalies are observed as two curvilinear trends that could form a semi-circular enclosure with other adjacent linear and rectilinear trends (**E112**). The origin of these could be archaeological, however the topography of this area is on a slight slope at the curvilinear may represent the geological break in the slope.
- 6.109 A further linear running north to south is located in the area and is most likely to represent another former field boundary forming a cross (**E113**). This is seen on historic Ordnance Survey mapping of 1853 (Old Maps, 2017). Interpretation is difficult as the anomaly follows the same direction as ploughing trends also located in the area.
- 6.110 A further curvilinear trend runs from a gateway at the area boundary and it is likely that the responses located in this area represent a former trackway into the field (**E114**).
- 6.111 Within the recorded data are a number of predominantly north-south ploughing trends which most likely represent a former ridge and furrow ploughing scheme in the field (**E115**). These anomalies measure approximately 10m in width and are slightly curved and are similar to known ridge and furrow anomalies from other surveyed sites in Britain.
- 6.112 A number of pit like anomalies are located in the area and again these might be archaeological in origin (**E116**). With the area being slightly higher in topography and with possible linear features of an archaeological nature in close proximity, these may well be pits of an anthropogenic origin rather than natural soil variations. An interesting clump of these pits are also located in the area that could be of archaeological interest (**E117**).
- 6.113 Across the field are a quantity of isolated dipolar anomalies / iron spikes (example **E118**). These are commonly caused by ferrous or magnetically susceptible material on the surface or within the topsoil of the site, and it is likely that modern agricultural activity has changed the magnetic properties of the top soil and created a high level of background 'noise' within the data set.

7 Conclusion

- 7.1 The gradiometer survey has identified two areas where archaeological features could be present. These have both been recorded through historic aerial photography and although the geophysical interpretation highlights the anomalies in these areas as being discrete trends, they must be considered to be of archaeological potential due to the other evidence present. These sites are recorded on the HER as MNY10018 and Monument 1318872 in Area 5 and MNY9969 in Area 11.
- 7.2 Remains of the former Burn Airfield (MNY1063) have also potentially been identified in Area 7.
- 7.3 Along the route several further discrete trends have been recorded which may or may not be archaeological in origin. These were located in Areas 1, 3, 5, 11, 16 and 17. These anomalies are not clear enough to confidently say they are archaeological in nature and they do not have any accompanying HER records or aerial photograph recordings to help determine their origin.
- 7.4 Other areas contain possible archaeological features, in particular field 15, however these features are more likely to be the result of geological variations rather than being anthropogenic in origin.

- 7.5 The majority of features detected along the route have been related to agricultural drainage and ploughing trends. In the majority of areas, elaborate patterns of varying drainage systems have been recorded, some that even cross each other which gives a very complicated outlook in the results. Agricultural ploughing has also been identified in different forms. Older ridge and furrow ploughing has been recorded in Areas 3, 4 and 17, which are slightly curved and wider in separation and appearance when compared to the modern ploughing which is straighter and much closer together.
- 7.6 Many areas where survey was carried out right to the field edges located clear agricultural headlands in the data, in particular Area 9. In most cases the headlands were also seen visibly on the surface at the time of survey.
- 7.7 Former field boundaries have also been identified in a number of areas and it is clear that since the first edition Ordnance Survey Maps, many of the small fields have had their boundaries removed to allow for much larger fields to be cultivated.
- 7.8 Geological variations and alluvium have also been noted in several areas, in particular Areas 14, 15 and 16 where the results have a particular noisy appearance due to the geology. The data in some areas looks smoother where flood alluvium has built, and this is seen in particular in Area 16. Interestingly another field where the data looks particularly quiet compared to others is Area 8. At first glance it could be suggested that the alluvium is higher in this field, as again the data looks smooth. However as the area is not located close to a river, it may well be an agricultural affect where the field has been destoned. This is undertaken for crops such as carrots often grown in the local area. Destoning is where stones and materials are removed from the topsoil to make the soil finer for carrots to grow. In doing so the removal of these stones may have meant that the data has been affected less by magnetic spikes giving a smoother data set.
- 7.9 Possible pipes and several areas of modern magnetic disturbance have also been detected during the course of the survey. Ferrous spikes have also been located throughout all datasets and all these responses would suggest modern activity and manuring.

8 Conclusion for Areas of Potential

- 8.1 The potential for archaeology along the route would appear to be highest in the areas where aerial photography in the HER have highlighted remains which have been supported by geophysical anomalies (Areas 5 and 11). Areas 1, 3 and 17 contain trends which could be indicative of an archaeological origin. Interestingly Area 16 has also been included in the areas of potential, mainly as very weak trends have been recorded. More intrusive evaluation in the future may well confirm these to be natural geological anomalies but it would be wrong to dismiss these at these stage as archaeological remains located beneath the alluvium is a possibility.

9 Statement of Indemnity

- 9.1 Although the results and interpretation detailed in this report have been produced as accurately as possible, it should be noted that the conclusions offered are a subjective assessment of collected data sets.
- 9.2 The success of a geophysical survey in identifying archaeological remains can be heavily influenced by several factors, including geology, seasonality, field conditions, the technique used and the properties of archaeological features being detected. Therefore geophysical survey may only reveal certain archaeological features and not create a complete plan of all the archaeological remains within a survey area.

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EGGBOROUGH COMBINED CYCLE GAS TURBINE
(CCGT), NORTH YORKSHIRE
AOC PROJECT NO. 51669

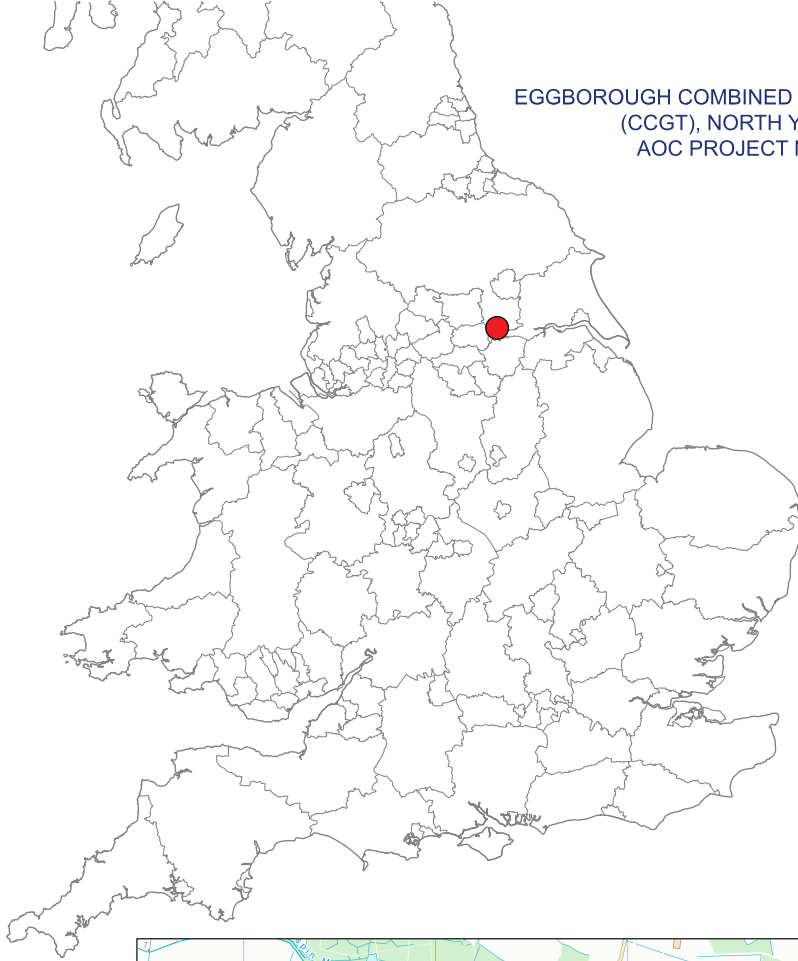


Figure
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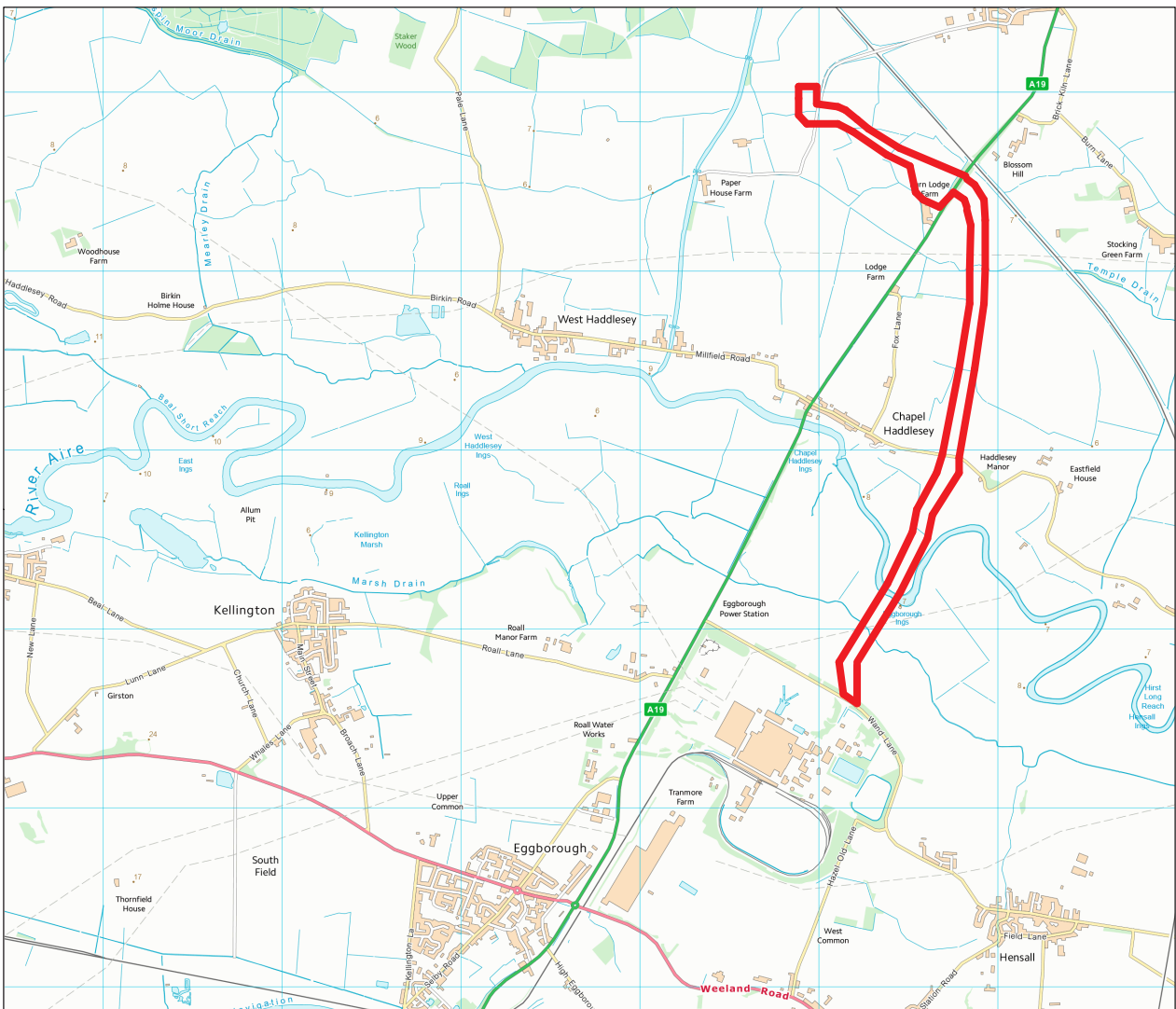


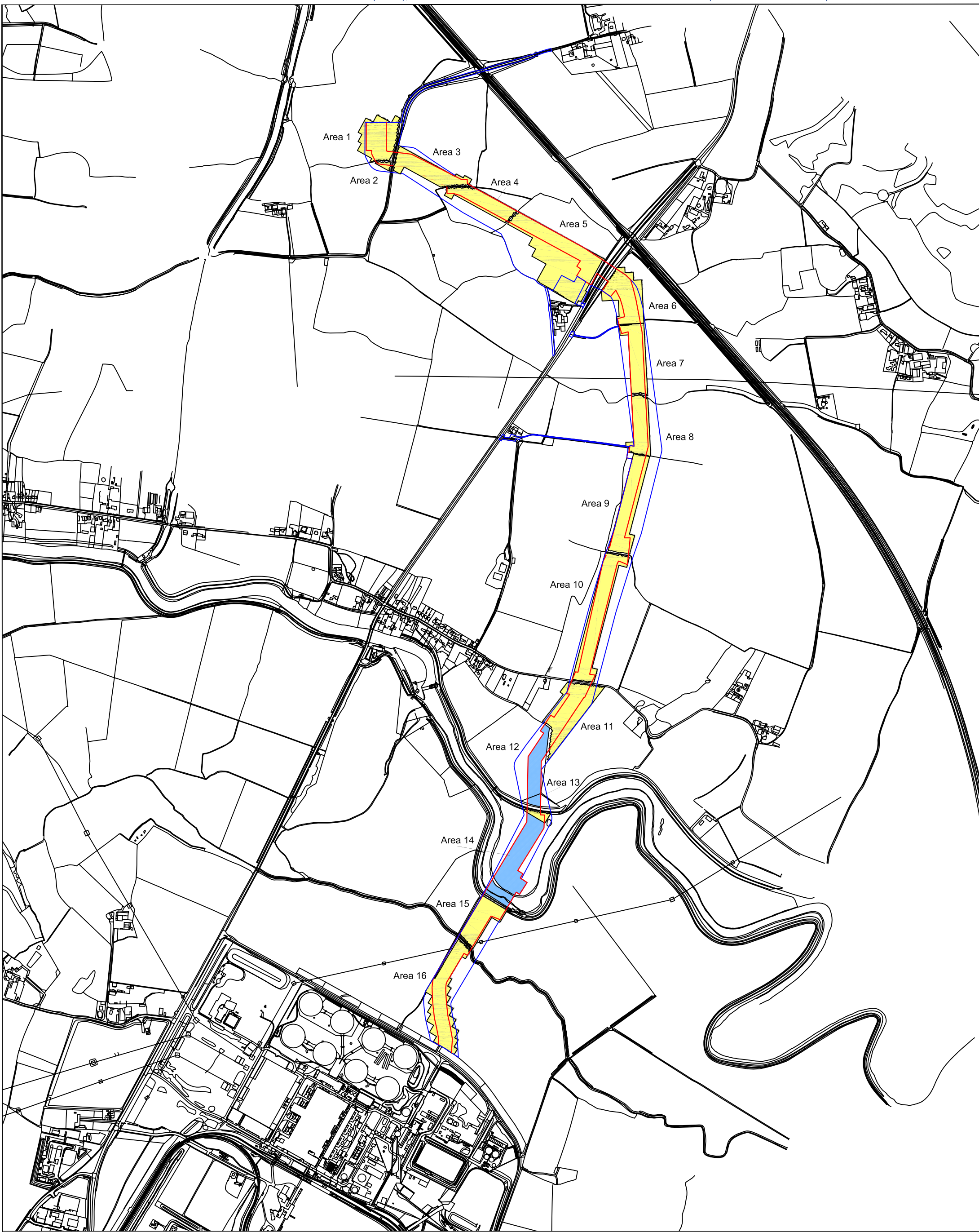
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


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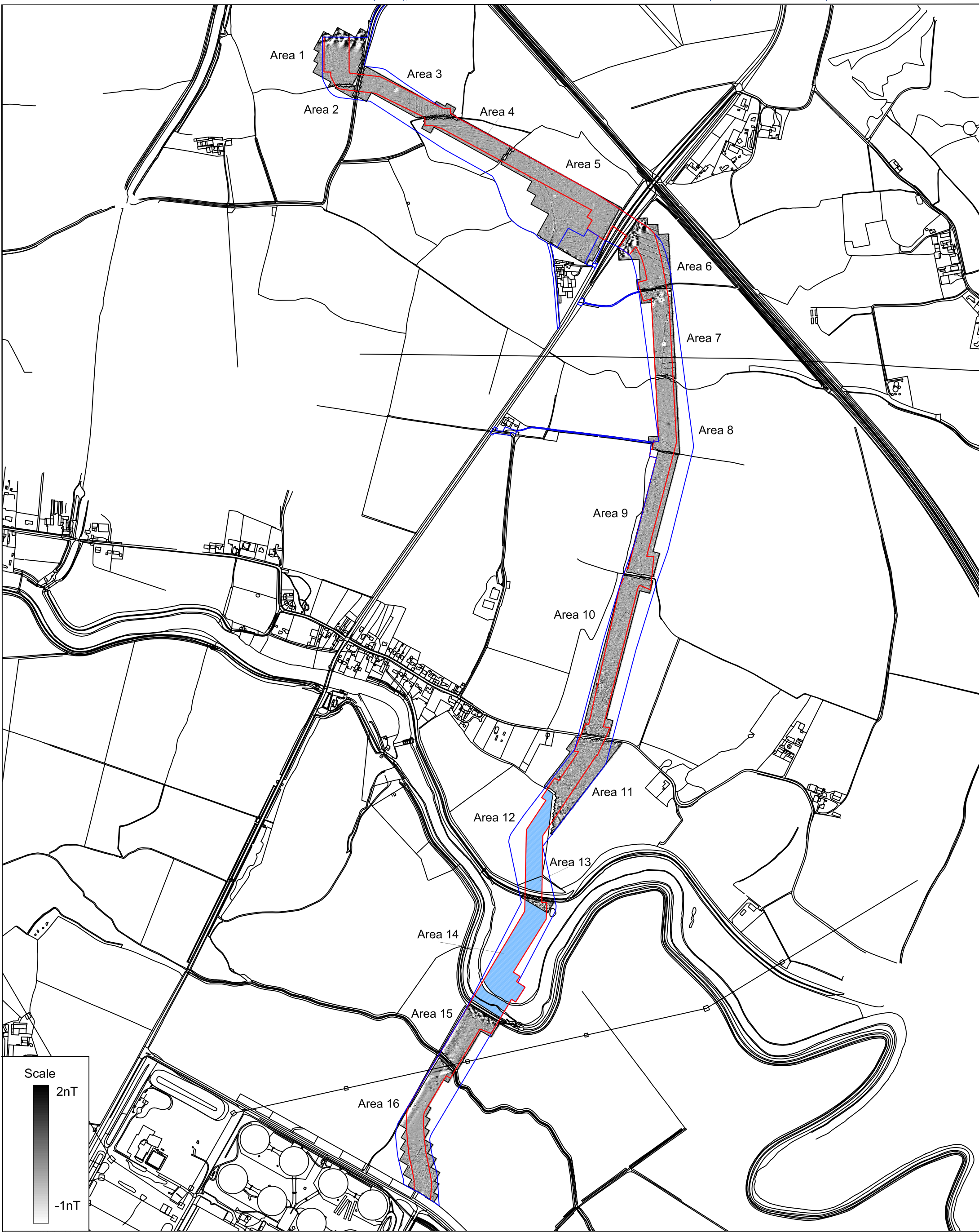


Location of survey areas

Figure 2

-  Surveyed area
-  Red line boundary
-  Area not surveyed
-  Blue line boundary

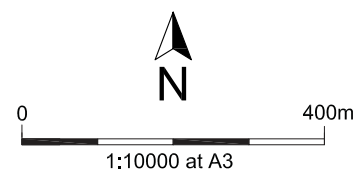




Overall view of Gradiometer Survey data - Greyscale Plot

Figure 3

- Red line boundary
- Blue line boundary
- Area not surveyed



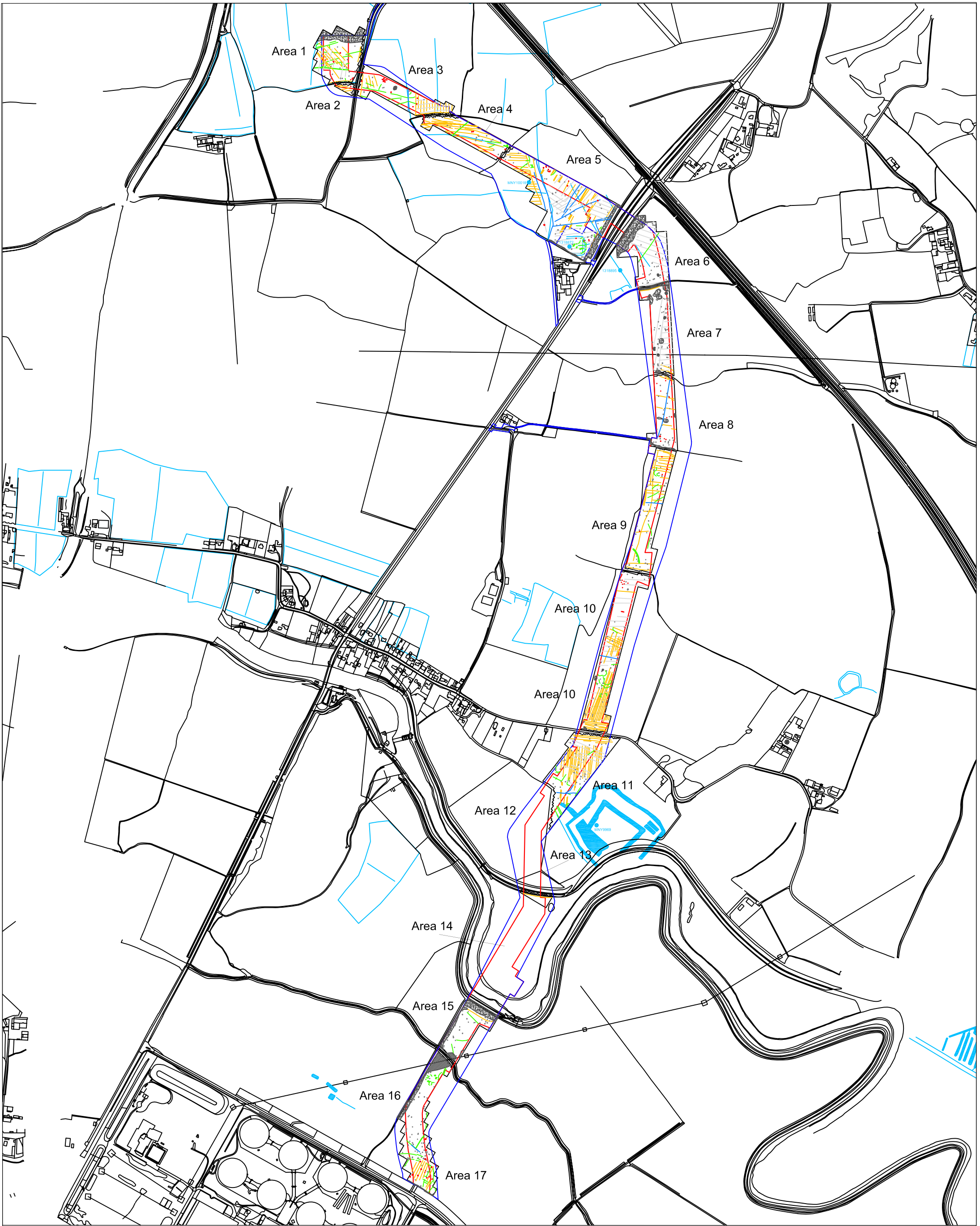
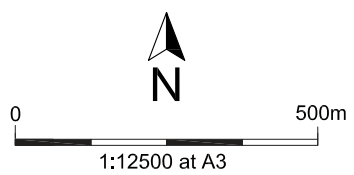


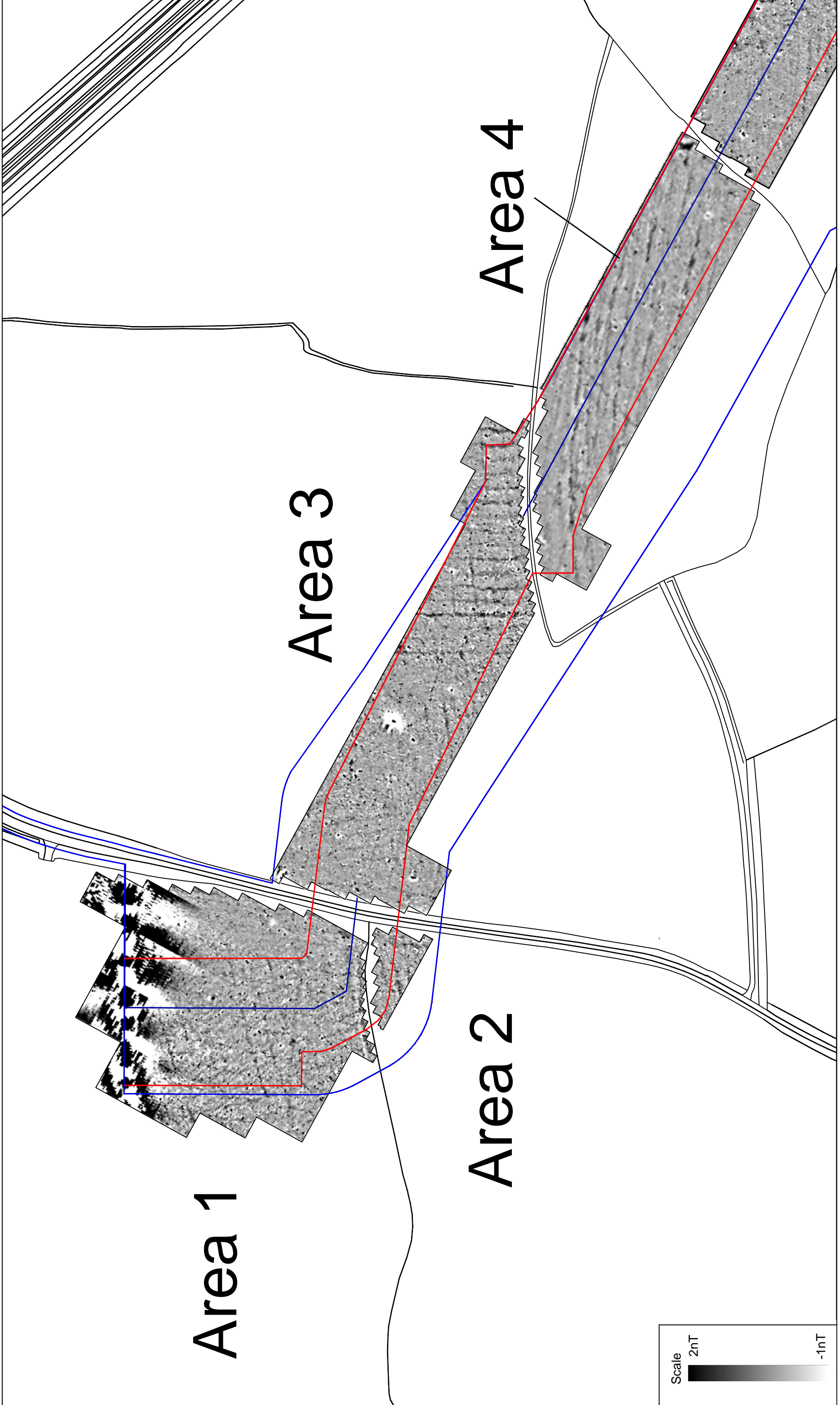
Figure 4: Overall Interpretation of gradiometer survey results

Figure 4

- Red line boundary
- Blue line boundary

- HER point data and corresponding ID
- HER cropmark and field division data





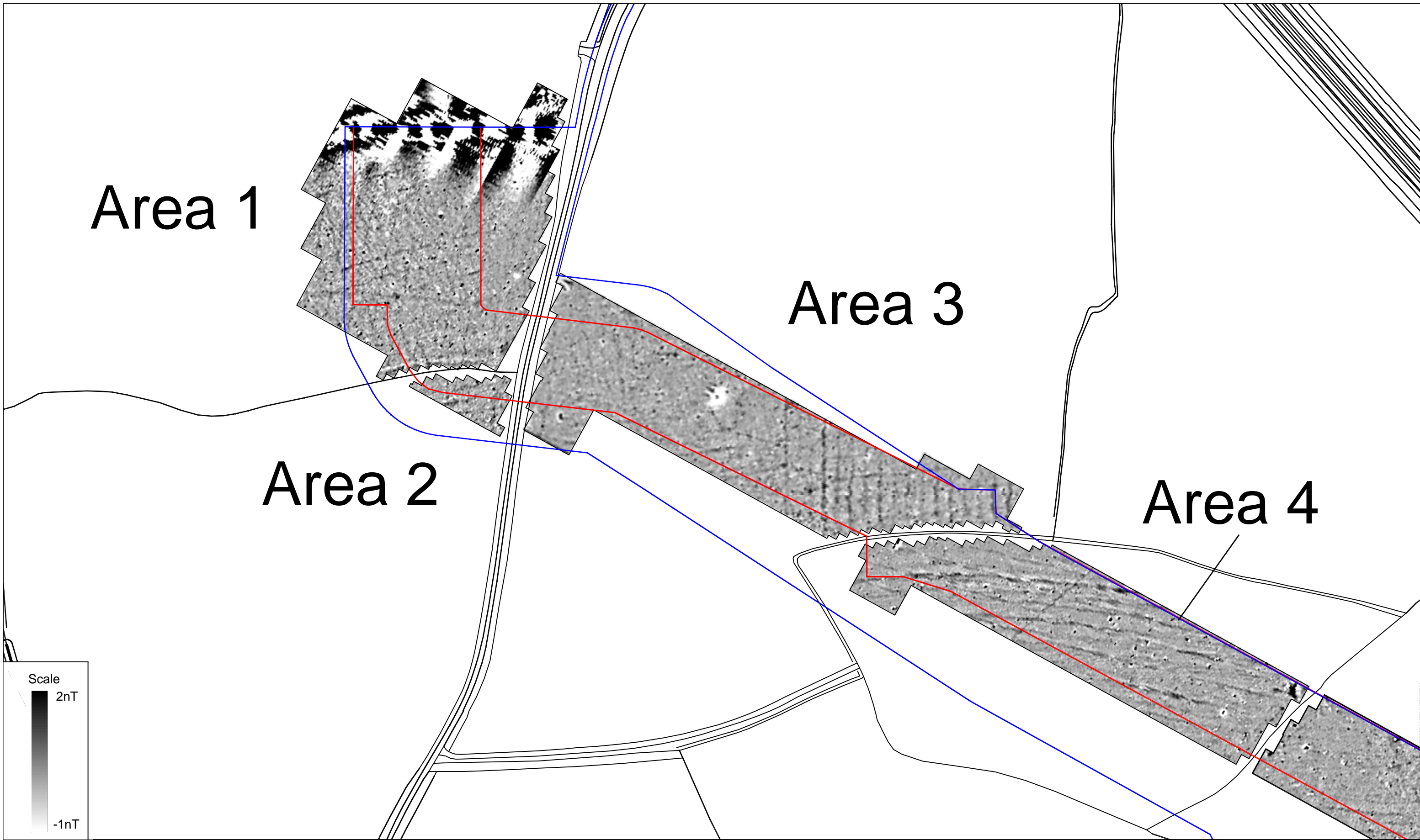
Unprocessed gradiometer survey results - greyscale plot - Areas 1 - 4

Red Line Boundary
Blue Line Boundary



Figure
5



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Processed gradiometer survey results - Greyscale plot - Areas 1 - 4

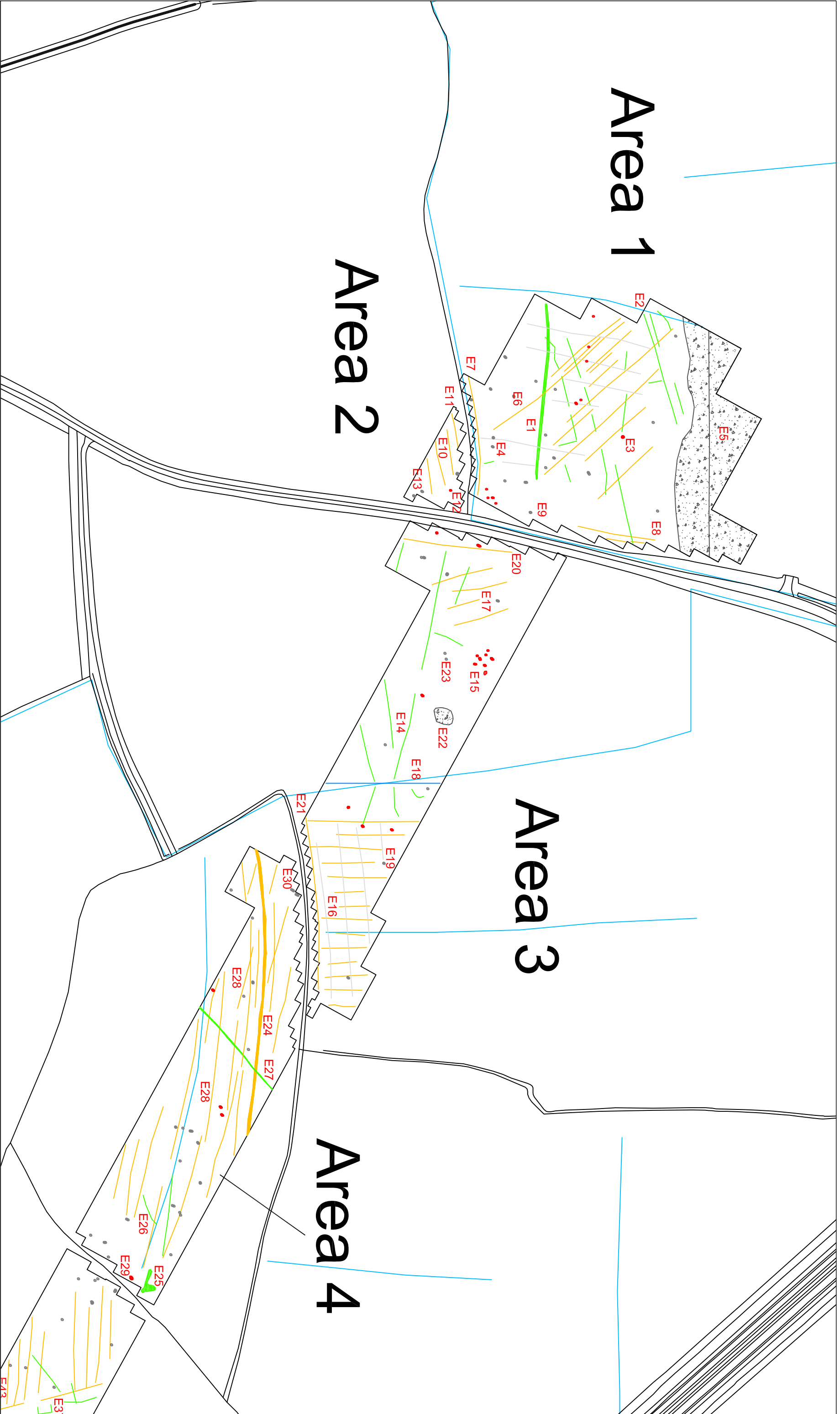
Figure
6



-  Red line boundary
-  Blue line boundary

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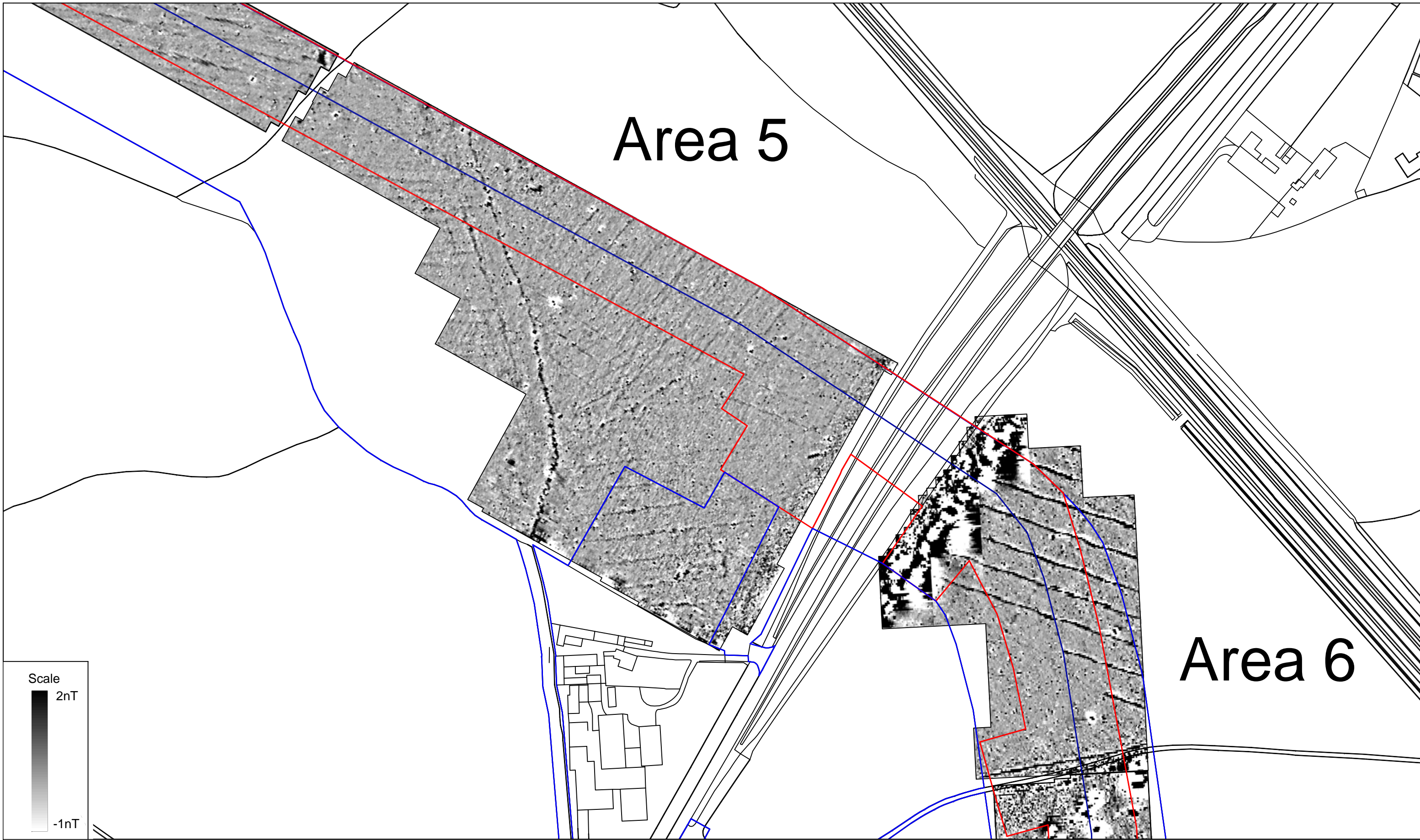




Interpretation of gradiometer survey results - Areas 1 - 4

- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes
- HER point data and corresponding ID
- HER cropmark and field division data

Figure 7



Unprocessed gradiometer survey results - greyscale plot - Areas 5 & 6

Figure
8



- Red Line Boundary
- Blue Line Boundary

0 80m
1:2000 at A3





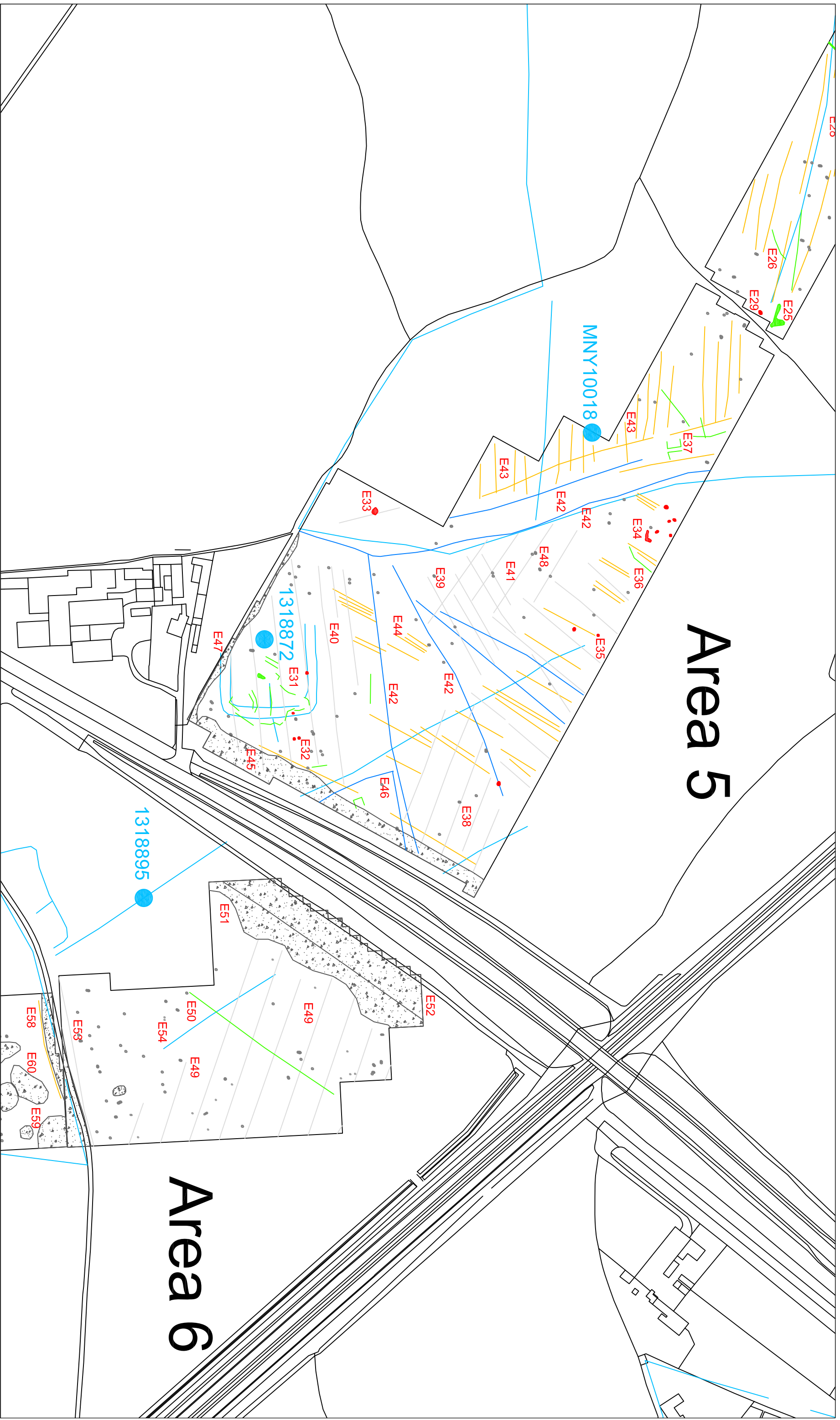
Processed gradiometer survey results - Greyscale plot - Areas 5 & 6

Red line boundary
Blue line boundary



Figure 9

0 80m
1:2000 at A3



Interpretation of gradiometer survey results - Areas 5 & 6

Figure 10



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes
- HER point data and corresponding ID
- HER cropmark and field division data





Figure 11



Red Line Boundary
Blue Line Boundary

0 80m
1:2000 at A3

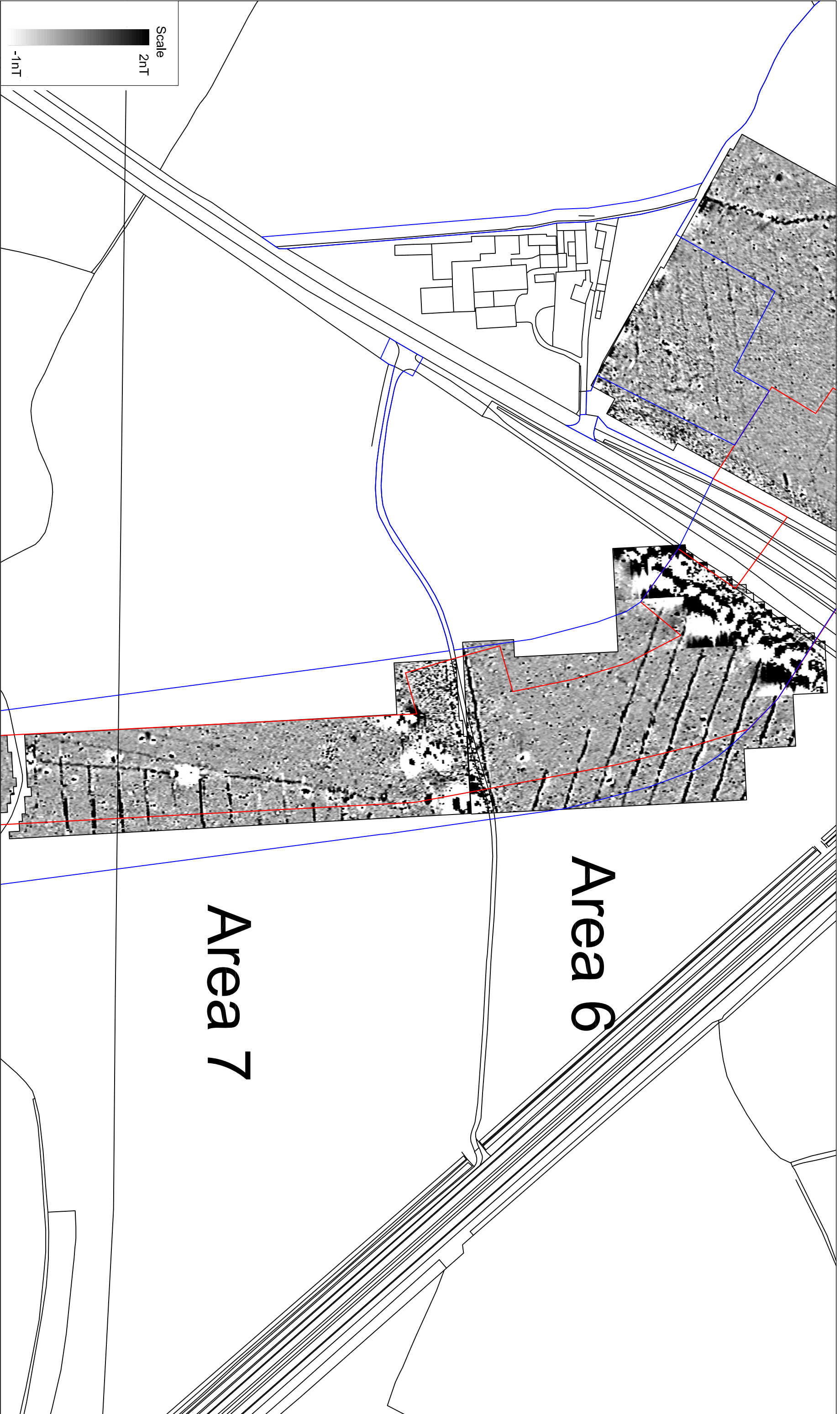


Figure
12



Red line boundary
Blue line boundary

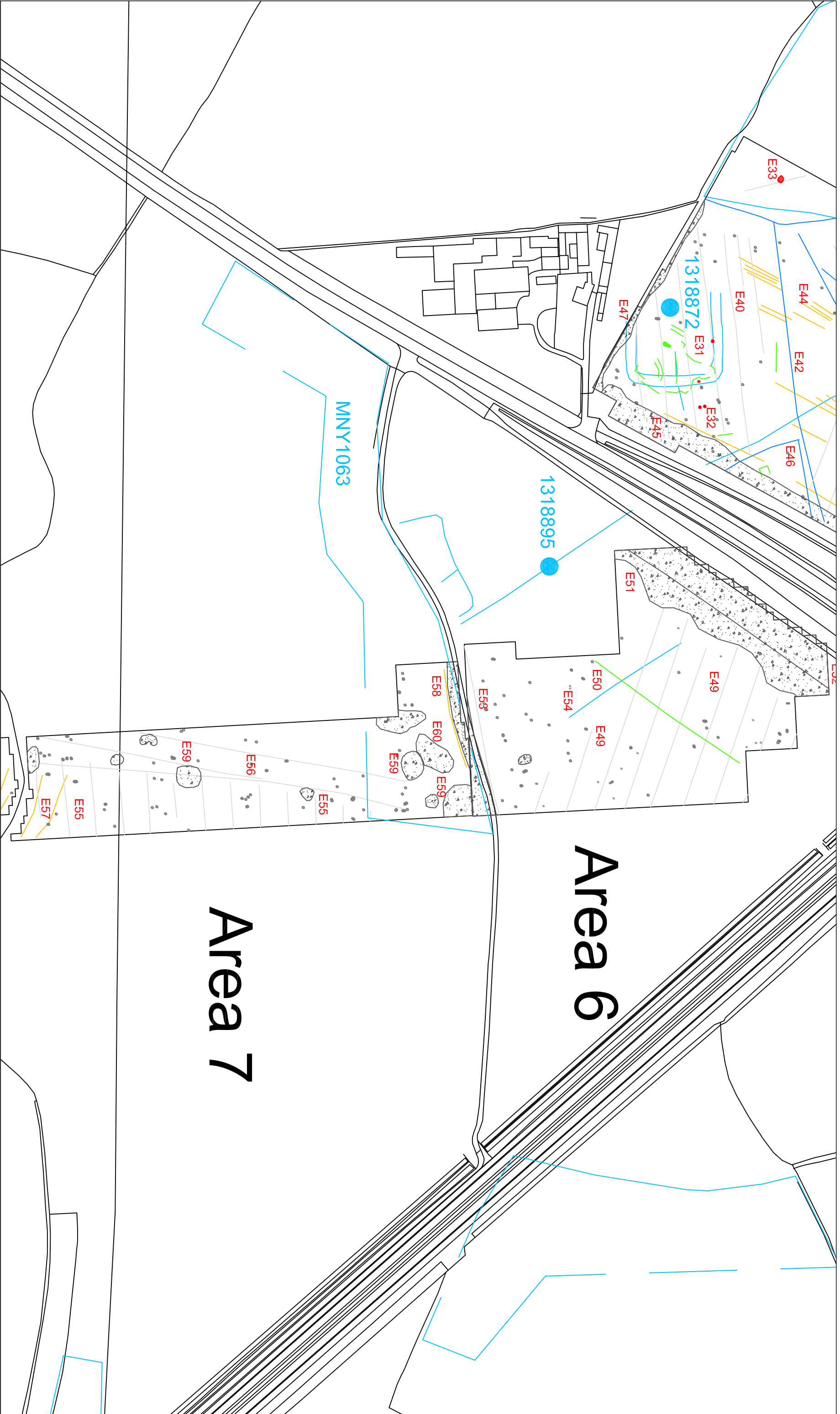
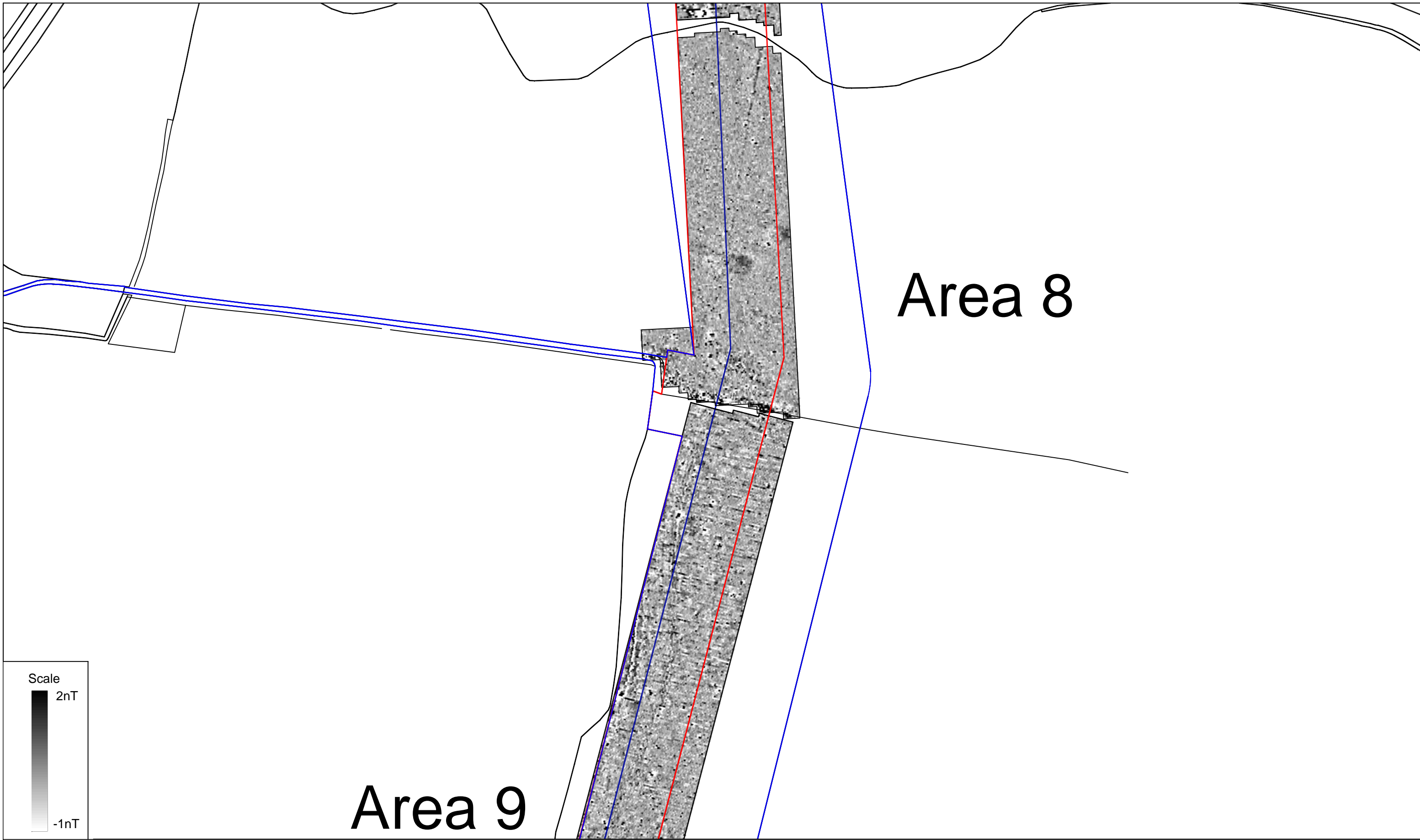


Figure 13



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes
- HER point data and corresponding ID
- HER cropmark and field division data





Area 9

Area 8

Unprocessed gradiometer survey results - greyscale plot - Areas 8 & 9

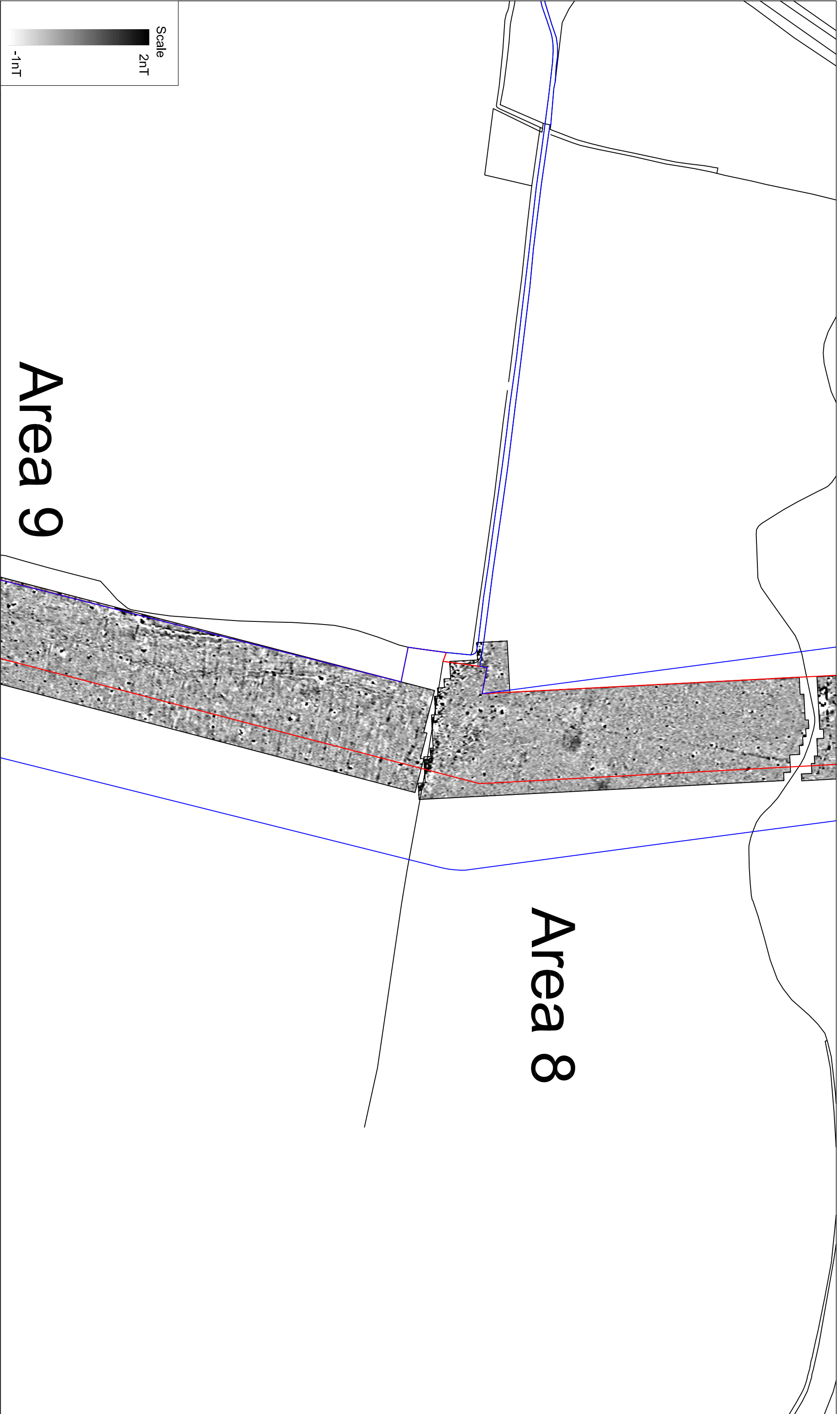
Figure
14



- Red Line Boundary
- Blue Line Boundary

0 80m
1:2000 at A3







Area 9

Area 8

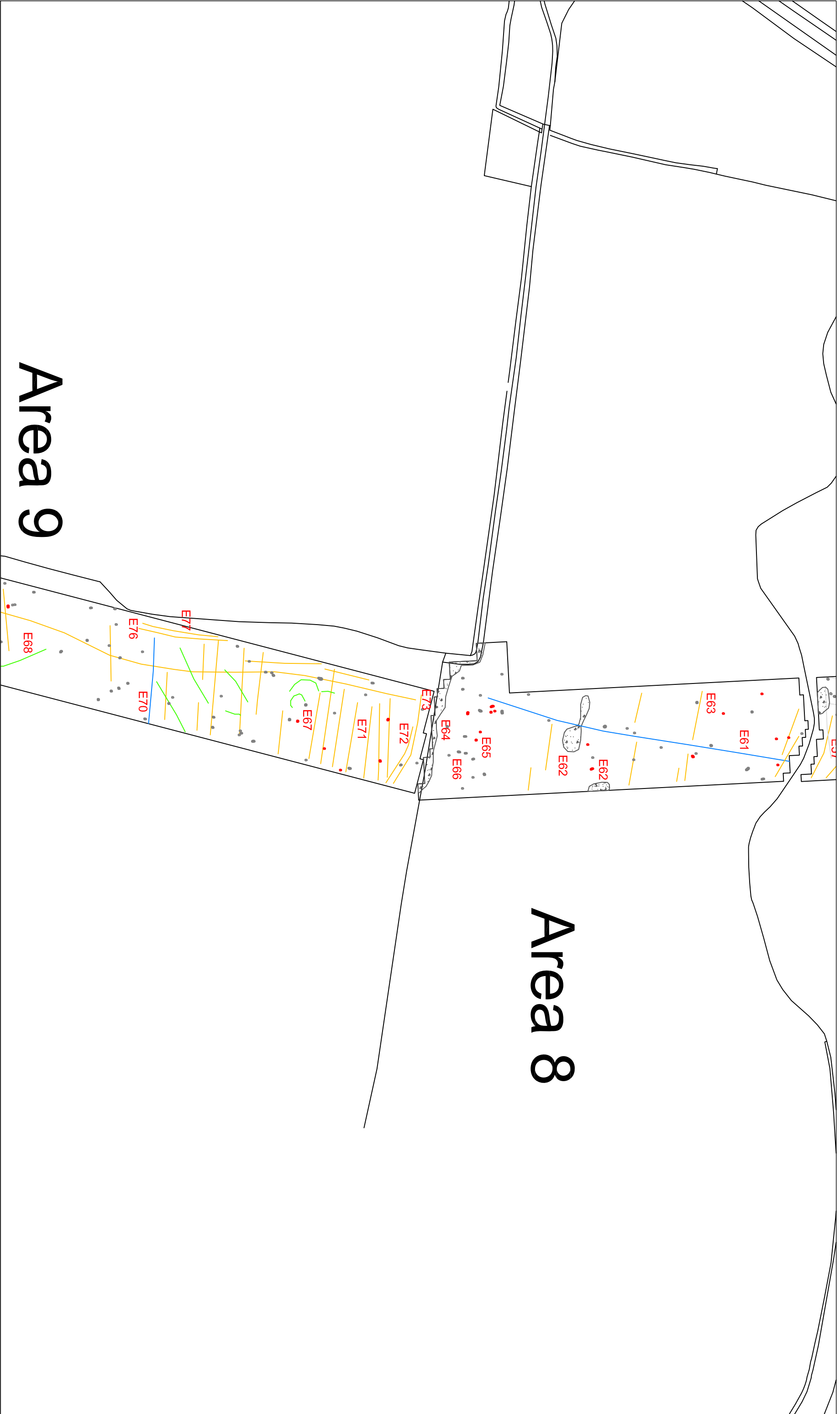
Processed gradiometer survey results - Greyscale plot - Areas 8 & 9

Figure
15



-  Red line boundary
-  Blue line boundary

0
1:2000 at A3
80m



Area 9

Area 8

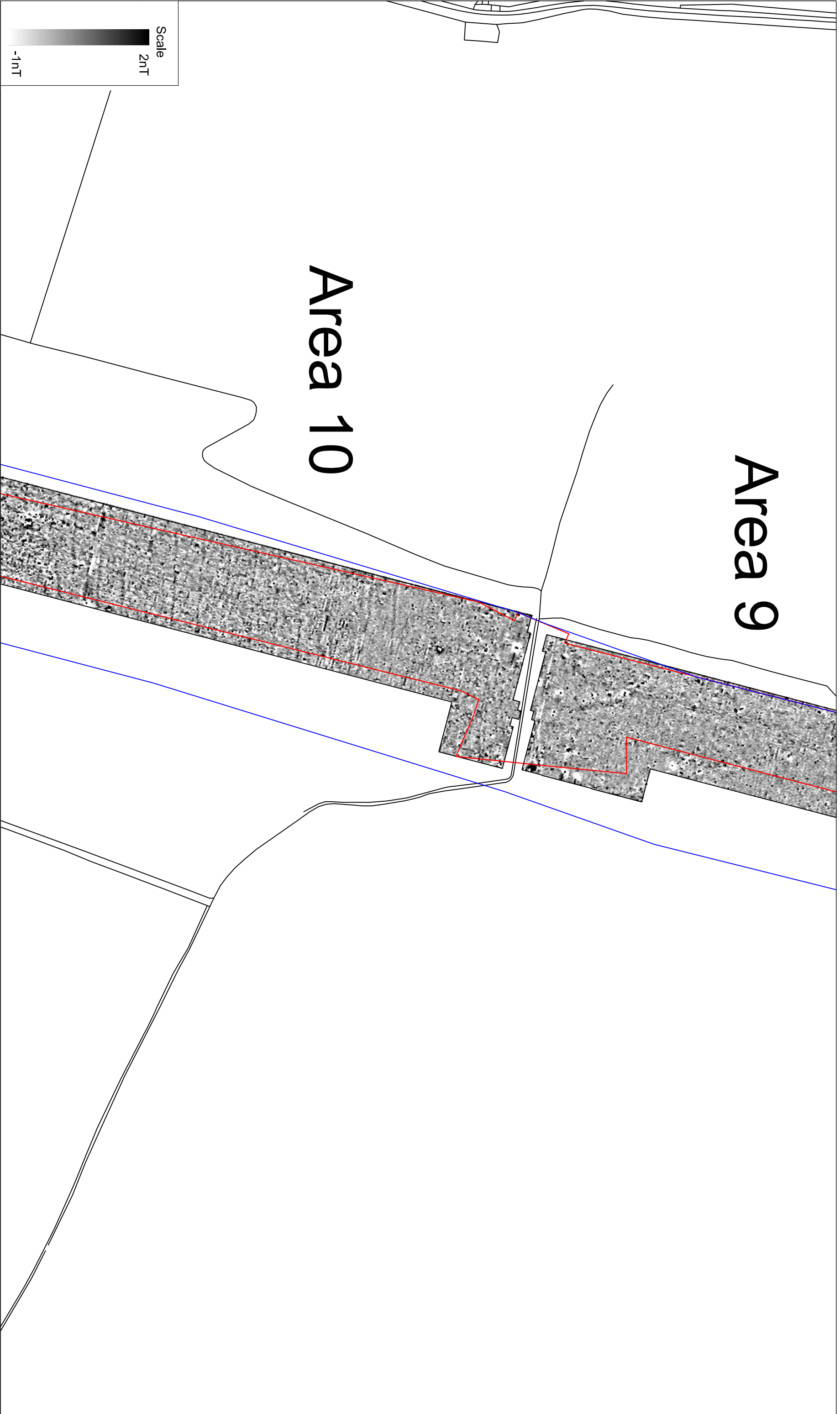
Interpretation of gradiometer survey results - Areas 8 & 9

Figure
16



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes





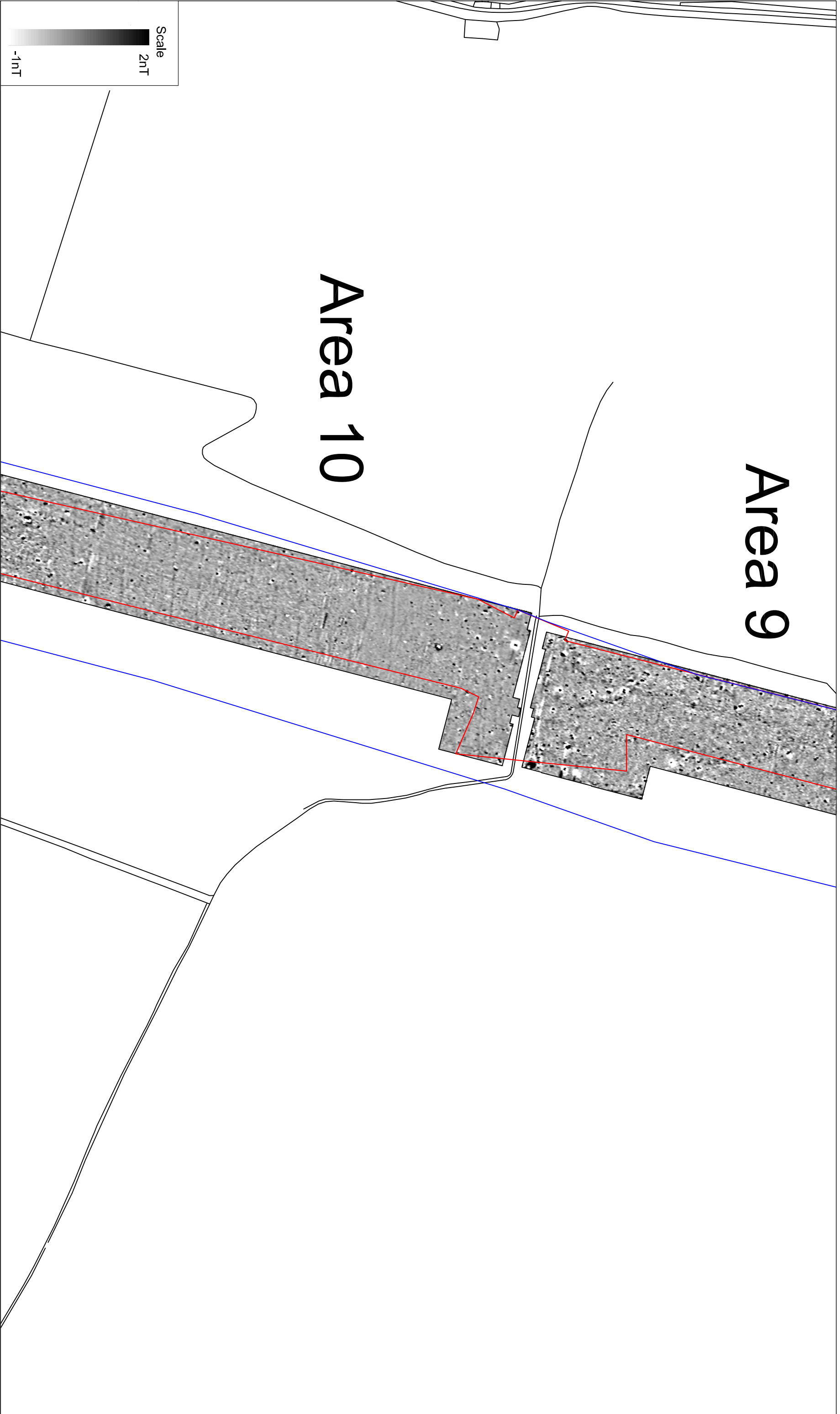
Unprocessed gradiometer survey results - greyscale plot - Areas 9 & 10

Figure
17



Red Line Boundary
Blue Line Boundary

0
1:2000 at A3
80m



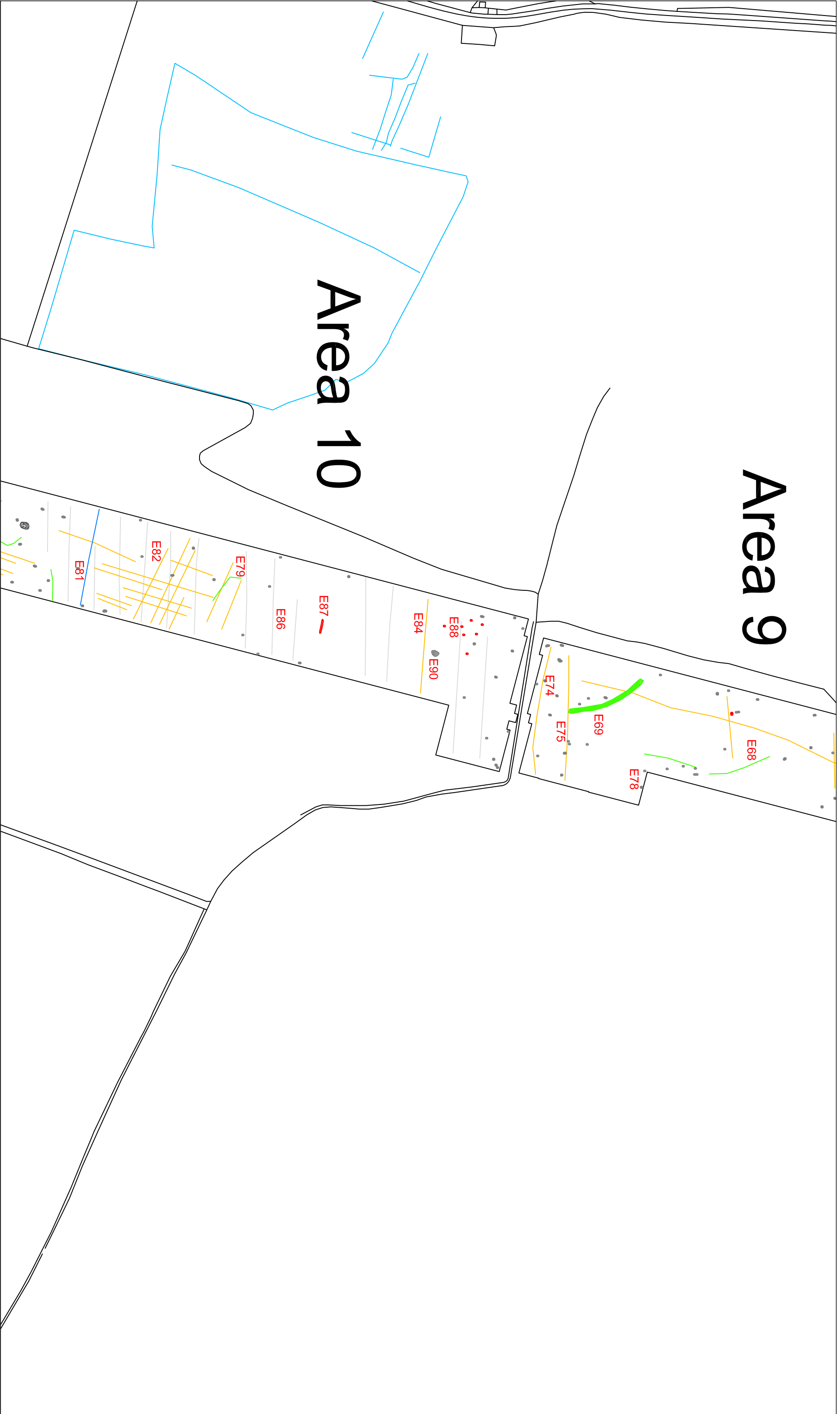
Processed gradiometer survey results - Greyscale plot - Areas 9 & 10

Figure
18



- Red line boundary
- Blue line boundary

0 80m
1:2000 at A3



Area 9

Area 10

Interpretation of gradiometer survey results - Areas 9 & 10

Figure
19



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes
- HER point data and corresponding ID
- HER cropmark and field division data



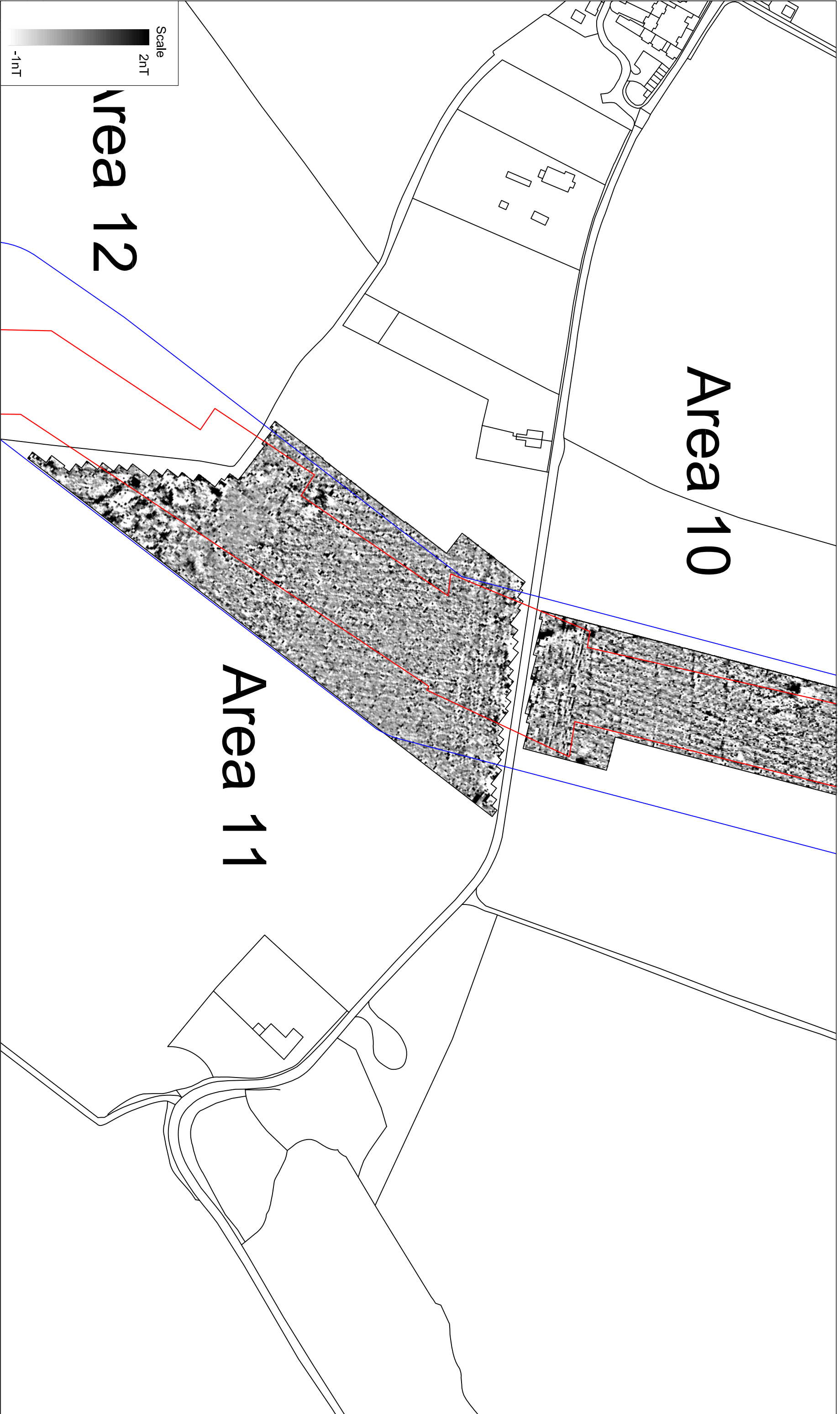
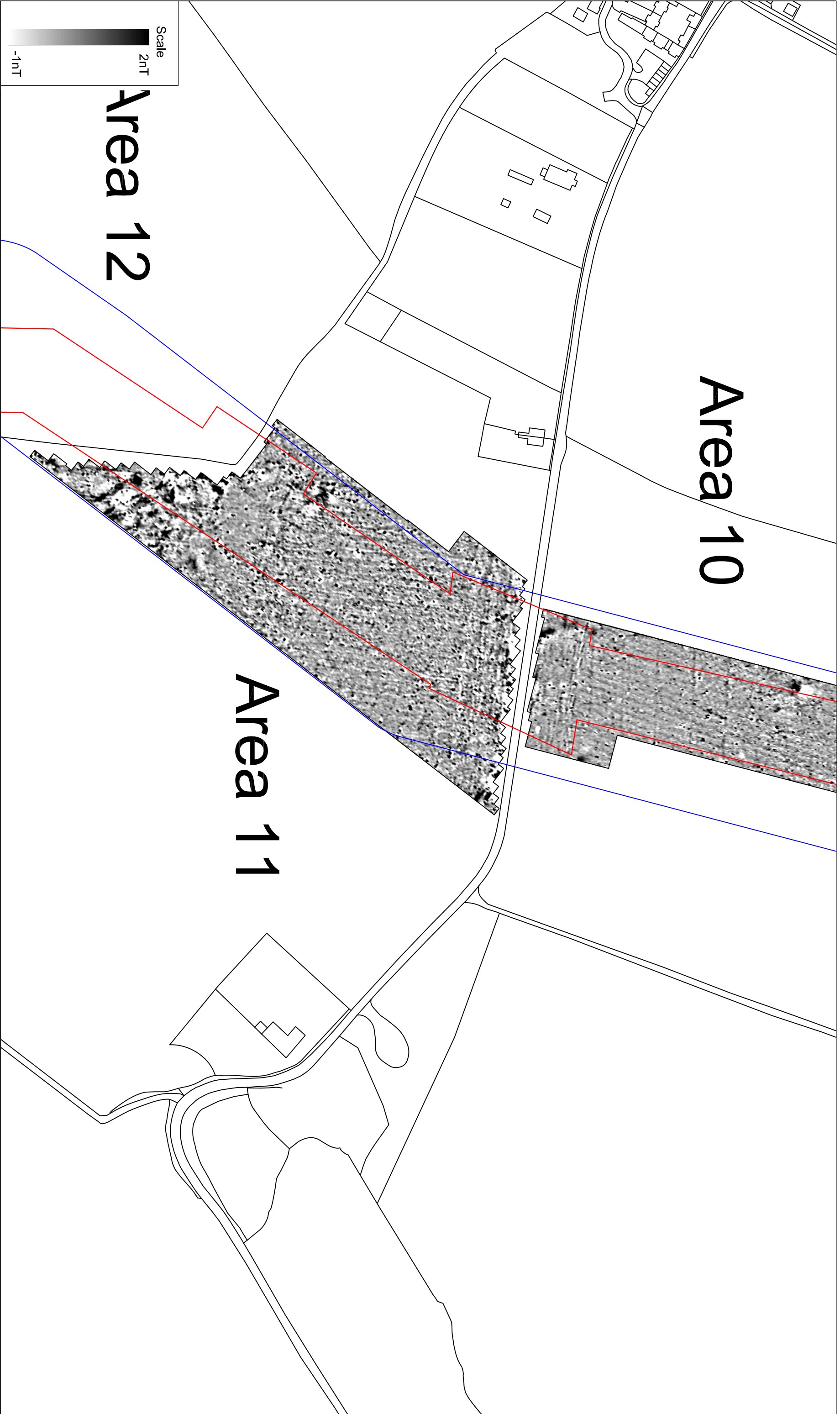


Figure 20



Red Line Boundary
Blue Line Boundary

0 80m
1:2000 at A3



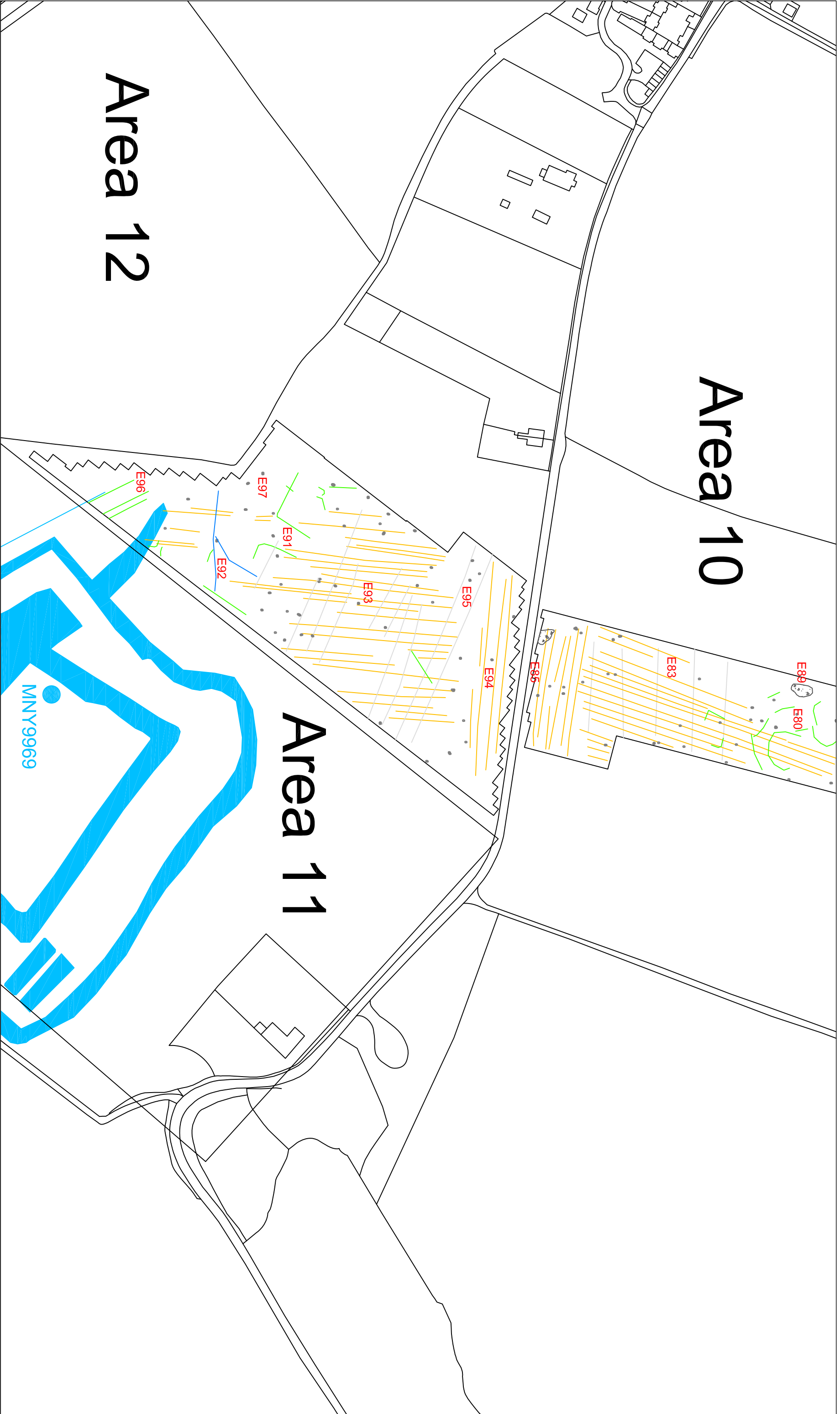
Processed gradiometer survey results - Greyscale plot - Areas 10 & 11

Figure 21



- Red line boundary
- Blue line boundary





Interpretation of gradiometer survey results - Areas 10 & 11

Area 12

Area 10

Area 11

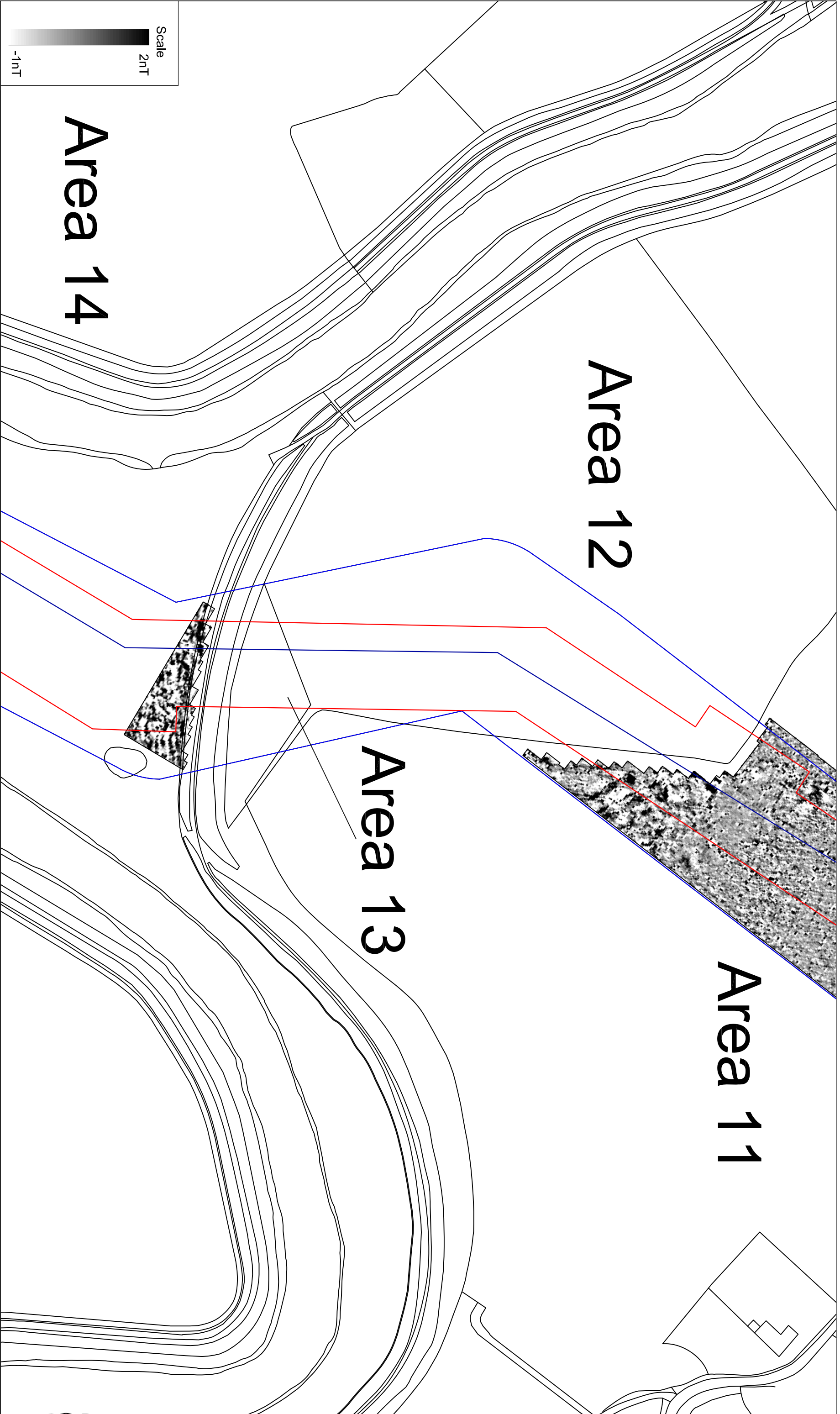
MNY9969

Figure 22



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes
- HER point data and corresponding ID
- HER cropmark and field division data





Unprocessed gradiometer survey results - greyscale plot - Area 14

Area 14

Area 12

Area 13

Area 11

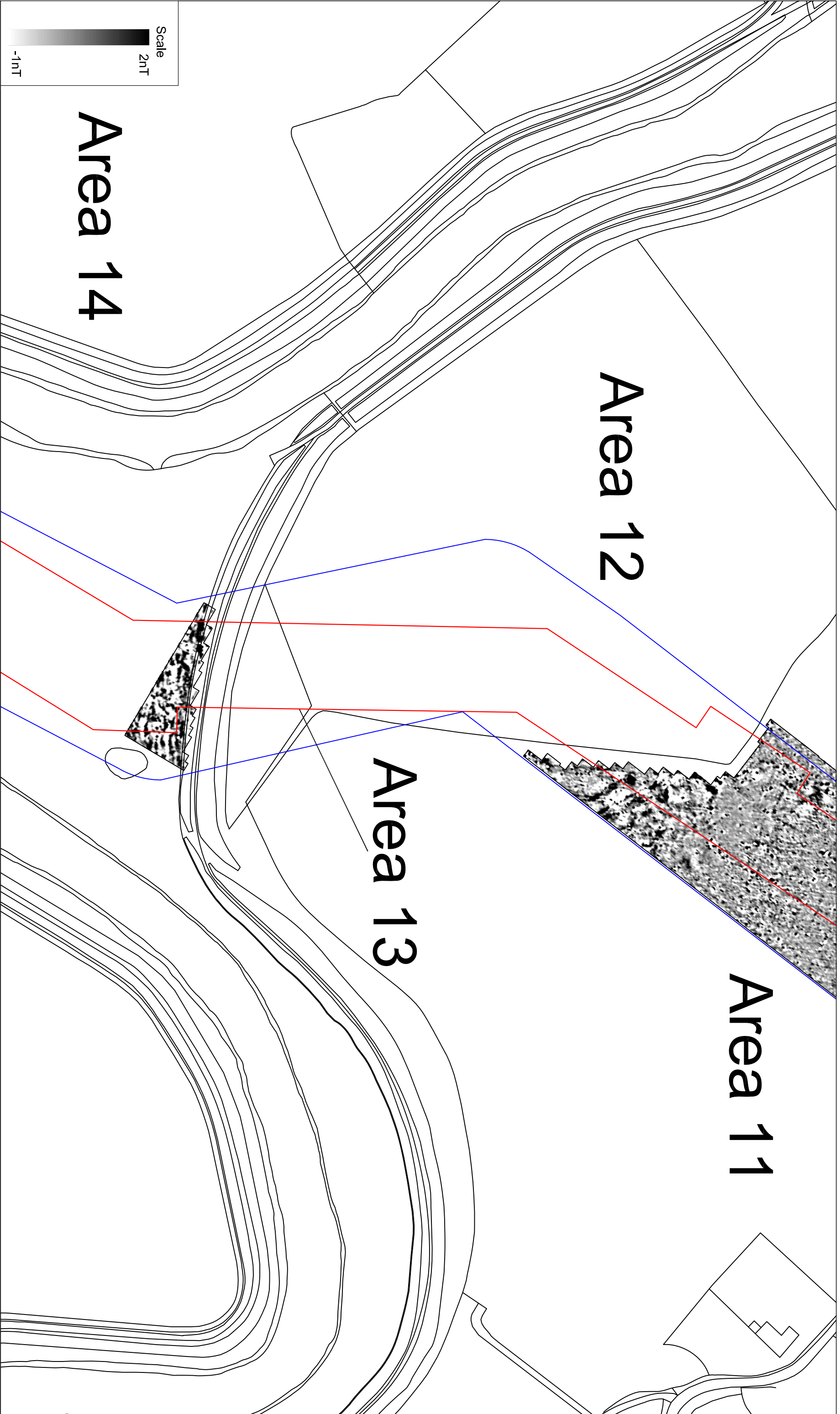


Figure
23



- Red Line Boundary
- Blue Line Boundary





Area 14

Area 12

Area 13

Area 11

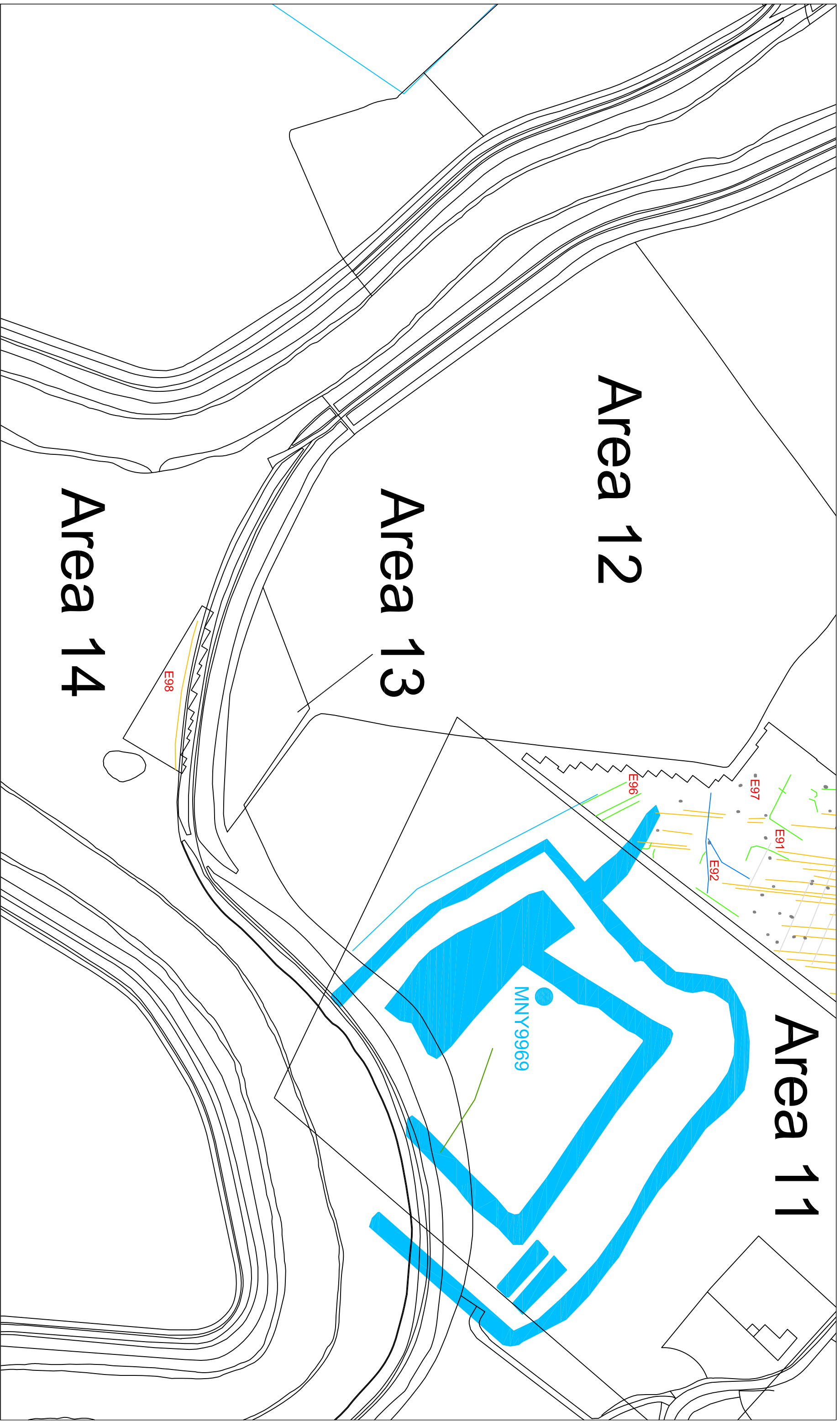
Processed gradiometer survey results - Greyscale plot - Area 14

Figure
24



- Red line boundary
- Blue line boundary





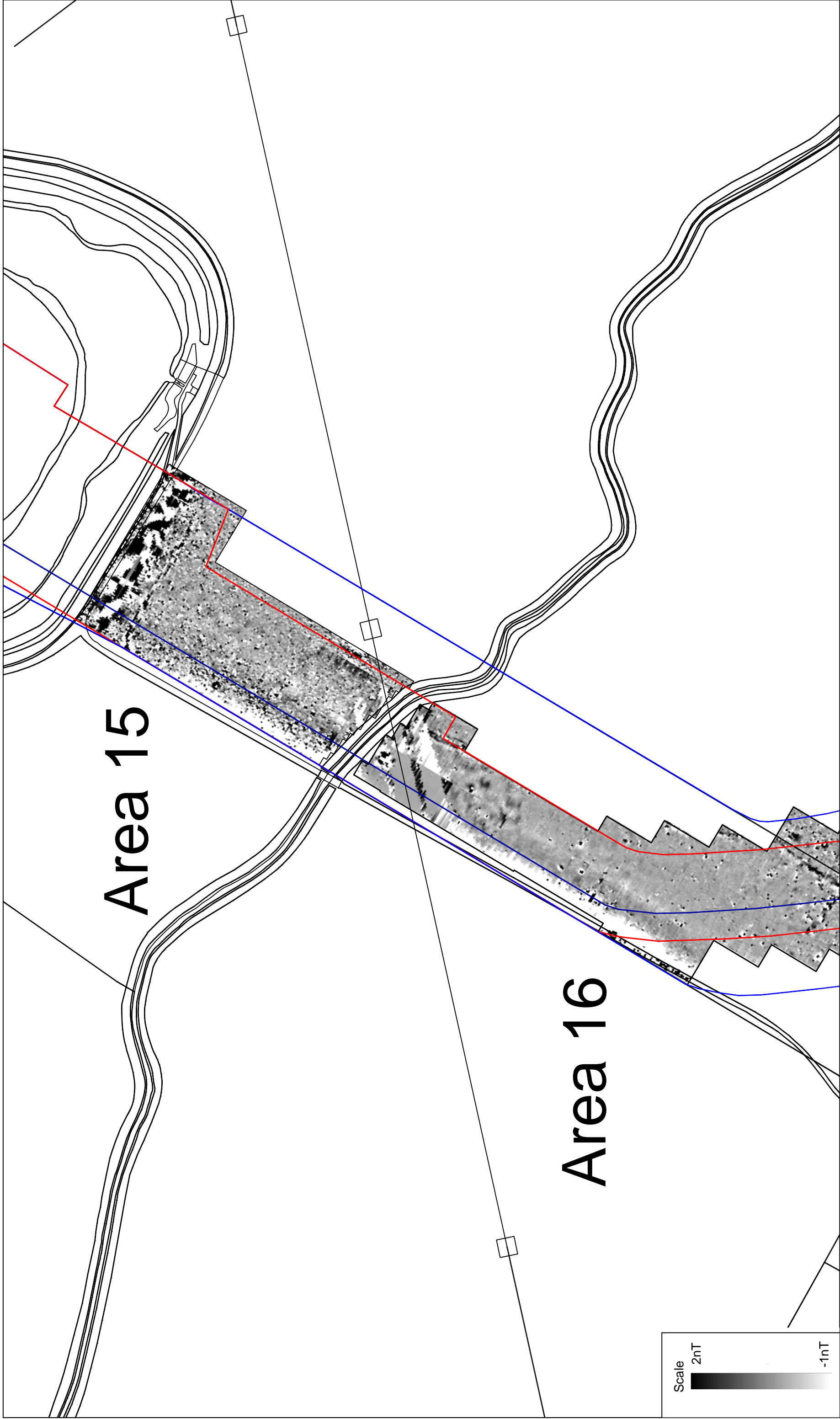
Interpretation of gradiometer survey results - Area 14

Figure
25



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes
- HER point data and corresponding ID
- HER cropmark and field division data

0 80m
1:2000 at A3



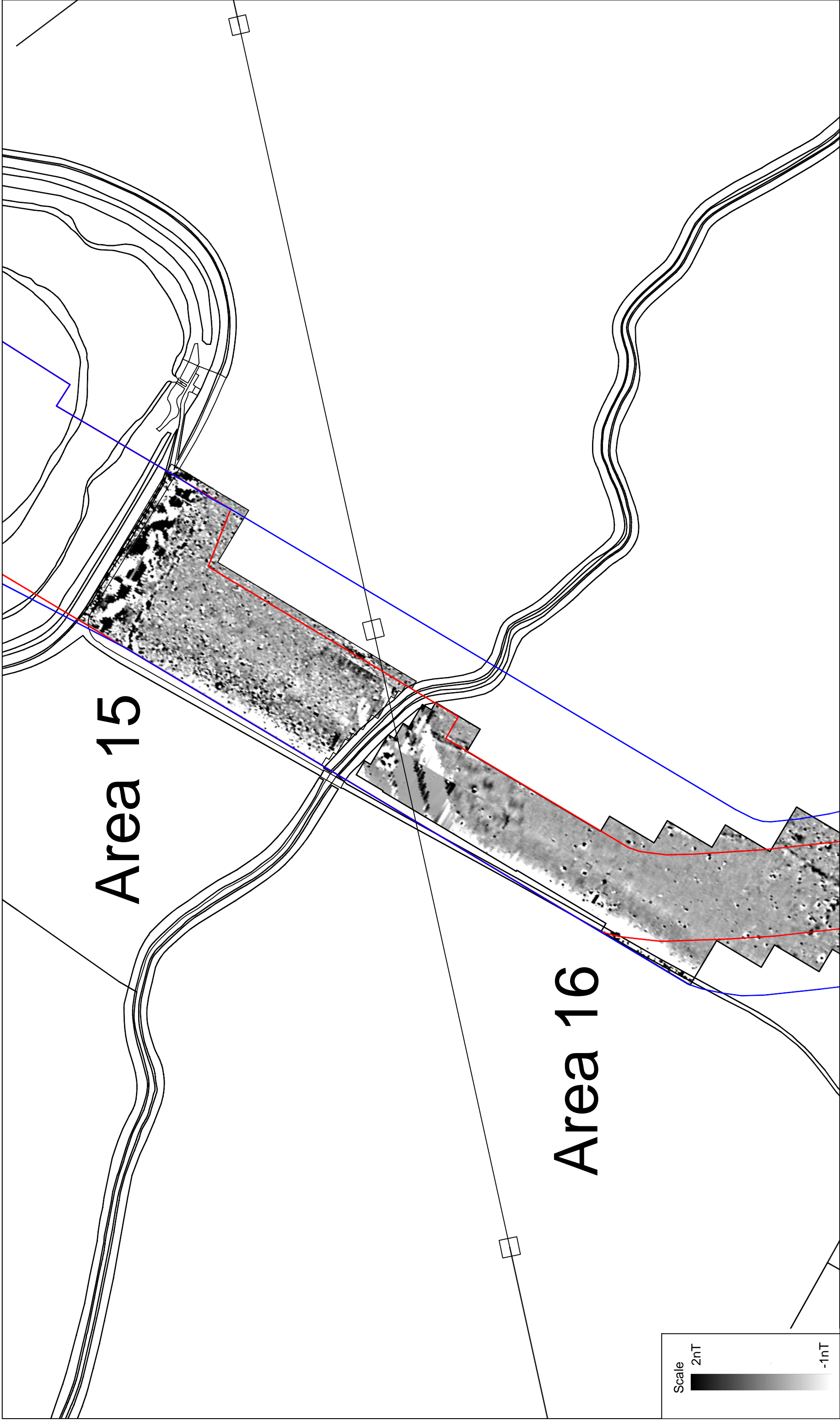
Unprocessed gradiometer survey results - greyscale plot - Areas 15 & 16

Red Line Boundary
Blue Line Boundary



Figure
26

0 80m
1:2000 at A3



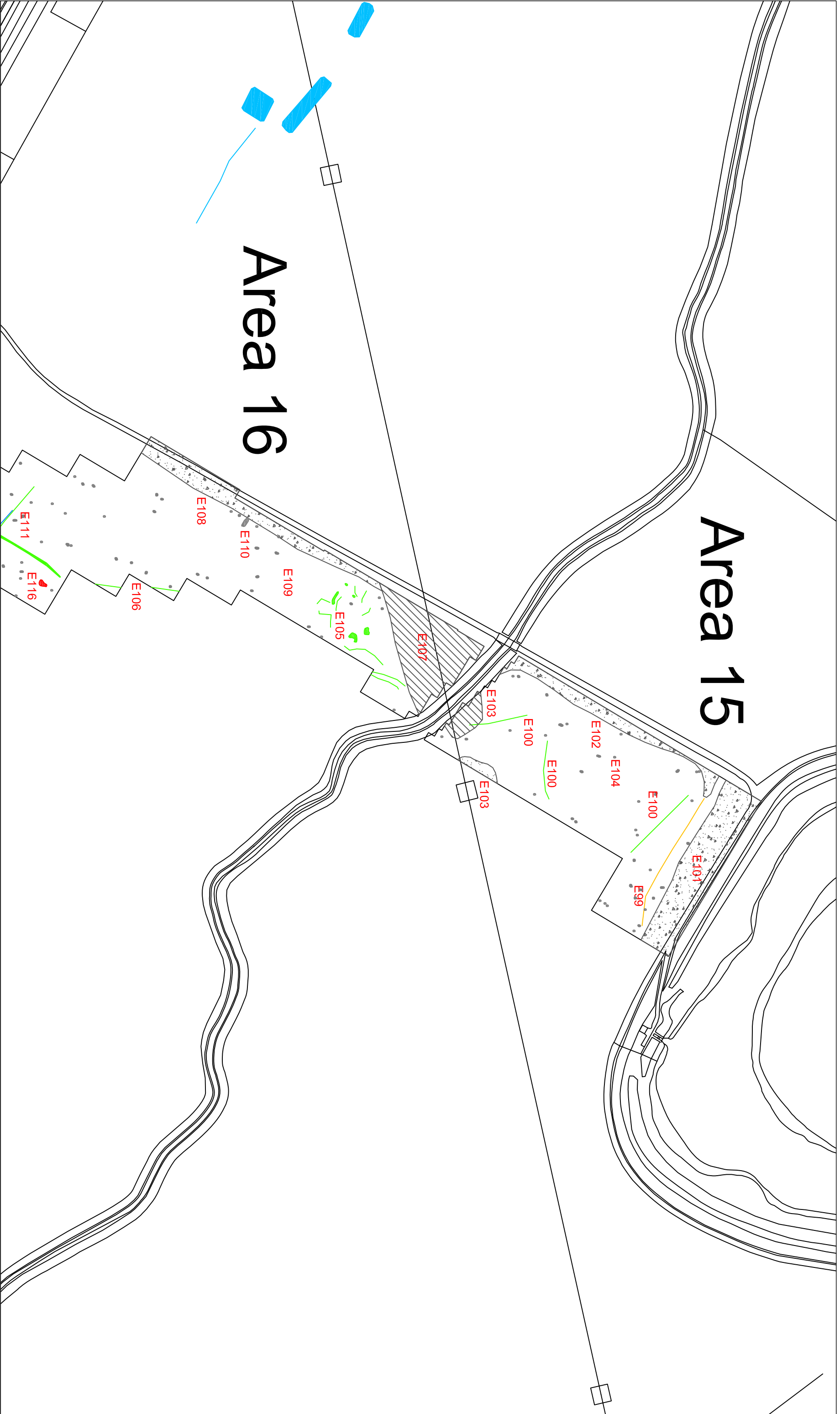
Processed gradiometer survey results - Greyscale plot - Areas 15 & 16

Red line boundary
Blue line boundary



Figure
27

0 80m
1:2000 at A3



Interpretation of gradiometer survey results - Areas 15 & 16

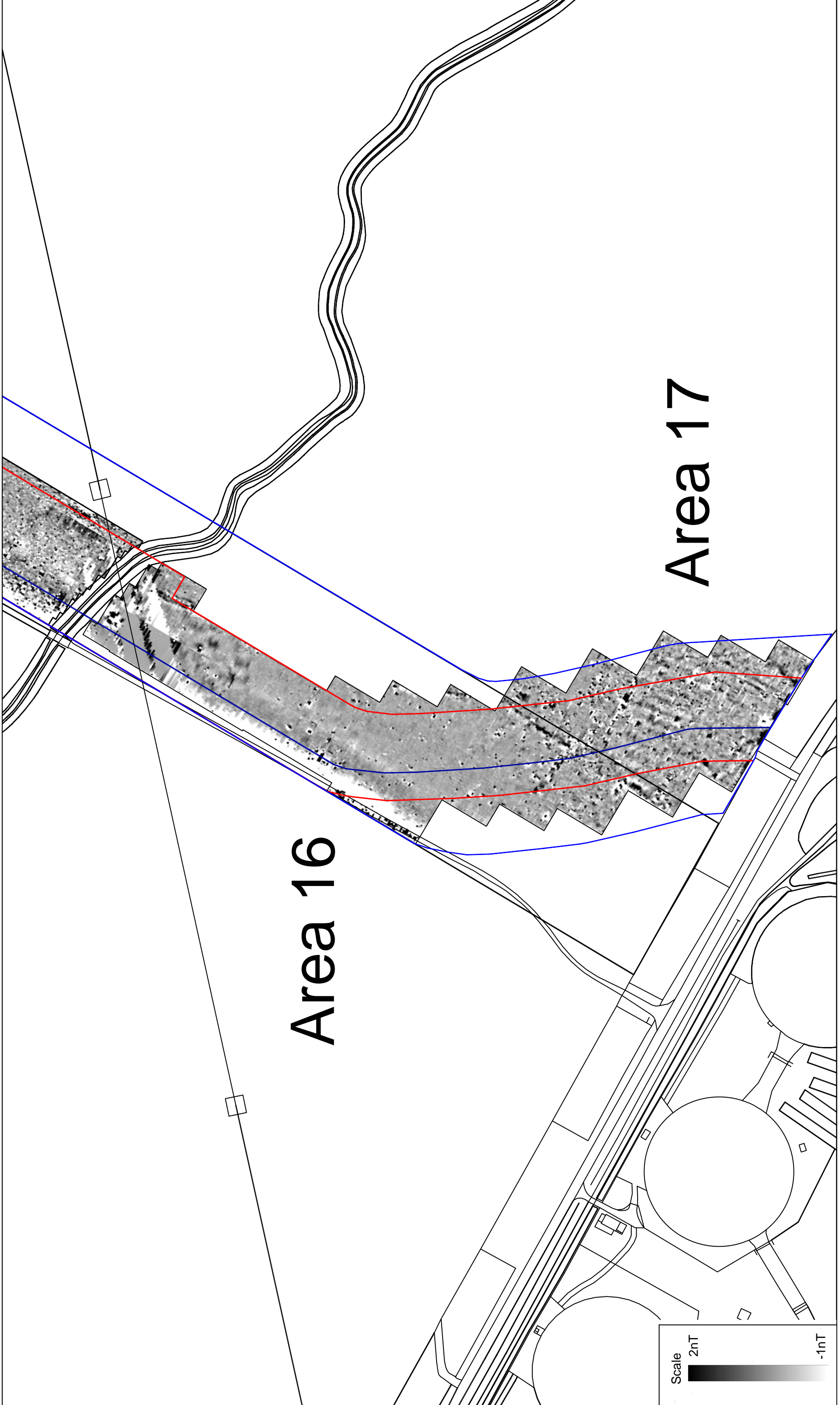
- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary

- Magnetic Disturbance (Modern)
- Magnetic Disturbance (from electrical wires)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes

- HER point data and corresponding ID
- HER cropmark and field division data

Figure 28





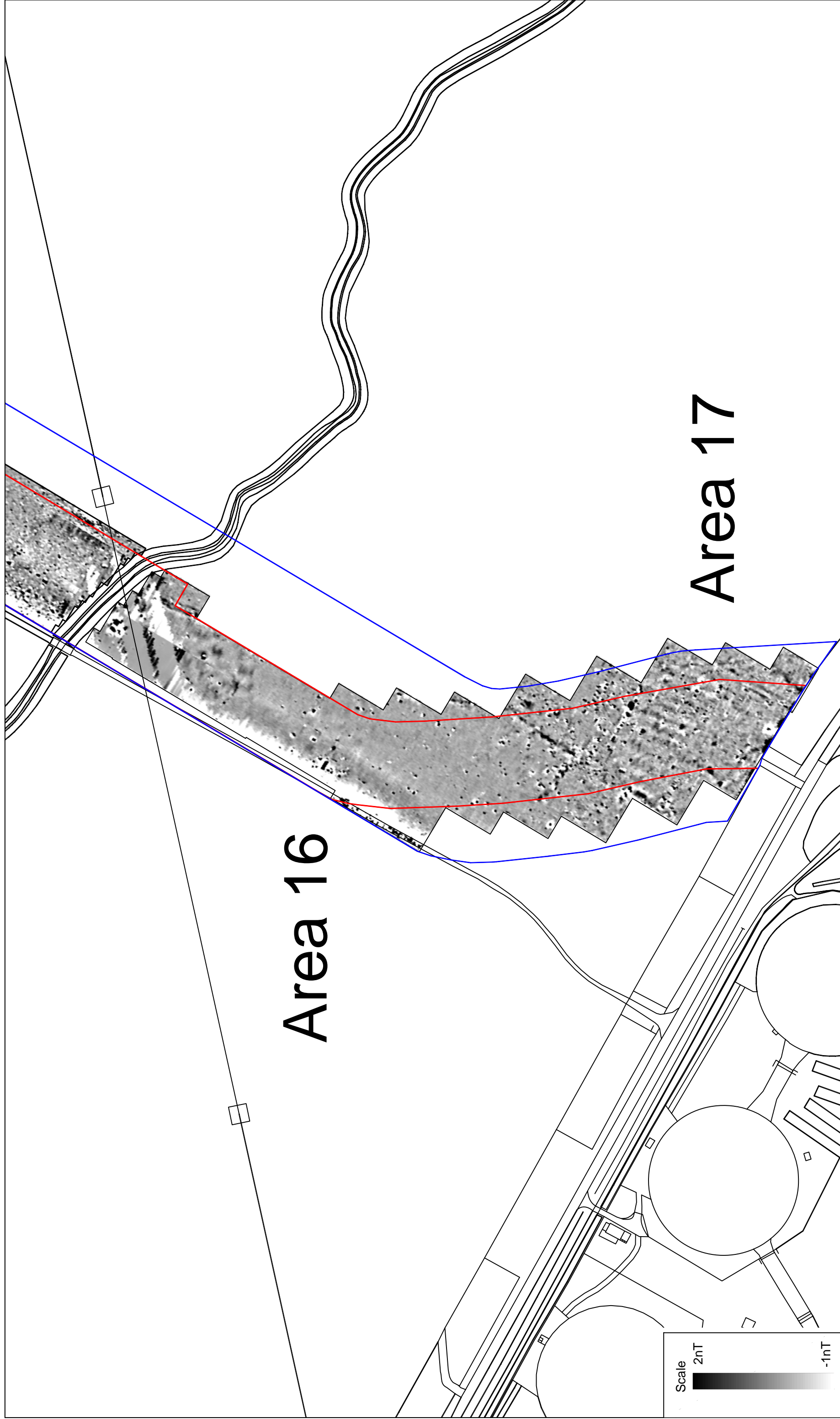
Unprocessed gradiometer survey results - greyscale plot - Area 16 & 17

Red Line Boundary
Blue Line Boundary



Figure
29

0 80m
1:2000 at A3



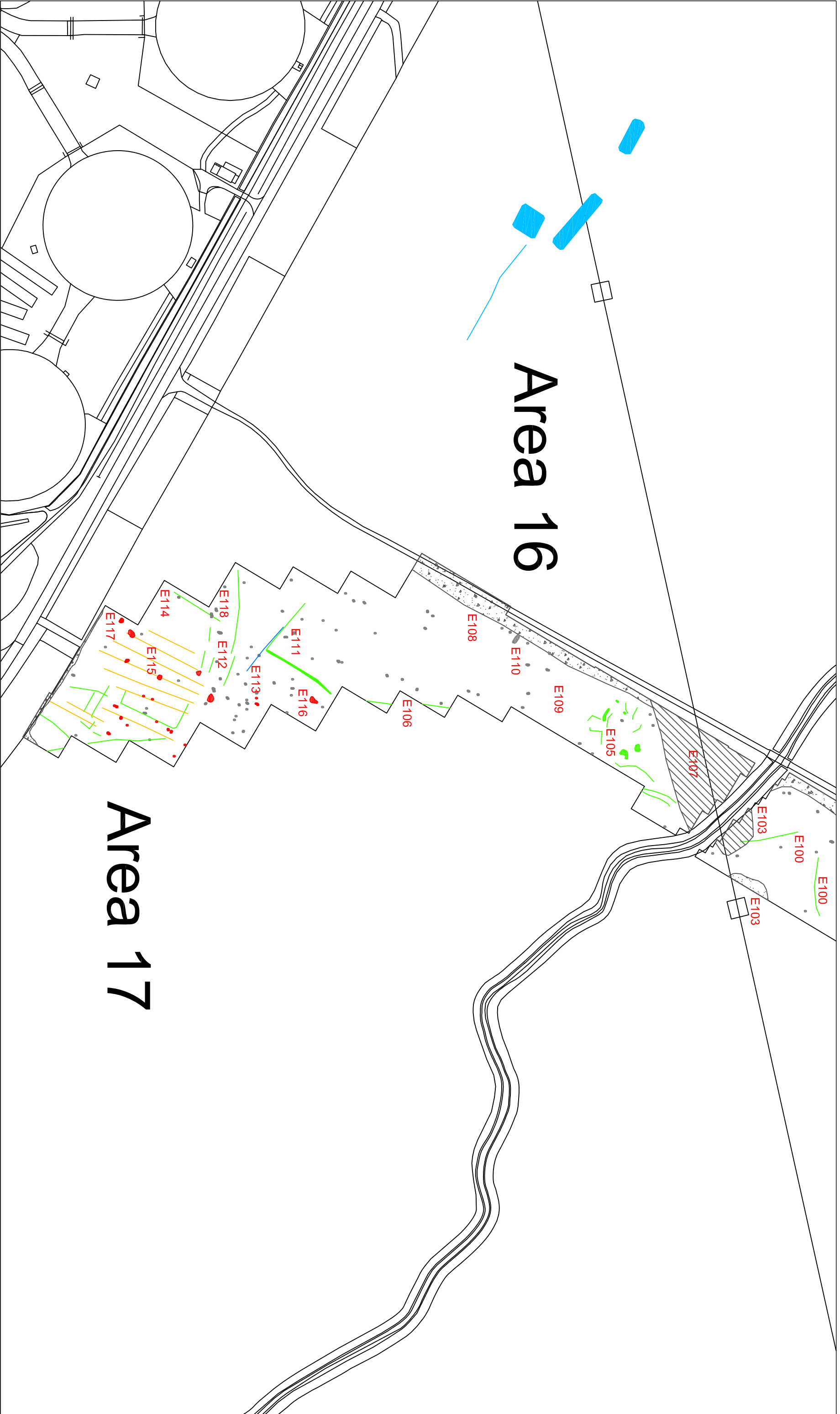
Processed gradiometer survey results - Greyscale plot - Areas 16 & 17

Red line boundary
Blue line boundary



Figure
30

0 80m
1:2000 at A3



Interpretation of gradiometer survey results - Areas 16 & 17

Figure
31



- Discrete Linear Trend (Archaeology?)
- Linear Trend (Agricultural)
- Pit
- Old Field Boundary
- Magnetic Disturbance (Modern)
- Magnetic Disturbance (from electrical wires)
- Linear Trend (Modern - Pipe)
- Ferrous / Iron Spikes

0
1:2000 at A3
80m



Plate 1. Area 1 looking south



Plate 2. Area 2 looking west



Plate 3. Area 3 looking north



Plate 4. Area 4 looking west



Plate 5. Area 5 looking south



Plate 6. Area 6 looking east along trackway



Plate 7. Area 7 looking south towards Eggborough Power Station



Plate 8. Area 8 looking south



Plate 9. Area 9 looking south



Plate 10. Area 10 looking west



Plate 11. Area 11 looking south



Plate 12. Area 14 looking east



Plate 13. Area 15 looking east



Plate 14. Area 16 and 17 looking east

Appendix 1: Survey Information

Field	Description
Surveyor	AOC Archaeology
Client	AECOM
Site	Eggborough
County	North Yorkshire
NGR	South: SE 58232 24594 North: SE 57888 28035
Solid geology	Bedrock: Sherwood Sandstone Group-Sandstone. Superficial Geology: Alluvium-Clay, Silt, Sand and Gravel; Brighton Sand Formation-Sand; Hemingborough Glaciolacustrine Formation-Clay, Silty (BGS 2017).
Soil composition	The soils are made up of a combination of freely draining slightly acid sandy soils, loamy soils with naturally high groundwater, slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, and loamy and clayey floodplain soils with naturally high groundwater (Soilscapes 2017)
Historical documentation/ mapping on site	None
Known archaeology on site	None
Scheduled Ancient Monument	No
Land use/ field condition	Plough (heavy and light), arable cultivation, overgrown floodplain
Duration	09/01/17-12/01/2017, 13/02/2017-14/02/2017
Weather	Sunny
Survey type	Gradiometer Survey
Instrumentation	Trimble GXOR system Bartington Grad 601-2
Area covered	Approx 26ha (369 full or partial grids)
Data collection staffing	James Lawton, Kimberley Teale, Alistair Galt
Download software	Grad601 PC Software v313
Processing software	Geoplot v3.0 and v4.0
Visualisation software	AutoCAD LT 2009
Report title	Eggborough, Combined Cycle Gas Turbine (CCGT), North Yorkshire
Project number	51669
Report Author	James Lawton
Report approved by	Graeme Cavers

Appendix 2: Archaeological Prospection Techniques, Instrumentation and Software Utilised

Gradiometer survey

Gradiometer surveys measure small changes in the earth's magnetic field. Archaeological materials and activity can be detected by identifying changes to the magnetic values caused by the presence of weakly magnetised iron oxides in the soil (Aspinall *et al.*, 2008, 23; Sharma, 1997, 105). Human habitation often causes alterations to the magnetic properties of the ground (Aspinall *et al.*, 2008, 21). There are two physical transformations that produce a significant contrast between the magnetic properties of archaeological features and the surrounding soil: the enhancement of magnetic susceptibility and thermoremanent magnetization (Aspinall *et al.*, 2008, 21; Heron and Gaffney 1987, 72).

Ditches and pits can be easily detected through gradiometer survey as the top soil is generally suggested to have a greater magnetisation than the subsoil caused by human habitation. Also areas of burning or materials which have been subjected to heat commonly have high magnetic signatures, examples include: hearths, kilns, fired clay and mudbricks (Clark 1996, 65; Lowe and Fogel 2010, 24). It should be noted that negative anomalies can also be useful for characterising archaeological features. If the buried remains are composed of a material with a lower magnetisation compared with the surrounding soil, the surrounding soil will consequently have a greater magnetisation resulting in the feature displaying a negative signature. For example stone materials of a structural nature that are composed of sedimentary rocks are considered non-magnetic and so will appear a negative features within the data set.

Ferrous objects- i.e. iron and its alloys- are strongly magnetic and are typically detected as high-value peaks in gradiometer survey data, though it is not usually possible to determine whether these relate to archaeological or modern objects.

Although gradiometer surveys have been successfully carried out in all areas of the United Kingdom, the effectiveness of the technique is lessened in areas with complex geology, particularly where igneous and metamorphic bedrock is present. All magnetic geophysical surveys must therefore take the effects of background geological and geomorphological conditions into account.

Gradiometer survey instrumentation

AOC Archaeology's gradiometer surveys are carried out using Bartington Grad601-2 magnetic gradiometers. The Grad601-2 is a high-stability fluxgate magnetic gradient sensor, which uses a 1m sensor separation. The detection resolution is from 0.03 nT/m to 0.1nT/m, depending on the sensor parameters selected, making the Grad601-2 an ideal instrument for prospective survey of large areas as well as detailed surveys of known archaeology. The instrument stores the data collected on an on-board data-logger, which is then downloaded as a series of survey grids for processing.

Gradiometer survey software

Following the survey, gradiometer data was downloaded from the instrument using Grad601 PC Software v313. Survey grids were then assembled into composites and enhanced using a range of processing techniques are applied to the data using Geoscan's Geoplot v3.0 (see Appendix 2 for a summary of the processes used in Geoplot and Appendix 3 for a list of processes used to create final data plots).

Appendix 3: Summary of Processes used in Geoplot

Process	Effect
Clip	Replaces data values outside a specified range, in order to display important data with relative values stretched across the display range.
De-spike	Removes exceptionally high values represented in the data that can obscure the visibility of archaeological features. In resistivity survey, these can be caused by poor contact of the mobile probes with the ground; in gradiometer survey, these can be caused by highly magnetic items such as buried ferrous objects.
De-stagger	Counteracts the striping effect caused by misalignment of data when collected on a zig-zag traverse pattern.
Edge Match	Counteracts edge effects in grid composites by subtracting the difference between mean values in the two lines either side of the grid edge.
High pass filter	Removes low-frequency, large scale detail in order to remove background trends in the data, such as variations in geology.
Interpolate	Increases the resolution of a survey by interpolating new values between surveyed data points
Low Pass filter	Uses a Gaussian filter to remove high-frequency, small scale detail, typically for smoothing or generalising data.
Periodic Filter	Used to either remove or reduce amplitudes of constant and reoccurring features that distort other potential patterns. An example of which is plough lines.
Wallis filter	Applies a locally adaptive contrast enhancement filter.
Zero Mean Grid	Resets the mean value of each grid to zero, in order to counteract edge discontinuities in composite assemblies.
Zero Mean Traverse	Resets the mean value of each traverse to zero, in order to address the effect of striping in the data and counteract edge effects.

Appendix 4: Survey Processing Steps

Process	Extent
Survey Area	
Zero Mean Traverse	All LMS =on, threshold -5 to 5
Despike	X=1 Y=1 Thr = 3 Repl = Mean
Clip	Min =-5 Max = 5
Destagger	All grids dir Shift = 2 Line Pattern 34-78 Dual-DS
Low Pass filter	X=1 Y=1 Wt=G
Interpolate	Y, Expand – Expand –SinX/X x2
Raw Palette Scale	Grey55 Min= - Max= 2
Palette Scale	Grey55 Min= -1 Max= 2

Appendix 5: Technical Terminology

Type of Anomaly	Description
Archaeology	
(Isolated Linear trends)	
Linear trend (field boundary)	Isolated long linear anomalies that are likely to relate to field boundaries. Signal may appear inconsistent but patterning and positioning, especially when compared with historic mapping suggests such anomalies belong to former field division systems
Linear trend (field boundary?)	Anomalies of a long linear form, but lack the necessary patterning, signal strength or positioning to be positively identified as field boundaries.
Archaeology	
Linear trend (fortification)	Linear anomalies that are composed of a patterning and positioning that is likely to relate to structural remains such as town fortifications. These anomalies can be composed of either an increase or decrease in magnetic values, relating to in-filled ditches or buried walls.
Linear trend (road)	A regular linear trend that is identified through the absence of buried remains, especially through areas containing a variety of rectilinear anomalies that appear to have structural associations.
Linear trend (archaeology)	These can either be isolated linear anomalies or rectilinear in form and often suggest the presence of structural remains. Anomalies are either characterised by an increase or decrease in signal compared to background values depending on the properties of the feature being recorded.
Disturbed area (archaeology)	These are characterised by a general increase or decrease in the magnetic background over a localised area but do not appear as having a linear form. These anomalies do not have the high dipolar response which are manifested in an 'iron spike' anomaly, and can be the result of in-filled pits and post-holes, or kilns.
Pit	Isolated circular anomalies composed of an increase in magnetic values with a patterning that is suggestive of buried remains such as the infill of a pit
Discrete	
Linear trend (archaeology?)	Anomalies of a linear form either composed of an increased or decreased signal compared to background values. It is possible these anomalies belong to structural remains, but poor patterning or response values makes interpretation difficult.
Disturbed area (archaeological?)	Anomalies with an increase or decrease in values compared with background reading over a localised area. Poor patterning or weak signal changes creates difficulty in defining the nature of the archaeology and so interpretation is fairly tentative. On certain geologies these anomalies could be caused by in-filled natural features, and it would be necessary to undertake intrusive archaeological investigation to establish their form and character.
Possible archaeology (Unclear to origins of the remains)	Anomalies composed of a weak change in signal values compared to background reading or are composed of incomplete patterning. Consequently, interpretation is tentative and it is unclear to whether anomalies belong to an archaeological nature.

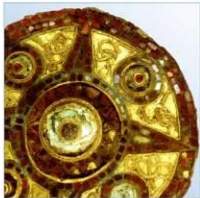
(Archaeology?) (Unclear to origins of the remains)	Like with above, but located in an area previously excavated so is either potentially a product of excavation related activity or relates to subtle changes in the magnetic properties in the soil caused by earlier activity, which was not detected during previous archaeological assessment works.
Area of Disturbance (archaeology?)	A large area of general disturbance which could relate to earlier human activity which has caused an increase in the magnetic properties of the soil. Generally these areas contain a variety of increased and decreased magnetic values, but lack sufficient patterning for detailed interpretation. They could indicate the presence of buried rubble relating to fallen structures, or instead denote modern material either caused by quarrying or agricultural activity.
Pit?	Isolated circular anomalies composed of an increase in magnetic values with a patterning that may be suggestive of buried remains such as the infill of a pit.
Linear trend (plough lines)	A series of regular anomalies of a linear form either composed of an increased or decreased signal compared to background values. Likely to denote the presence of ploughing and relating to archaeological agricultural activity such as ridge and furrow.
Non- Archaeology	
Linear trend (plough lines)	A series of regular anomalies of a linear form either composed of an increased or decreased signal compared to background values. Likely to denote the presence of ploughing and relating to modern agricultural activity.
Linear trend (agricultural)	Series of linear anomalies, of an indeterminate date, likely to have been caused by agricultural activity such as ploughing and land drainage
Linear trend (modern?)	Anomalies of a linear form that are likely to belong to modern features, but are composed of values, patterning or positioning which makes definite interpretation difficult
Disturbed area (modern?)	Area of disturbance that is composed of significant increases or decreases in values compared with background readings. It is highly likely that these readings are caused by modern disturbances, but interpretation is tentative.
Linear trend (modern)	Anomalies of a linear form often composed of contrasting positive and negative values. Such anomalies usually signify a feature with a high level of magnetisation and are likely to belong to modern activity such as pipe lines
Disturbed area (modern)	Area of disturbance that is likely to be caused by modern disturbances and is characterised by significant increases or decreases in values compared with background readings.
Isolated dipolar anomalies (iron spikes)	Response normally caused by ferrous materials on the surface or within the top soil of the site, which cause a 'spike' representing a rapid variation in the magnetic response. These are generally not assessed to be archaeological when surveying on rural sites, and generally represent modern material often re-deposited during manuring.
Geology	Area of disturbance that is composed of irregular significant increase or decreases in values compared with background readings and are likely to indicate natural variations in soil composition or geology

Appendix 6: Individual Characterisation of Identified Anomalies

Anomaly Identifier (Site Name: Eggborough, North Yorkshire)	Type of Archaeology
Gradiometer survey	
E1	Discrete linear trend (Positive) Archaeology?
E2	Linear Trend, Former field boundary
E3	Pits?
E4	Linear trend (Drainage?)
E5	Linear trend (Modern pipe)
E6	Linear trends (Modern Ploughing?)
E7	Discrete linear trend (Negative) Agricultural Headland?
E8	Discrete linear trend (Negative) Agricultural Headland?
E9	Isolated Ferrous Spikes
E10	Possible Archaeology/Geology trend
E11	Discrete linear trend (Negative) Agricultural Headland?
E12	Pits?
E13	Isolated Ferrous Spikes
E14	Discrete linear trend (Positive) Archaeology?
E15	Pits?
E16	Linear trends (Ridge and Furrow ploughing?)
E17	Linear trend (Drainage?)
E18	Linear Trend, Former field boundary
E19	Linear trend (Drainage?)
E20	Discrete linear trend (Negative) Agricultural Headland?
E21	Discrete linear trend (Negative) Agricultural Headland?
E22	Magnetic Disturbance Modern, Telegraph Pole?
E23	Isolated Ferrous Spikes
E24	Discrete linear trend (Negative) Agricultural Headland?
E25	Possible Archaeology/Geology trend?
E26	Possible Archaeology/Geology trend?
E27	Possible Archaeology/Old field boundary trend?
E28	Curvilinear trends (Ridge and Furrow ploughing?)
E29	Pits?
E30	Isolated Ferrous Spikes
E31	Discrete linear trend (Positive) Archaeology?
E32	Pits?
E33	Pits?
E34	Pits?
E35	Pits?
E36	Possible Archaeology/Geology trend?
E37	Possible Archaeology/Geology trend?
E38	Linear trend (Drainage?)
E39	Linear trend (Drainage?)
E40	Linear trend (Drainage?)

E41	Linear trend (Drainage?)
E42	Linear Trend, Former field boundaries
E43	Linear trends (Ridge and Furrow ploughing?)
E44	Linear trends (Modern Ploughing?)
E45	Modern disturbance?
E46	Linear Trend, Former field boundary
E47	Modern disturbance?
E48	Isolated Ferrous Spikes
E49	Linear trend (Drainage?)
E50	Possible Archaeology/Drain trend?
E51	Linear trend (Modern pipe)
E52	Linear trend (Modern track)
E53	Linear trend (Drainage and track)
E54	Isolated Ferrous Spikes
E55	Linear trend (Drainage?)
E56	Linear trend (Drainage?)
E57	Discrete linear trends (Negative) Agricultural Headlands?
E58	Linear trend (Modern track)
E59	Modern disturbance? Telegraph Poles
E60	Isolated Ferrous Spikes
E61	Linear Trend, Former field boundary
E62	Magnetic disturbance flooding?
E63	Linear trends (Modern Ploughing?)
E64	Modern disturbance?
E65	Pits?
E66	Isolated Ferrous Spikes
E67	Discrete linear trend (Positive) Archaeology?
E68	Discrete linear trend (Positive) Archaeology?
E69	Discrete linear trend (Positive) Archaeology?
E70	Linear Trend, Former field boundary
E71	Linear trends (Drainage/Ridge and Furrow ploughing?)
E72	Discrete linear trend (Negative) Agricultural Headland?
E73	Discrete linear trend (Negative) Agricultural Headland?
E74	Discrete linear trend (Negative) Agricultural Headland?
E75	Discrete linear trend (Negative) Agricultural Headland?
E76	Discrete linear trend (Negative) Agricultural Headland?
E77	Discrete linear trend (Negative) Agricultural Headland?
E78	Isolated Ferrous Spikes
E79	Discrete linear trend (Positive) Archaeology?
E80	Discrete linear trend (Positive) Archaeology?
E81	Linear Trend, Former field boundary
E82	Linear trends (Modern Ploughing?)
E83	Linear trends (Modern Ploughing?)
E84	Discrete linear trends (Negative) Agricultural Headlands?
E85	Discrete linear trends (Negative) Agricultural Headlands?
E86	Linear trend (Drainage?)

E87	Pits, Archaeology/Geology trend?
E88	Pits, Archaeology/Geology trend?
E89	Magnetic disturbance Telegraph Pole?
E90	Isolated Ferrous Spikes
E91	Discrete rectilinear trends (Positive) Archaeology?
E92	Linear Trend, Former field boundary
E93	Linear trends (Modern Ploughing?)
E94	Discrete linear trends (Negative) Agricultural Headlands?
E95	Linear trend (Drainage?)
E96	Possible Archaeology/Geology trend?
E97	Isolated Ferrous Spikes
E98	Discrete linear trend (Negative) Flood defence base?
E99	Linear Trend, Former field boundary
E100	Possible Archaeology/Geology trend?
E101	Linear trend (Modern pipe)
E102	Magnetic disturbance (Track)
E103	Magnetic disturbance (Pylon)
E104	Isolated Ferrous Spikes
E105	Possible Archaeology/Geology trend?
E106	Possible Archaeology/Drainage trend?
E107	Magnetic disturbance (Pylon)
E108	Magnetic disturbance (Track)
E109	Geological Trends?
E110	Isolated Ferrous Spikes
E111	Possible Archaeology/Geology trend?
E112	Possible Archaeology/Geology trend?
E113	Linear Trend, Former field boundary
E114	Linear trend, Former Trackway?
E115	Linear trends (Ridge and Furrow ploughing?)
E116	Pits?
E117	Pits?
E118	Isolated Ferrous Spikes



AOC Archaeology Group, The Raylor Centre, James Street, York, YO10 3DW
tel: 01904 413 404 | e-mail: york@aocarchaeology.com

www.aocarchaeology.com