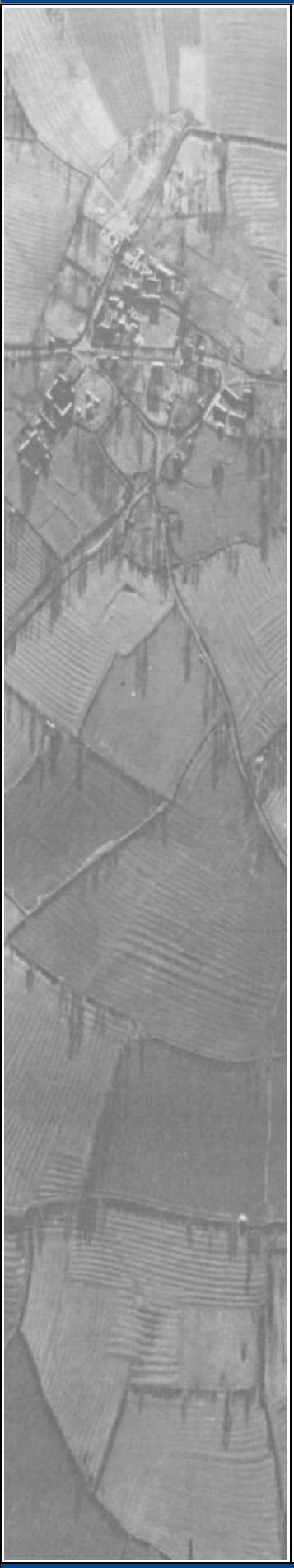

Oadby to Arnesby Scheme Leicestershire

MAGNETOMETER SURVEY REPORT

for

Geomap Ltd

Kerry Donaldson & David Sabin

April 2020

Ref. no. J804

DRAFT

ARCHAEOLOGICAL SURVEYS LTD

Oadby to Arnesby Scheme
Leicestershire

MAGNETOMETER SURVEY REPORT

for

Geomap Ltd

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DRAFT

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SUMMARY

A geophysical survey, comprising detailed magnetometry, was carried out along a 4500m section of a proposed water pipeline to the east of Leicester. An additional 900m length was also surveyed adjacent to the north and south edges of the Grand Union Canal. Five areas contain anomalies with archaeological potential, including positive linear anomalies indicating ditch-like features within Area 6 to the north of Newton Harcourt and Area 10 to the west. Also to the west of Newton Harcourt are a number of rectilinear enclosures, linear ditches and pits that indicate a Romano-British settlement. The proposed route of the scheme was adjusted to avoid this archaeology. To the south of the Grand Union Canal are at least three highly magnetic responses to industrial features. These appear to indicate brick kilns used during construction of the canal in the late 18th century.

1 INTRODUCTION

1.1 Survey background

1.1.1 Archaeological Surveys Ltd was commissioned by Geomap Ltd, on behalf of Severn Trent Water, to undertake a magnetometer survey along the route of a new water main known as the Oadby to Arnesby Scheme in Leicestershire. The survey was carried out over a 50m wide corridor, centred on the new pipeline route between the A6 London Road in the north and ending near Kilby in the south. The total survey corridor covers approximately 5400m that is a combination of 4500m in length and two additional sections alongside the Grand Union Canal totalling another 900m.

1.1.2 The geophysical survey was carried out in accordance with a Written Scheme of Investigation (WSI) produced by Archaeological Surveys (2019) and issued to the client prior to commencing the fieldwork.

1.2 Survey objectives and techniques

1.2.1 The objective of the survey was to use magnetometry to locate geophysical anomalies that may be archaeological in origin so that they may be assessed prior to groundworks associated with laying of the new water main. The methodology is considered an efficient and effective approach to archaeological prospection.

1.2.2 Geophysical survey can provide useful information on the archaeological potential of a site; however, the outcome of any survey relies on a number of factors and as a consequence results can vary. The success in meeting the aims and objectives of a survey is, therefore, often impossible to predetermine.

1.3 Standards, guidance and recommendations for the use of this report

1.3.1 The survey and report generally follow the recommendations set out by: European Archaeological Council (2015) *Guidelines for the Use of Geophysics in Archaeology;* Institute for Archaeologists (2002) *The use of Geophysical Techniques in Archaeological Evaluations.* The work has been carried out to the Chartered Institute for Archaeologists (2014) *Standard and Guidance for Archaeological Geophysical Survey.* Note: currently Historic England (2018) no longer support the guidelines set out in English Heritage (2008) *Geophysical survey in archaeological field evaluation* and there are currently no plans to update the document. As a consequence other sources of written guidance referring to this document may be out of date and/or contain unsupported information (e.g. Chartered Institute for Archaeologists, 2014).

1.3.2 Archaeological Surveys Ltd provide a detailed geophysical survey report and it is recommended that where possible the contents should be considered in full. The Summary provides a brief overview of the results with more detail available in the Discussion and/or Conclusion. The *List of anomalies* within the Results provides a detailed assessment of the anomalies within separate categories which can be useful in inferring a level of confidence to the interpretation. Quality and factors influencing the interpretation of anomalies is also set out within the results.

1.3.3 It is recommended that the full report should always be considered when using data and interpretation plots; where this is not possible, in the field for example, the abstraction and interpretation plots should retain their colour coding and be used with a corresponding legend.

1.3.4 Where targeting of anomalies by excavation is to be carried out, care should be taken to place trenches over solid lines or features visible on the abstraction and interpretation plots. Archaeological Surveys abstraction and interpretation avoids the use of dashed or dotted line formats, and broken or fragmented lines used in interpretive plots may well correspond closely with truncation of archaeological features.

1.4 Site location, description and survey conditions

1.4.1 The survey corridor is located between the A6 London Road near Oadby on the outskirts of Leicester (SP 64030 98824). It then extends for approximately 1.9km southwards towards Newton Harcourt and then to the west for another 1.2km to the north of Glen Road and the railway line. It then extends southwards for another 1.4km crossing beneath the railway and the Grand Union Canal to Wistow Road, just east of Kilby (SP 62417 95489). Two sections to the north and south of and parallel with the canal have also been surveyed (SP 62192 96166 to SP 62564 96099) (see Figs 01 to 07 for referencing).

1.4.2 The geophysical survey covers approximately 25ha within seventeen survey

areas. The survey was carried out 25m either side of the central line of the pipeline route. Three areas were not surveyed due to the presence of horses in Area 1 in the north of the site, a change in the scope of the scheme to remove areas north of Glen Road (Area 9) and severe and prolonged waterlogging to the south of the River Sence (Area 18).

1.4.3 The ground conditions across the site were generally very poor and areas were difficult to access and traverse due to prolonged rain causing waterlogging and flooding. Weather conditions during the survey were frequently poor due to persistent rain and high winds. Survey was frequently abandoned or delayed to allow improvement to conditions, although between October 2019 and March 2020 very few survey opportunities arose due to exceptionally high rainfall badly affecting the clayey open soil within many of the survey areas.

1.5 Site history and archaeological potential

1.5.1 There is evidence for extant ridge and furrow within pasture at the far northern end of the corridor, but the majority of the survey corridor has been under modern arable cultivation which has generally eradicated the majority of ridge and furrow. The Leicestershire Historic Environment Record also records that while there are no other heritage assets within the survey corridor, the former location of a WW2 "Starfish" decoy site, designed to resemble the railway junction at Knighton was located 100m to the west of the survey corridor (MKE22668). A Bronze Age axe hammer was also found 100m to the west of the survey corridor (MLE6345).

1.5.2 To the west of Newton Harcourt, to the south of the survey corridor, are medieval village earthwork remains (MLE2660). The survey corridor extends along part of the Midland Railway (MLE16083) and also along side the Grand Union Canal (MLE16300). To the south of the canal and adjacent to the survey corridor is the location of two post-medieval square enclosures, surrounded by ridge and furrow, but could be associated with the construction of the canal (MLE2659).

1.6 Geology and soils

1.6.1 The underlying solid geology across the site is mudstone from the Blue Lias Formation with a small area of Charmouth Mudstone Formation to the north of Newton Harcourt. However, there are overlying glacial deposits of Diamicton from the Oadby Member across the majority of the site with some colluvial deposits in valley bottoms and alluvium along the River Sence in the southern part of the survey corridor (BGS, 2017).

1.6.2 The overlying soil across the majority of the survey corridor is from the Ragdale association which is a pelo-stagnogley soil. It consists of a slowly permeable, seasonally waterlogged, clayey soil. Within the floodplain of the River Sence in the southern part of the survey corridor, the soil is from the

Fladbury 1 association which is a pelo-alluvial gley soil and consists of a stoneless, clayey soil at risk of flooding (Soil Survey of England and Wales, 1983).

1.6.3 The underlying geology and soils are frequently associated with low magnetic contrast and low levels of magnetic susceptibility. However, cut features of archaeological potential may be located where human activity has altered the magnetic characteristics of the soil sufficiently. The underlying geology and soils are, therefore, considered acceptable for magnetic survey.

2 METHODOLOGY

2.1 Technical synopsis

2.1.1 Magnetometry survey records localised magnetic fields that can be associated with features formed by human activity. Magnetic susceptibility and magnetic thermoremnance (also known as thermoremanence) are factors associated with the formation of localised fields.

2.1.2 Iron minerals within the soil may become altered by burning and the break down of biological material; effectively the magnetic susceptibility of the soil is increased, and the iron minerals become magnetic in the presence of the Earth's magnetic field. Accumulations of magnetically enhanced soils within features, such as pits and ditches, may produce magnetic anomalies that can be mapped by magnetic prospection.

2.1.3 Magnetic thermoremnance can occur when ferrous minerals have been heated to high temperatures such as in a kiln, hearth, oven etc. On cooling, a permanent magnetisation may be acquired due to the presence of the Earth's magnetic field. Certain natural processes associated with the formation of some igneous and metamorphic rock may also result in magnetic thermoremnance.

2.1.4 The localised variations in magnetism are measured as sub-units of the Tesla, which is a SI unit of magnetic flux density. These sub-units are nano Teslas (nT), which are equivalent to 10^{-9} Tesla (T). Additional details are set out in 2.2 below and within Appendix A.

2.2 Equipment configuration, data collection and survey detail

2.2.1 The detailed magnetic survey was carried out using a SENSYS MAGNETO®MXPDA 5 channel cart-based system. The instrument has 5 fluxgate gradiometers (FGM650) spaced 0.5m apart with readings recorded at 20Hz. The cart is pushed at walking speed and not towed. Each sensor is not zeroed in the field as the vertical axis alignment is precisely fixed leaving sensor offsets that are removed during data processing. The fixing of the vertical alignment ensures the sensors are not unduly influenced by localised magnetic fields and that the vertical

component of a magnetic anomaly is measured. The gradiometers have a range of recording data between ±0.1nT and ±8000nT. They are linked to a Leica GS10 RTK GNSS with data recorded by SENSYS MAGNETO®MXPDA software on a rugged PDA computer system.

2.2.2 Due to the fixed offsets within the fluxgate sensors, as a result of the manufacturing and tensioning process, the survey data do not provide a visually useful dataset until a zero median traverse algorithm is applied. It is recognised that this has the potential to affect some anomalies detrimentally by removing linear features orientated parallel to survey transects. However, this has not been noted as a particular problem with the system due to the high resolution data collection, generally long length of traverses and variability within the magnetic characteristics of a linear anomaly.

2.2.3 Data are collected along a series of parallel survey transects to achieve 100% coverage of the surveyable land. The length of each transect is variable and relates to the size of the survey area and other factors including ground conditions. A visual display allows accurate placing of transects and helps maintain the correct separation between adjacent traverses. Data are not collected within fixed grids and data points are considered to be random even though the data are collected in a systematic manner covering all accessible areas (Aspinall, Gaffney and Schmidt, 2009).

2.2.4 Fluxgate sensors are highly sensitive to temperature change and this manifests as drift during the course of a survey. This can be particularly noticeable during the morning as temperatures rise and the equipment warms or cools. Sensor drift within the course of a traverse will appear as a line trending from negative to positive after processing with a zero median traverse algorithm. To remove the potential for temperature drift, data were collected after a 20 minute stabilisation period and traverses were limited to a time of generally <60s.

2.3 Data processing and presentation

2.3.1 Magnetic data collected by the MAGNETO®MXPDA cart-based system are initially prepared using SENSYS MAGNETO®DLMGPS software. The software effectively allocates a geographic position for each data point and can compensate for fixed offsets present within the FGM650 sensors. The offsets are positive or negative values present on all fluxgate gradiometer sensors. Some systems use manual or electronic balancing to effectively zero the sensors; however, this is a short term measure that is prone to drift through temperature changes and vibration and can easily be incorrectly set due to localised magnetic fields. The FGM650 sensors are very accurately aligned to the vertical magnetic gradient and are highly stable showing negligible drift on long traverses. The offset values are removed using TerraSurveyor software.

2.3.2 Survey tracks are analysed and georeferenced raw data (UTM Z30N) are then exported in ASCII format for further analysis and display within TerraSurveyor.

The removal of the offset values (compensation) of the sensors is also carried out in TerraSurveyor using a zero median traverse function. Data are then considered to be minimally processed. Note: without the zero median traverse function it is not possible to create a meaningful data plot as all sensors have a different offset value. Although a zero median traverse algorithm can remove anomalies aligned with the survey tracks, in practice this rarely occurs due to the use of long traverses, high resolution measurement and variability within the magnetic susceptibility of long linear features.

2.3.3 The minimally processed data are collected between limits of ±8000nT and clipped for display at ±3nT. Data are interpolated to a resolution of effectively 0.5m between tracks and 0.15m along each survey track.

2.3.4 Additional data processing has been carried out in the form of high pass filtering within all areas. This effectively removes low frequency variation along a traverse that has been caused by large magnetic bodies, cultivation or rapid temperature change. Data treated to additional processing have been compared to unprocessed data to ensure that no significant anomalies have been removed.

2.3.5 Additional data processing has also been carried out for Areas 3, 4, 5 & 13 in the form of low pass filtering. This effectively removes high frequency variation along a traverse that has been caused by uneven ground and associated vibration.

2.3.6 Appendix C contains metadata concerning the survey and data attributes and is derived directly from TerraSurveyor. Reference should be made to Appendix B for further information on processing.

2.3.7 A TIF file is produced by TerraSurveyor software along with an associated world file (.TFW) that allows automatic georeferencing (OSGB36 datum) when using GIS or CAD software. The main form of data display used in the report is the minimally processed greyscale plot. With regard to the Sensys MXPDA, minimally processed data are considered by the manufacturer to be data that are compensated by SENSYS MAGNETO DLMGPS software, see 2.3.1 and 2.3.2. Note: traceplots are not considered to be appropriate as they do not provide an accurate or useful assessment of the magnetic anomalies due to the very high density of data collection. In addition, traceplots cannot be meaningfully plotted against base mapping and in areas of complexity traces may be lost or highly confused. Traceplots may be used to demonstrate characteristic magnetic profiles across discrete features where it is considered beneficial.

2.3.8 The raster images are combined with base mapping using ProgeCAD Professional 2016, creating DWG (2010) file formats. All images are externally referenced to the CAD drawing in order to maintain good graphical quality. The CAD plots are effectively georeferenced facilitating relocation of features using GNSS, resection method, etc.

2.3.9 An abstraction and interpretation is drawn and plotted for all geophysical anomalies located by the survey. Anomalies are abstracted using colour coded points, lines and polygons. All plots are scaled to landscape A3 for paper printing. Appendix E sets out CAD layer names with colour and graphic content for each interpretation category, see 3.3.

2.3.10 A brief summary of each anomaly, with an appropriate reference number, is set out in list form within the results (Section 3) to allow a rapid and objective assessment of features within each survey area. Where further interpretation is possible, or where a number of possible origins should be considered, more subjective discussion is set out in Section 4.

2.3.11 A digital archive is produced with this report, see Appendix D below. The main archive is held at the offices of Archaeological Surveys Ltd.

3 RESULTS

3.1 General assessment of survey results

3.1.1 The detailed magnetic survey was carried out over a total of 17 survey areas covering approximately 25ha. Area 1, in the north of the corridor was unsurveyable due to loose horses, where the owner was unknown. To the north of Glen Road, two areas were taken out of the scheme, one (Area 8) prior to survey taking place, and one (Area 9) after the survey and the results are displayed in this report. The scheme was changed to take the route along Glen Road, rather than through the original survey areas. Within the southern part of the route, a small area adjacent to the River Sence (Area 18) was not surveyable due to prolonged waterlogging and flooding.

3.1.2 Magnetic anomalies located can be generally classified as positive linear and discrete positive responses of archaeological potential, positive and negative linear anomalies of an uncertain origin, linear anomalies of an agricultural origin, areas of magnetic debris and disturbance, strong discrete dipolar anomalies relating to ferrous objects and strong multiple dipolar linear anomalies relating to buried services or pipelines.

3.1.3 Anomalies located within each survey area have been numbered and are described in 3.4 to 3.20 below with subsequent discussion in Section 4.

3.2 Statement of data quality and factors influencing the interpretation of anomalies

3.2.1 Data are considered representative of the magnetic anomalies present within the site. There are no significant defects within the dataset. High magnitude magnetic disturbance associated with services and adjacent to the canal has the potential to obscure features within localised zones.

3.2.2 Generally, along most of the corridor magnetic contrast appears good with several former cut features of archaeological potential clearly visible. Numerous anomalies of natural origin were located across low lying land near the River Sence and these have the potential to obscure or confuse the interpretation of anthropogenic anomalies.

3.2.3 Several arable fields appear to contain moderate levels of widespread magnetic debris. Observations during the survey indicated characteristic small plastic fragments and other material typical of contaminated 'green waste' spread recently as a soil conditioner. It is possible that other industrial waste material has been used as a soil conditioner in the Modern or Industrial Periods also. The magnetic response to the debris does have the potential to obscure weak anomalies and certainly weak anomalies relating to former ridge and furrow cultivation are difficult to trace from the data in some areas.

3.3 Data interpretation

3.3.1 The list of sub-headings below attempts to define a number of separate categories that reflect the range and type of features located during the survey. A general explanation of the characteristics of the magnetic anomalies is set out for each category in order to justify interpretation, see Table 1.

Interpretation category	Description and origin of anomalies
Anomalies with archaeological potential	Anomalies have the characteristics (mainly morphological) of a range of archaeological features such as pits, ring ditches, enclosures, etc. The category is used where there is a high level of confidence which may be due to additional supporting information where morphology is unclear or uncharacteristic.
Anomalies with an uncertain origin	The category applies to a range of anomalies where there is not enough evidence to confidently suggest an origin. Anomalies in this category may well be related to archaeologically significant features, but equally relatively modern features, geological/pedological features and agricultural features should be considered. Morphology may be unclear or uncharacteristic and there may be a lack of additional supporting information. Positive anomalies are indicative of magnetically enhanced soils that may form the fill of 'cut' features or may be produced by accumulation within layers or 'earthwork' features; soils subject to burning may also produce positive anomalies. Negative anomalies are produced by material of comparatively low magnetic susceptibility such as stone and subsoil.
Anomalies relating to land management	Anomalies are mainly linear and may be indicative of the magnetically enhanced fill of cut features (i.e. ditches). The anomalies may be long and/or form rectilinear elements and they may relate to topographic features or be visible on early mapping. Associated agricultural anomalies (e.g. headlands, plough marks and former ridge and furrow) may support the interpretation. Land drains can appear in a classic herringbone pattern of interconnected multiple dipolar linear anomalies, or as parallel linear anomalies. The multiple dipolar response indicates ceramic land drains.
Anomalies with an agricultural origin	The anomalies are often linear and form a series of parallel responses or are parallel to extant land boundaries. Where the response is broad, former ridge and furrow is likely; narrow response is often related to modern ploughing. This category does not include agricultural features of early date or considered to be of archaeological potential (e.g. animal

	stockades, enclosures, farmsteads, etc).
Anomalies associated with magnetic debris	Magnetic debris often appears as areas containing many small dipolar anomalies that may range from weak to very strong in magnitude. They often occur where there has been dumping or ground make-up and are related to magnetically thermoremnant materials such as brick or tile or other small fragments of ferrous material. This type of response is occasionally associated with kilns, furnace structures, hearths and nail spreads from former wooden structures or rooves and may, therefore, be archaeologically significant. It is also possible that the response may be caused by natural material such as certain gravels and fragments of igneous or metamorphic rock. Strong discrete dipolar anomalies are responses to ferrous objects within the topsoil.
Anomalies with a modern origin	The magnetic response is often strong and dipolar indicative of ferrous material and may be associated with extant above surface features such as wire fencing, cables, pylons etc. Often a significant area around these features has a strong magnetic flux which may create magnetic disturbance; such disturbance can effectively obscure low magnitude anomalies if they are present. Fluxgate sensors may respond erratically adjacent to strong magnetic sources. Buried services may produce characteristic multiple dipolar anomalies dependant upon their construction.
Anomalies with a natural origin	Naturally formed magnetic anomalies are caused by localised variability in the magnetic susceptibility of soils, subsoils and other drift or solid geologies. Anomalies may be amorphous, linear or curvilinear and may appear 'fluvial' or discrete; the latter are almost impossible to distinguish from pit-like anomalies with an anthropogenic origin. Fluvial, glacial and periglacial processes may be responsible for their formation within drift material and subsoil. Igneous and metamorphic activity can lead to anomalies within more solid geology.

Table 1: List and description of interpretation categories

3.4 List of anomalies - Area 2

Area 2 centred on OS NGR 463963 298637 - 463903 298479, see Fig 08.

3.4.1 Area 2 contains two discrete positive anomalies and a number of short, weakly positive linear anomalies. These could be natural in origin or associated with ground disturbance.

3.5 List of anomalies - Area 3

Area 3 centred on OS NGR 463938 298584 - 463861 298356, see Fig 09.

Anomalies with an uncertain origin

(1) - A positive linear anomaly is associated with high magnitude responses indicative of possible ferrous material or burning.

Anomalies associated with land management

(2) - A positive linear anomaly is associated with a formerly mapped field boundary.

(3) - Weak, multiple dipolar, linear anomalies are a response to ceramic land drains.

Anomalies with an agricultural origin

(4 & 5) - A series of parallel linear anomalies oriented north west to south east relate to former ridge and furrow (4). More modern agricultural activity (5) is oriented north north east to south south west.

Anomalies associated with magnetic debris

(6) - A patch of magnetic debris is likely to be related to dumped magnetically thermoremnant material.

Anomalies with a modern origin

(7) - A strong, multiple dipolar, linear anomaly relates to the existing water main.

3.6 List of anomalies - Area 4

Area 4 centred on OS NGR 463858 298329 - 463778 297897, see Figs 10 & 11.

3.6.1 Area 4 contains a small number of weakly positive linear and discrete anomalies but these cannot be confidently interpreted as former cut features. Land drains, ridge and furrow and the existing water main are also evident.

3.7 List of anomalies - Area 5

Area 5 centred on OS NGR 463777 297891 - 463709 297613, see Figs 12 & 13.

3.7.1 Area 5 also contains ridge and furrow, land drains and patches of magnetic debris from dumped material used for ground consolidation.

3.8 List of anomalies - Area 6

Area 6 centred on OS NGR 463708 297609 - 463642 297292, see Figs 13 & 14.

Anomalies of archaeological potential

(8) - In the southern part of Area 6 is a positive linear anomaly. It can be seen both sides of the current field boundary, although it is much weaker on the south eastern

side. However, it is oriented north west to south east and is not parallel with any current or previously mapped field boundaries. It also appears to have been truncated by the land drains within ridge and furrow. It is possible, therefore, that this relates to a cut feature that pre-dates the existing field layout and systems of ridge and furrow.

Anomalies with an uncertain origin

(9) - A small number of very short and weakly positive linear anomalies can be seen within the survey area; however, they lack a coherent morphology and cannot be confidently interpreted.

3.9 List of anomalies - Area 7

Area 7 centred on OS NGR 463638 297280 463598 296978, see Figs 14 & 15.

Anomalies with an uncertain origin

(10) - Located at the southern end of the survey area are a number of positive linear anomalies. Their origin is uncertain, although they may be associated with the widespread magnetic debris.

Anomalies associated with magnetic debris

(11) - Widespread, strongly magnetic debris is located at the southern end of the survey area. It is likely to have a relatively modern origin associated with burning or dumped soil.

3.10 List of anomalies - Area 9

Area 9 centred on OS NGR 463427 296923, see Figs 16 – 18.

Anomalies of archaeological potential

(12) - Positive rectilinear anomalies represent a series of enclosure ditches containing further linear ditches and pits. The morphology suggests they relate to a Romano-British settlement.

(13) - Positive linear anomalies at the western end of the survey area are weak and indistinct but have archaeological potential.

3.11 List of anomalies - Area 10

Area 10 centred on OS NGR 463266 296823 - 462652 296844, see Figs 19 – 21.

Anomalies of archaeological potential

(14) - A positive linear anomaly appears to have been partially truncated by, and therefore pre-dates, the former ridge and furrow (17). Another linear anomaly appears to extend towards it from the south and may be associated.

Anomalies with an uncertain origin

(15) - Located at the far eastern end of the pipeline corridor is a positive linear anomaly. Although the response could be to a buried cable, given the proximity to similar anomalies to the east and west, then an archaeological origin is possible.

(16) - The central part of the survey area contains a small number of weakly positive linear anomalies and several discrete positive responses. They are indistinct and poorly defined, mainly due to the overlying modern magnetic debris (18). However it is possible that they relate to further cut features.

Anomalies with an agricultural origin

(17) - A series of former ridge and furrow can be seen across the survey area, despite the overlying magnetic debris.

Anomalies associated with magnetic debris

(18) - The entire survey area is covered with widespread magnetic debris which has been derived from ferrous contamination within 'green waste' spread on the field as a soil conditioner. This can obscure weaker anomalies.

3.12 List of anomalies - Area 11

Area 11 centred on OS NGR 462508 296808 - 462468 296557, see Fig 22.

3.12.1 The survey area contains widespread magnetic debris similar to Area 10. It is not possible to resolve any weaker anomalies due to the magnetic contamination.

3.13 List of anomalies - Area 12

Area 12 centred on OS NGR 462467 296550 - 462355 296125 & 462192 296099 - 462375 296150, see Figs 23 & 24.

3.13.1 Area 12 is also contaminated with widespread magnetic debris which has obscured weaker anomalies. There are a small number of poorly defined weakly positive linear and discrete anomalies, but it is not possible to confirm if they are likely to relate to cut features. A former field boundary, land drainage and former ridge and furrow can be seen.

3.14 List of anomalies - Area 13

Area 13 centred on OS NGR 462385 296153 - 462564 296099, see Figs 25 – 27.

3.14.1 Area 13 lies to the north of the canal. It contains a small number of very weakly positive linear and discrete anomalies but these lack a coherent morphology. Ridge and furrow, magnetic debris and a land drain are also evident as well as high magnitude magnetic disturbance caused by the nearby canal lock system.

3.15 List of anomalies - Area 14

Area 14 centred on OS NGR 462033 296155 - 462194 296104, see Figs 28 – 30.

3.15.1 Area 14 lies to the south west of the canal. Positive responses that could relate to former alluvial features can be seen. A broad positive response could also relate to former fluvial activity, but this is uncertain. Land drains and strongly magnetic debris along a track can also be seen.

3.16 List of anomalies - Area 15

Area 15 centred on OS NGR 462219 296697 - 462350 296077 & 462344 296099 - 462289 295961, see Figs 28 – 30.

Anomalies of archaeological potential

(19) - A small number of negative rectilinear or sub-rectilinear anomalies contain and are surrounded by positive responses. Two have dimensions of 10m by 6m and another, less distinct anomaly, is 9m by 4.5m. The internal response is over 200nT which indicates intense burning. Externally there are amorphous areas of positive responses which are also associated. The anomalies lie 100m south west of the Turnover Bridge and two canal locks and it is possible that this type of response relates to temporary brick kilns used during the construction of the canal infrastructure.

Anomalies with an uncertain origin

(20) - A number of short, positive linear anomalies can be seen to the north and south of anomalies (19). They are indistinct and poorly defined, but could be associated.

Anomalies associated with land management

(21) - A positive linear anomaly and associated magnetic debris relates to a former field boundary. Anomalies (19) appear mainly to be situated to the north of this boundary feature.

Anomalies associated with magnetic debris

(22) - Magnetic debris appears to be associated with magnetically thermoremnant material derived from anomalies (19)

(23) - Magnetic debris along the northern edge of the survey area relates to material used to consolidate a farm track.

3.17 List of anomalies - Area 16

Area 16 centred on OS NGR 462361 296078 - 462352 296058, see Figs 25 – 27.

Anomalies of archaeological potential

(24) - A strongly positive response with surrounding negative rectilinear anomalies and associated positive linear and discrete responses relates to a feature similar to those seen in Area 15, 120-150m to the west (19). This appears to also be associated with an industrial feature, likely to relate to a brick kiln used during construction of the canal, locks and turnover bridge during the late 18th century.

Anomalies with an uncertain origin

(25) - A number of interconnected positive linear anomalies can be seen within the survey area but their origin is uncertain.

Anomalies associated with magnetic debris

(26) - The eastern edge of the survey area partially encroaches into a mound that appears on aerial photographs as a square enclosure and on LiDAR imagery as a mound overlying ridge and furrow to the south. Magnetic debris indicates magnetically thermoremnant material within the matrix. It is likely that this is associated with canal construction or maintenance.

3.18 List of anomalies - Area 17

Area 17 centred on OS NGR 462285 295953 - 462256 295797, see Fig 31.

Anomalies with an uncertain origin

(27) - Discrete positive responses indicate moderate magnetic enhancement. It is not clear if they relate to pit-like features with a natural or anthropogenic origin.

Anomalies with a natural origin

(28) - Magnetically variable anomalies relate to alluvium and former fluvial activity.

3.19 List of anomalies - Area 19

Area 19 centred on OS NGR 462296 295686 - 462418 295535, see Figs 32 – 34.

3.19.1 Positive responses within Area 19 are indicative of naturally formed features within the floodplain. Magnetic debris is also evident.

3.20 List of anomalies - Area 20

Area 20 centred on OS NGR 462417 295517 - 462417 295489 see Figs 32 – 34.

3.20.1 Magnetic disturbance from the existing water main and magnetic debris are evident.

4 DISCUSSION

4.1.1 The geophysical survey has located anomalies with archaeological potential within five of the seventeen surveyable areas. This includes a single positive linear anomaly (8) at the southern end of Area 6, to the north of Newton Harcourt. There are other linear anomalies in the vicinity, but it is not clear if they are associated. To the north of Glen Road, west of Newton Harcourt, there are a number of rectilinear enclosures along with other ditches and pits within Area 9 that are indicative of Roman settlement (12 & 13). The scope of the scheme was modified in order to avoid the archaeology and the route of the pipeline is due to go to the south, along the edge of Glen Road. To the west of this are other positive linear anomalies (14) within Area 10 that also appear to relate to cut features with archaeological potential. Widespread magnetic debris (18) incorporated into the topsoil during the process of

manuring using composted 'green waste' may have obscured weaker anomalies. Similar widespread magnetic debris can also be seen in Areas 11 and 12 between the railway and the canal.

4.1.2 The areas with greatest archaeological potential lie to the south of the Grand Union Canal and a linear corridor was also surveyed parallel to the canal to the east and west of the pipeline corridor. Within Areas 15 and 16 to the south of the canal are a number of strongly magnetic anomalies (19 & 24) that indicate industrial features likely to relate to brick kilns used during construction of the canal, turnover bridge and locks.

5 CONCLUSION

5.1.1 Detailed magnetometry was carried out along a 4500m by 50m wide section of a new water pipeline, part of the Oadby to Arnesby Scheme, with an additional 900m length of survey adjacent to the Grand Union Canal. The survey located anomalies with archaeological potential within five of the seventeen surveyable areas. This includes a single linear ditch-like feature to the north of Newton Harcourt and a number of rectilinear enclosures, ditches and pits to the west of Newton Harcourt, which has since been taken out of the scope of the scheme. Other linear features were also located further to the west.

5.1.2 Survey to the south of the canal located a number of highly magnetic anomalies which are likely to relate to brick kilns associated with construction of the canal, turnover bridge and locks.

5.1.3 The majority of the survey areas contain weak, indistinct, short and fragmented positive linear anomalies that lack a coherent morphology which prevents confident interpretation. Many of these may be associated with naturally formed features and agricultural activity. Evidence for ridge and furrow, land drainage and in several survey areas widespread magnetic debris from composted 'green waste' have also been located.

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Appendix A – basic principles of magnetic survey

Iron minerals are always present to some degree within the topsoil and enhancement associated with human activity is related to increases in the level of magnetic susceptibility and thermoremnant material. Magnetic susceptibility is an induced magnetism within a material when it is in the presence of a magnetic field. This can be thought of as effectively permanent due to the presence of the Earth's magnetic field. Thermoremnant magnetism occurs when ferrous material is heated beyond a specific temperature known as the Curie Point. Demagnetisation occurs at this temperature with re-magnetisation by the Earth's magnetic field upon cooling.

Enhancement of magnetic susceptibility can occur in areas subject to burning and complex fermentation processes on biological material; these are frequently associated with human settlement. Thermoremnant features include ovens, hearths, and kilns. In addition thermoremnant material such as tile and brick may also be associated with human activity and settlement.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil can create an area of enhancement compared with surrounding soils and subsoils into which the feature is cut. Mapping enhanced areas will produce linear and discrete anomalies allowing an assessment and characterisation of hidden subsurface features.

It should be noted that areas of negative enhancement can be produced from material having lower magnetic properties compared to the topsoil. This is common for many sedimentary bedrocks and subsoils which were often used in the construction of banks and walls etc. Mapping these 'negative' anomalies may also reveal archaeological features.

Magnetic survey or magnetometry can be carried out using a fluxgate gradiometer and may be referred to as gradiometry. The SENSYS gradiometer is a passive instrument consisting of two fluxgate sensors mounted vertically 65cm apart. The instrument is carried about 10-20cm above the ground surface and the upper sensor measures the Earth's magnetic field as does the lower sensor but this is influenced to a greater degree by any localised buried magnetic field. The difference between the two sensors will relate to the strength of the magnetic field created by the buried feature.

There are a number of factors that may affect the magnetic survey and these include soil type, local geology and previous human activity. Situations arise where magnetic disturbance associated with modern services, metal fencing, dumped waste material etc., obscures low magnitude fields associated with archaeological features.

Appendix B – data processing notes

Clipping

Minimum and maximum values are set and replace data outside of the range with those values. Extreme values are removed improving colour or greyscale contrast associated with data values that may be archaeologically significant. Different ranges are applied to data in order to determine the most suitable for anomaly abstraction and display.

Despike

Removal of data points that exceed the mean/median/threshold by selecting a window size of data points and replace by mean/median/threshold. Magnetic spikes can be caused iron objects on the surface or within the topsoil. Despike can improve the appearance of data and remove extreme readings that may affect further processing.

High Pass Filter

Removes low frequency anomalies within the data that are not considered to be archaeologically significant and may be natural in origin. A window passes over the data, the mean of all the data within the window is subtracted from the centre value. The size of the window is adjusted as is the weighting which may be uniform or Gaussian. The process is used to improve the visibility of anomalies of interest.

Low Pass Filter

Removes high frequency anomalies or 'noise' within datasets and provides a smoother output. A window passes over the data, the mean of all the data within the window is used to replace the centre value. The size of the window is adjusted as is the weighting. The process is used to improve the visibility of anomalies of interest.

Zero Median/Mean Traverse

The median (or mean) of data from each traverse is calculated ignoring data outside a threshold value, the median (or mean) is then subtracted from the traverse. The process is used to equalise differences between the offset values of the gradiometer sensors. The process can remove archaeological features that run along a traverse but with the high resolution datasets created by the Sensys FGM650 sensors and the method of data collection this has not been a notable problem. In fact, the removal of offsets using software avoids carrying out a balancing procedure on site, which inevitably can never be done in magnetically clean conditions and results in improperly aligned fluxgate sensors and/or electronic adjustment values.

Appendix C – survey and data information

Area 2 minimally processed data

Filename: J804-mag-Area2-proc.xcp
Description: Imported as Composite from: J804-mag-Area2.asc
Instrument Type: Sensys DLMGPS
Units: nT
UTM Zone: 30U
Survey corner coordinates (X/Y):OSGB36
Northwest corner: 463904.11 298692.08 m
Southeast corner: 463978.96, 298468.43 m
Collection Method: Randomised
Sensors: 5
Dummy Value: 32702
Source GPS Points: 134400
Dimensions
Composite Size (readings): 499 x 1491
Survey Size (meters): 74.9 m x 224 m
Grid Size: 74.9 m x 224 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.33
Mean: -0.05
Median: 0.02
Composite Area: 1.674 ha
Surveyed Area: 0.52601 ha
PROGRAM
Name: TerraSurveyor
Version: 3.0.23.0
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 2 filtered data

Filename: J804-mag-Area2-proc-hpf-lpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.16
Mean: -0.08
Median: -0.01
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Area 3 minimally processed data

Filename: J804-mag-Area3-proc.xcp
Northwest corner: 463831.78, 298597.93 m
Southeast corner: 463936.63 298334.68m
Source GPS Points: 259700
Dimensions
Composite Size (readings): 699 x 1755
Survey Size (meters): 105 m x 263 m
Grid Size: 105 m x 263 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.45
Mean: -0.09
Median: 0.03
Composite Area: 2.7602 ha
Surveyed Area: 0.90638 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 3 filtered data

Filename: J804-mag-Area3-proc-hpf-lpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.18
Mean: -0.07
Median: 0.00
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Area 4 minimally processed data

Filename: J804-mag-Area4-proc.xcp
Northwest corner: 463754.46, 298359.16 m
Southeast corner: 463891.86, 297847.36 m
Source GPS Points: 710000

Dimensions
Composite Size (readings): 916 x 3412
Survey Size (meters): 137 m x 512 m
Grid Size: 137 m x 512 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.53
Mean: -0.05
Median: 0.01
Composite Area: 7.0321 ha
Surveyed Area: 2.0377 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 4 filtered data

Filename: J804-mag-Area4-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.19
Mean: -0.02
Median: -0.01
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Area 5 minimally processed data

Filename: J804-mag-Area5-proc.xcp
Northwest corner: 463685.07 297902.129 m
Southeast corner: 463793.82, 297429.47 m
Source GPS Points: 478200
Dimensions
Composite Size (readings): 725 x 3151
Survey Size (meters): 109 m x 473 m
Grid Size: 109 m x 473 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.43
Mean: -0.02
Median: 0.00
Composite Area: 5.1401 ha
Surveyed Area: 1.5141 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 5 filtered data

Filename: J804-mag-Area5-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.30
Mean: 0.00
Median: 0.00
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Area 6 minimally processed data

Filename: J804-mag-Area6-proc.xcp
Northwest corner: 463611.11, 297613.45 m
Southeast corner: 463713.26, 297289.00 m
Source GPS Points: 384800
Dimensions
Composite Size (readings): 681 x 2163
Survey Size (meters): 102 m x 324 m
Grid Size: 102 m x 324 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats:
Max: 3.32
Min: -3.30
Std Dev: 1.79
Mean: 0.03
Median: -0.02

Composite Area: 3.3143 ha
Surveyed Area: 1.0931 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 6 filtered data

Filename: J804-mag-Area6-proc-hpf.xcp
Northwest corner: 463611.11, 297613.45m
Southeast corner: 463713.26, 297289.00 m
Source GPS Points: 384800
Dimensions
Composite Size (readings): 681 x 2163
Survey Size (meters): 102 m x 324 m
Grid Size: 102 m x 324 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.56
Mean: 0.02
Median: -0.02
Composite Area: 3.3143 ha
Surveyed Area: 1.0931 ha
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 7 minimally processed data

Filename: J804-mag-Area7-proc.xcp
Northwest corner: 463578.56, 297395.31 m
Southeast corner: 463689.26, 296977.86 m
Source GPS Points: 615300
Dimensions
Composite Size (readings): 738 x 2783
Survey Size (meters): 111 m x 417 m
Grid Size: 111 m x 417 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.77
Mean: 0.00
Median: 0.01
Composite Area: 4.6212 ha
Surveyed Area: 1.6059 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 7 filtered data

Filename: J804-mag-Area7-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.67
Mean: 0.00
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 9 minimally processed data

Filename: J804-mag-Area9-proc.xcp
Northwest corner: 463270.81 296956.34 m
Southeast corner: 463432.51, 296840.09m
Source GPS Points: 278100
Dimensions
Composite Size (readings): 1078 x 775
Survey Size (meters): 162 m x 116 m
Grid Size: 162 m x 116 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.54
Mean: 0.02
Median: 0.00
Composite Area: 1.8798 ha
Surveyed Area: 0.7ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 9 filtered data

Filename: J804-mag-Area9-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.51
Mean: 0.03
Median: 0.00
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 10 minimally processed data

Filename: J804-mag-Area10-proc.xcp
Northwest corner: 462639.88 296866.20 m
Southeast corner: 463289.98 296769.15 m
Source GPS Points: 1162000
Dimensions
Composite Size (readings): 4334 x 647
Survey Size (meters): 650 m x 97.1 m
Grid Size: 650 m x 97.1 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.81
Mean: 0.02
Median: 0.01
Composite Area: 6.3092 ha
Surveyed Area: 3.2099 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 10 filtered data

Filename: J804-mag-Area10-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.72
Mean: 0.02
Median: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 11 minimally processed data
Filename: J804-mag-Area11-proc.xcp
Northwest corner: 462442.40, 296810.68 m
Southeast corner: 462537.05, 296547.43 m
Source GPS Points: 401000
Dimensions
Composite Size (readings): 631 x 1755
Survey Size (meters): 94.7 m x 263 m
Grid Size: 94.7 m x 263 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.90
Mean: 0.02
Median: 0.02
Composite Area: 2.4917 ha
Surveyed Area: 1.3817 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 11 filtered data

Filename: J804-mag-Area11-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.88
Mean: 0.01
Median: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 12 minimally processed data

Filename: J804-mag-Area12-proc.xcp
Northwest corner: 462185.32, 296556.15m
Southeast corner: 462485.92, 296122.95 m
Source GPS Points: 992200
Dimensions
Composite Size (readings): 2004 x 2888
Survey Size (meters): 301 m x 433 m
Grid Size: 301 m x 433 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.59
Mean: 0.01
Median: 0.01
Composite Area: 13.022 ha
Surveyed Area: 2.5637 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 12 filtered data

Filename: J804-mag-Area12-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.54
Mean: 0.01
Median: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 13 minimally processed data

Filename: J804-mag-Area13-proc.xcp
Northwest corner: 462384.74, 296194.14 m
Southeast corner: 462571.34, 296087.94 m
Source GPS Points: 298300
Dimensions
Composite Size (readings): 1244 x 708
Survey Size (meters): 187 m x 106 m
Grid Size: 187 m x 106 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.21
Mean: -0.04
Median: 0.02
Composite Area: 1.9817 ha
Surveyed Area: 0.78495 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 14 minimally processed data

Filename: J804-mag-Area14-proc.xcp
Northwest corner: 462029.16, 296176.64 m
Southeast corner: 462195.51, 296076.74 m
Source GPS Points: 216400
Dimensions
Composite Size (readings): 1109 x 666
Survey Size (meters): 166 m x 99.9 m
Grid Size: 166 m x 99.9 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.44
Mean: 0.00
Median: 0.00
Composite Area: 1.6618 ha
Surveyed Area: 0.62076 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).

3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 14 filtered data

Filename: J804-mag-Area14-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.35
Mean: 0.01
Median: -0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 15 minimally processed data

Filename: J804-mag-Area15-proc.xcp
Northwest corner: 462188.07, 296115.68 m
Southeast corner: 462359.22 295944.23 m
Source GPS Points: 388700
Dimensions
Composite Size (readings): 1141 x 1143
Survey Size (meters): 171 m x 171 m
Grid Size: 171 m x 171 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.54
Mean: -0.06
Median: 0.01
Composite Area: 2.9344 ha
Surveyed Area: 1.1179 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 15 filtered data

Filename: J804-mag-Area15-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.46
Mean: -0.02
Median: -0.01
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Area 16 minimally processed data

Filename: J804-mag-Area16-proc.xcp
Northwest corner: 462355.31 296103.41 m
Southeast corner: 462533.81, 296032.76 m
Source GPS Points: 169100
Dimensions
Composite Size (readings): 1190 x 471
Survey Size (meters): 179 m x 70.7 m
Grid Size: 179 m x 70.7 m
X Interval: 0.15 m
Y Interval: 0.15 m

Stats
Max: 3.32
Min: -3.30
Std Dev: 1.64
Mean: -0.09
Median: 0.04
Composite Area: 1.2611 ha
Surveyed Area: 0.61284 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 16 filtered data

Filename: J804-mag-Area16-proc-hpf.xcp
Northwest corner: 462355.31, 296103.41 m
Southeast corner: 462533.81, 296032.76m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.45
Mean: -0.10
Median: -0.02
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Clip from -3.00 to 3.00 nT

Area 17 minimally processed data

Filename: J804-mag-Area17-proc.xcp
Northwest corner: 462218.21, 295973.02 m
Southeast corner: 462308.06, 295797.22 m
Source GPS Points: 261900
Dimensions
Composite Size (readings): 599 x 1172
Survey Size (meters): 89.9 m x 176 m
Grid Size: 89.9 m x 176 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.88
Mean: 0.00
Median: 0.01
Composite Area: 1.5796 ha
Surveyed Area: 0.86114 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 17 filtered data
Filename: J804-mag-Area17-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 0.82
Mean: 0.01
Median: 0.01
GPS based Proce5
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Lo pass Uniform (median) filter: Window dia: 13
5 Clip from -3.00 to 3.00 nT

Area 19 minimally processed data

Filename: J804-mag-Area19-proc.xcp
Northwest corner: 462287.69, 295712.45 m
Southeast corner: 462454.19, 295521.95 m
Source GPS Points: 364900
Dimensions
Composite Size (readings): 1110 x 1270
Survey Size (meters): 167 m x 191 m
Grid Size: 167 m x 191 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.52
Mean: 0.01
Median: -0.01
Composite Area: 3.1718 ha
Surveyed Area: 1.0341 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 19 filtered data

Filename: J804-mag-Area19-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 1.32
Mean: 0.01
Median: 0.00
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Area 20 minimally processed data

Filename: J804-mag-Area20-proc.xcp
Northwest corner: 462389.85, 295530.85 m
Southeast corner: 462444.90, 295484.20 m
Source GPS Points: 76500
Dimensions
Composite Size (readings): 367 x 311
Survey Size (meters): 55.1 m x 46.7 m
Grid Size: 55.1 m x 46.7 m
X Interval: 0.15 m
Y Interval: 0.15 m
Stats
Max: 3.32
Min: -3.30
Std Dev: 2.18
Mean: -0.04
Median: -0.02
Composite Area: 0.25681 ha
Surveyed Area: 0.15381 ha
GPS based Proce4
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 Clip from -3.00 to 3.00 nT

Area 20 filtered data

Filename: J804-mag-Area20-proc-hpf.xcp
Stats
Max: 3.32
Min: -3.30
Std Dev: 2.00
Mean: -0.03
Median: 0.00
GPS based Proce6
1 Base Layer.
2 Unit Conversion Layer (Lat/Long to OSGB36).
3 DeStripe Median Traverse:
4 High pass Uniform (median) filter: Window dia: 300
5 Lo pass Uniform (median) filter: Window dia: 13
6 Clip from -3.00 to 3.00 nT

Appendix D – digital archive

Archaeological Surveys Ltd hold the primary digital archive at their offices in Wiltshire. Data are backed-up onto an on-site data storage drive and at the earliest opportunity data are copied to CD ROM for storage on-site and off-site.

A PDF copy will be supplied to the Leicestershire Historic Environment Record. The report will also be uploaded to the Online AccesS to the Index of archaeological investigationS (OASIS).

Archive contents:

File type	Naming scheme	Description
Data	J804-mag-**[area number/name]**.asc J804-mag-**[area number/name]**.xcp J804-mag-**[area number/name]**-proc.xcp	Raw data as ASCII CSV TerraSurveyor raw data TerraSurveyor minimally processed data
Graphics	J804-mag-**[area number/name]**-proc.tif	Image in TIF format
Drawing	J804-**[version number]**.dwg	CAD file in 2010 dwg format
Report	J804 report.odt	Report text in Open Office odt format

Table 2: Archive metadata

Appendix E – CAD layers for abstraction and interpretation plots

The table below sets out Archaeological Surveys Ltd CAD layer names with associated colours and graphical content. Where CAD files are available layers may be extracted for further CAD/GIS use. Note: hatched polygon boundaries are contained within layers with the RGB colour code 254, 255, 255 (near white) in order to prevent their visibility.

Report sub-heading and associated CAD layer names	Colour with RGB index		Layer content
Anomalies with archaeological potential			
AS-ABST MAG POS DISCRETE ARCHAEOLOGY		Red 255,0,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS ARCHAEOLOGY		Red 255,0,0	Polygon (cross hatched ANSI37)
AS-ABST MAG POS ENCLOSURE DITCH		127,0,255	Line, polyline or polygon (solid)
Anomalies with an uncertain origin			
AS-ABST MAG POS LINEAR UNCERTAIN		255,127,0	Line, polyline or polygon (solid)
AS-ABST MAG NEG LINEAR UNCERTAIN		Blue 0,0,255	Line, polyline or polygon (solid)
AS-ABST MAG POS DISCRETE UNCERTAIN		255,127,0	Solid donut, point or polygon (solid)
AS-ABST MAG POS UNCERTAIN		255,127,0	Polygon (cross hatched ANSI37)
Anomalies relating to land management			
AS-ABST MAG BOUNDARY		127,0,0	Line, polyline or polygon (solid or cross hatched ANSI37)
AS-ABST MAG LAND DRAIN		Cyan 0,255,255	Line or polyline
Anomalies with an agricultural origin			
AS-ABST MAG AGRICULTURAL		Green 0,255,0	Line or polyline
AS-ABST MAG RIDGE AND FURROW		0,127,63	Line, polyline or polygon (cross hatched ANSI37)
Anomalies associated with magnetic debris			
AS-ABST MAG DEBRIS		132, 132, 132	Polygon (cross hatched ANSI37)
AS-ABST MAG STRONG DIPOLAR		132, 132, 132	Solid donut, point or polygon (solid)
Anomalies with a modern origin			
AS-ABST MAG DISTURBANCE		132, 132, 132	Polygon (hatched ANSI31)
AS-ABST MAG SERVICE		132, 132, 132	Line or polyline
Anomalies with a natural origin			
AS-ABST MAG NATURAL FEATURES		Yellow 255,255,0	Polygon (cross hatched ANSI37)

Table 3: CAD layering

Appendix F – copyright and intellectual property

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www.archaeological-surveys.co.uk
info@archaeological-surveys.co.uk
Tel: 01249 814 231

N

Survey location

Site centred on OS NGR
SP 64030 98824 to SP 62418 95489

SCALE 1:25 000

0m 500m 1000m

SCALE TRUE AT A3

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Specialist Geophysical Surveyors

Geophysical Survey
Oadby to Arnesby Scheme
Leicestershire

Map of survey area

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 01

461000
462000
463000
464000
465000
298000
297000
296000

Area 1 unsurveyable due to horses
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8 taken out of scope prior to survey
Area 9 taken out of scope after survey
Area 10
Area 11
Area 12
Area 13
Area 14
Area 15
Area 16
Area 17
Area 18 unsurveyable waterlogged soil
Area 19
Area 20

N

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Geophysical Survey
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Leicestershire

Referencing information

Referencing grid to OSGB36 datum at 100m intervals

- Survey tracks
- Survey track start
- Survey track stop
- Central pipeline & 50m wide corridor

SCALE 1:12500

0m 250 500m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 02

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Oadby to Arnesby Scheme
Leicestershire

Referencing information - Areas 1 to 7
A6 to Glen Road

Area 1
Unsurveyable due to horses

Area 2
Area 3
Area 4
Area 5
Area 6
Area 7

Referencing grid to OSGB36 datum at 100m intervals

Survey tracks
Survey track start
Survey track stop
Central pipeline & 50m wide corridor

SCALE 1:2500
0m 50 100m
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 03

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463100 463200 463300 463400 463500 463600 463700 463800

297200 297100 297000 296900 296800 296700

Area 7

Area 8

Area 9

Taken out of scope after survey

Taken out of scope prior to survey

N

Issues

Sinks

Newton Willow

Salwete

Waiora

Oadby Cottage Hospital

Thorn House

100.2m

98.7m

El Sub Sta

Windrush

Mowthouse

Brooklands

Bhakti

99.1m

Elms Cottage

Paddock View

Long Row

Short Row

GLEN ROAD

99.7m

Elm Tree Farm

91.7m

Spinney Lock

Wain Bridge

Overflow

Overflow

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Referencing information - Areas 8 & 9 North of Glen Road

Referencing grid to OSGB36 datum at 100m intervals

- Survey tracks
- Survey track start
- Survey track stop
- Central pipeline & 50m wide corridor

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 04

462500 462600 462700 462800 462900 463000 463100 463200

297100 297000 296900 296800 296700 296600 296500

N

Track

Pond

Waterlogged

Area 10

Take
after

91.7m

OP

Wai

Top Half-Mile Lock

Drain

Overflow

Flaxman's Spinney

Pond

Tythorn Hill

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Referencing information - Area 10 North of railway

Referencing grid to OSGB36 datum at 100m intervals

- Survey tracks
- Survey track start
- Survey track stop
- Central pipeline & 50m wide corridor

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 05

462200
462300
462400
462500
462600
462700
462800

296700
296600
296500
296400
296300
296200

Area 11
Area 12
Area 12
Area 12
Area 13

Ruin
Pond
Tythorn Hill
Track
Turnover Bridge
Towpath
Grand Union Canal

N

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Referencing information - Areas 11 to 13 Between railway and canal

Referencing grid to OSGB36 datum at 100m intervals

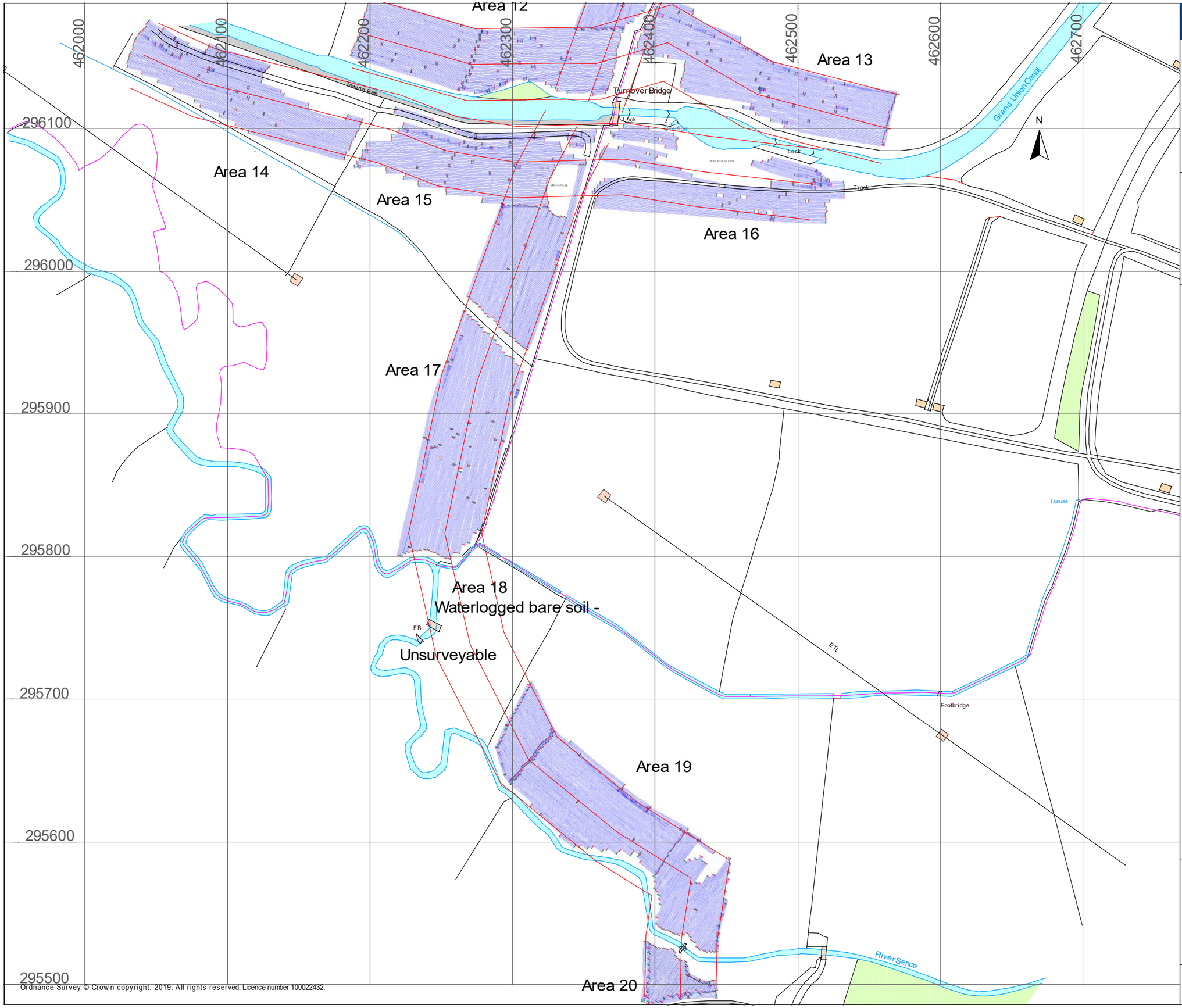
- Survey tracks
- Survey track start
- Survey track stop
- Central pipeline & 50m wide corridor

SCALE 1:2500

0m 50 100m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 06



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Referencing information -
Area 14 to 20
South of canal

Referencing grid to OSGB36 datum at 100m intervals

- Survey tracks
- Survey track start
- Survey track stop
- Central pipeline & 50m wide corridor

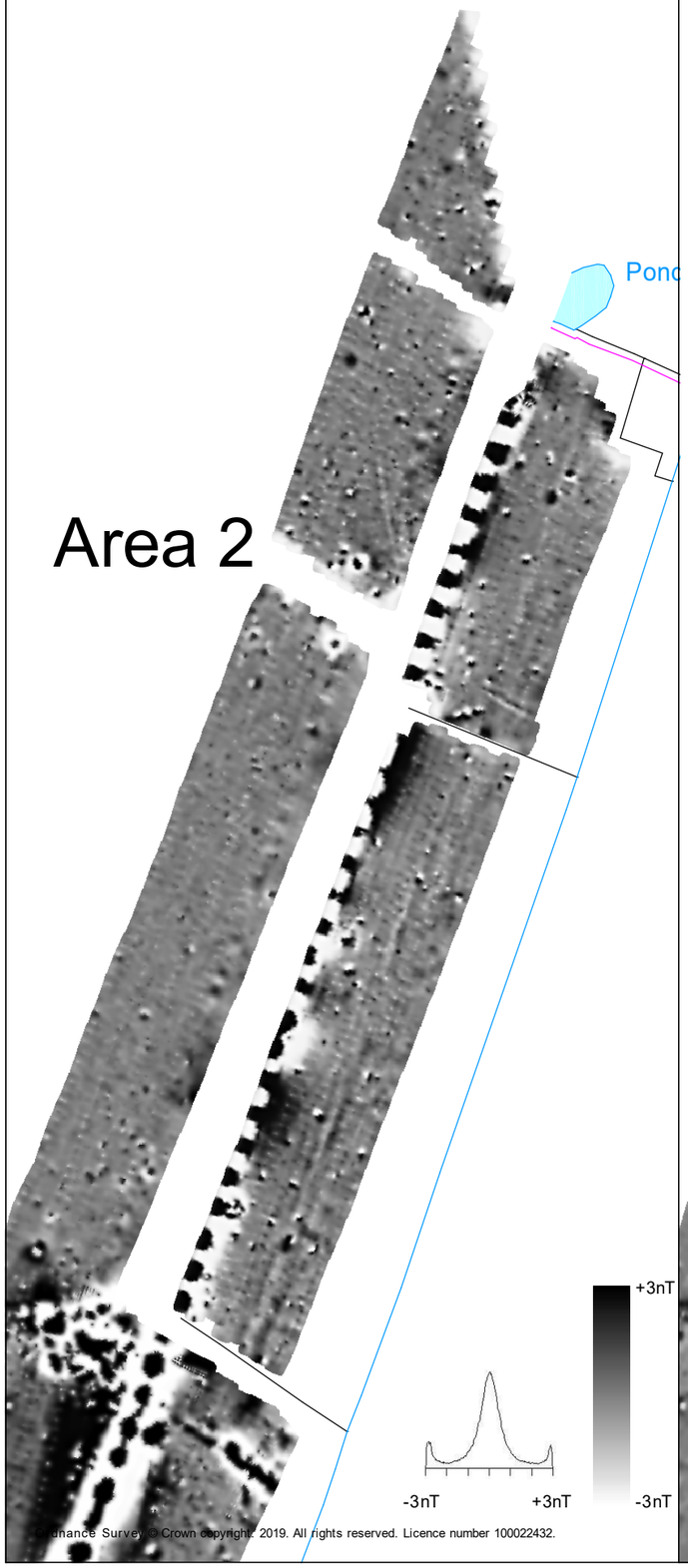
SCALE 1:2500

0m 50 100m

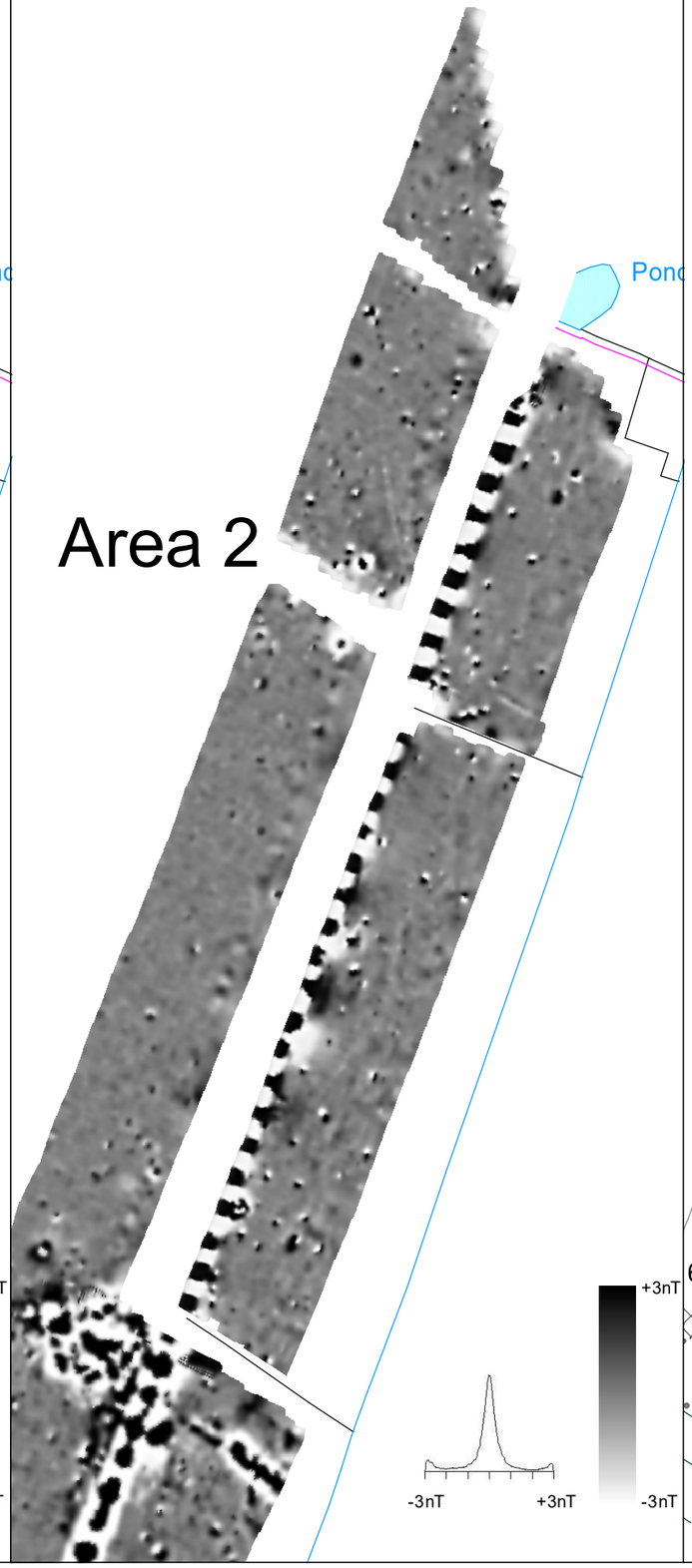
SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 07

Greyscale plot of minimally processed magnetometer data



Greyscale plot of filtered magnetometer data



Abstraction & interpretation of magnetic anomalies

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 2

- Positive linear anomaly - possible ditch-like feature
- Positive linear anomaly - possible land drain
- Discrete positive response - possible pit-like feature
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 08

Area 2

Greyscale plot of minimally processed magnetometer data

Area 3

+3nT

-3nT

+3nT +3nT

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Area 2

Greyscale plot of filtered magnetometer data

Area 3

+3nT

-3nT

-3nT +3nT

Area 2

Abstraction & interpretation of magnetic anomalies

N

Area 3

1
2
3
4
5
6
7

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Leicestershire

Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 3

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - of agricultural origin
- Linear anomaly - ridge and furrow
- Weak multiple dipolar linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 09

Greyscale plot of minimally processed magnetometer data

Area 4

+3nT

+3nT +3nT -3nT

Greyscale plot of filtered magnetometer data

Area 4

+3nT

-3nT +3nT -3nT

Abstraction & interpretation of magnetic anomalies

Area 4

N

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 4 north

- Positive linear anomaly - of uncertain origin
- Linear anomaly - ridge and furrow
- Weak multiple dipolar linear anomaly - possible land drain
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 10

Greyscale plot of minimally processed magnetometer data

Area 4

+3nT

-3nT

-3nT +3nT

Greyscale plot of filtered magnetometer data

Area 4

+3nT

-3nT

-3nT +3nT

Abstraction & interpretation of magnetic anomalies

Area 4

N

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 4 south

- Positive linear anomaly - of uncertain origin
- Linear anomaly - ridge and furrow
- Weak multiple dipolar linear anomaly - possible land drain
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 11

Greyscale plot of minimally processed magnetometer data

Area 5

+3nT

-3nT

-3nT +3nT

Greyscale plot of filtered magnetometer data

Area 5

+3nT

-3nT

-3nT +3nT

Abstraction & interpretation of magnetic anomalies

Area 5

N

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 5 north

- Linear anomaly - ridge and furrow
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 12

Greyscale plot of minimally processed magnetometer data

Area 5

Area 6

Track

-3nT Area 5 +3nT

-3nT Area 6 +3nT

+3nT

-3nT

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Greyscale plot of filtered magnetometer data

Area 5

Area 6

Track

-3nT Area 5 +3nT

-3nT Area 6 +3nT

+3nT

-3nT

Abstraction & interpretation of magnetic anomalies

Area 5

Area 6

Track

N

Linear anomaly - ridge and furrow

Weak dipolar linear anomaly - land drain

Magnetic debris - spread of magnetically thermoremnant/ferrous material

Magnetic disturbance from ferrous material

Strong multiple dipolar linear anomaly - pipeline

Strong dipolar anomaly - ferrous object

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 5 south & Area 6 north

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 13

Greyscale plot of minimally processed magnetometer data

Area 6

Area 7

-3nT Area 6 +3nT

-3nT Area 7 +3nT

+3nT

-3nT

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Greyscale plot of filtered magnetometer data

Area 6

Area 7

-3nT Area 6 +3nT

-3nT Area 7 +3nT

+3nT

-3nT

Abstraction & interpretation of magnetic anomalies

Area 6

Area 7

N

8

9

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 6 south & Area 7 north

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - of uncertain origin
- Linear anomaly - ridge and furrow
- Weak multiple dipola linear anomaly - land drain
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

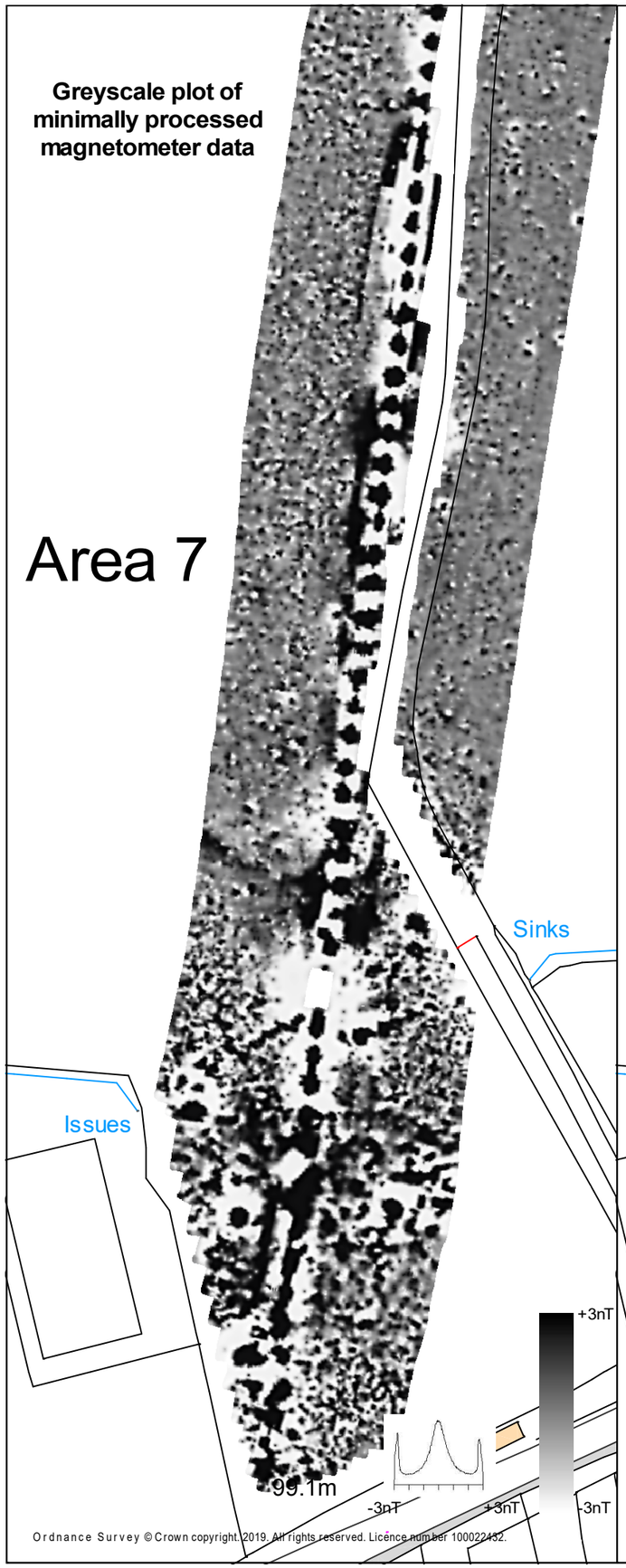
0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 14

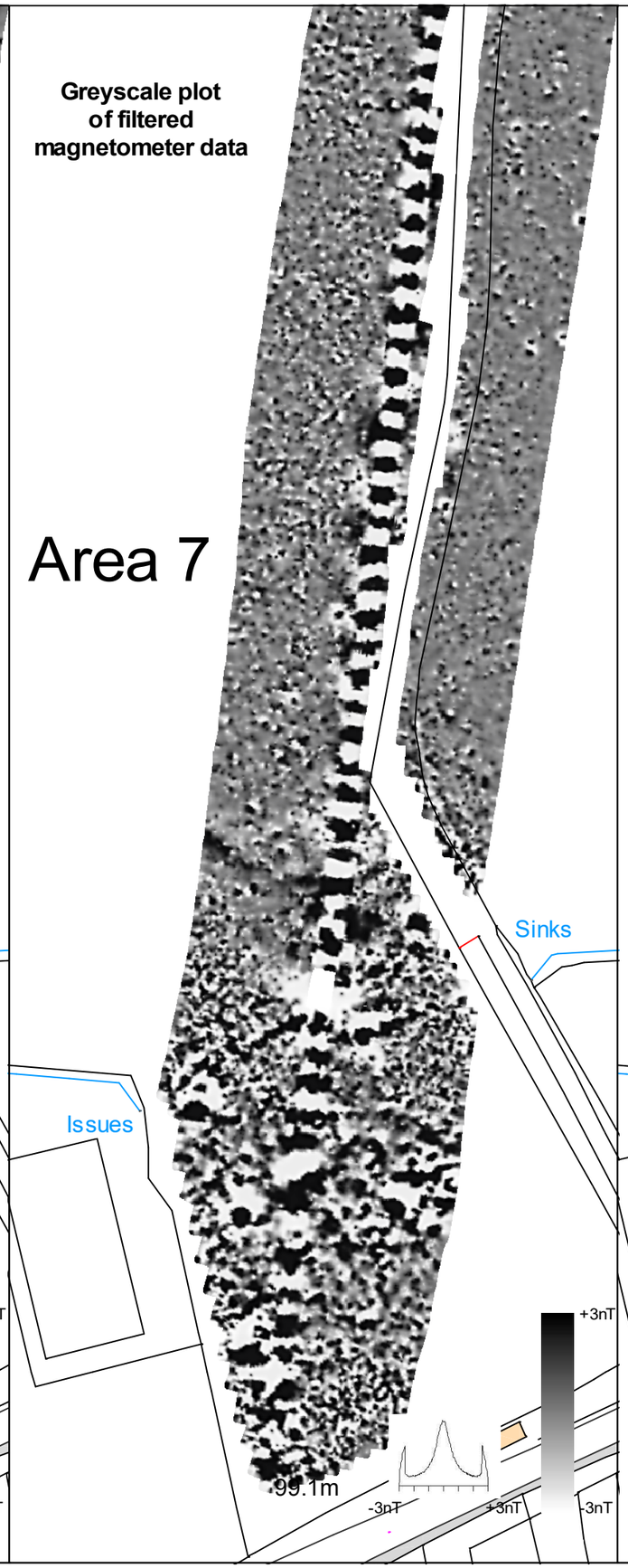
Greyscale plot of minimally processed magnetometer data

Area 7



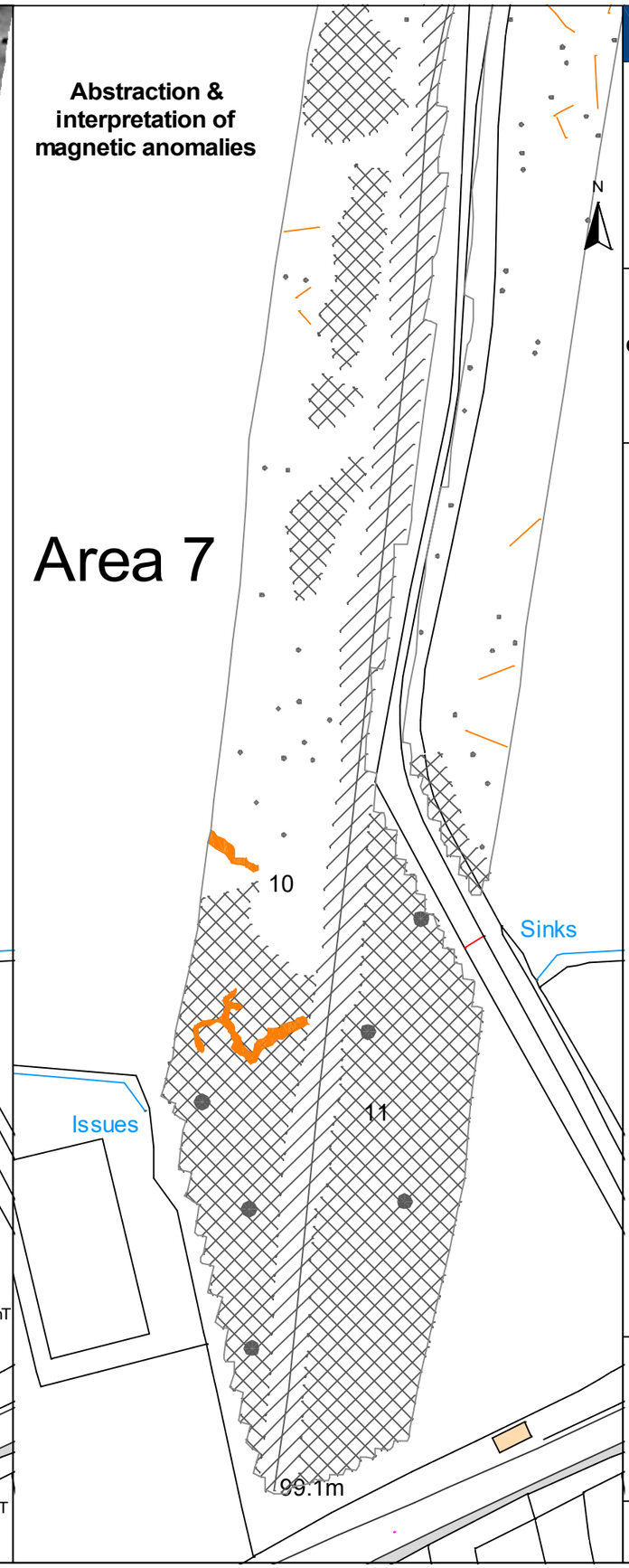
Greyscale plot of filtered magnetometer data

Area 7



Abstraction & interpretation of magnetic anomalies

Area 7



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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 7 south

- Positive linear anomaly - possible ditch-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 15

Taken out of scope after survey

Area 8

Taken out of scope prior to survey

Area 9

Issues

N

GLEN ROAD

99.7m

Elms Cottage

Paddock View

Elm Tree Farm

GP

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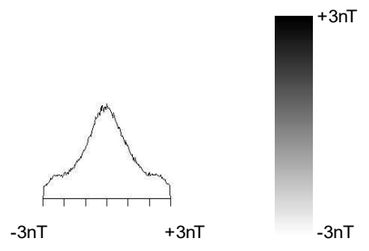
Greyscale plot of minimally processed magnetometer data - Area 9



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 16

Taken out of scope after survey

Area 8

Taken out of scope prior to survey

Area 9

Issues

N

GLEN ROAD

99.7m

Elms Cottage

Paddock View

Elm Tree Farm

GP

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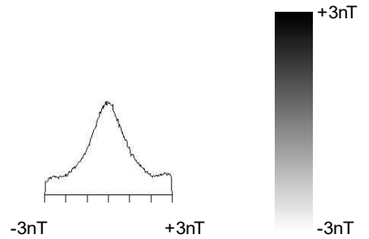
Greyscale plot of filtered magnetometer data - Area 9



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 17

Taken out of scope after survey

Area 8

Taken out of scope prior to survey

Area 9

Issues

N

12

13

GLEN ROAD

99.7m

Elms Cottage

Paddock View

Elm Tree Farm

GP

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Abstraction and interpretation of magnetic anomalies - Area 9

- Positive linear anomaly - cut feature of archaeological potential
- Positive rectilinear anomaly - enclosure ditch
- Linear anomaly - ridge and furrow
- Discrete positive response - cut feature of archaeological potential
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

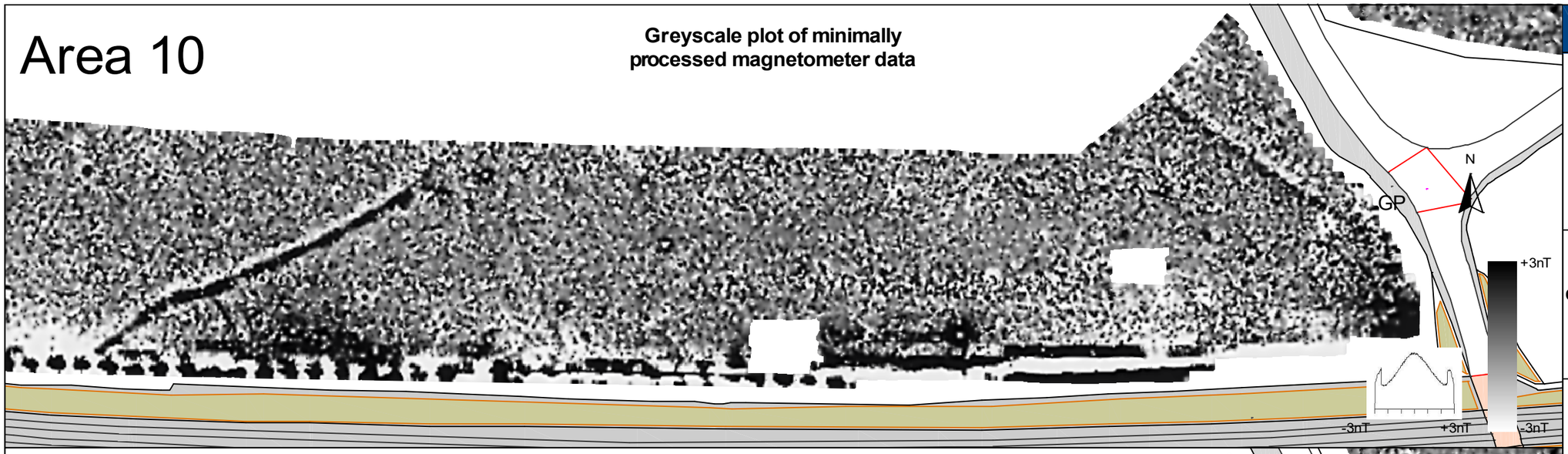
0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 18

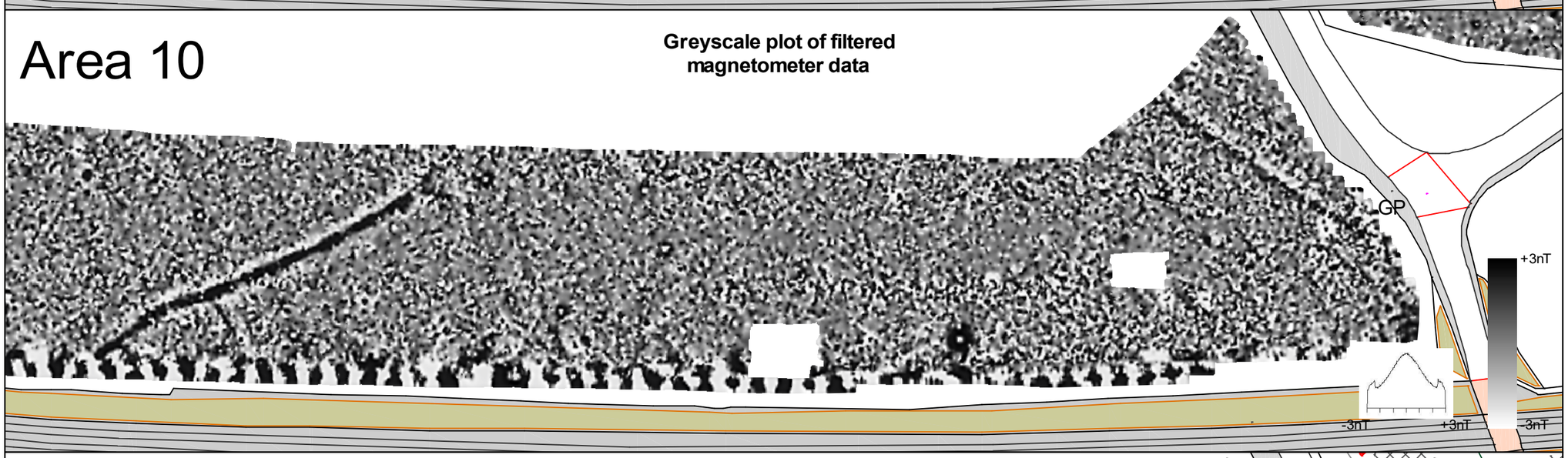
Area 10

Greyscale plot of minimally processed magnetometer data



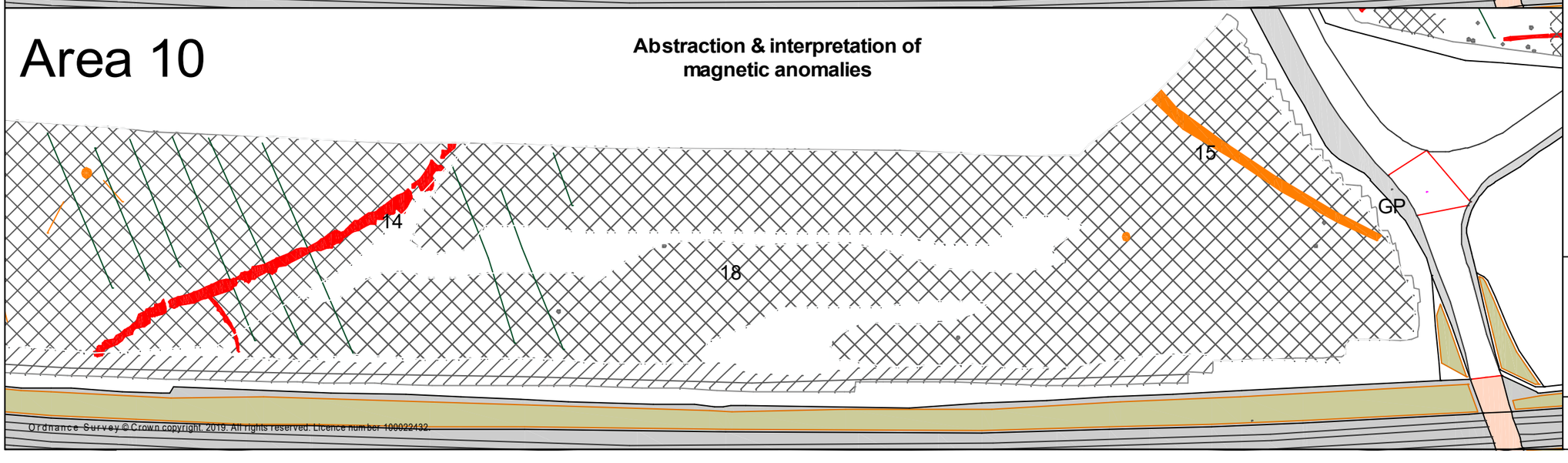
Area 10

Greyscale plot of filtered magnetometer data



Area 10

Abstraction & interpretation of magnetic anomalies



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Greyscale plot of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 10 east

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 19

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Greyscale plot of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 10 centre

Greyscale plot of minimally processed magnetometer data

Area 10

N

+3nT

-3nT -3nT +3nT

Greyscale plot of filtered magnetometer data

Area 10

+3nT

-3nT -3nT +3nT

Abstraction & interpretation of magnetic anomalies

Area 10

17

16

- Positive linear anomaly - cut feature of archaeological potential
- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 20

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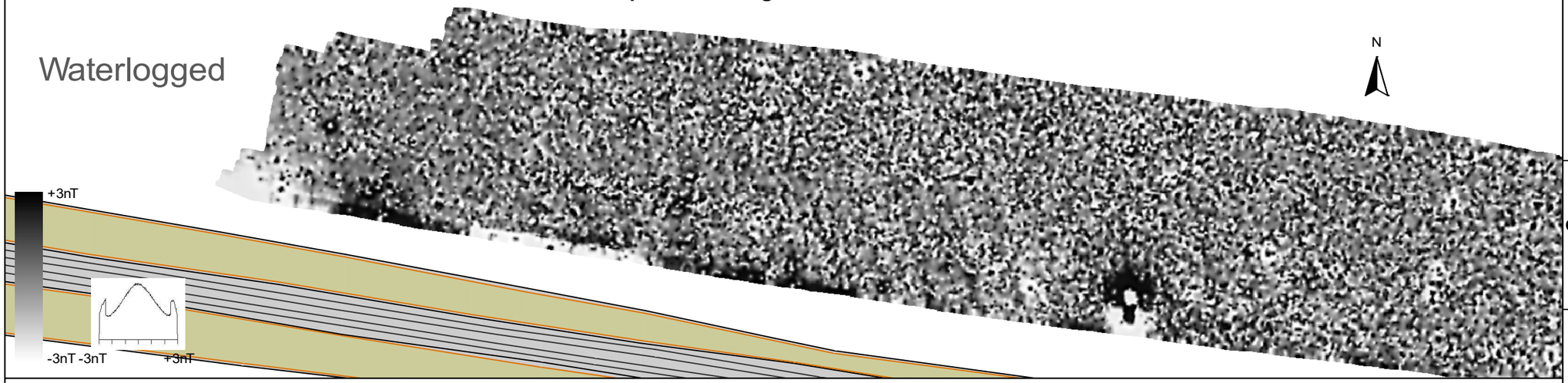
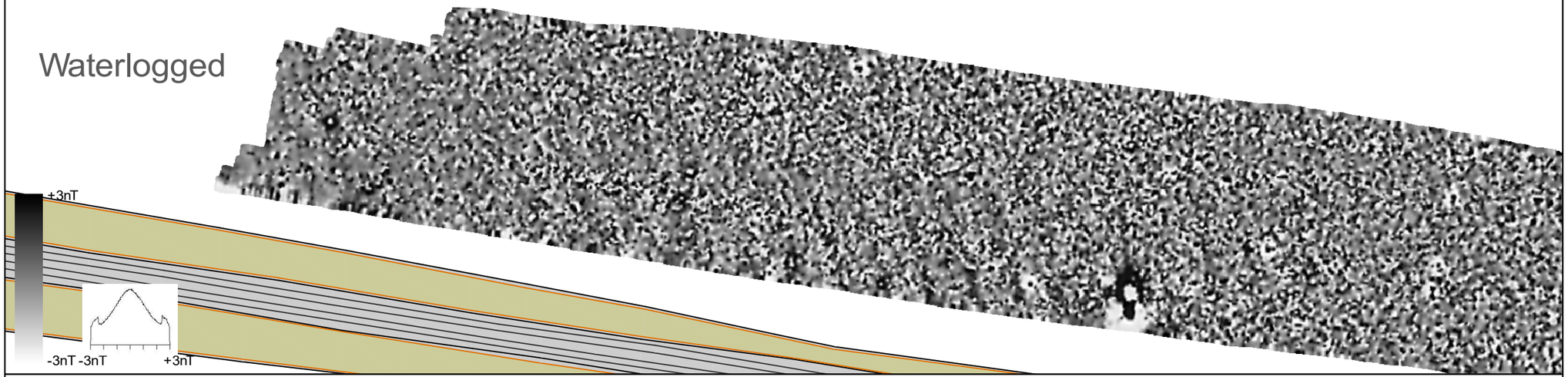
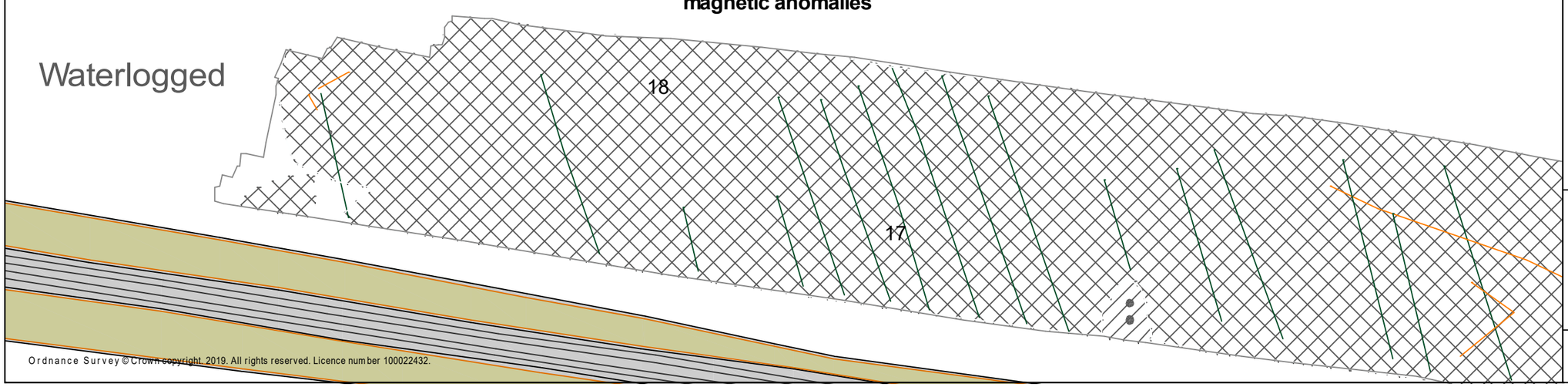
Greyscale plot of minimally processed magnetometer data



Greyscale plot of filtered magnetometer data



Abstraction & interpretation of magnetic anomalies



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Greyscale plot of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 10 west

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

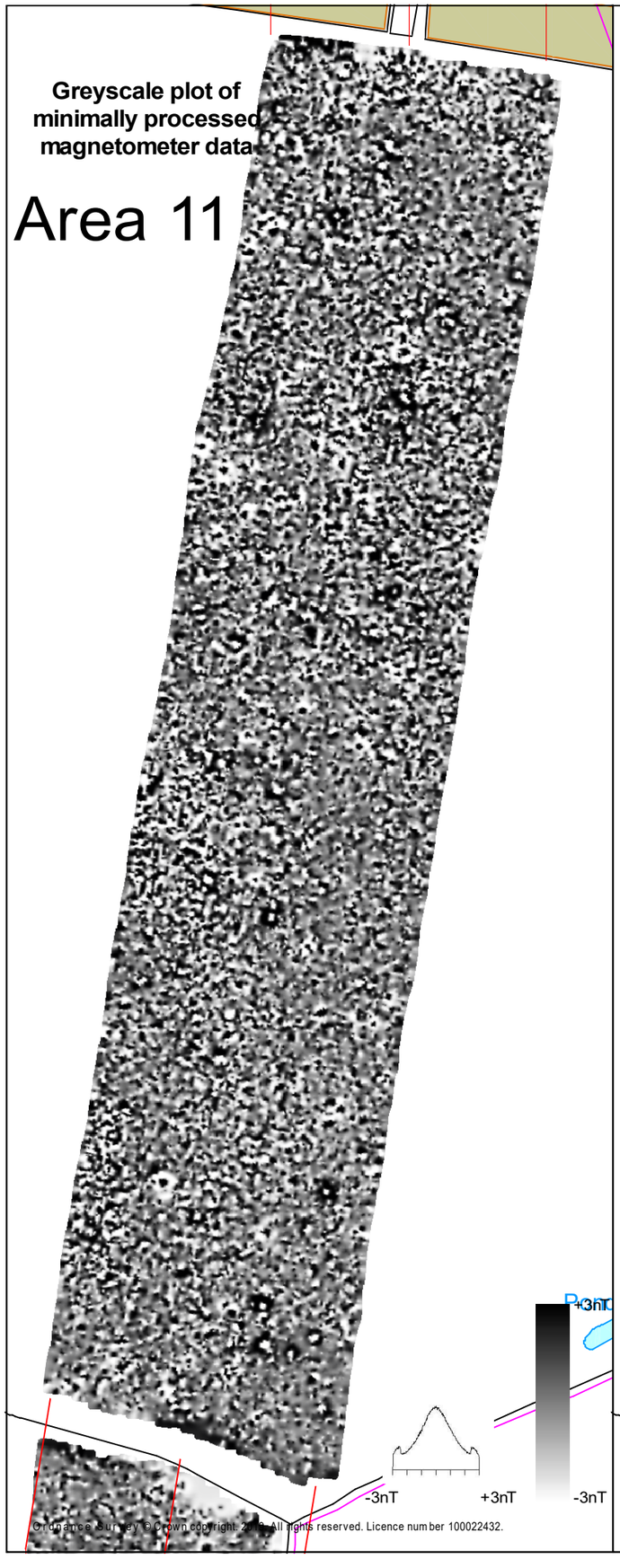
0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 21

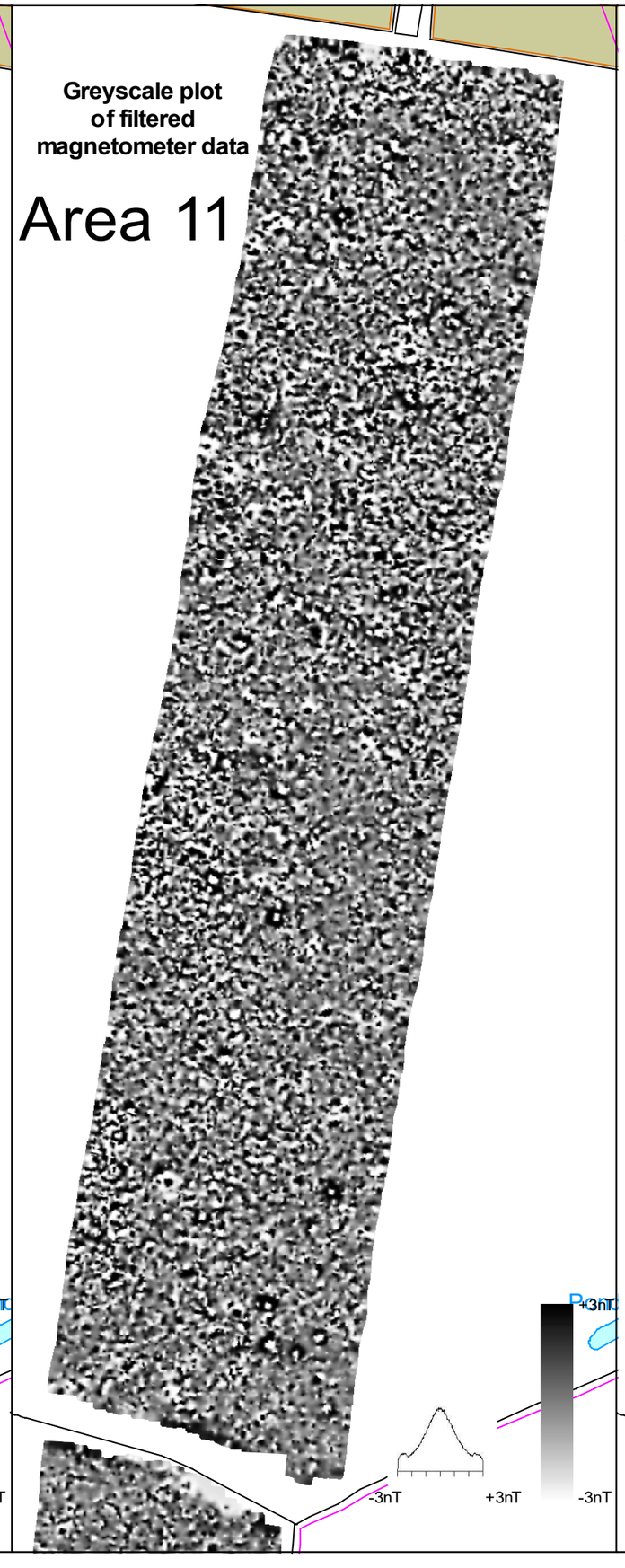
Greyscale plot of minimally processed magnetometer data

Area 11



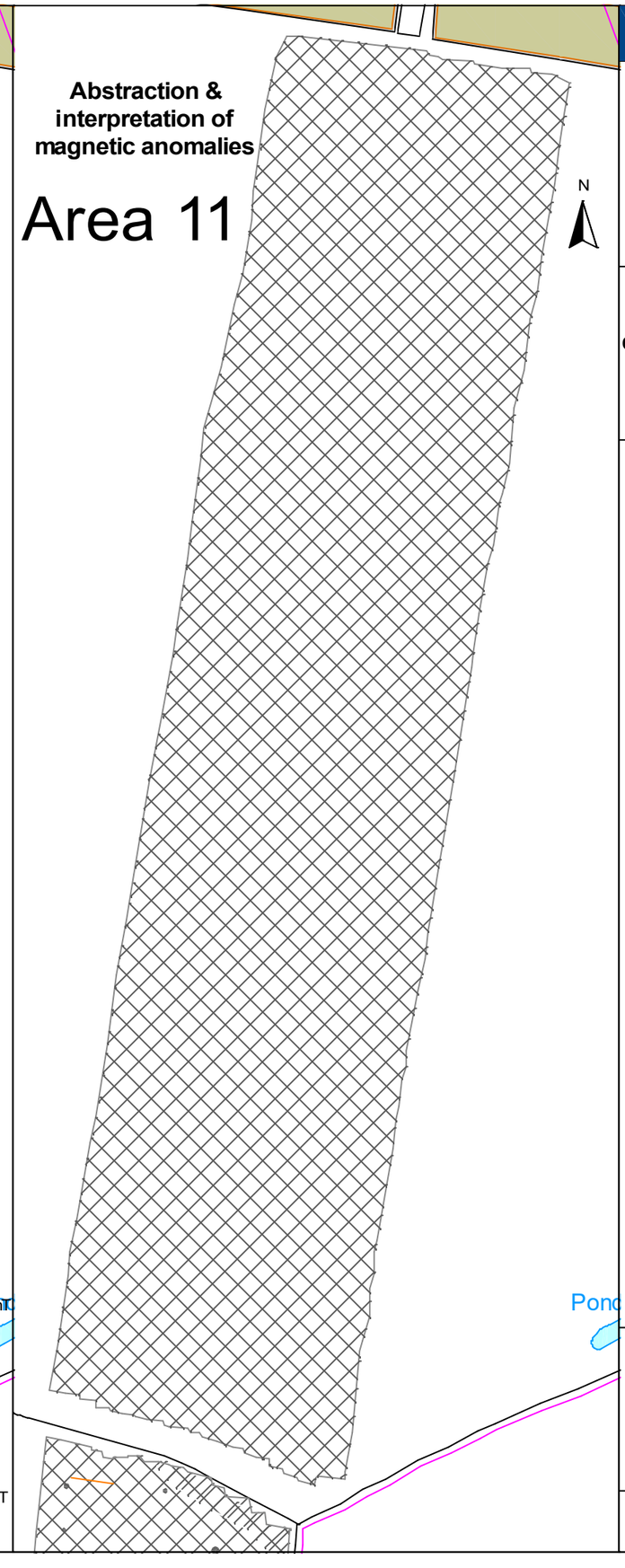
Greyscale plot of filtered magnetometer data

Area 11



Abstraction & interpretation of magnetic anomalies

Area 11



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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 11

Magnetic debris - spread of magnetically thermoremnant/ferrous material spread through green waste manuring

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 22

Greyscale plot of minimally processed magnetometer data

Area 12

-3nT +3nT

+3nT -3nT

Greyscale plot of filtered magnetometer data

Area 12

-3nT +3nT

+3nT -3nT

Abstraction & interpretation of magnetic anomalies

Area 12

N

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 12 north

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - ridge and furrow
- Discrete positive response - possible pit-like feature
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 23

Greyscale plot of minimally processed magnetometer data

Area 12

Turnover Bridge

Lock

-3nT Overflow +3nT

+3nT

-3nT

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Greyscale plot of filtered magnetometer data

Area 12

Turnover Bridge

Lock

-3nT Overflow +3nT

+3nT

-3nT

Abstraction & interpretation of magnetic anomalies

Area 12

Turnover Bridge

Lock

Overflow

N

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Area 12 south

- Positive linear anomaly - possible ditch-like feature
- Linear anomaly - possible land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - possible pit-like feature
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 24

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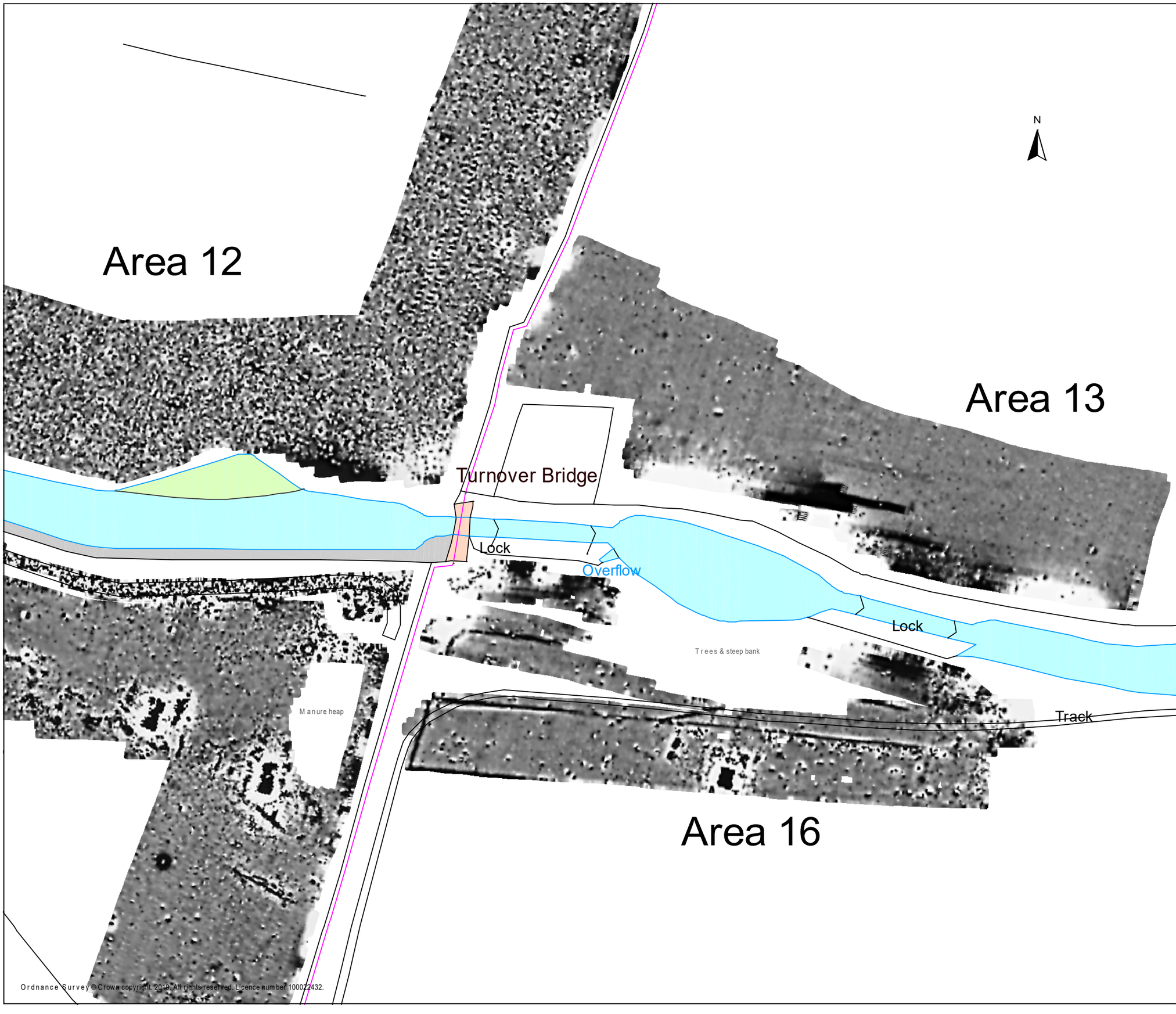
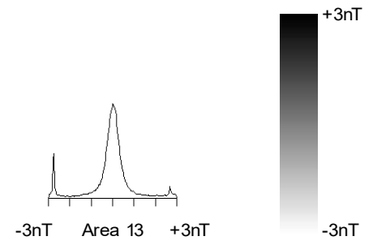
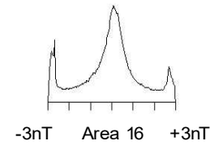
Greyscale plot of minimally processed magnetometer data - Areas 13 & 16







SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 25

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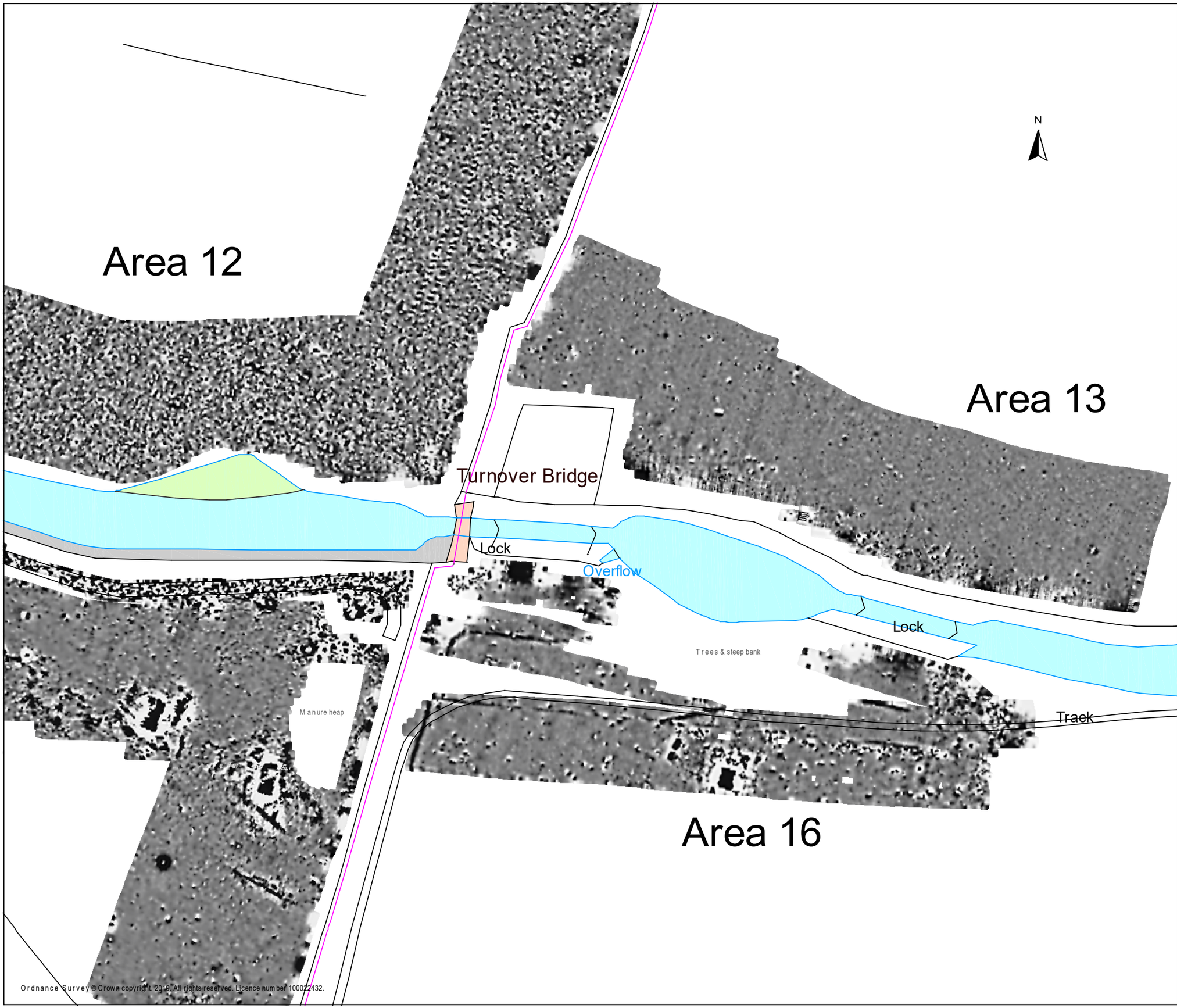
Greyscale plot of filtered magnetometer data - Areas 13 & 16



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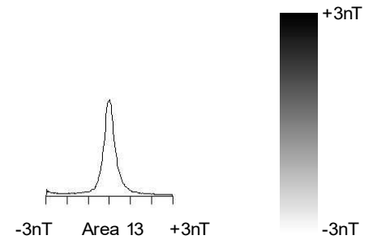

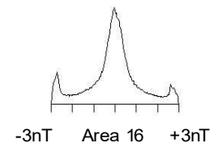

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 26

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Abstraction and interpretation of magnetic anomalies - Areas 13 & 16

Area 12

Area 13

Area 16

Turnover Bridge

Lock

Overflow

Lock

Trees & steep bank

Track

Manure heap

19

20

21

22

23

24

25

26

N

- Positive linear anomaly - cut feature / burnt material of archaeological potential
- Negative linear anomaly - of archaeological potential
- Positive linear anomaly - of uncertain origin
- Weak multiple dipolar linear anomaly - land drain
- Linear anomaly - ridge and furrow
- Discrete positive response - cut feature / burnt material of archaeological potential
- Discrete positive response - possible pit-like feature
- Positive response - of natural origin
- Positive anomaly - burnt material of archaeological potential
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 27

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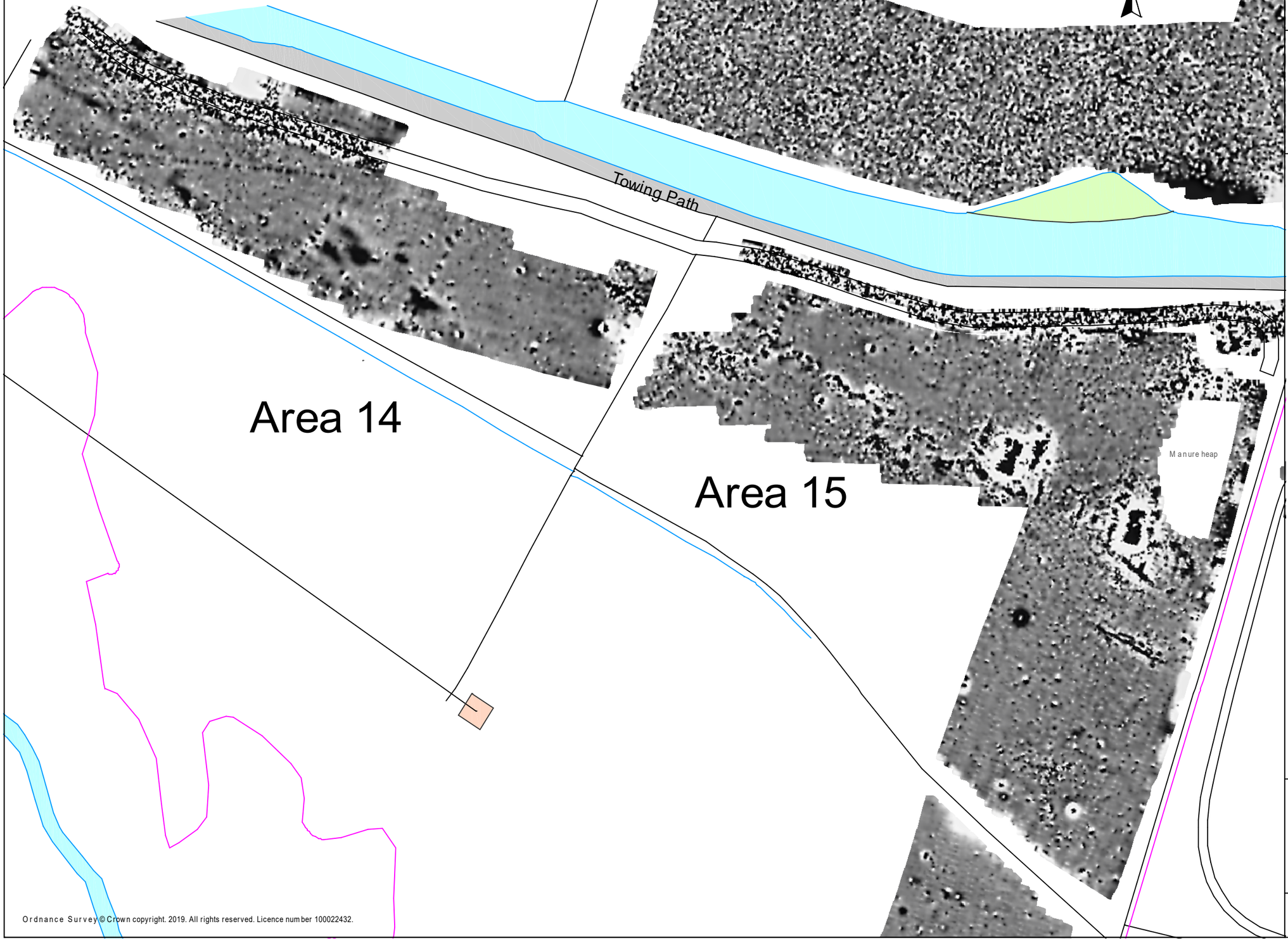
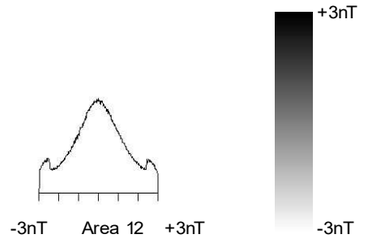
Greyscale plot of minimally processed magnetometer data - Areas 12 south west, 14 & 15





SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 28

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Greyscale plot of filtered magnetometer data - Areas 12 south west, 14 & 15

Area 12

N

Towing Path

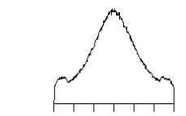
Area 14

Area 15

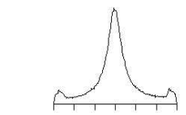
Manure heap

+3nT

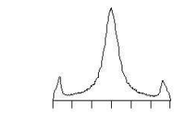
-3nT



-3nT Area 12 +3nT



-3nT Area 14 +3nT



-3nT Area 15 +3nT

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 29

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Abstraction and interpretation of magnetic anomalies - Areas 12 south west, 14 & 15

Area 12

Area 14

Area 15

Towing Path

N

20

23

19

21

22

Manure heap

- Positive linear anomaly - cut feature / burnt material of archaeological potential
- Negative linear anomaly - of archaeological potential
- Positive linear anomaly - of uncertain origin
- Weak multiple dipolar linear anomaly - land drain
- Positive linear anomaly - former field boundary
- Discrete positive response - cut feature / burnt material of archaeological potential
- Discrete positive response - possible pit-like feature
- Positive anomaly - burnt material of archaeological potential
- Positive anomaly - magnetically enhanced material of uncertain origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 30

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Greyscale plot of minimally processed magnetometer data

Area 17

Area 18

Waterlogged b

FB

Unsurveyable

+3nT

-3nT

+3nT

-3nT

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Greyscale plot of filtered magnetometer data

Area 17

Area 18

Waterlogged b

FB

Unsurveyable

+3nT

-3nT

+3nT

-3nT

Abstraction & interpretation of magnetic anomalies

Area 17

N

27

28

Area 18

Waterlogged b

FB

Unsurveyable

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Greyscale plots of magnetometer data & abstraction & interpretation of magnetic anomalies - Areas 17

- Positive linear anomaly - possible ditch-like feature
- Discrete positive response - possible pit-like feature
- Variable magnetic response - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 31

Unsurveyable

ETL

N

Area 19

Area 20

FB

Pond

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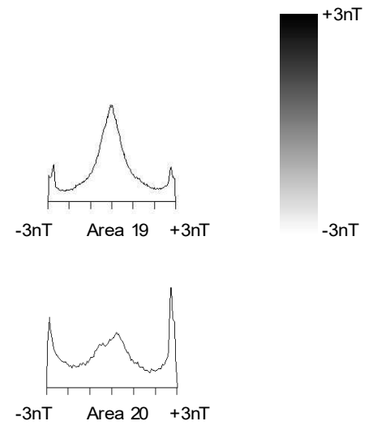
Greyscale plot of minimally processed magnetometer data - Areas 19 & 20



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 32

Unsurveyable

ETL

N

Area 19

Area 20

FB

Pond

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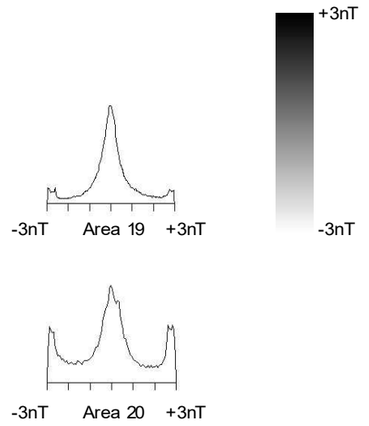
Greyscale plot of filtered magnetometer data - Areas 19 & 20



SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 33

Unsurveyable

ETL

N

Area 19

FB

Area 20

Pond

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Abstraction and interpretation of magnetic anomalies - Areas 19 & 20

- Positive anomaly - of natural origin
- Magnetic debris - spread of magnetically thermoremnant/ferrous material
- Magnetic disturbance from ferrous material
- Strong multiple dipolar linear anomaly - pipeline / cable / service
- Strong dipolar anomaly - ferrous object

SCALE 1:1000

0m 10 20 30 40 50m

SCALE TRUE AT A3

DRAWN BY	CHECKED BY	
KTD	DJS	FIG 34