WYAS Archaeological Services

Land at Studfold Farm and Spring Hill Farm

Upper Nidderdale

North Yorkshire

Geophysical Survey

Report no. 2965
May 2017

Client: Upper Nidderdale Iron Age Project

REGISTERED CIfA ORGANISATION

West Yorkshire Joint Services

Our Farm Heritage, Upper Nidderdale

Geophysical Survey

Summary

A geophysical (magnetometer and resistance) survey, covering approximately 6.2 hectares was undertaken on pastoral land at two sites, one at Studfold Farm and the other at Spring Hill Farm within Upper Nidderdale. This was part of a research agenda led by Iron Age Nidderdale. No anomalies associated with definite archaeological remains were detected although there is the potential for anthropogenic anomalies associated with a former quarry. The majority of the responses are associated with topographical features. Therefore the archaeological potential for the site is negligible at Studfold Farm and low at Spring Hill Farm based upon the areas of possible archaeology.

WYAS Archaeological Services

Report Information

Client:	Upper Nidderdale Landscape Partnership
Address:	The Old Workhouse, King Street, Pateley Bridge, Harrogate, HG3 5LE
Report Type:	Geophysical Survey
Location:	Studfold Farm and Spring Hill Farm
County:	North Yorkshire
Grid Reference:	SE 099 730 (Studfold Farm) SE 140 673 (Spring Hill Farm)
Period(s) of activity:	19th century - modern
Report Number:	2965
Project Number:	6550
Site Code:	OFH16
OASIS ID:	Archaeol11-284380
Date of fieldwork:	February 2017
Date of report:	May 2017
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1 Introduction

Archaeological Services WYAS (ASWYAS) were commissioned by Upper Nidderdale Landscape Partnership to undertake a geophysical (magnetometer and resistance) survey as part of the Our Farm Heritage research project led by Iron Age Nidderdale on farmland at Studfold Farm and Spring Hill Farm. Guidance contained within the National Planning Policy Framework (DCLG 2012) was followed, in line with current best practice (CIfA 2014; David *et al*. 2008). The survey was carried out between the 13th - 17th February 2017.

Site location, topography and land-use

The survey areas consists of three fields at Studfold Farm, totaling approximately 4.75ha and one field approximately 1.45ha at Spring Hill. Studfold Farm lies to the south of the village of Lofthouse, approximately 10km to the northwest of Pateley Bridge. The How Stean Beck runs to the south of the site. Spring Hill Farm lies within the hamlet of Heathfield, to the east of Grange Lane, approximately 2km to the northwest of Pateley Bridge (see Fig. 1). At the time of survey. Ground cover consisted of pasture on all sites. The survey area at Studfold Farm is centred at SE 0989 7306. Topography of this site is sloping down from southwest to northeast and was quite steep in places with a height above Ordnance Datum (aOD) ranging from 170m to 191m. Earthworks were also visible on the ground.

Spring Hill Farm is centred at SE 1404 6740 and was undulating with earthworks, and lies between 202m aOD in the south to 212m in the north. The ground was also under pasture.

Soils and geology

The underlying geology at Studfold Farm comprises of the middle limestone association – limestone which formed approximately 326 to 331 million years ago in the Carboniferous Period. No superficial deposits have been recorded. The geology at Spring Hill Farm is recorded as the Millstone grit group – sandstone which formed 313 to 326 million years ago, again, no superficial deposits have been recorded (BGS 2017). Soils at Studfold Farm belong to the East Keswick 2 association (541y) consisting of deep well drained fine and coarse loamy soils with locally steep slopes. Soils at Spring Hill Farm belong to the Rivington 2 association (541g) consisting of well drained coarse loamy soils over rock (SSEW 1983).

2 Archaeological Background

A search on the pastscapes website (HE 2017) has revealed a number of limestone quarries (Monument numbers 559068, 559070) and a lime kiln (559069) within a 250m radius of Studfold Farm. The lower half of a beehive rotary quern has been built into a wall on the northwest side of Stud Fold Bank (48640).

A search for the area around Spring Bank Farm has only revealed a cottage dating to the 17th century known as Grange Cottage (524049).

3 Aims and Methodology

The main aim of the geophysical survey was to provide additional information on the investigation works that have been and are going to be carried out by the Upper Nidderdale Landscape Partnership. To achieve this aim, a magnetometer survey covering all amenable parts of the PDA was undertaken (see Fig. 2) which was followed by a targeted resistance survey.

The general objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic and resistance anomalies identified;
- to therefore determine the presence/absence and extent of any buried archaeological features; and
- to prepare a report summarising the results of the survey.

Magnetometer survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble 5800 model). The survey was undertaken using Bartington Grad601 magnetic gradiometers. These were employed taking readings at 0.25m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 1.

Resistance survey

The survey was undertaken using a Geoscan RM15 resistance meter with MPX15 multiplexer and a Geoscan RM85. These were employed taking readings at 1m intervals on zig-zag traverses 1.0m apart within 30m by 30m grids. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data. Further details are given in Appendix 2.

Reporting

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 shows a more detailed site location plan at a scale of 1:20000. The processed and minimally processed data, together with an interpretation of the survey results are presented in Figures 3 to 14 inclusive at a scale of 1:1000.

Technical information on the equipment used, data processing and survey methodologies are given in Appendices 1 and 2. Technical information on locating the survey area is provided in

Appendix 3. Appendix 4 describes the composition and location of the archive. A copy of the completed OASIS form is included in Appendix 5.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All figures reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

The figures in this report have been produced following analysis of the data in processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

4 Results and Discussion (see Figures 3 to 14)

The results and discussion below have been broken down, dealing with the magnetic survey at both Studfold Farm and Spring Hill Farm, first followed by the resistance results. Studfold Farm, because it consisted of a number of fields, has been discussed as Areas 1 – 3 (Fig 3-5). The survey at Spring Hill Farm, as it was self-contained to a solitary field, is discussed without such breakdown.

Magnetic Survey

Ferrous anomalies

Ferrous anomalies, as individual 'spikes', or as large discrete areas are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. There is no obvious pattern or clustering to their distribution in this survey to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

Within Area 3 at Studfold Farm a band of magnetic disturbance (**A**) (Fig 5) can be seen on a northeast to southwest alignment which corresponds to the earthworks within the field. It is likely that this anomaly reflects a former field boundary shown on the First edition Ordnance Survey (OS) mapping dating from 1853 (OS 2017). This response differs to the other earthwork responses as it is much more magnetically enhanced, it is likely that the boundary ditch has been infilled with magnetic material such as bricks and/or rubble.

Perpendicular to the above anomaly, a further area of magnetic disturbance can be seen at (**B**) (Fig 5) which is suggestive of an area of hard standing or rubble. There was no indication of the anomaly in the field and there are no features shown on available old maps. It runs parallel with the current field boundary to the southwest and also to a former boundary seen on the 1853 map it is therefore possible that it is a former division pre-dating the OS maps.

Also, within this field, a gas service pipe can be seen producing a large magnetic halo which will have masked any further anomalies within the vicinity.

An area of magnetic disturbance (**C**) within the Spring Hill Farm site corresponds to a building marked on the 1853 map (Fig 5). By 1891 the building has been demolished.

Agricultural anomalies

A handful of linear trends within Area 2 at Studfold possibly reflect some sort of agricultural regime (**D**). However, this part of the field was steeply sloping and it seems unlikely that it has been ploughed. The anomalies may have been formed by natural drainage of the field.

A former field boundary which corresponds to the First edition OS map can be seen at (**E**), lying adjacent to the demolished building at Spring Hill (Fig 11).

Geological anomalies

Small discrete low magnitude anomalies have been identified throughout and are thought to be caused by variations in the depth and composition of the soils and the superficial deposits from which they derive.

Larger anomalies have been detected in Areas 1-3, whilst the majority of these are likely to reflect the topography of the site such as those at (**F**) there is a possibility that they have an anthropogenic origin. However, without any corroborative evidence this interpretation is tentative.

Quarrying anomalies

To the south of the disused quarry curvi-linear anomalies can be seen. It is likely that they are associated with the quarry in the form of former tracks.

Possible archaeological anomalies

A handful of anomalies within Area 2 at Studfold have been interpreted as possible archaeology on the basis that they appear to form three sides of a large enclosure of some sort. However, it has been noted that the southern and eastern ‘arm’ of the anomaly roughly correspond to former field boundaries on the First edition OS mapping (OS 2017).

Resistance Survey

Areas to be surveyed with resistance was based upon the magnetic survey results. No survey was undertaken in Area 1, because it was considered unlikely to yield meaningful or discernable results At the time of survey, heavy rainfall had some effect on the data which can be seen within the raw data plots (Figs 6 and 10). As explained in Appendix 2, earth resistance relies upon the transference of current between points. Wet conditions facilitate this transference and when they occur during survey, a distinct effect can be seen.

Geological anomalies

Areas of both high and low resistance have been detected across all survey areas which are largely due to the topography and are thought not to be of archaeological interest. During data collection, readings that were obtained on the steep slopes were very low suggesting a high moisture content in the soils, which is not unexpected and therefore was attributed to the heavy rainfall at the time of survey.

Possible archaeological anomalies

High resistance anomalies located in the northwest of the survey area at Spring Hill have the most potential to be of interest. These correlate to earthworks in the field which are likely to be associated with the former quarry. No other anomalies of archaeological interest have been detected by the resistance survey.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

5 Conclusions

Results from both the magnetic and resistance surveys have helped to increase an understanding of the landscape surrounding the farms. Whilst no definite archaeological features have been detected there is the potential for anthropogenic activity on both sites. At Studfold Farm anomalies which may relate to ditches have been located, which suggest the possibly of an enclosure, but former boundary ditches are equally likely. At Spring Hill Farm anomalies associated with the former quarry have been recorded in both the magnetic and resistance surveys.

Areas of magnetic disturbance at Studfold Farm have produced an inconclusive interpretation and may warrant further investigation.

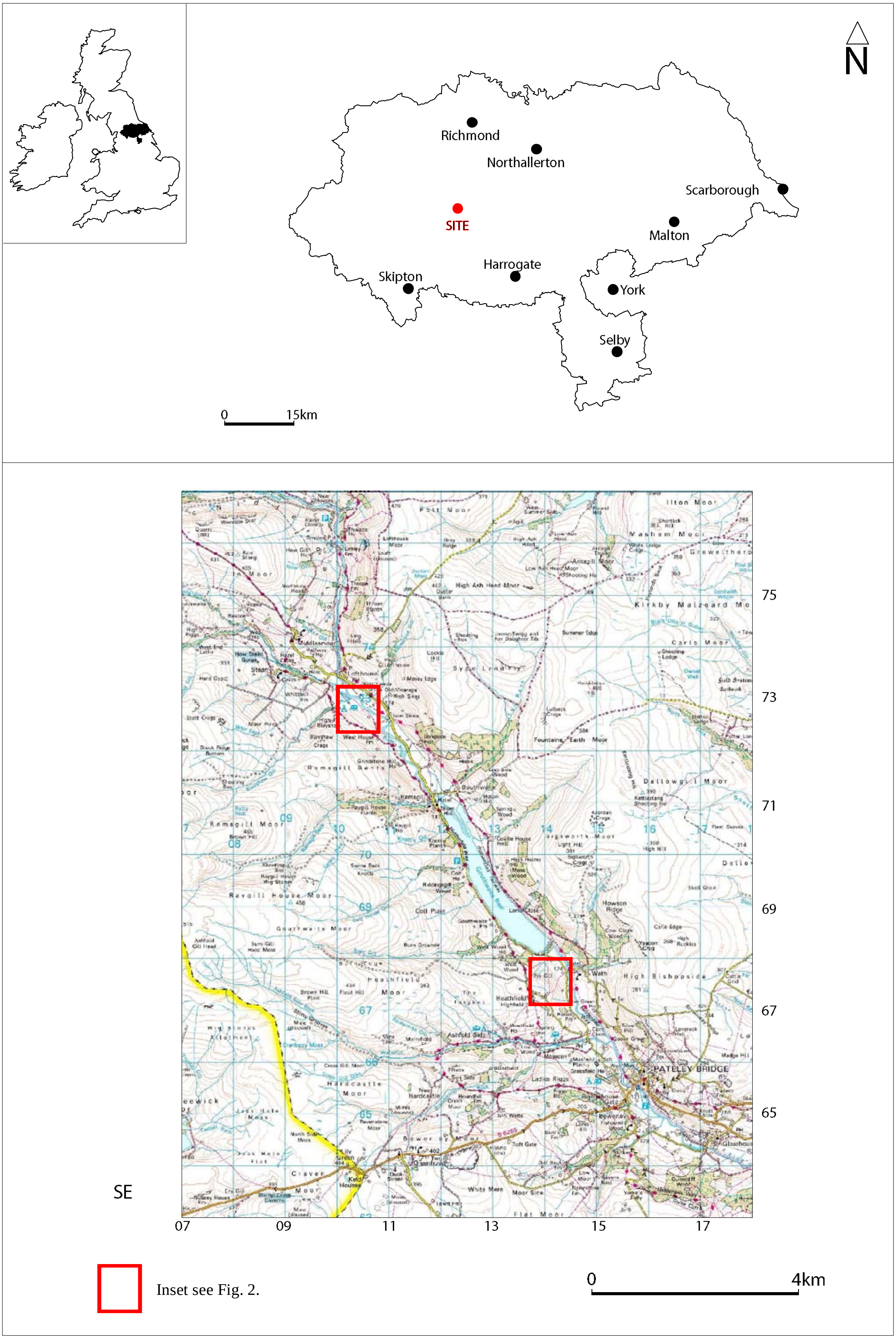

Fig. 1. Site location

Fig. 2. Site location (1:20,000 @ A3)

0 500m

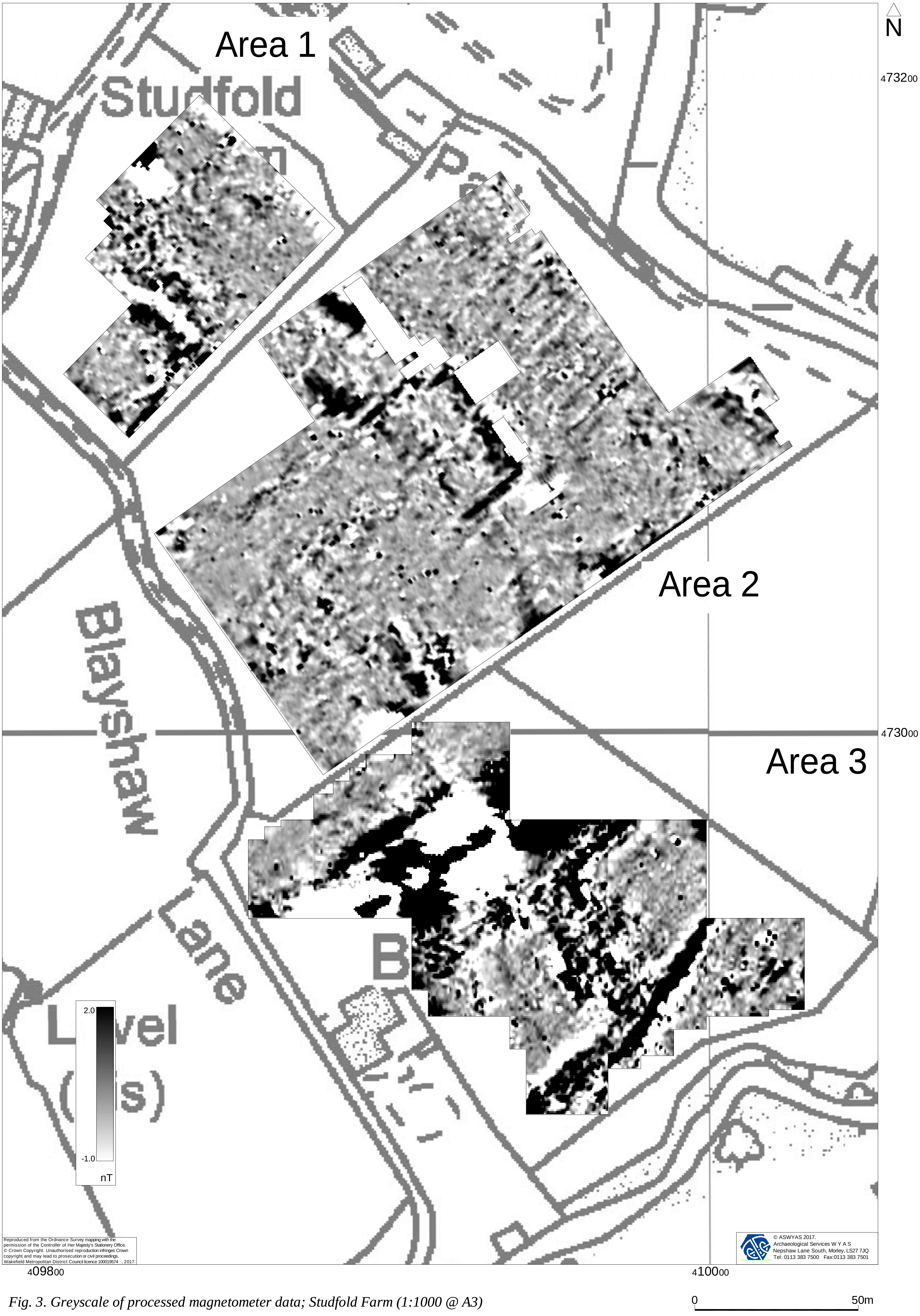

Fig. 3. Greyscale of processed magnetometer data; Studfold Farm (1:1000 @ A3)

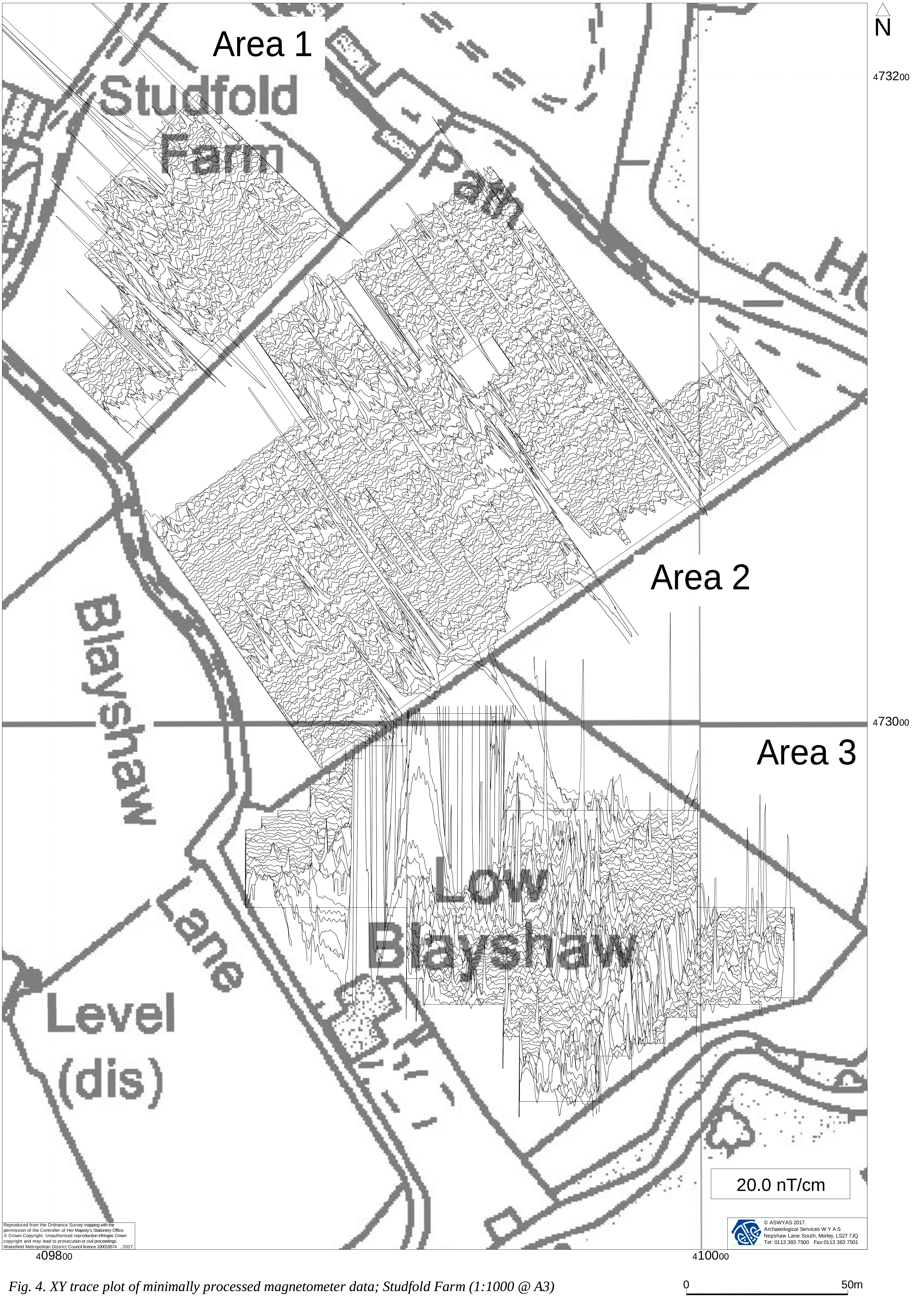

Fig. 4. XY trace plot of minimally processed magnetometer data; Studfold Farm (1:1000 @ A3)

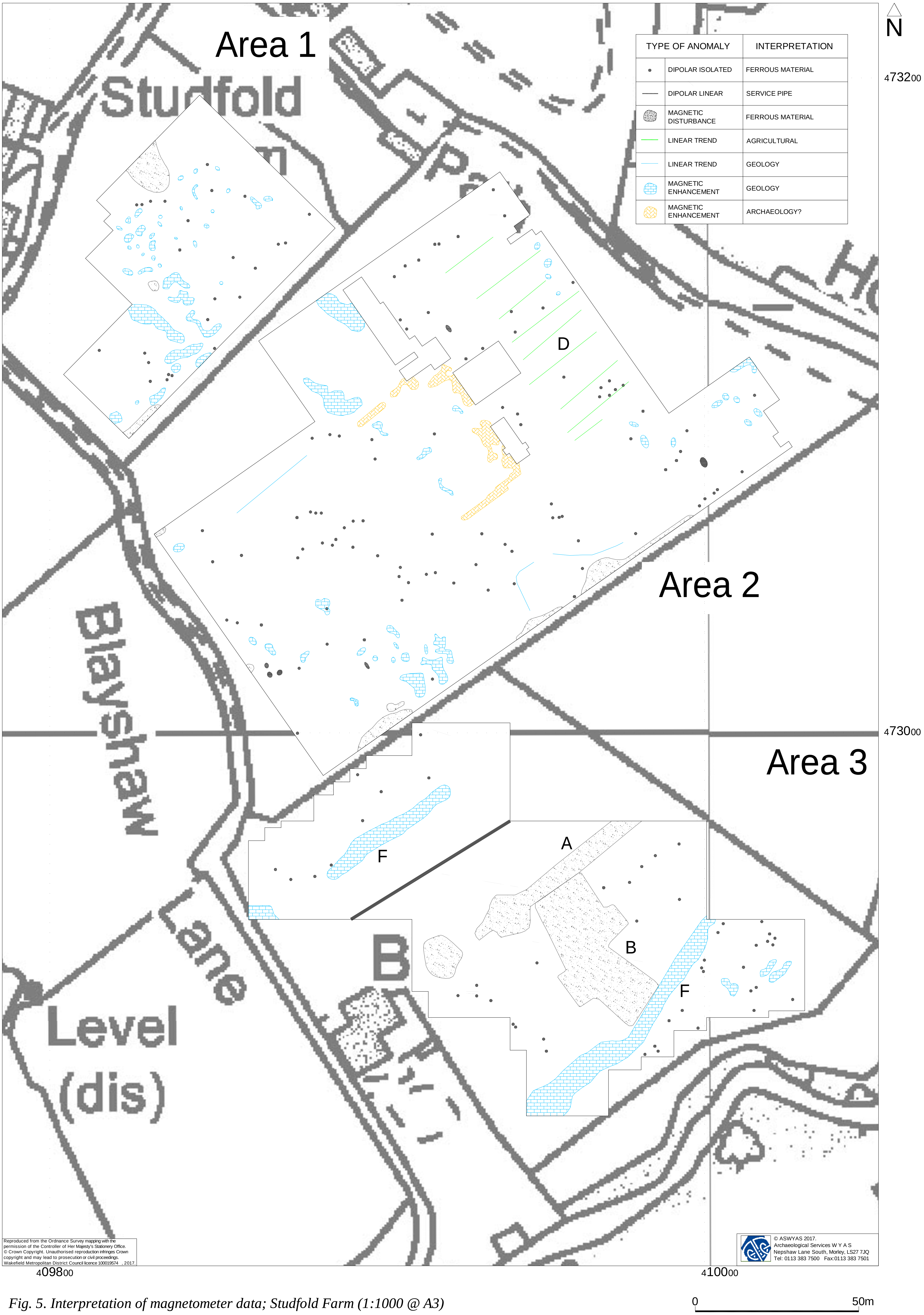

Fig. 5. Interpretation of magnetometer data; Studfold Farm (1:1000 @ A3)

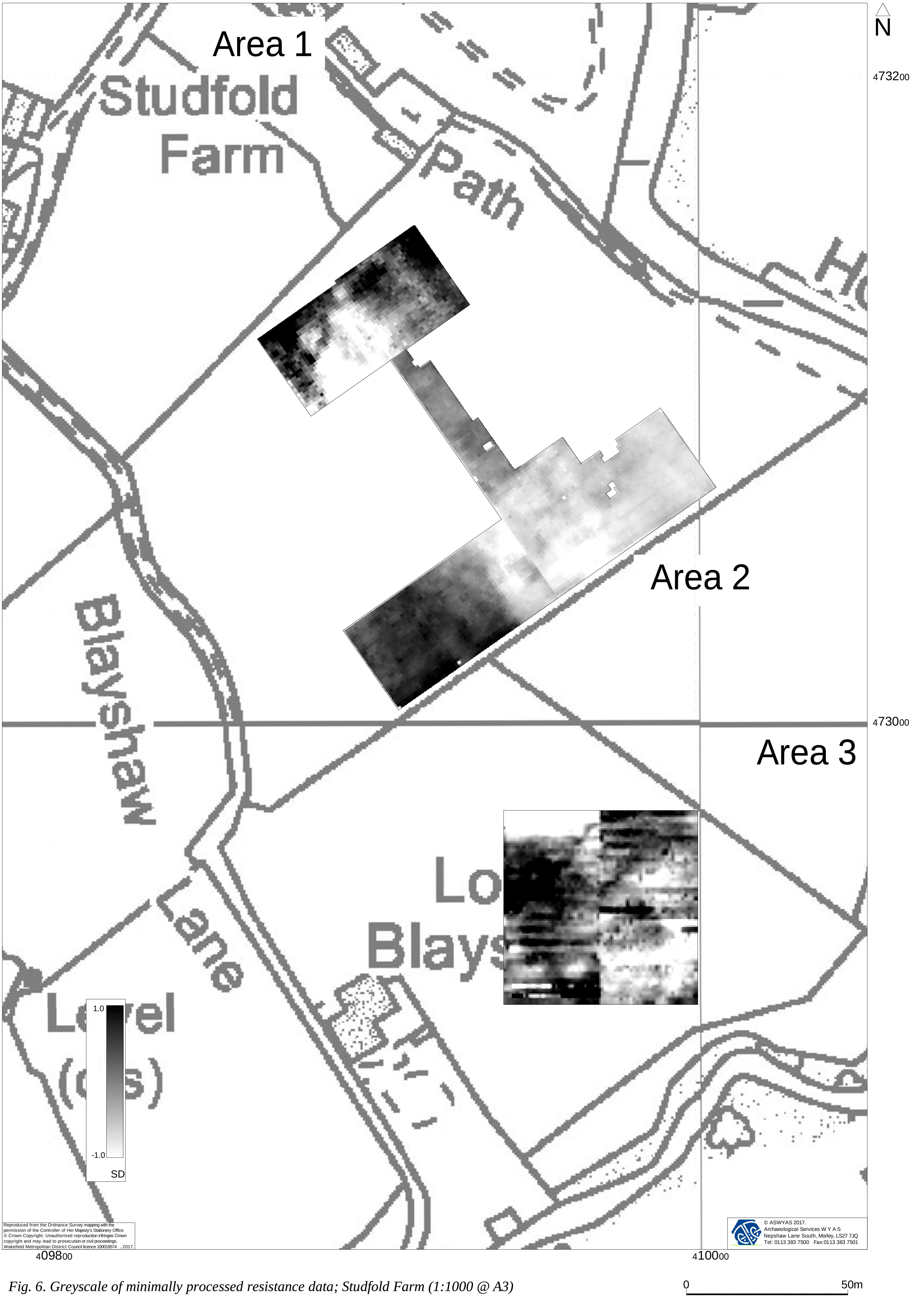

Fig. 6. Greyscale of minimally processed resistance data; Studfold Farm (1:1000 @ A3)

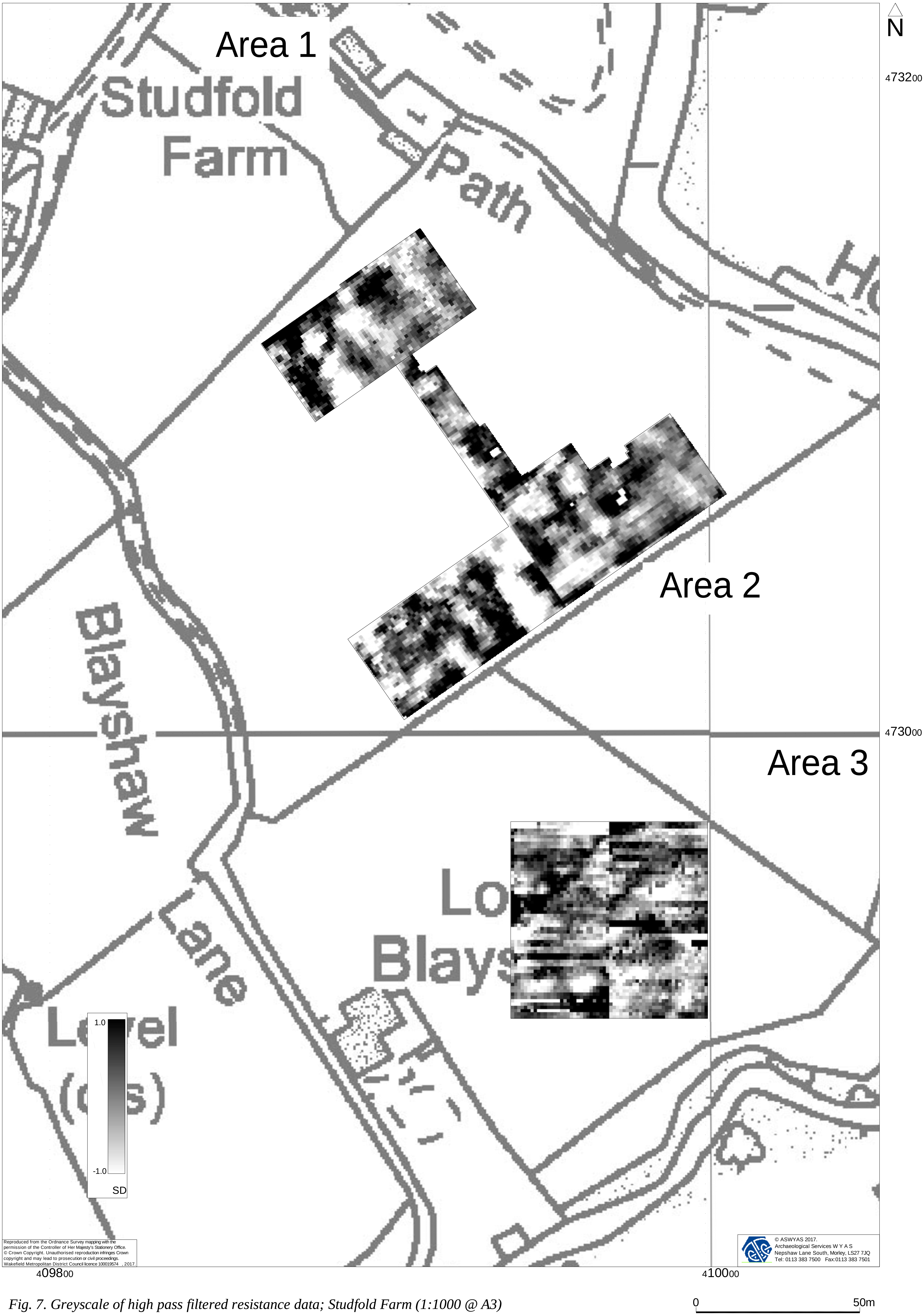

Fig. 7. Greyscale of high pass filtered resistance data; Studfold Farm (1:1000 @ A3)

Fig. 8. Interpretation of resistance data; Studfold Farm (1:1000 @ A3)

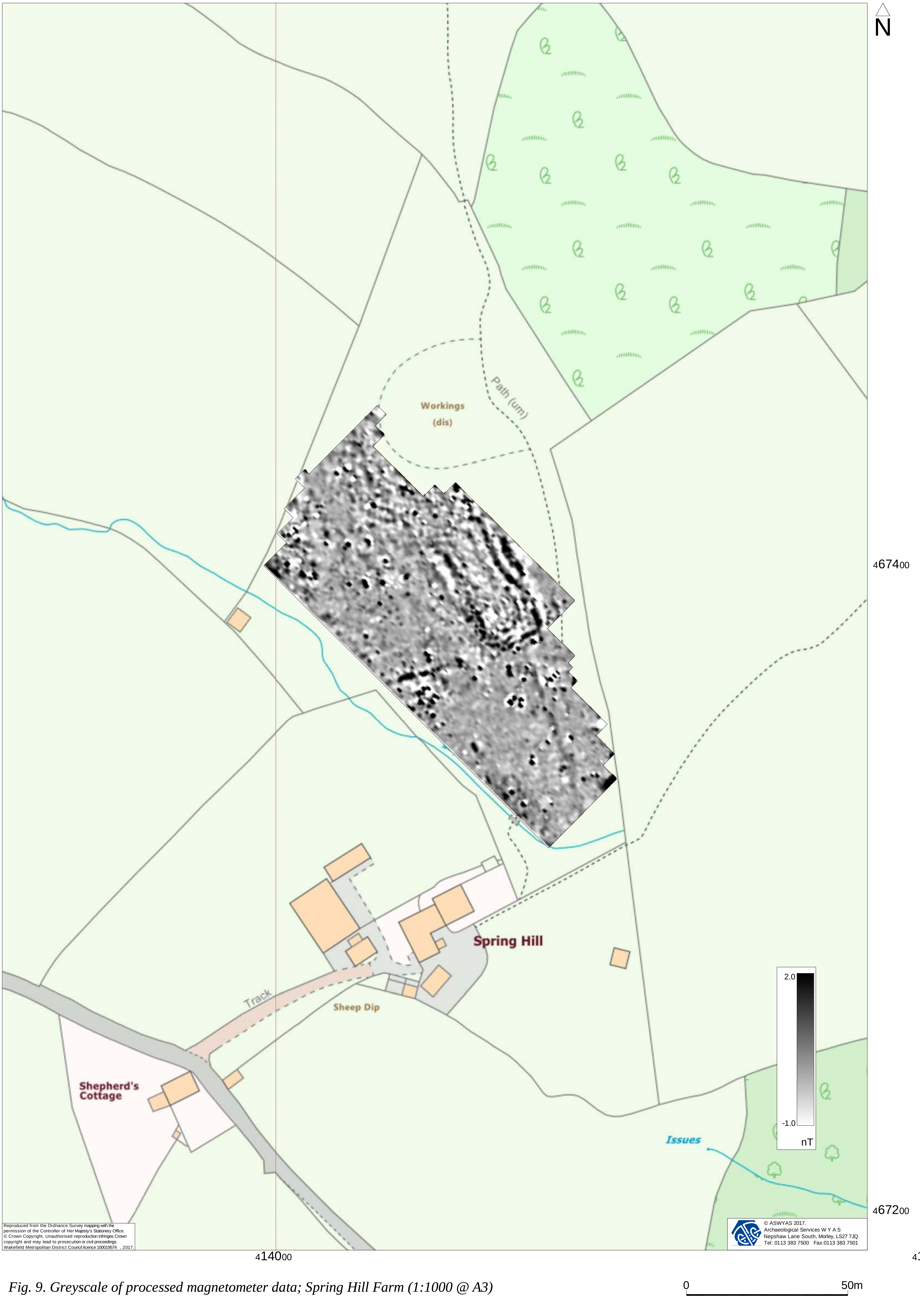

Fig. 9. Greyscale of processed magnetometer data; Spring Hill Farm (1:1000 @ A3)

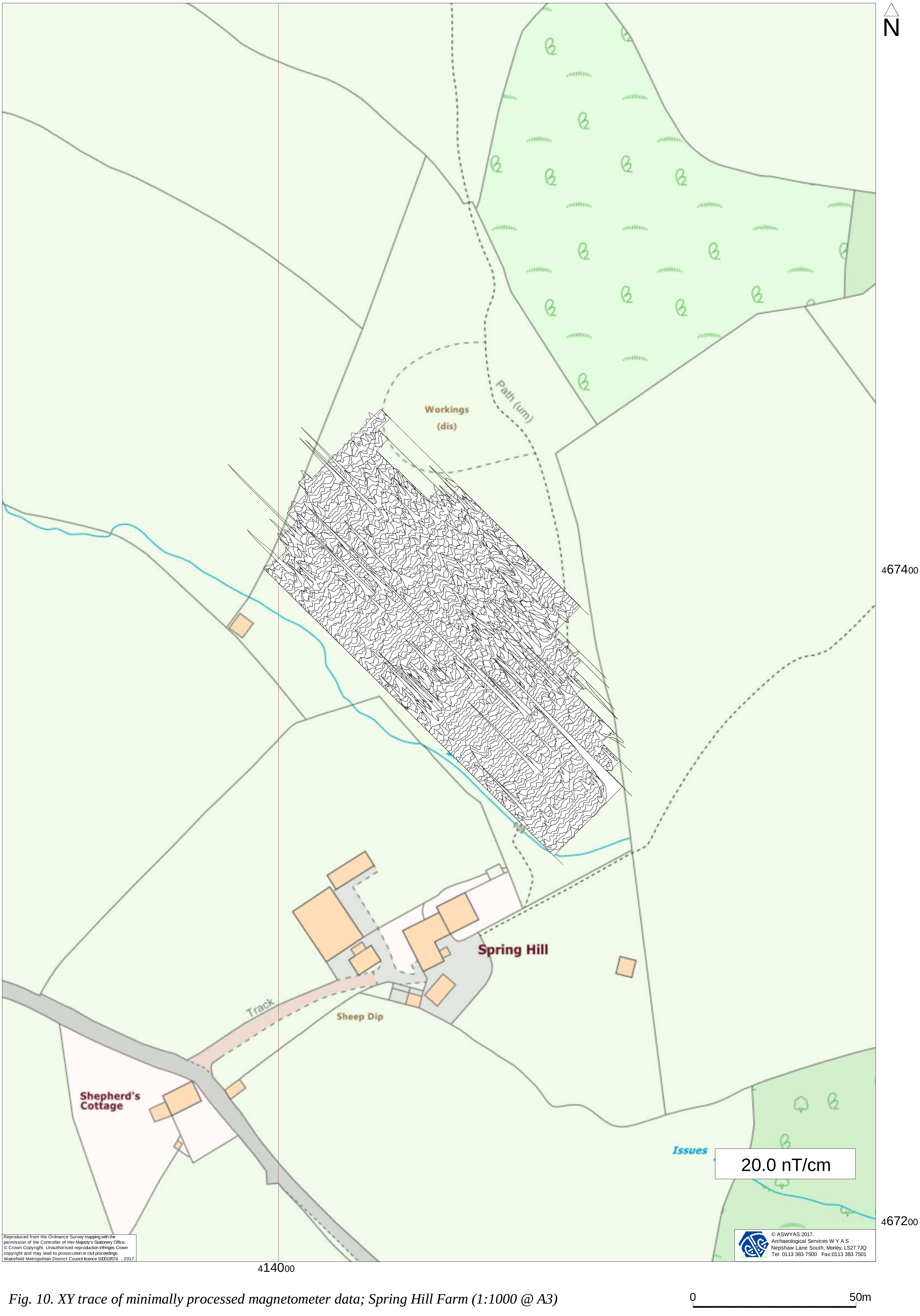

Fig. 10. XY trace of minimally processed magnetometer data; Spring Hill Farm (1:1000 @ A3)

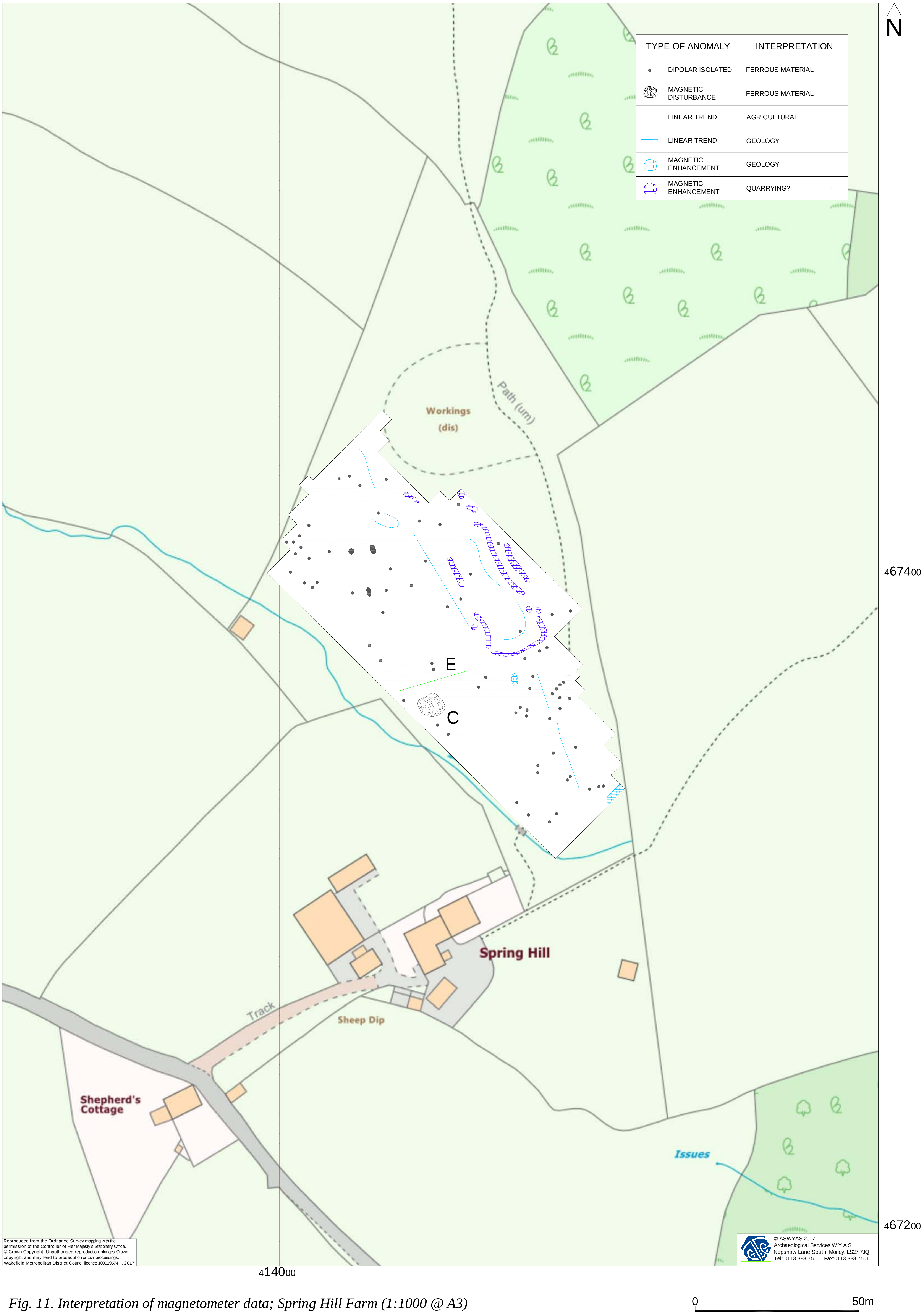

Fig. 11. Interpretation of magnetometer data; Spring Hill Farm (1:1000 @ A3)

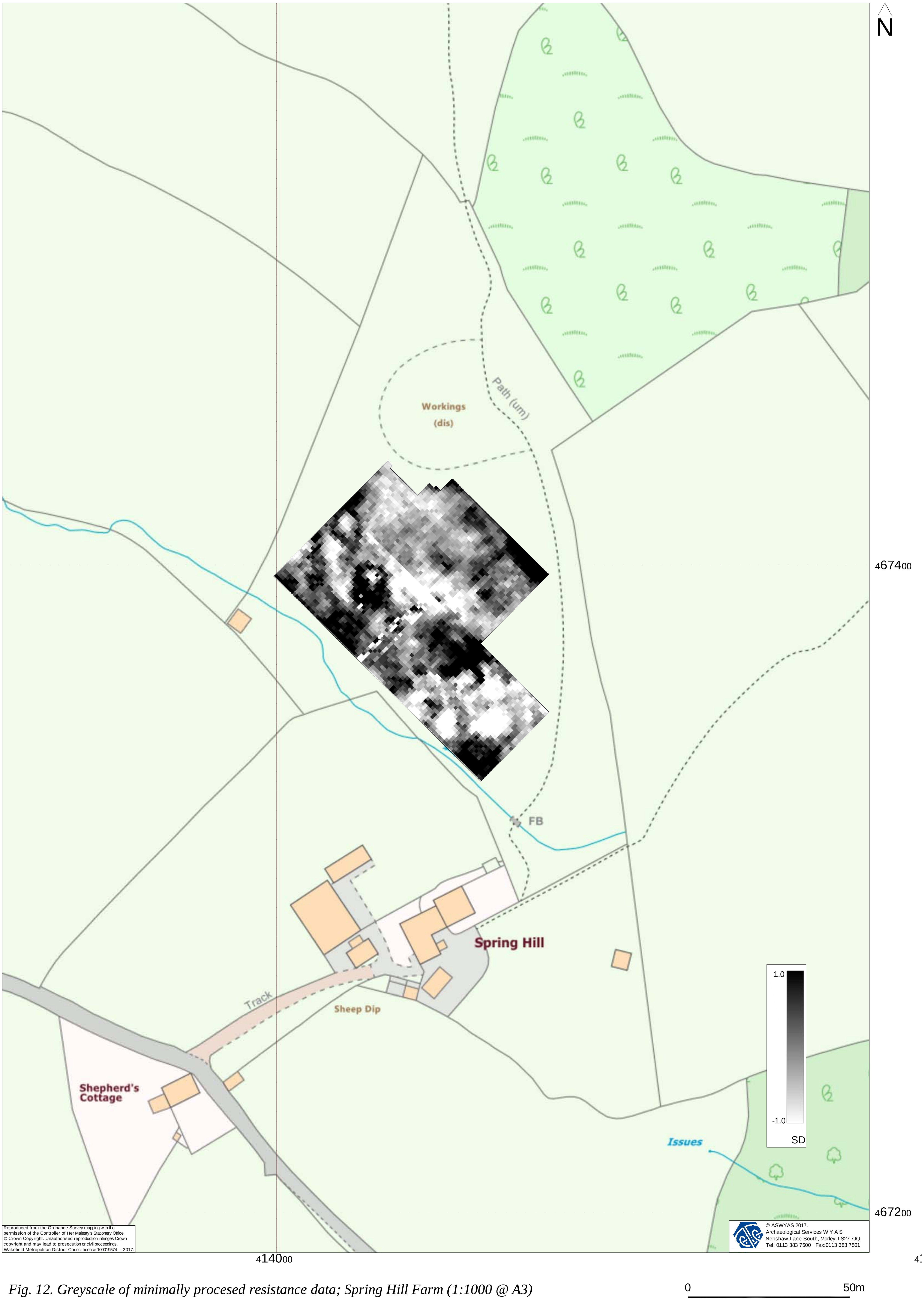

Fig. 12. Greyscale of minimally procesed resistance data; Spring Hill Farm (1:1000 @ A3)

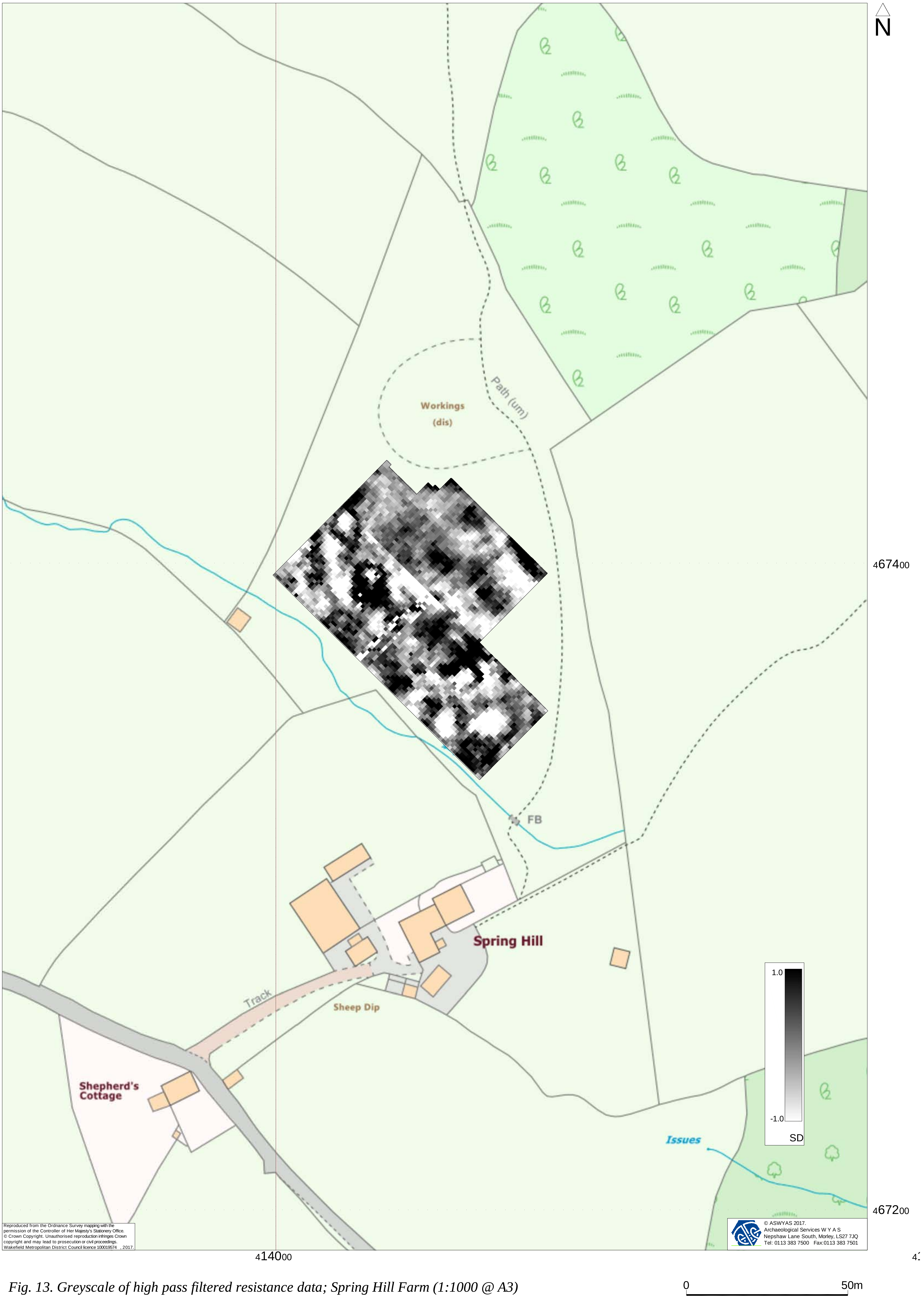

Fig. 13. Greyscale of high pass filtered resistance data; Spring Hill Farm (1:1000 @ A3)

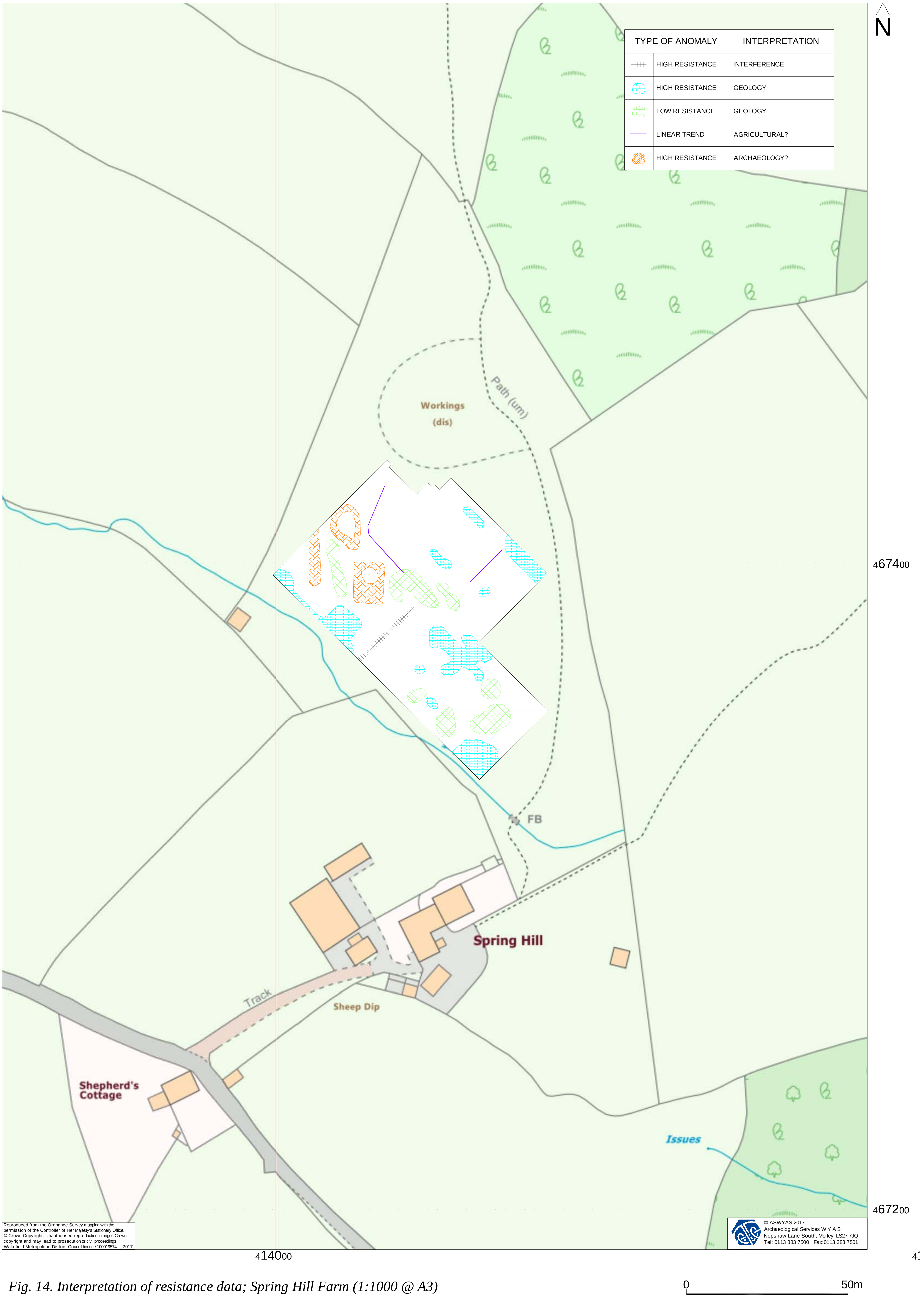

Fig. 14. Interpretation of resistance data; Spring Hill Farm (1:1000 @ A3)

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Methodology: Gradiometer Survey

The main method of using the fluxgate gradiometer for commercial evaluations is referred to as ***detailed survey*** and requires the surveyor to walk at an even pace carrying the instrument within a grid system. A sample trigger automatically takes readings at predetermined points, typically at 0.25m intervals, on traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

During this survey a Bartington Grad601 magnetic gradiometer was used taking readings on the 0.1nT range, at 0.25m intervals on zig-zag traverses 0.5m apart within 30m by 30m square grids. The instrument was checked for electronic and mechanical drift at a common point and calibrated as necessary. The drift from zero was not logged.

The gradiometer data have been presented in this report in processed greyscale format. The data in the greyscale images have been interpolated and selectively filtered to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Appendix 2: Earth resistance survey - technical information

Soil Resistance

The electrical resistance of the upper soil horizons is predominantly dependant on the amount and distribution of water within the soil matrix. Buried archaeological features, such as walls or infilled ditches, by their differing capacity to retain moisture, will impact on the distribution of sub-surface moisture and hence affect electrical resistance. In this way there may be a measurable contrast between the resistance of archaeological features and that of the surrounding deposits. This contrast is needed in order for sub-surface features to be detected by a resistance survey.

The most striking contrast will usually occur between a solid structure, such as a wall, and water-retentive subsoil. This shows as a resistive high. A weak contrast can often be measured between the infill of a ditch feature and the subsoil. If the infill material is soil it is likely to be less compact and hence more water retentive than the subsoil and so the feature will show as a resistive low. If the infill is stone the feature may retain less water than the subsoil and so will show as a resistive high.

The method of measuring variations in ground resistance involves passing a small electric current (1mA) into the ground via a pair of electrodes (current electrodes) and then measuring changes in current flow (the potential gradient) using a second pair of electrodes (potential electrodes). In this way, if a structural feature, such as a wall, lies buried in a soil of uniform resistance much of the current will flow around the feature following the path of least resistance. This reduces the current density in the vicinity of the feature, which in turn increases the potential gradient. It is this potential gradient that is measured to determine the resistance. In this case, the gradient would be increased around the wall giving a positive or high resistance anomaly.

In contrast a feature such as an infilled ditch may have a moisture retentive fill that is comparatively less resistive to current flow. This will increase the current density and decrease the potential gradient over the feature giving a negative or low resistance anomaly.

Survey Methodology

The most widely used archaeological technique for earth resistance surveys uses a twin probe configuration. One current and one potential electrode (the remote or static probes) are fixed firmly in the ground a set distance away from the area being surveyed. The other current and potential electrodes (the mobile probes) are mounted on a frame and are moved from one survey point to the next. Each time the mobile probes make contact with the ground an electrical circuit is formed between the current electrodes and the potential gradient between the mobile and remote probes is measured and stored in the memory of the instrument.

A Geoscan RM15 resistance meter with MPX multichannel adapter, and an RM85, were used during this survey, with the instrument logging each reading automatically at 1m intervals on traverses 1m apart. The mobile probe spacing was 0.5m with the remote probes 15m apart and at least 15m away from the grid under survey. This mobile probe spacing of 0.5m gives an approximate depth of penetration of 1m for most archaeological features. Consequently a soil cover in excess of 1m may mask, or significantly attenuate, a geophysical response.

Appendix 3: Survey location information

An initial survey station was established using a Trimble VRS differential Global Positioning System (Trimble R6 model). The data was geo-referenced using the geo-referenced survey station with a Trimble RTK differential Global Positioning System (Trimble R6 model). The accuracy of this equipment is better than 0.01m. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

Appendix 4: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS6 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS although it is anticipated that it may eventually be lodged with the Archaeology Data Service (ADS). Brief details may also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the North Yorkshire Historic Environment Record).

Appendix 5: Oasis form

OASIS DATA COLLECTION FORM: England

Printable version

OASIS ID: archaeol11-284380

Project details

Project name	Our Farm Heritage, Upper Nidderdale
Short description of the project	A geophysical (magnetometer and resistance) survey, covering approximately 6.2 hectares was undertaken on pastoral land at two sites, one at Studfold Farm and the other at Spring Hill Farm within Upper Nidderdale. This was part of a research agenda led by Iron Age Nidderdale. No anomalies associated with definite archaeological remains were detected although there is the potential for anthropogenic anomalies associated with a former quarry. The majority of the responses are associated with topographical features. Therefore the archaeological potential for the site is negligible at Studfold Farm and low at Spring Hill Farm based upon the areas of possible archaeology.
Project dates	Start: 13-02-2017 End: 17-02-2017
Previous/future work	Yes / Yes
Any associated project reference codes	6550 - Sitecode
Type of project	Research project
Monument type	NONE None
Significant Finds	?QUARRY Modern
Investigation type	''Geophysical Survey''
Prompt	Research
Solid geology (other)	limestone
Drift geology (other)	loamy soils
Techniques	Magnetometry
Techniques	Resistivity - area

Project location

Country	England
Site location	NORTH YORKSHIRE HARROGATE STONEBECK DOWN Studfold and Spring Hill Farm
Study area	4.75 Hectares

Site coordinates	SE 0989 7306 54.153091107475 -1.848550912238 54 09 11 N 001 50 54 W Point
Site coordinates	SE 1404 6740 54.102119755532 -1.785264130892 54 06 07 N 001 47 06 W Point
Height OD / Depth	Min: 170m Max: 212m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Upper Nidderdale Landscape Partnership
Project design originator	Upper Nidderdale Landscape Partnership
Project director/manager	C. Sykes
Project supervisor	E Brunning
Type of sponsor/funding body	Heritage Lottery Fund

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Upper Nidderdale Landscape Partnership
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Survey","Text"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Our Farm Heritage, Upper Nidderdale
Author(s)/Editor(s)	Brunning, E
Date	2017
Issuer or publisher	ASWYAS
Place of issue or publication	Morley, Leeds
Description	A4 report with A3 figures

Entered by	Emma Brunning (emma.brunning@aswyas.com)
Entered on	5 May 2017

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