WYAS Archaeological Services

Newington Quarry

Misson

Nottinghamshire

Geophysical Survey and Archaeological Trial Trenching

Report no. 2787
September 2015

Client: Andrew Josephs Associates

West Yorkshire Joint Services

Newington Quarry
Misson
Nottinghamshire

Geophysical Survey and Archaeological Trial Trenching

Summary

A geophysical (magnetometer) survey, covering approximately 15.4 hectares, was carried out on land at Newington Quarry, near Misson, Nottinghamshire. This identified anomalies consistent with former agricultural practice, specifically former field boundaries. There followed a scheme of archaeological evaluation by trial trenching which targeted the geophysical anomalies as well as apparently blank areas. Both the geophysical survey and the subsequent trial trenching identified the archaeological potential of the site as very low.

The work was required by Nottinghamshire County Council to inform a planning application for the proposed western extension of Newington Quarry.

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Report Information

Client:	Andrew Josephs Associates
Address:	16 South Terrace, Sowerby, Thirsk, YO7 1RH
Report Type:	Geophysical Survey and Archaeological Trial Trenching
Location:	Newington Quarry, near Misson
County:	Nottinghamshire
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Museum Accession No.:	awaiting number
Date of fieldwork:	August 2015
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Authorisation for distribution: ---

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1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Andrew Josephs Associates (the Client), to undertake a geophysical (magnetometer) survey of approximately 15.4 hectares on land Newington Quarry, near Misson, Nottinghamshire, followed by a scheme of archaeological trial trenching. The work was undertaken in order to inform a planning application for the proposed western extension of Hanson's Newington Quarry in accordance with the National Planning Policy Framework (DCLG 2012), in line with current best practice (Historic England 2006; 2008; CIfA 2014a; 2014b; David *et al*. 2008) and to a Project Design (Richardson 2015a; 2015b). The geophysical survey was carried out between 12th to 14th August 2015 and the trial trenching between 13th and 24th August 2015.

Site location, topography and land-use

The survey area is located to the east of Newington and to the south-west of Misson. It comprises two agricultural fields, bounded by Newington Road to the north, Slaynes Road to the south, with small lake to the east and elsewhere by farmland. The total size of the survey area is 15.4 hectares and is situated at *c*. 3-4m AOD. The site is centred at SK 67646 94081.

Soils and geology

The underlying bedrock comprises sandstone of the Nottingham Castle Sandstone Formation, with superficial deposits of peat, but also river terrace deposits of sand and gravel (British Geological Survey 2015). The soils in this area are classified in the Altcar 2 association, characterised as fen peat, as well as soils in Newport 1 association, characterised by deep well drained sandy and coarse loamy soils (Soil Survey of England and Wales 1983).

2 Archaeological Background

A cultural heritage assessment by the Client (AJA 2015) established that Iron Age or Roman activity is possible, as well as earlier prehistoric activity as indicated by the recovery of a small domestic flint assemblage from the quarry which appeared to be predominantly of middle to later Neolithic/early Bronze Age date and a large assemblage of worked flints of Mesolithic date. This may hint at a Mesolithic settlement in the near vicinity.

3 Aims and Methodology

Magnetometer survey

The aim of the geophysical survey as described in the Project Design (Richardson 2015a) was to, as far as possible, identify the presence or absence, and extent and layout, of buried archaeological remains across the site, through the interpretation of magnetic anomalies identified following the processing of data gathered during the survey.

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. Features such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the Earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney and Gater 2003). Further information on the types of anomalies is provided as Appendix 1.

On this site Bartington Grad601 magnetic gradiometers were used. These instruments are calibrated to take readings at 0.25m intervals on zig-zag traverses 1m apart within a series of 30m by 30m grids resulting in 3600 readings per 30m grid square. The data are stored in the memory of the instrument before being downloaded to a lap-top computer each day in preparation for data processing and interpretation.

The survey grid was laid out using a Trimble VRS differential Global Positioning System (Trimble TSC3 model) providing an accuracy greater than 0.01m. The locations of the survey grid and anomalies are available as a DXF file. 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.

Data processing

The gradiometer data have been presented in this report in XY trace and greyscale formats. In the former format the data shown are 'raw' with no processing other than grid biasing having been done. An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data have been clipped. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. The data in the greyscale images have been interpolated and selectively filtered, using Geoplot 3 (Geoscan Research) software 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.

Presentation

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 shows the extent of the survey areas together with the processed data at a scale of 1:3000. Figure 3 displays an overall interpretation of the site, at a scale of 1:3000 and the location of the trenches. Detailed data plots ('raw' and processed) and interpretative figures are presented at a scale of 1:1000 in Figures 4 to 13 inclusive.

Further information on magnetic survey and characterisation and interpretation of anomaly types are given in Appendix 1. Appendix 2 describes the composition and location of the site archive and Appendix 3 reproduces the OASIS entry.

The survey methodology, report and any recommendations comply with the Project Design (Richardson 2015) and 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).

Disclaimers

The figures in this report have been produced following analysis of the data in 'raw' and 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.

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.

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

Trial trenching

The overall aim of the evaluation was to provide information on the presence or absence and the extent, character, date, depth of burial and degree of survival of any archaeological features or deposits which may be present within the PDA (Richardson 2015b). The results of the trial trenching, in conjunction with the geophysical survey results, will be used to inform the level and type of mitigation work that might be required to ensure that the archaeological resource is adequately recorded before extraction.

To achieve this aim, a total of 30 trenches were excavated, 28 of which measured 50m x 2m, with one measuring 25m x 2m and a further trench measuring 31m x 2m. Ten trenches were placed to investigate geophysical anomalies with the remainder investigating apparently blank areas of the site. Excavation of the trenches was carried out using a mechanical excavator equipped with a toothless ditching bucket until either the top of the first archaeological horizon or undisturbed natural was reached. The resulting surface was inspected for archaeological remains. Linear features were excavated in slots at least 1m in length in order to investigate their depth and profile and to recover finds, whilst discreet features were 50% sampled.

A full written, drawn and photographic (35mm monochrome and digital) record of all material revealed during the course of the work was made. The trench locations were set out using GPS survey equipment with hand drawn trench plans and sections produced at a suitable scale and tied to the Ordnance Survey National Grid. All sections, plans and elevations included spot-heights related to Ordnance Datum in metres as correct to two decimal places.

All artefacts recovered were retained and removed from the site for assessment (with the exception of modern items which were noted and discarded). No suitable soil samples were available.

An inventory of the primary archive is presented in Appendix 4, and a concordance of finds and samples by context, is presented in Appendix 5.

4 Results

Geophysical survey

The geophysical survey identified ferrous anomalies, geological anomalies and agricultural anomalies (see Figures 4-13 inclusive). Those relating to ferrous and geological anomalies are described first below. Those relating to agricultural anomalies are described next, and then referred to in conjunction with the results of the trial trenching when these anomalies were tested by excavation.

Ferrous anomalies

Ferrous responses, either as individual ‘spike’ anomalies or more extensive areas of magnetic disturbance, are typically caused by modern ferrous (magnetic) debris, either on the ground surface or in the plough-soil, or are due to the proximity of magnetic material in field boundaries, buildings or other above ground features. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as 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 to suggest anything other than a random background scatter of ferrous debris in the plough-soil.

There are concentrated areas of magnetic disturbance which largely correlate with the location of former field boundaries. These survey results are indicative of disturbance caused by their removal.

Geological anomalies

Throughout the survey area discrete anomalies, characterised as localised areas of enhanced magnetic response. These largely occur at the terminals of former field boundaries and relate to bedrock and geological material being disturbed and brought to surface.

Agricultural anomalies

There is evidence of former field boundaries in the survey area (A-E, Fig. 3), supported by analysis of cartographic data, which the geophysical survey has largely detected. Not all former field boundaries were detected by the magnetometer survey, however, in part due to their total removal, being masked by magnetic disturbance, and the nature of the soils and geology of the survey area.

Archaeological trial trenching

The results from the trial trenching are summarised in Table 1 and final trench locations are shown in Fig. 3 in relation to geophysical anomalies. Ground cover was primarily crop stubble after a recent harvest apart from the southernmost extent of the field which was too waterlogged and marshy for cultivation. Due to health and safety concerns, Trenches 21, 22, 23 and 25 were moved from their original locations to avoid working under an overhead cable, running parallel with Newington Road, at the northern end of the site. Trench 26 was divided into two smaller trenches for the same reason.

A dark brown silty-sand topsoil was encountered across the entire site and measuring around 0.30m to 0.40m in depth. In the low-lying areas of Trenches 15, 16, 17, 18, 27 and 30 and the eastern ends of Trenches 22, 28 and 29 a dark brown, desiccated peat subsoil was encountered, with a depth of no more than 0.15m. Beneath this, the natural superficial geology was encountered, consisting of light orange and grey sand. Several trenches contained remains of tree roots in irregularly shaped patches which were concentrated and clearest in the areas where peat was found. These were test-excavated and proved to be negative as archaeological features.

Trench 2 was excavated on a southwards slope into a low-lying marshy area. Beyond the cultivated area the sand sloped away steeply southwards, possibly marking a now relict riverbank, with peat deposits becoming increasingly thicker. Excavation was halted at 1m in depth due to health and safety concerns with the base of the peat layer not exposed in all but the north-eastern extent of the trench. The peat contained a large number of tree roots and several large sections of branch and tree trunk measuring up to 2.5m in length and 0.50m in diameter. The trees are probably the remains of a prehistoric forest such as those seen elsewhere locally (Josephs 2015), but no waterlogged archaeological features or worked timber was seen during the excavation. Trench 2 quickly filled with water and as a result Trench 1 was also abandoned following consultation with Andrew Josephs.

Of the 29 trenches excavated, ten contained archaeological features which were cut into the natural and were sealed by topsoil and/or subsoil. These trenches were targeting clear geophysical linear anomalies and are discussed in detail below. The remainder of the trenches were placed in apparently blank areas of the site and these confirmed the lack of archaeological features and deposits in these areas.

Table 1. Summary of results by trench

Trench No.	Dimensions	Total depth	Observations
1	50m x 2m	N/A	Not excavated
2	50m x 2m	1.00m (max)	No archaeological remains present. Plate 1
3	50m x 2m	0.30m	Trench targeting a linear geophysical anomaly (A): archaeological remains present, see below. Plate 2
4	50m x 2m	0.40m	No archaeological remains present
5	50m x 2m	0.45m	No archaeological remains present
6	50m x 2m	0.40m	Trench targeting a linear geophysical anomaly (A): archaeological remains present, see below
7	50m x 2m	0.30m	Trench targeting a linear geophysical anomaly (B): archaeological remains present, see below
8	50m x 2m	0.40m	No archaeological remains present
9	50m x 2m	0.30m	No archaeological remains present
10	50m x 2m	0.35m	No archaeological remains present
11	50m x 2m	0.50m	No archaeological remains present
12	50m x 2m	0.35m	No archaeological remains present
13	50m x 2m	0.30m	No archaeological remains present
14	50m x 2m	0.30m	No archaeological remains present
15	50m x 2m	0.45m	No archaeological remains present
16	50m x 2m	0.45m	No archaeological remains present

Trench No.	Dimensions	Total depth	Observations
17	50m x 2m	0.30m	No archaeological remains present
18	50m x 2m	0.30m	No archaeological remains present
19	50m x 2m	0.35m	Trench targeting a linear geophysical anomaly (C): archaeological remains present, see below
20	50m x 2m	0.30m	Trench targeting a linear geophysical anomaly (C): archaeological remains present, see below
21	50m x 2m	0.30m	No archaeological remains present
22	50m x 2m	0.45m	Trench targeting a linear geophysical anomaly (D): archaeological remains present, see below
23	50m x 2m	0.35m	Trench targeting a linear geophysical anomaly (D): archaeological remains present, see below. Plate 3
24	50m x 2m	0.40m	Trench targeting a linear geophysical anomaly (D): archaeological remains present, see below
25	50m x 2m	0.30m	No archaeological remains present
26a	31m x 2m	0.35m	Trench targeting a linear geophysical anomaly (E): no archaeological remains present, see below
26b	25m x 2m	0.30m	No archaeological remains present
27	50m x 2m	0.30m	No archaeological remains present
28	50m x 2m	0.40m	Trench targeting a linear geophysical anomaly (D): archaeological remains present, see below. Plate 4
29	50m x 2m	0.35m	Trench targeting a linear geophysical anomaly (D): archaeological remains present, see below
30	50m x 2m	0.40m	No archaeological remains present

Trench 3 (Fig. 13, Plate 2)

A large ditch [305] ran roughly north to south across the centre of the trench, identified as an anomaly (A) during the geophysical survey. It measured 3.08m wide, but its full depth was not determined due to excavation stopping at a depth of *c.* 1.20m. A series of four separate fills were identified, each containing modern and post-medieval material such as brick or tile and land-drain fragments. The fills were disordered and appear to represent a sudden, probably recent, backfilling of the feature and are probably largely contemporary rather than distinct stratigraphic events. The feature was interpreted as a modern field boundary, probably backfilled in the recent past to combine two agricultural fields into one larger area.

Trench 6 (Fig. 14)

Ditch [604] ran north to south 14m from the south-western end of the trench. The feature was seen as the same geophysical anomaly (A) as ditch [305]. The feature had a width of 2.18m and a depth of 0.63m and contained a similar sequence of recently backfilled deposits as seen in ditch [305]. A small gully [606] was also seen extending for 8m, on an east to west alignment, across the north-eastern end of the trench. It measured 0.55m wide and 0.12m deep and contained a single dark brown silty-sand fill (605), but no finds.

Trench 7 (Fig. 15)

A ditch [701] ran south-west to north-east across the centre of the trench, around 25m from its north-western end. This appears to be the cause of a geophysical anomaly (B), and is probably a recent field boundary. The ditch measured 2.30m in width and 0.75m in depth and was filled with a single mottled mid-orangey or yellowish grey silty-sand (702). Plastic sheeting was seen in the base of the ditch fill indicating recent backfilling, as seen in Trenches 3 and 6.

Trench 19 (Fig. 16)

A linear feature [1902] ran south-east to north-west 16m from the north-eastern end of the trench which was also identified during the geophysical survey as an anomaly (C). It measured 1.04m wide and 0.19m deep. It contained a single mid-brown silty-sand fill (1901) with a single sherd of early modern creamware pottery and a residual flint blade.

Trench 20 (Fig. 17)

The geophysics indicates that the anomaly (C) recorded as ditch [1902] in Trench 19 should extend north-west to cross the north-eastern end of the trench, albeit as a weaker magnetic anomaly. A single linear feature [2002] was found to run across the centre of the trench but this is probably too far to the south-west to be the cause of the anomaly but no other archaeological features were identified in the trench. The feature was measured at around 1.2m in width and 0.10m and had a single mid-brownish-grey silty-sand fill (2001) with no finds. It was poorly defined and may well be a natural variation or disturbance within the sand.

Trenches 22, 23 and 24 (Figs 18-20, Plate 3)

A clear linear geophysical anomaly (D) ran south-west to north-east through Trench 29, 28 and 22 before turning north-west and running across Trench 23 and 24. The feature was generally very poorly defined and it was often unclear if it was a cut feature or rooted disturbance along a previously hedged field boundary. The strong magnetic response for such an indefinite feature was unexpected but could be explained by iron materials, possibly fence-posts lying in the topsoil along the field boundary.

In Trench 22, this feature was recorded as [2204] and was located 17.5m from its north-western end and was filled with light greyish-brown or brownish-grey silty-sand with no finds. It measured 1.62m wide and around 0.15m in depth with a poorly defined, diffuse edge. In Trench 23 it was recorded as feature [2302] and measured 0.85m wide and around 0.10m deep and was filled with a mid-brownish-grey silty-sand fill (2301). In Trench 24 the same feature [2403] measured 1.64m wide and 0.20m deep with a light greyish-brown fill (2403). Its south-western edge had been disturbed by a number of deep plough scars.

Trench 28 (Fig. 21, Plate 4)

The linear geophysical anomaly (D) identified in Trenches 22-24 above was identified crossing Trench 28, but no trace of it was found on excavation. Instead a thin lens of dark greyish-brown material (2801) was found 13m from the western end of the trench. It formed a linear shape running south to north across the trench 1.60m wide. On excavation it was found to have a depth of 0.10m and contained metallic slag. Similar material was seen in section downslope to the east, perhaps indicating that the deposit had been disturbed by ploughing and had been partially redeposited downslope. In was unclear if the deposit had been contained within a cut.

A second putative linear feature [2803], aligned south-east to north-west, ran for 5m across the eastern end of the trench, with a width of 0.72m and a depth of 0.08m. Its dark blackish-grey silty-sand fill (2802) was similar to that found in natural features nearby and it appeared to be sealed by the peat subsoil. It may represent a natural feature, although an archaeological origin cannot be entirely discounted.

Trench 29

A linear feature [2902], again appearing to relate to the geophysical anomaly (D) discussed above was seen, but once again was difficult to discern during excavation. It was found running across the trench 19m from its north-western end and measured 1.68m wide and 0.14m deep and had a single mid-greyish-brown silty-sand fill (2901). A number of fragments of animal bone (all cattle tooth fragments) were found in the fill.

5 Artefact Record

Flint by I.P. Brooks

A single flint artefact was recovered from fill (1901) of ditch [1902]: the central section of a broken blade 30.6mm long, 17.4mm wide and 5.6mm thick. Both the proximal and distal ends of the artefact have been deliberately removed, but there are no further signs of modification neither by retouching nor by use. Although essentially undiagnostic, the size of the original blade may suggest a broadly Neolithic date for the artefact.

The flint used for this artefacts varies from moderate yellowish brown (10 YR 5/4) to dark yellowish orange (10 YR 6/6) in colour and is almost opaque. There are no natural flint resources within the immediate area of Newington Quarry. The nearest chalk outcrops are those of the Lincolnshire Wolds, but the flint within these deposits tends to be grey in colour, opaque and of relatively poor quality (Henson 1985, Brooks 1989). There are, however, a series of Devensian and pre-Ipswichian deposits, south of the Humber, which contain a range of flint resources including those similar to the flint used for the artefact. Further uncertainty also occurs as the gravels of the local river systems have recycled flint from all the possible sources. It is noticeable that Newington Quarry is only 500m from the river Idle and it is possible that the gravels associated with this river may be the source of the flint.

Industrial debris by G. McDonnell

A brief overview of the material classified as slag is provided here, followed by a detailed description and quantification. The significance of the material is discussed and recommendations made for further work. The assessment report follows the guidelines issued by English Heritage (Dungworth 2015, 13-14).

Methodology and Slag Classification

The slags were visually examined and the classification is based solely on morphology. The debris associated with metalworking, or submitted in the understanding that they are associated with metalworking, can be divided into three broad groups, residues diagnostic of a particular metallurgical process or non-diagnostic residues that may derived from any pyrotechnological process (McDonnell 2001). The diagnostic ferrous debris can be attributed to a particular ironworking process; these comprise ores and the ironworking slags, i.e. the macro, hand recovered smelting and smithing slags and the micro-residues such as hammerscale and slag fragments recovered from sieving programmes. The second group, are the diagnostic non-ferrous metalworking debris, e.g. crucibles and moulds. Thirdly, there are the non-diagnostic slags, which could have been generated by a number of different processes but show no diagnostic characteristic that can identify the process. In many cases the non-diagnostic residues, e.g. hearth or furnace lining, may be ascribed to a particular process through archaeological association. The residue classifications used in the report are defined below. The count and weight of each slag type present in each context was recorded.

Diagnostic Ferrous Slags and Residues

Smelting Slag - iron silicate slag generated by the smelting process, i.e. the extraction of the metal from the ore.

Furnace Slag - a fused mass of slag, charcoal fragments and other material including reacted furnace lining and partially reduced ore.

Non-Diagnostic Slags and Residues

Hearth or Furnace Lining - the clay lining of an industrial hearth, furnace or kiln that has a vitrified or slag-attacked face. It is not possible to distinguish between furnace and hearth lining.

Results

The slag recovered from the site derived from iron working, but lacks clear diagnostic characteristics that limits the interpretation. A fragment of hearth or furnace lining is present.

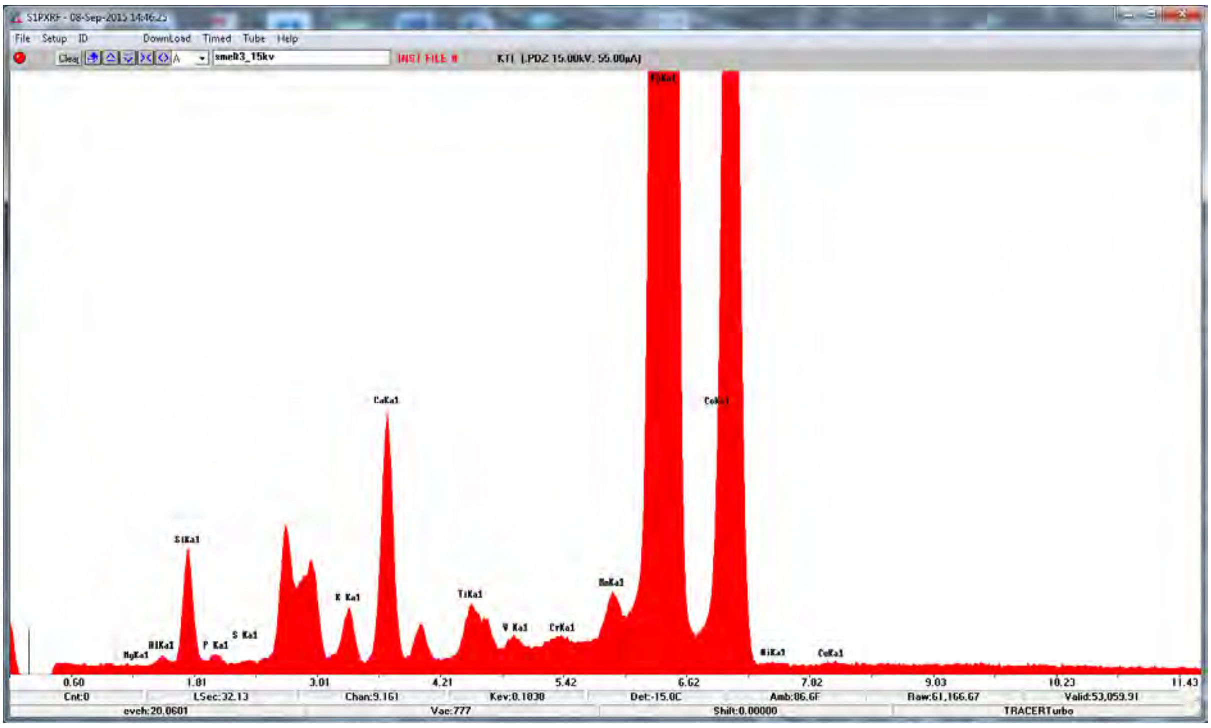
A small quantity of metalworking debris (0.8kg) was recovered from a thin lens of dark greyish-brown material (2801) in Trench 28. The assemblage included three types of material, *c*. 0.5kg of ironworking slag, provisionally identified as smelting slag, one piece of furnace slag (250g) and a single piece of hearth or furnace lining. The dust residue in the sample bag was trawled with a magnet and showed that it was rich in magnetic material. This was examined using a low power binocular microscope (magnification X20) and showed that no hammerscale was present. The magnetic fragments appeared either to be slag or magnetized clay lining or natural material. The smelting slag displayed flowed and liquid surfaces. The slag could be smithing slag, so three fragments were analysed by hand-held X-Ray Fluorescence (details of the method are provided below). The results show that the spectra are typical of ironworking slags, but also show a small, but significant manganese content (Graph 1). Manganese oxide is present at varying concentrations in many iron ores and is portioned into the slag by the iron smelting technologies used in antiquity. In most cases blacksmithing slags contain no or very little manganese.

Although the preliminary examination cannot confirm the slag as iron smelting, it is probable that it derives from that process. The fragment of hearth lining is thick (15mm) and vitrified/slag attacked through the full thickness. This would suggest furnace lining rather than hearth lining which tends to be thinner, and vitrification penetration less. The furnace slag is also indicative of furnace, such slags do not normally occur on smithing sites. If it is smelting slag, the morphology of the slag would indicate an Iron Age or Saxon date for the activity. The presence of magnetic material and the furnace lining fragment suggest that the slag derives from a nearby, albeit unexcavated, feature, because otherwise these materials would probably have been separated from the slag during re-deposition of the slag.

Recommendations

The magnetic geophysical survey should be examined in detail to assess the potential for ironworking features, and structures, and evidence for other slag deposits to be present. If further excavation is undertaken, costs for archaeometallurgical input should be included at the planning stage and during the excavation and post-excavation programme.

Graph 1. XRF spectrum generated from one of the smelting slag samples.



XRF Methodology

The instrument is a Bruker S1 Turbosdr hand-held XRF instrument operating at 15kV. A beam of x-rays is generated in the instrument and focussed on a fresh fractured surface of the sample, the x-rays interact with the elements present in the sample resulting in the emission of secondary x-rays which are characteristic (in terms of their energy and wavelength) of the elements present in the sample. The energy of the secondary x-rays are measured and a spectrum generated showing a level of background noise with peaks of the elements present superimposed on the background noise. Samples will analysed for 30 live seconds, the spectrum is stored and a normalised composition determined using a bespoke Bruker programme. All elements heavier than magnesium (Mg, Z=12), can be detected. The technique is non-destructive.

6 Environmental Record

No suitable environmental samples were recovered due to the recent date of the features investigated or the disturbed nature of the fills. Fragments of cattle teeth, however, were recovered from the fill (2901) of feature [2902], but no further analysis of them is required.

7 Conclusions

The geophysical survey detected agricultural anomalies relating to former field boundaries. The removal of these boundaries has also created areas of intense concentration of geological material which have been brought to the surface as a result. No archaeological anomalies were detected by the geophysical survey, and this was largely confirmed by the subsequent trial trenching.

The evaluation methodology used here has been successful in understanding the character, depth and survival of archaeological features within the constraints of a trench evaluation. Alongside the geophysical survey, the results of the trial trenching indicate that an extension to the quarry is unlikely to have a significant impact on any surviving archaeological remains. The features investigated to date have been interpreted as the remains of early modern field boundaries, and certainly the features representing anomalies A, B, D and probably C reflect field boundaries shown on Ordnance Survey mapping from 1948.

One deposit (2801) from Trench 28 contained industrial debris relating to smelting activity of either Iron Age or Saxon date. Whether this was contained within a cut, such as a hearth or furnace however, could not be determined within the trench limits. It is possible that the site of a furnace lies beyond the trench and only the debris dispersed by later activity has been recovered here.

Overall, the archaeological potential of the site is considered to be very low.

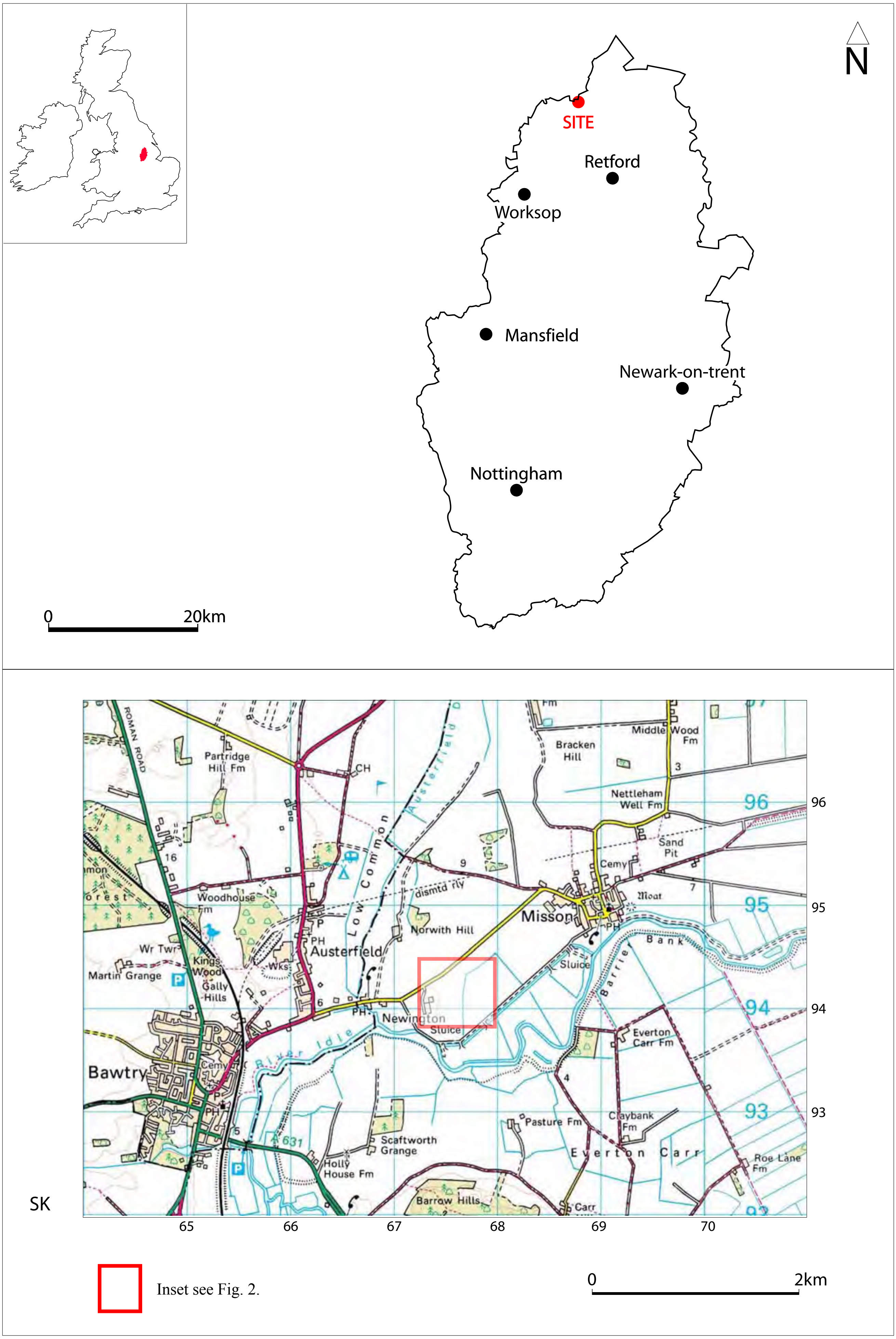


Fig. 1. Site location

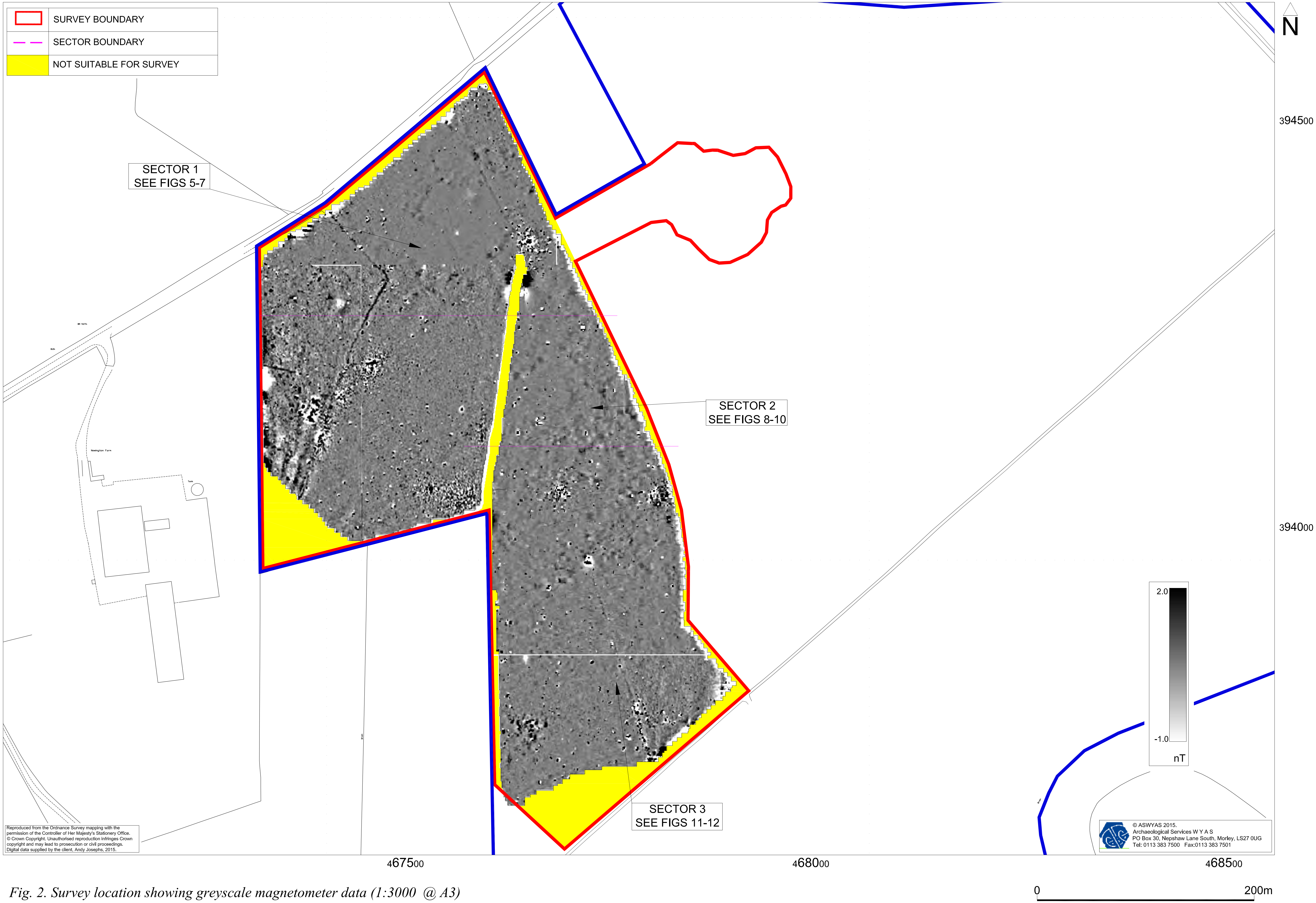


Fig. 2. Survey location showing greyscale magnetometer data (1:3000 @ A3)

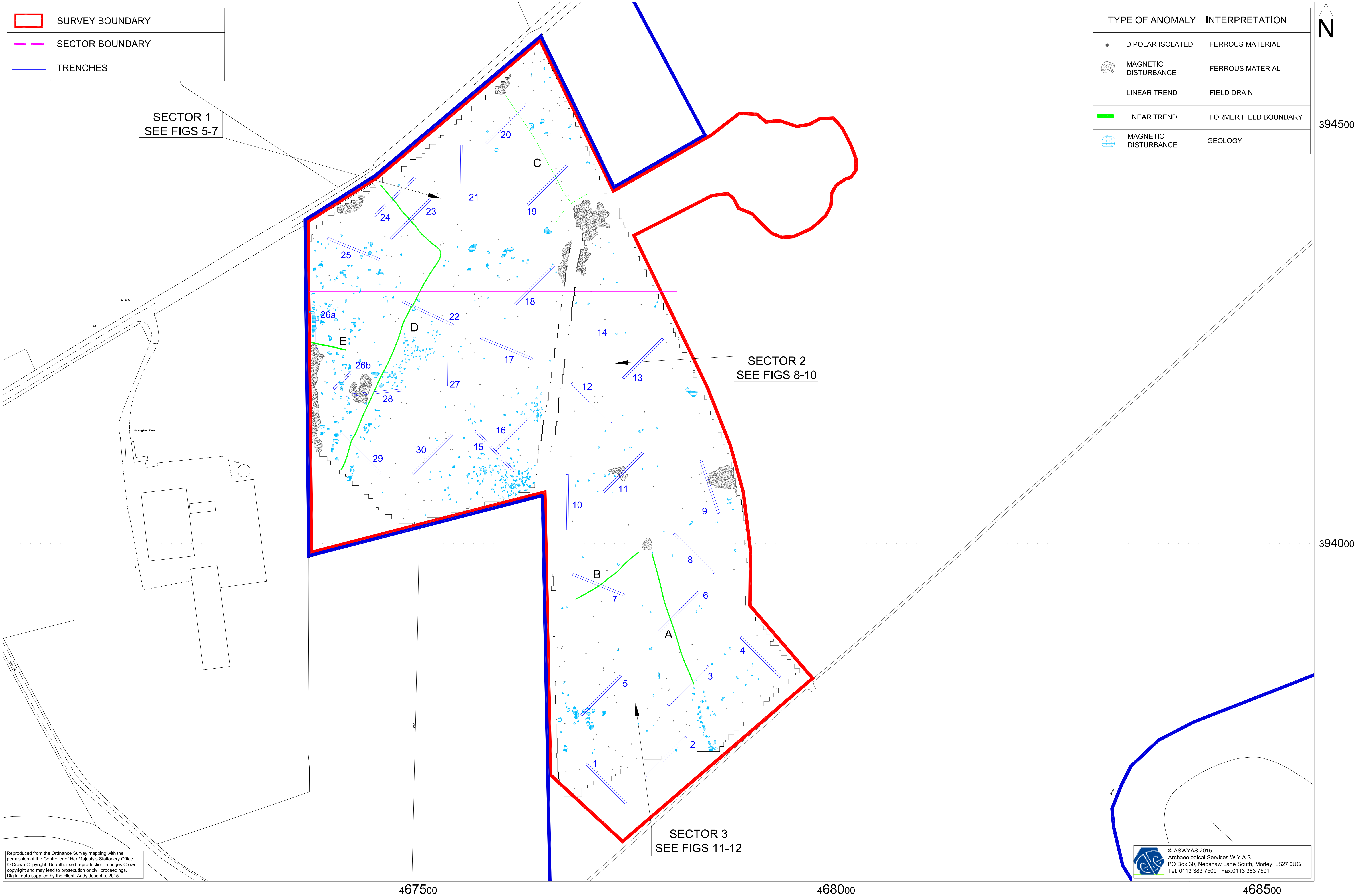


Fig. 3. Overall interpretation of magnetometer data with trench locations (1:3000 @ A3)

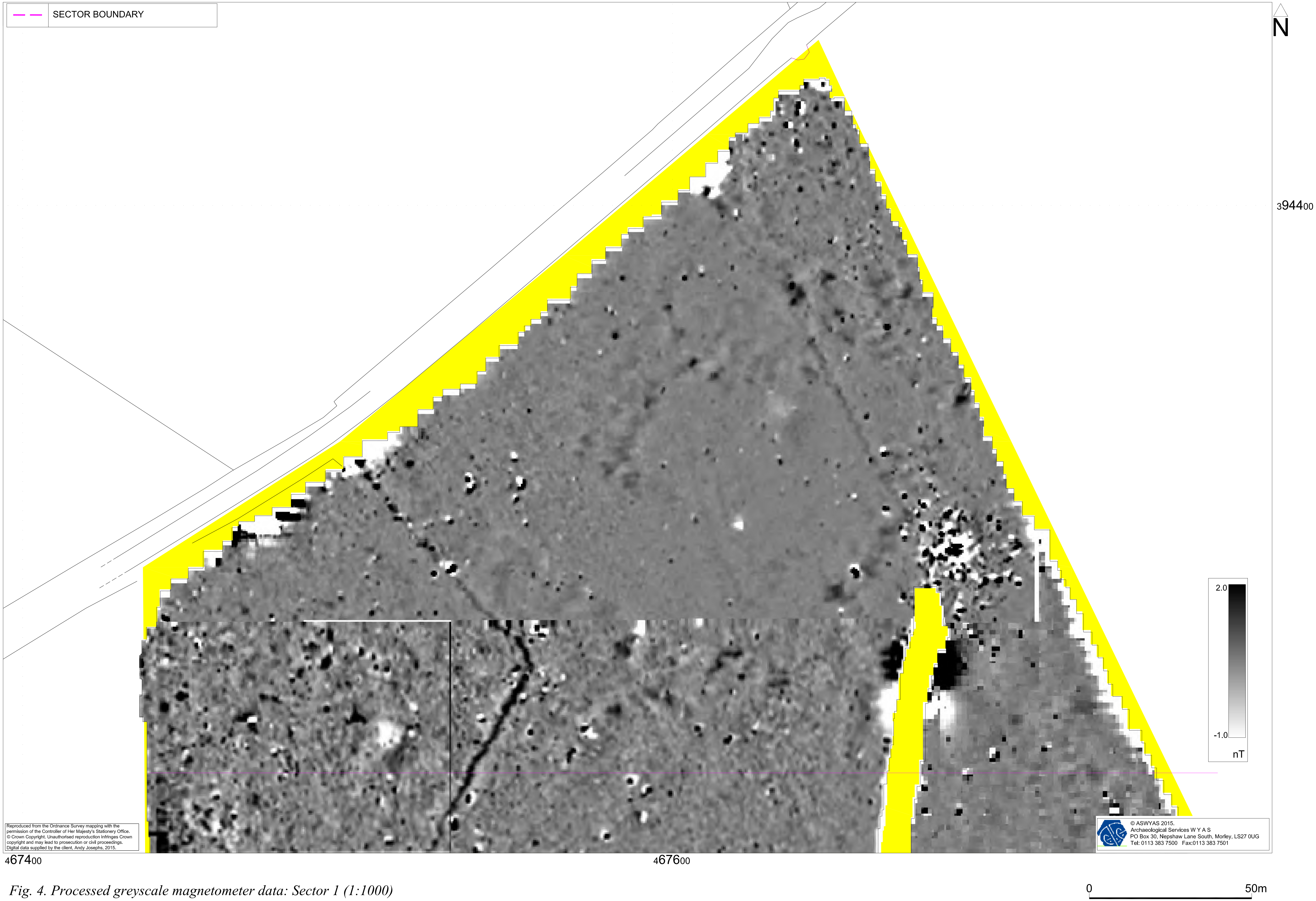


Fig. 4. Processed greyscale magnetometer data: Sector 1 (1:1000)

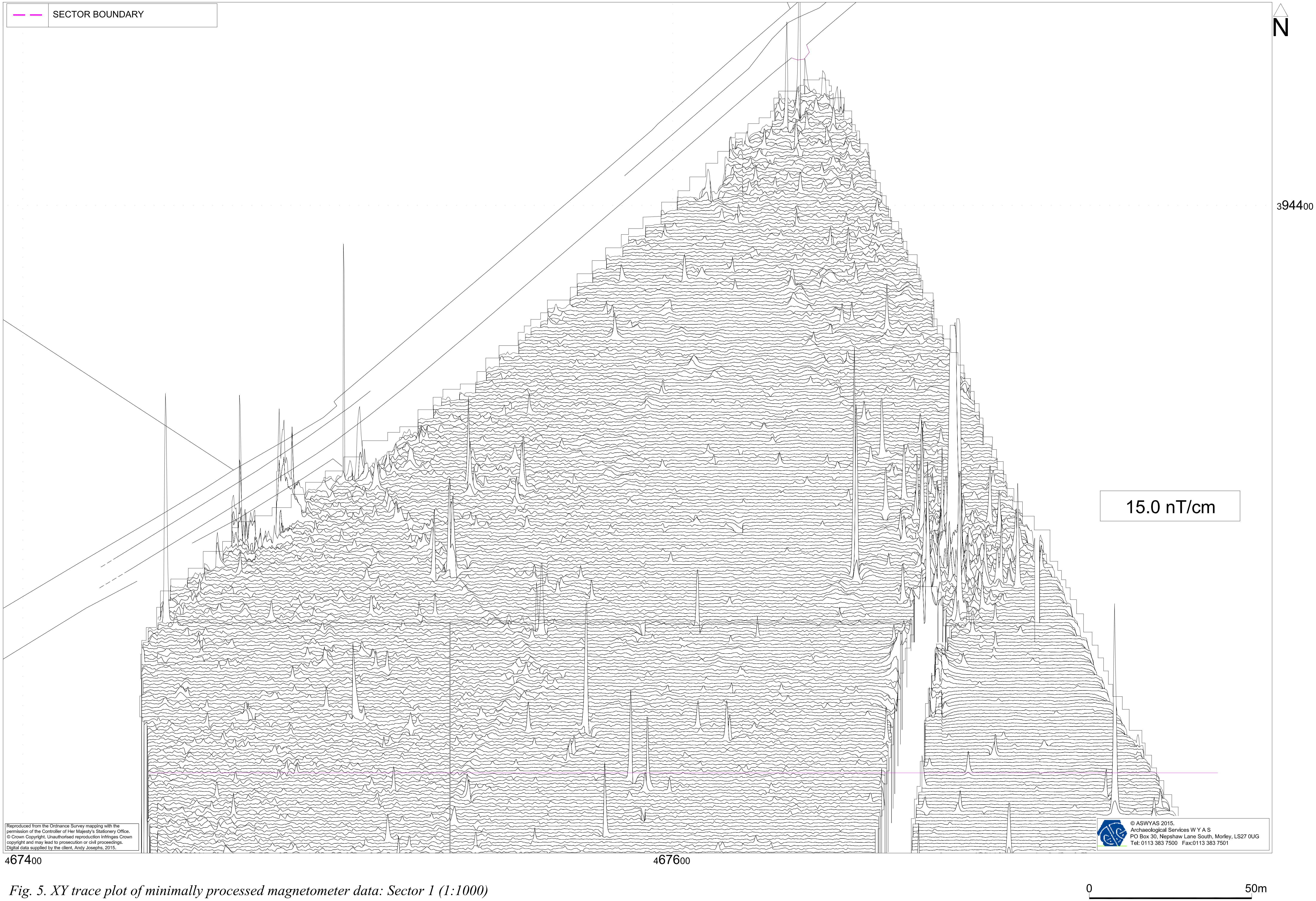


Fig. 5. XY trace plot of minimally processed magnetometer data: Sector 1 (1:1000)

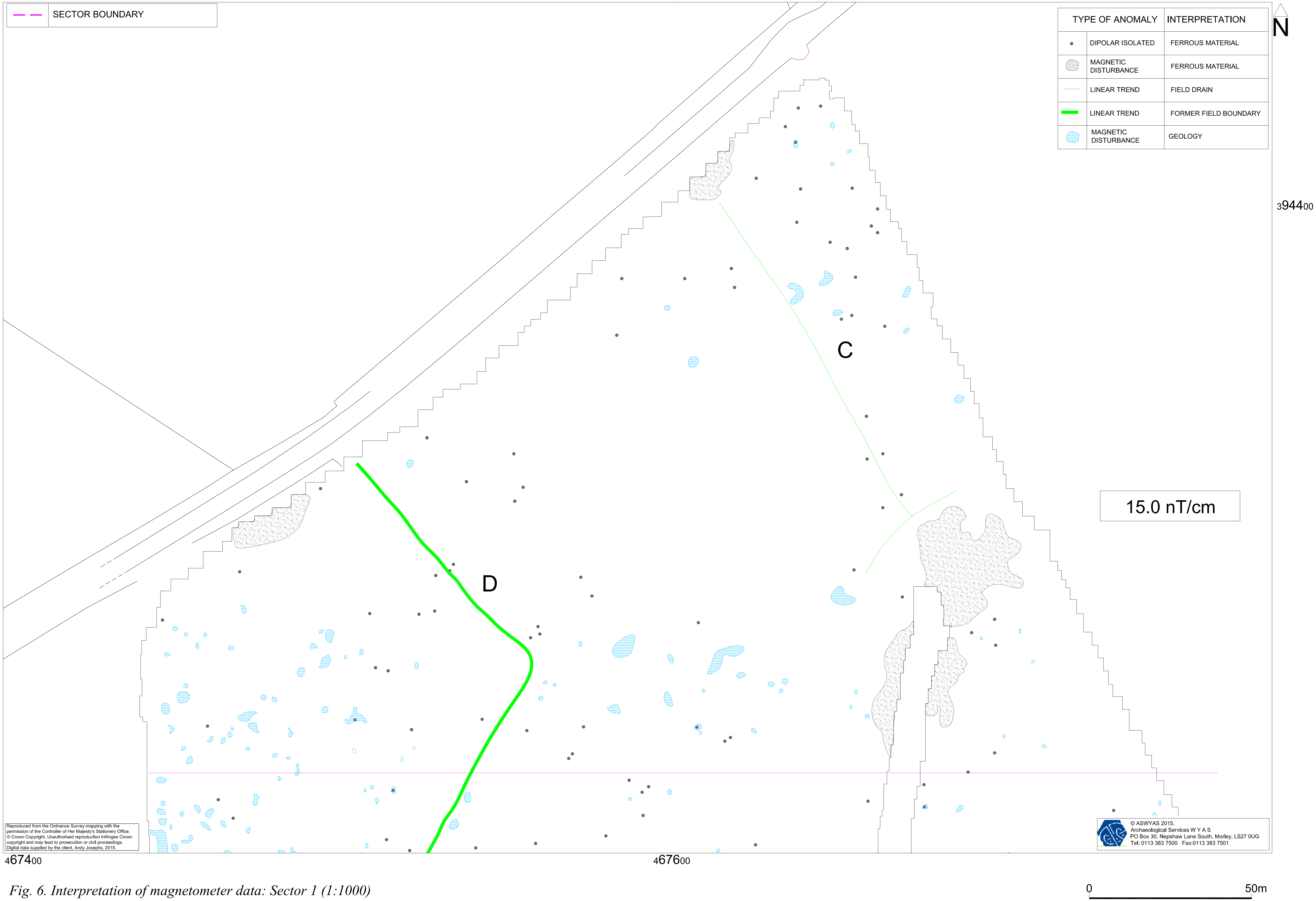
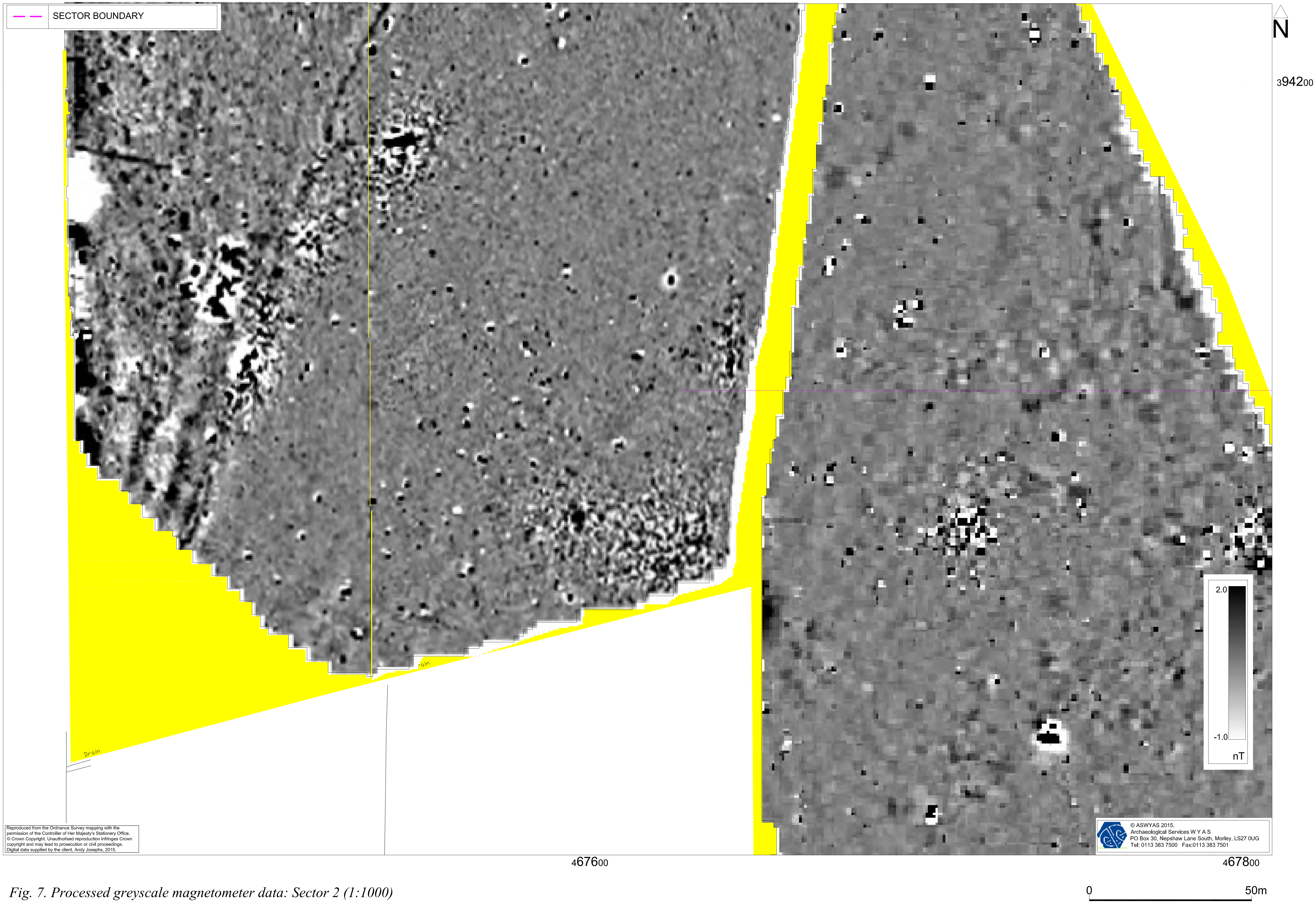


Fig. 6. Interpretation of magnetometer data: Sector 1 (1:1000)



Archaeological Services W Y A S
PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

Fig. 7. Processed greyscale magnetometer data: Sector 2 (1:1000)

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PO Box 30, Nepshaw Lane South, Morley, LS27 0UG
Tel: 0113 383 7500 Fax:0113 383 7501

Fig. 8. XY trace plot of minimally processed magnetometer data: Sector 2 (1:1000)

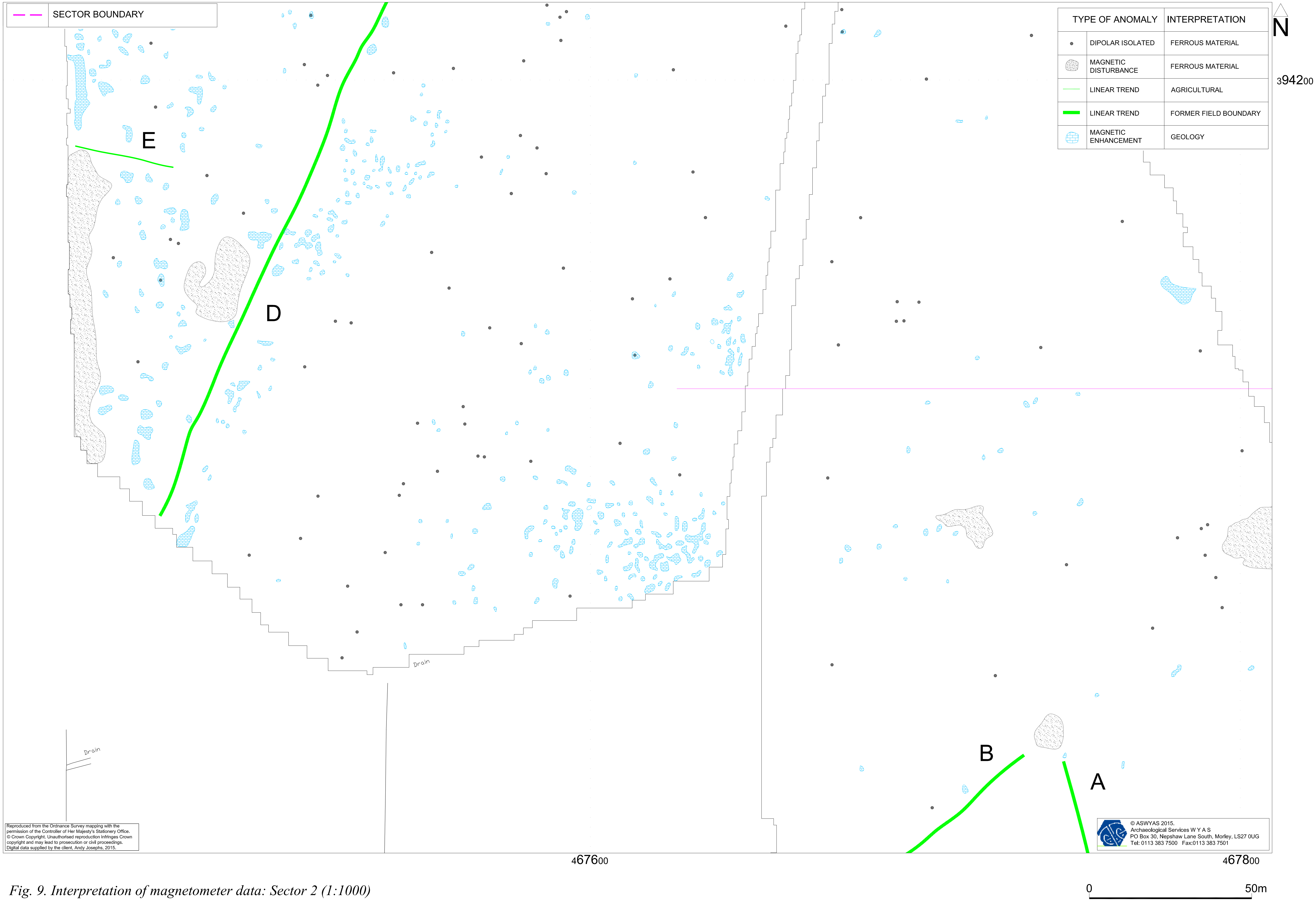

Fig. 9. Interpretation of magnetometer data: Sector 2 (1:1000)

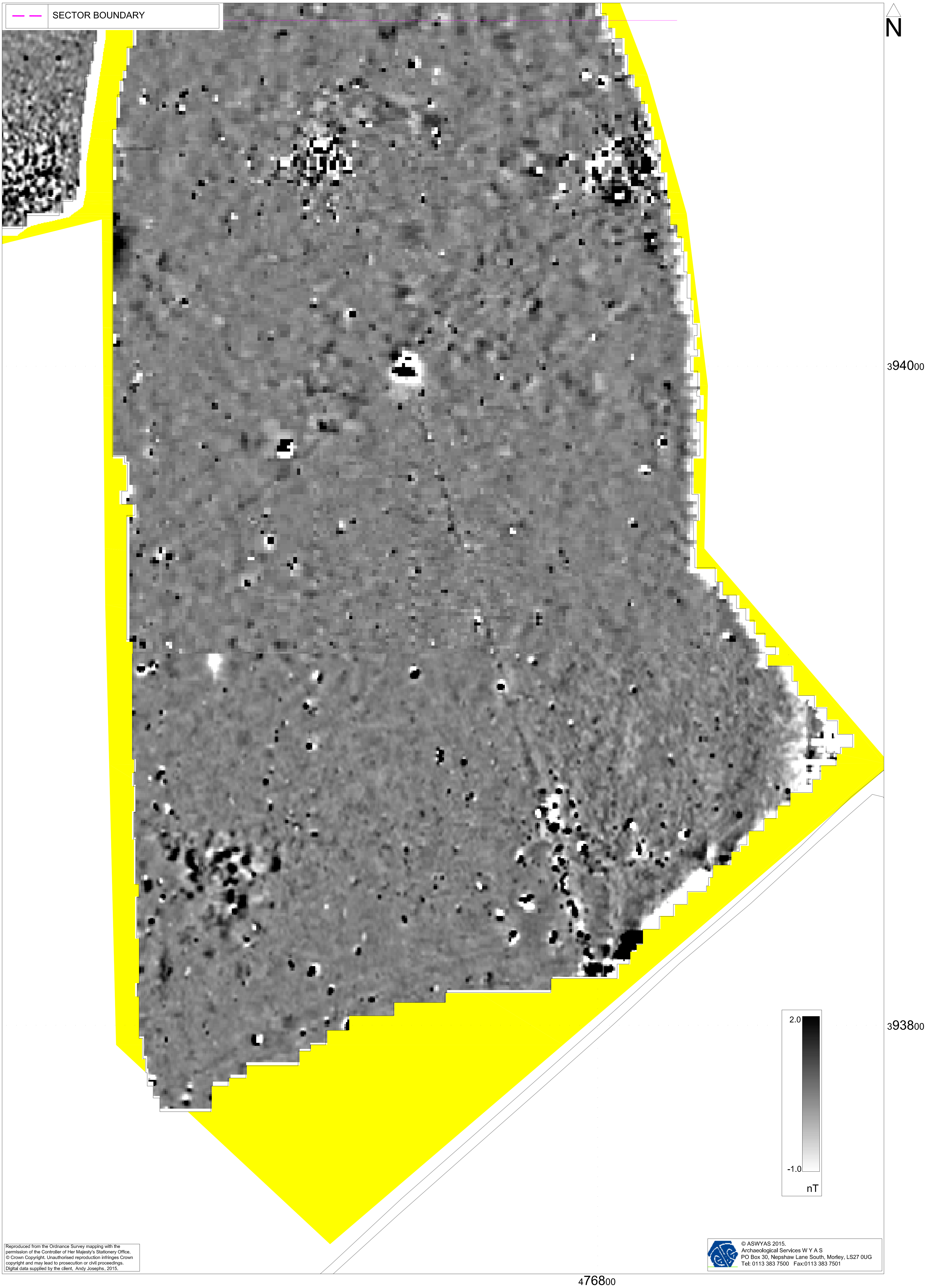

Fig. 10. Processed greyscale magnetometer data: Sector 3 (1:1000)

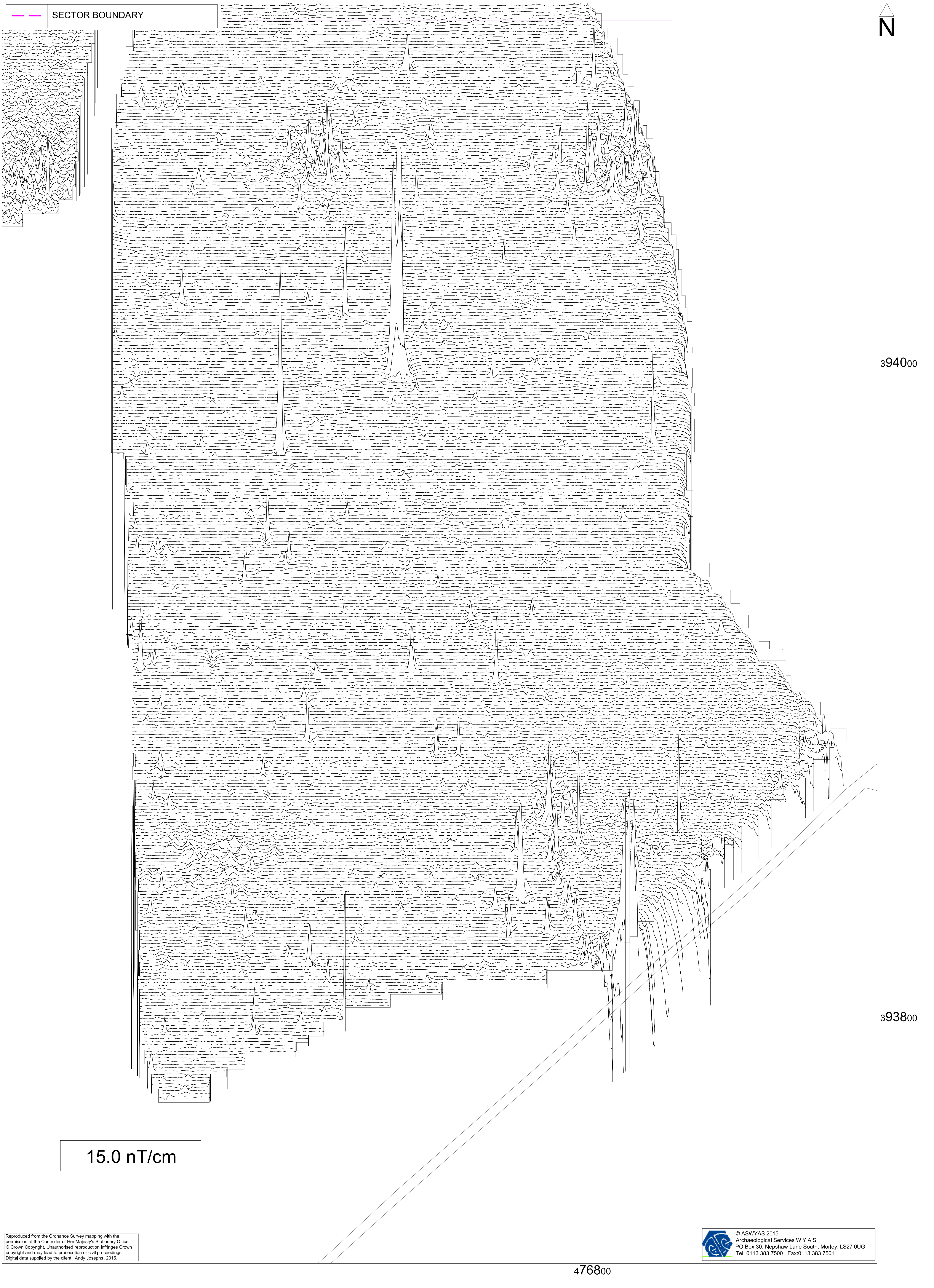

Fig. 11. XY trace plot of minimally processed magnetometer data: Sector 3 (1:1000)

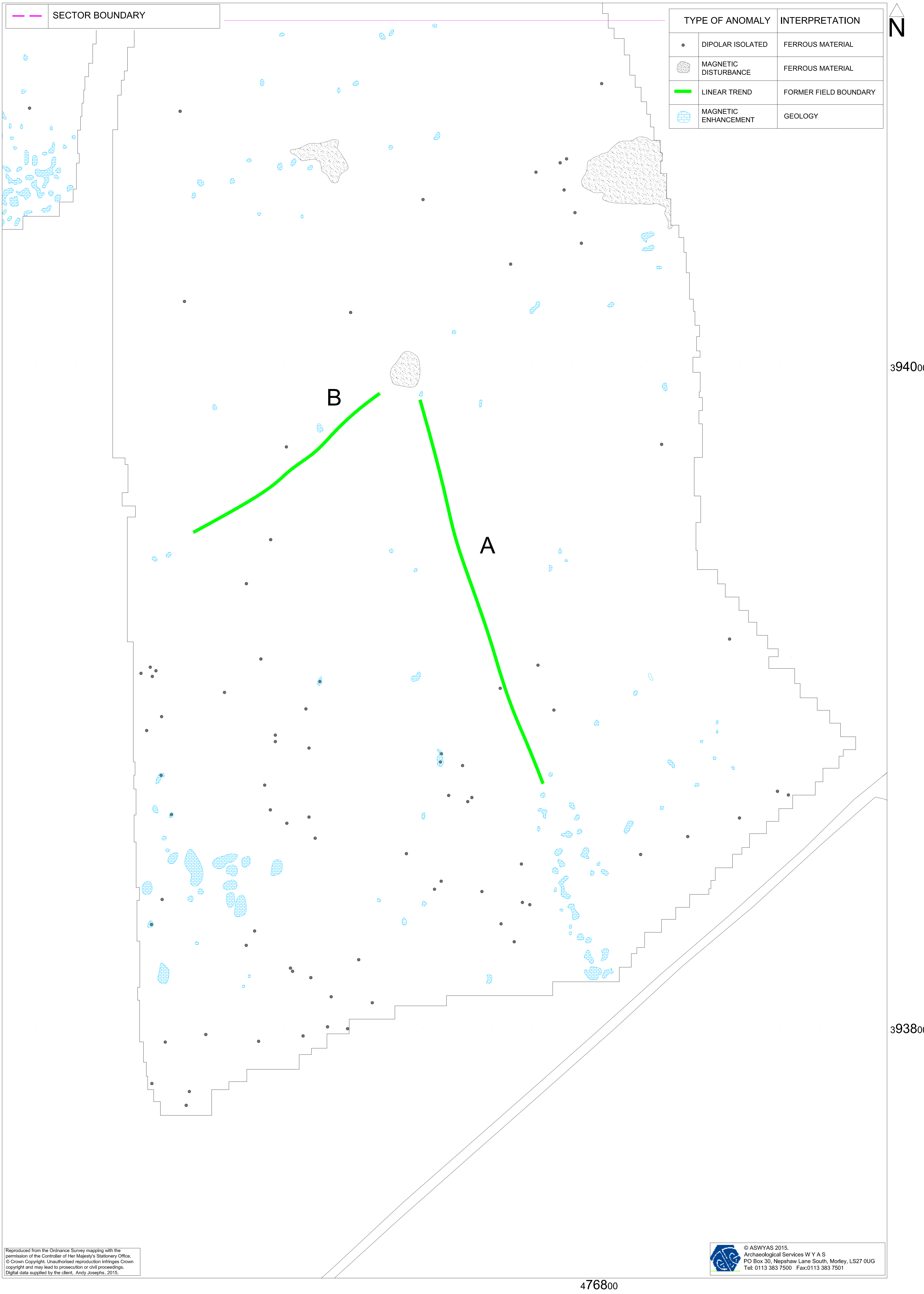

Fig. 12. Interpretation of magnetometer data: Sector 3 (1:1000)

Fig. 13. Trench 3 plan

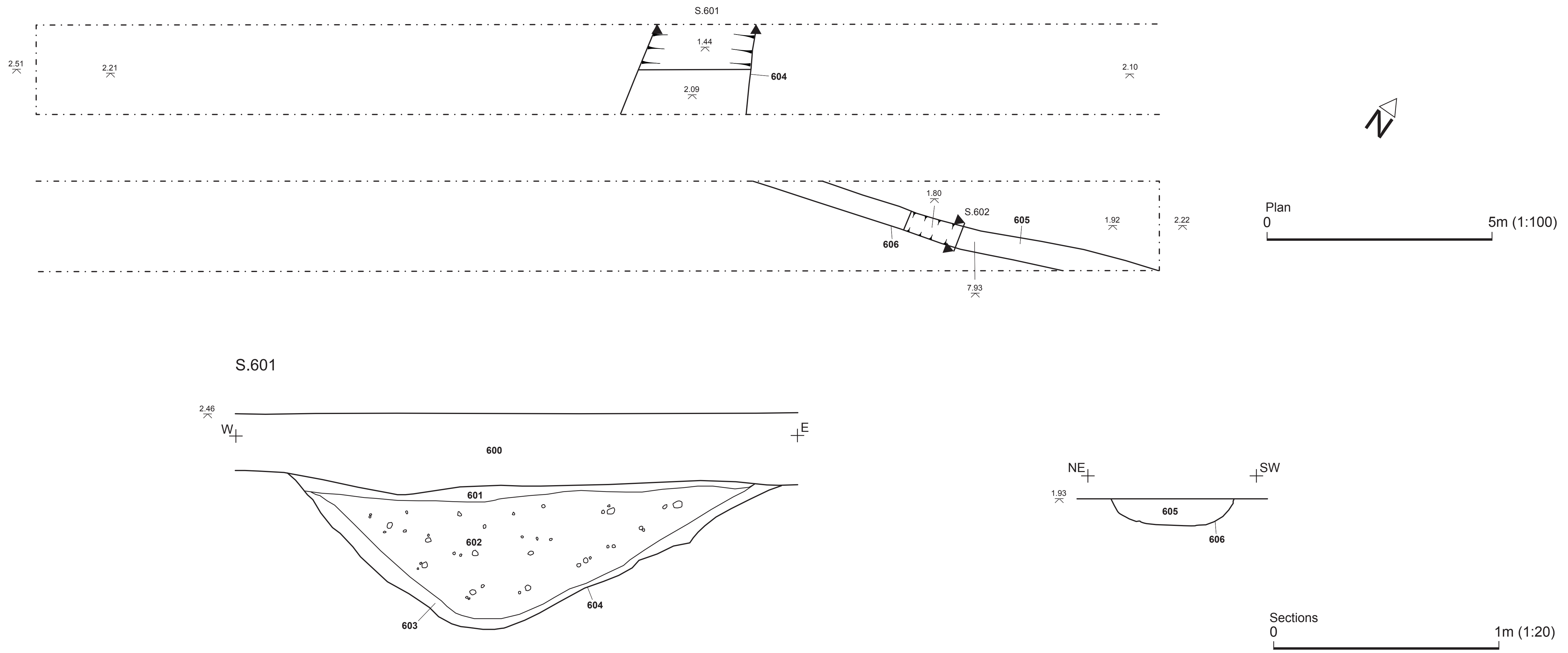

Fig. 14. Trench 6 plan and sections

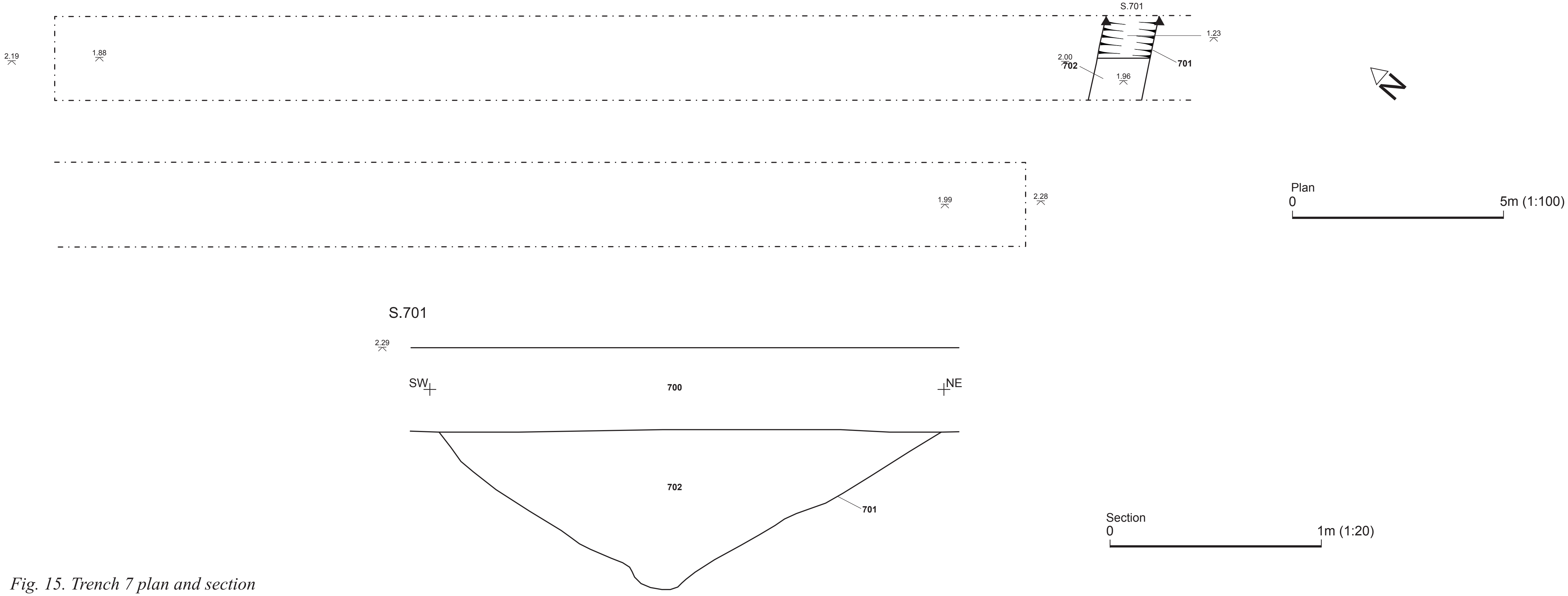

Fig. 15. Trench 7 plan and section

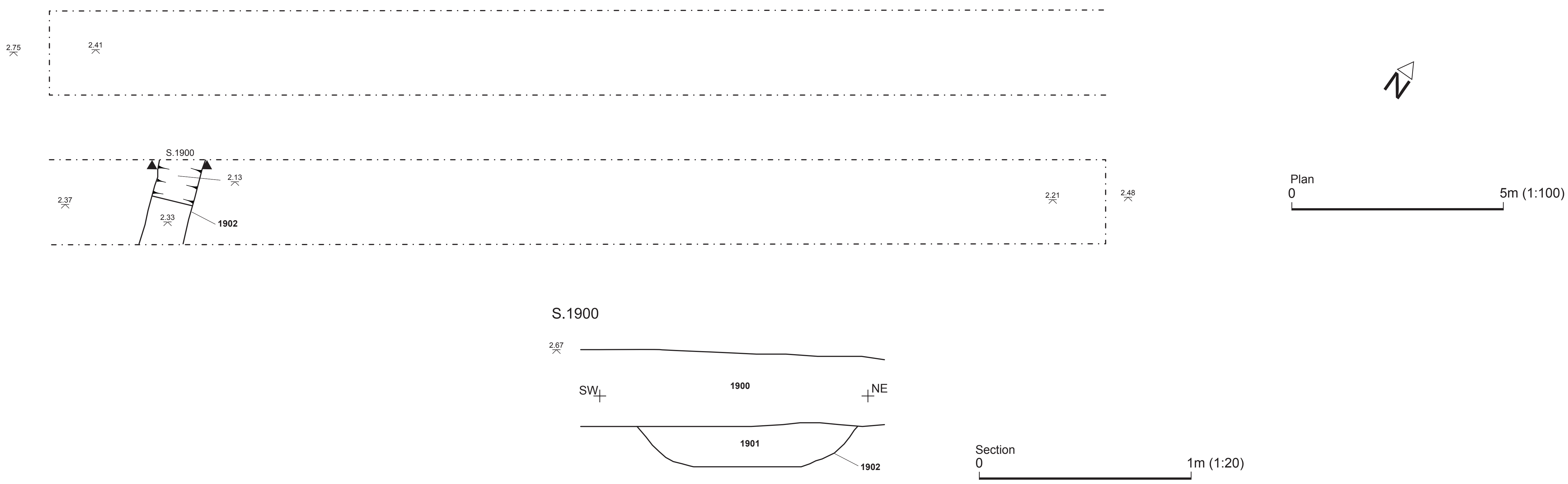

Fig. 16. Trench 19 plan and section

Fig. 17. Trench 20 plan

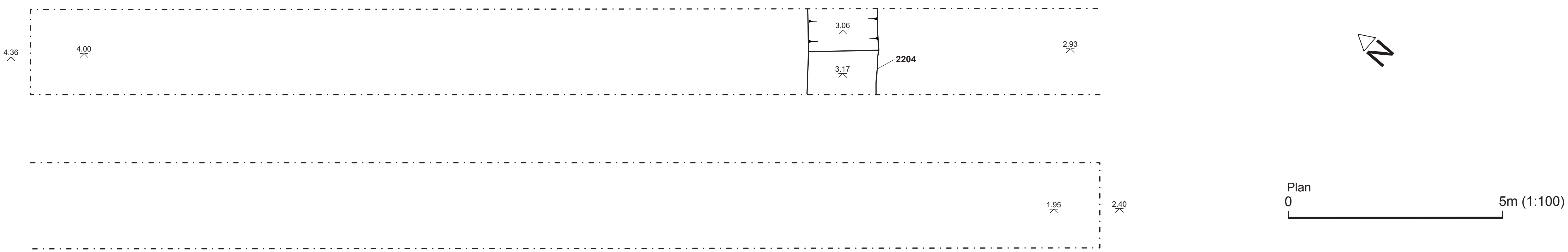

Fig. 18. Trench 22 plan

Fig. 19. Trench 23 plan

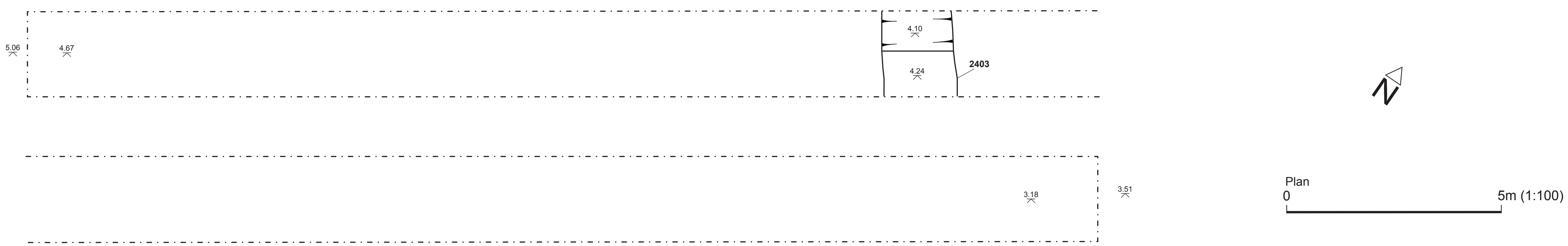

Fig. 20. Trench 24 plan

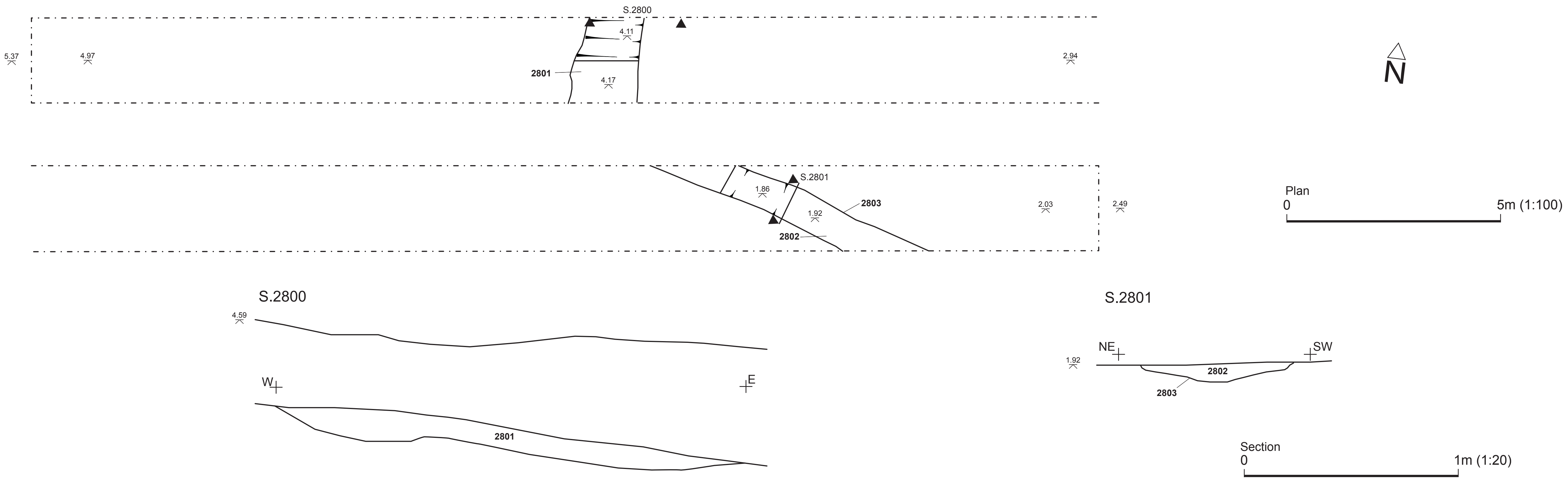

Fig. 21. Trench 28 plan and sections

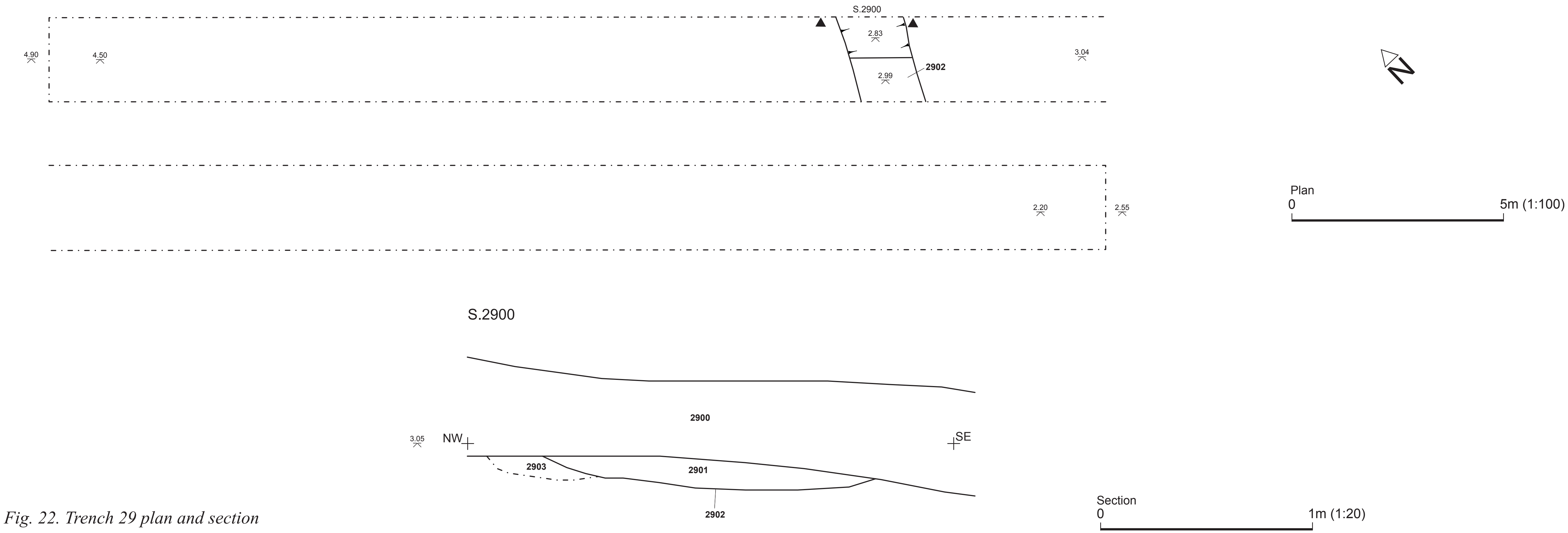

Fig. 22. Trench 29 plan and section


Plate 1. Trench 2, looking west


Plate 2. South-east facing section of ditch 305


Plate 3. South-east facing section of ditch 2302


Plate 4. North-west facing section of possible gully 2803

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. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

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 (sometimes only visible on an XY trace plot) 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.

Appendix 2: 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 West Yorkshire Historic Environment Record).

Appendix 3: OASIS Form

OASIS DATA COLLECTION FORM: England

List of Projects | Manage Projects | Search Projects | New project | Change your details | HER coverage | Change country | Log out

Printable version

OASIS ID: archaeol11-223053

Project details

Project name	Newington Quarry
Short description of the project	A geophysical (magnetometer) survey, covering approximately 15.4 hectares, was carried out on land at Newington Quarry, near Mission, Nottinghamshire, prior to the proposed extension of the quarry. This identified anomalies consistent with former agricultural practice, specifically former field boundaries. There followed a scheme of archaeological evaluation by trial trenching which targeted the geophysical anomalies as well as apparently blank areas. Both the geophysical survey and the subsequent trial trenching identified the archaeological potential of the site as low.
Project dates	Start: 12-08-2015 End: 24-08-2015
Previous/future work	No / Not known
Any associated project reference codes	NEW15 - Sitecode
Any associated project reference codes	6011 - Contracting Unit No.
Type of project	Recording project
Site status	None
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m
Monument type	FIELD BOUNDARY Post Medieval
Significant Finds	NONE None
Investigation type	"Geophysical Survey","Part Excavation"
Prompt	National Planning Policy Framework - NPPF
Solid geology (other)	Nottingham Castle Sandston Formation
Drift geology (other)	Altcar 2 association
Techniques	Magnetometry

Project location

Country	England
Site location	NOTTINGHAMSHIRE BASSETLAW MISSON Newingto Quarry
Study area	15.4 Hectares
Site coordinates	SK 67646 94081 53.438900421055 -0.9815480895 53 26 20 N 000 58 53 W Point
Height OD / Depth	Min: 3m Max: 4m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Consultant
Project design originator	Archaeological Services WYAS
Project director/manager	Richardson, J.
Project supervisor	Sykes, C.
Type of sponsor/funding body	Archaeological Consultancy
Name of sponsor/funding body	Andrew Josephs Associates

Project archives

Physical Archive recipient	Bassetlaw Museum
Physical Contents	"Animal Bones","Ceramics","Industrial","Worked stone/lithics"
Digital Archive recipient	N/A
Digital Contents	"none"
Digital Media available	"Geophysics"
Paper Archive recipient	Bassetlaw Museum
Paper Contents	"Animal Bones","Ceramics","Industrial","Worked stone/lithics"
Paper Media available	"Context sheet","Drawing","Notebook - Excavation',' Research',' General Notes","Photograph","Plan","Report","Section"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Newington Quarry, Misson, Nottinghamshire: Geophysical Survey and Archaeological Trial Trenching

Author(s)/Editor(s)	Goulding, R.
Author(s)/Editor(s)	Wells, M.
Author(s)/Editor(s)	Sykes, C.
Date	2015
Issuer or publisher	Archaeological Services WYAS
Place of issue or publication	Morley
Description	A4 Bound Report

Entered by	Zoe Horn (zhorn@aswyas.com)
Entered on	9 September 2015

OASIS:

Appendix 4: Inventory of primary archive

File	Description	Quantity
File 1	Trench record sheet	30
	Context register	10
	Context cards	31
	Levels sheet	3
	Digital photo record sheet	1
	Digital photo record sheet	2
	Photo record sheet (black and white)	1
	Finds register	1
	Permatrace sheets	9

Appendix 5: Concordance of contexts yielding artefacts or environmental remains

Context	Trench	Description	Artefacts
200	2	Topsoil	
201	2	Waterlogged peat	
202	2	Natural sand	
300	3	Topsoil	
301	3	Fill of ditch 305	
302	3	Fill of ditch 305	
303	3	Fill of ditch 305	
304	3	Fill of ditch 305	
305	3	Cut of ditch	
306	3	Natural sand	
400	4	Topsoil	
401	4	Natural sand	
500	5	Topsoil	
501	5	Natural sand	
600	6	Topsoil	
601	6	Fill of ditch 604	
602	6	Fill of ditch 604	
603	6	Fill of ditch 604	
604	6	Cut of ditch	
605	6	Fill of gully 606	
606	6	Cut of gully	
607	6	Natural Sand	
700	7	Topsoil	
701	7	Cut of ditch	
702	7	Dill of ditch 702	
703	7	Natural sand	
800	8	Topsoil	
801	8	Natural sand	

Context	Trench	Description	Artefacts
900	9	Topsoil	
901	9	Natural sand	
1000	10	Topsoil	
1001	10	Natural sand	
1100	11	Topsoil	
1101	11	Natural sand	
1200	12	Topsoil	
1201	12	Natural sand	
1300	13	Topsoil	
1301	13	Natural sand	
1400	14	Topsoil	
1401	14	Natural sand	
1500	15	Topsoil	
1501	15	Subsoil	
1502	15	Natural sand	
1600	16	Topsoil	
1601	16	Subsoil	
1602	16	Natural sand	
1700	17	Topsoil	
1701	17	Natural sand	
1800	18	Topsoil	
1801	18	Natural sand	
1900	19	Topsoil	
1901	19	Fill of ditch 1902	Post-medieval pottery (1), flint blade (1)
1902	19	Cut of ditch	
1903	19	Natural sand	
2000	20	Topsoil	
2001	20	Fill of ditch 2002	
2002	20	Cut of ditch	
2003	20	Natural	
2100	21	Topsoil	
2101	21	Natural sand	
2200	22	Topsoil	
2201	22	Fill of ditch 2204	
2202	22	Fill of ditch 2204	
2203	22	Natural sand	
2204	22	Cut of ditch	
2300	23	Topsoil	
2301	23	Fill of ditch 2302	
2302	23	Cut of ditch	
2303	23	Natural sand	
2400	24	Topsoil	
2401	24	Fill of ditch 2403	
2402	24	Fill of ditch 2403	
2403	24	Cut of ditch	
2404	24	Natural sand	

Context	Trench	Description	Artefacts
2500	25	Topsoil	
2501	25	Natural sand	
2600	26a	Topsoil	
2601	26a	Natural sand	
2602	26b	Topsoil	
2603	26b	Natural sand	
2700	27	Topsoil	
2701	27	Natural sand	
2800	28	Topsoil	
2801	28	Slag-rich deposit	Slag
2802	28	Fill of 2803	
2803	28	Cut of ditch	
2804	28	Desiccated peat subsoil	
2805	28	Natural sand	
2900	29	Topsoil	
2901	29	Fill of 2902	Animal bone (5)
2902	29	Cut of possible ditch	
2903	29	Natural sand	

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