



# Land at Goldthorpe Barnsley, South Yorkshire

Detailed Gradiometer Survey Report

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Unit R6  
Sheaf Bank Business Park  
Prospect Road  
Sheffield  
S2 3EN

[www.wessexarch.co.uk](http://www.wessexarch.co.uk)

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1 Newhall Street  
Birmingham  
B3 3NH

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Goldthorpe  
Barnsley  
S63 9PJ

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Project management by Tom Richardson  
Document compiled by Alastair Trace  
Contributions from Lydia Jones  
Graphics by Alastair Trace

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## Summary

A detailed gradiometer survey was conducted over land at (centred on NGR 444203 403510). The project was commissioned by RPS Consulting Services Ltd. with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features. This survey is in support of a planning application for an expansion of the commercial and industrial units located to the east.

The site comprises arable fields located 1 km west of Goldthorpe, 9.3 km to the east of Barnsley and 10 km north of Rotherham, covering an area of 98.8 ha. The geophysical survey was undertaken between 27 September 2022 – 28 September 2022 and 03 October 2022 – 06 October 2022. The detailed gradiometer survey has been successful in detecting anomalies of archaeological origin in the south and south-eastern portions of the site likely representative of a ditched field system. In addition to these, several weaker anomalies have been interpreted as possible archaeology and have the potential to relate to former field boundaries.

Across the southern half of the site the remains of a large field system has been recorded. Similar to other fields systems recorded in the surrounding area it is likely to be Iron Age/Romano-British in origin. Numerous additional anomalies have been identified across the site as possible archaeology. The majority of these are too weak or disturbed by increased magnetic disturbance to offer a confident interpretation. Most are likely ditches forming the remains of former field boundaries not recorded on first-edition OS mapping. It is also possible that they could equally relate to more modern agricultural or mining activity.

Evidence of historical cultivation has also been recorded in the form of ridge and furrow across the site. Often these are widely spaced and slightly curving, suggesting a medieval date. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on mid-19th-century OS mapping.

Several instances of increased magnetic response have been identified across the site. Some fields are dominated by an increased magnetic response, likely due to modern agricultural activity associated with fertilisation. Further disturbance has been identified across the northern areas expected to be the result of mining activity in the area. This has limited the effectiveness of the survey in these areas and some archaeological features might not be visible in the data.

The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drains, and modern services.

## Acknowledgements

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The fieldwork was undertaken by Andres Perez Arana, Jo Instone-Brewer, Jack Trueman, Amy Dunn and Davor Cakanic and Manasi Patil. The geophysical data was processed, interpreted, and reported on by Alastair Trace. The geophysical work was quality controlled by Tom Richardson. The project was managed on behalf of Wessex Archaeology by Tom Richardson.



# Land at Goldthorpe Rotherham, South Yorkshire

## Detailed Gradiometer Survey Report

### 1 INTRODUCTION

#### 1.1 Project background

1.1.1 Wessex Archaeology was commissioned by RPS Consulting Ltd. to carry out a geophysical survey at Goldthorpe, Barnsley, South Yorkshire (centred on NGR 444203 403510) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application for the expansion of commercial and industrial units located to the east.

#### 1.2 Scope of document

1.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

#### 1.3 The site

1.3.1 The site is located 1 km west of the village of Goldthorpe and 9.3 km east of Barnsley, in the county of South Yorkshire.

1.3.2 The survey comprises 98.8 ha of agricultural land, currently utilised for arable crops and tree plantation. The site is bounded by the A635 and arable fields to the north, arable fields, an industrial area, and residential housing to the east, Carr Head Lane and arable fields to the south, and further arable fields to the west.

1.3.3 The site is on a slight incline from 40 m above Ordnance Datum (aOD) at the southern boundary to 25 m aOD at the north-eastern edge, 28 m aOD at the northern edge, and 24 m aOD at the western edge.

1.3.4 Carr Dike runs north-east to south-west across the site. Various sets of overhead cables traverse the site.

1.3.5 The solid geology comprises Sandstone of Mexborough Rock in the north and south of the site with Mudstone, Siltstone, and Sandstone of the Pennine Middle Coal Measures Formation in the central section of the site. There are overlying superficial geological deposits of alluvium (clay, silt, sand, and gravel) across the site (BGS 2022).

1.3.6 The soils underlying the north and the narrow strip along the southern border of the site are likely to consist of the Cambrian stagnogley soils of the 713a (Bardsey) association. Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey. No soils are recorded in the southern portion of the site due to urban development.

### 2 ARCHAEOLOGICAL BACKGROUND

#### 2.1 Introduction

2.1.1 The following historical and archaeological background considers a 1 km study area of the site, using relevant publicly available online resources such as South Yorkshire Historic Environment Record (HER), the National Heritage List for England (NHLE), Heritage



Gateway, and the Archaeological Data Service (ADS), combined with the results of Wessex Archaeology's previous investigations of the area. This background is not exhaustive but is summarised from aspects of the above sources that are considered relevant to the interpretation of the geophysical survey data.

## **2.2 Summary of the archaeological resource**

- 2.2.1 There are no designated heritage assets within the site. There are seven Grade II listed post-medieval buildings within 1 km of the site. These are concentrated in the villages of Billingley, 500 m north of the site, and Bolton upon Dearne, 800 m east of the site. There are no other designated assets within 1 km of the site. The majority of the listed buildings are associated residential buildings and farmhouses dating from the 16th to the 19th century.
- 2.2.2 The earliest activity recorded within the site and the wider 1 km area early Iron Age. There is a wealth of activity relating to field systems including trackways, enclosures, and field boundaries dating to the early Iron Age to Romano-British period recorded within the study area. Within the site, itself are recorded cropmarks of field boundaries in the south and south-east (HER number 02687/01 & 00085/01) over LP\_013, and a semi-circular ditched enclosure in the west (HER number 00079/01) over LP\_012.
- 2.2.3 In the wider 1 km area there are 10 records relating to field systems including enclosures, trackways and field boundaries mainly detected via cropmarks. One has also been confirmed via trenching (HER number 04634) and another by geophysical survey (HER number 03032/01). In addition to field boundaries, a ring ditch is recorded 350 m to the north of the site (HER number 00086/01). These cropmarks probably form part of the regionally significant Iron Age to Romano-British field systems that are found throughout this area. These are characterised by rectangular fields with common boundaries along one axis, forming a brickwork pattern in plan. Embedded within these are enclosures - presumably for domestic and animal husbandry uses.
- 2.2.4 Two findspots are also recorded in the wider area with a beehive quern found 800 m to the north of the site (HER number 04298/01), and a bronze Roman bracelet from the 2nd – 3rd centuries found 350 m to the west of the site (HER number: 00593/01). The bracelet is decorated with indented dots and what appears to be a stylised snake's head at each end. It was found during open-cast coal mining in the 1950s and is now in the Barnsley Museums collection.
- 2.2.5 Located 700 m north of LP\_004, an Iron Age/Roman-British field system and probable roundhouse have been recorded as cropmarks on aerial photographs (Monument number 1571701) centred at SE 4424 0480. A series of ditched field boundaries form a rectilinear field system. Sat within one of the fields is a circular ditched feature approximately 12 m in diameter. It is likely to represent an unenclosed roundhouse but alternatively may represent a Bronze Age round barrow.
- 2.2.6 No early medieval or medieval activity is recorded within the site itself. Ridge and furrow has been identified via geophysical survey 560 m to the north-west (HER number 04105/01). 900 m to the south-east is the site of a now demolished timber-framed medieval building (HER number 01181/01).
- 2.2.7 There is a widespread post-medieval activity in the area, especially within the settlements of Billingley and Bolton-upon-Deerne where several of the post-medieval buildings are Grade II listed. Tithe maps (1837 – 1839) and Ordnance Survey (OS) mapping (1905) of the site show it divided into lots of small fields until around 1905. After this, the OS mapping



shows the removal of many of the field boundaries to form much larger fields. A post-medieval corn mill is recorded 1 km to the south of the site (HER number 04732). In the 1888 OS mapping, brickworks are recorded just outside the site's north-eastern border. By the 1945 – 1965 OS mapping, this is shown as disused.

- 2.2.8 Aerial photographs from 1948 – 1949 show open mine cast coal quarrying on the site. OS mapping does not however mention the area having been a quarry until 2006. OS mapping stops showing the area as fields (and shows a blank or just grassy open area) in the 1950 OS 1:25,000 mapping. By the 1967 OS mapping the area is again shown as fields with various drains running through them. The 1929 OS mapping also shows the area as fields, and the 1938 mapping shows fields but with an open area in the centre of the site, therefore indicating the coal quarry opened between 1929 – 1939 and operated until (at the latest) 1960-1964.
- 2.2.9 Various undated records are located within the wider 1 km area including a field system (HER number 04035/01) and linear cropmarks (HER number 04633) 660 m and 400 m to the north respectively. During excavation, various burials were discovered 630 m to the south-east of the site (HER number 02193/01).

### 2.3 Recent investigations in the immediate vicinity

- 2.3.1 South Yorkshire Archaeology Unit (1993) excavated 10 trenches 500 m north-east of LP\_013, to the west of Holy Grove Farm in an area of known cropmarks. These consist of a D-shaped enclosure, a 'brickwork' field pattern, and a drove way between two large ditches (HER number 04823). No dateable material nor evidence of human habitation was forthcoming. This was tentatively dated as Iron Age at the latest.
- 2.3.2 A gradiometer survey of a 9.2 ha site was undertaken by WYAS (1997) 1.6 km directly west of the study area at Bolton House Farm. The results of the survey included Iron Age/Romano-British features including drove ways, a square-shaped enclosure, and an associated field system.
- 2.3.3 Further works undertaken by WYAS in the form of a geophysical survey (2001) and resulting trenching evaluation (2003) at Goldthorpe Industrial Estate immediately to the east of the site established a ditched field system and associated features of Iron Age/Romano-British date. Originally identified via cropmarks, these features likely extend across a much wider area to the south and east. It is almost certain that they extend beyond the area surveyed.
- 2.3.4 16 trenches were excavated at Highgate House Farm, Goldthorpe, 1.3 km east of the study area, following a geophysical survey (AOC 2001) of known cropmarks. The excavation recorded post-medieval and undated activity only.

## 3 METHODOLOGY

### 3.1 Introduction

- 3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 27 – 28 September 2022 and 03 – 06 October 2022. Field conditions at the time of the survey were wet and overcast throughout. An overall coverage of 76.2 ha was achieved, whilst areas LP\_007, 008 and 012 were all deemed unsuitable for survey. The eastern majority of LP\_004 was also unsurveyable.
- 3.1.2 The methods and standards employed throughout the geophysical survey conform to current best practice, and guidance outlined by the Chartered Institute for Archaeologists' (CIfA 2014) and European Archaeologiae Consilium (Schmidt *et al.* 2015).



## 3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- To determine, as far as is reasonably possible, the nature of the detectable archaeological resource within a specified area using appropriate methods and practices; and
- To inform either the scope and nature of any further archaeological work that may be required; or the formation of a mitigation strategy (to offset the impact of the development on the archaeological resource); or a management strategy.

3.2.2 In order to achieve the above aims, the objectives of the geophysical survey are:

- To conduct a geophysical survey covering as much of the specified area as possible, allowing for on-site obstructions;
- To clarify the presence/absence of anomalies of archaeological potential; and
- Where possible, to determine the general nature of any anomalies of archaeological potential.

## 3.3 Fieldwork methodology

3.3.1 The cart-based gradiometer system used a Carlson BRX7 GNSS receiver, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS). Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).

3.3.2 The detailed gradiometer survey was undertaken using four SenSys FGM650/3 magnetic gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart both hand-pushed and towed by an ATV. Data were collected with an effective sensitivity of  $\pm 8 \mu\text{T}$  over  $\pm 1000 \text{ nT}$  range at a rate of 100 Hz, producing intervals of 0.02 m along transects spaced 4 m apart.

## 3.4 Data processing

3.4.1 Data from the survey were subjected to minimal correction processes. These comprise a 'Destripe' function ( $\pm 5 \text{ nT}$  thresholds), applied to correct for any variation between the sensors, and an interpolation used to grid the data and discard overlaps where transects have been collected too close together.

3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

# 4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

## 4.1 Introduction

4.1.1 Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:7,000 (**Fig. 2 to 3**) and 1:2,000 (**Fig. 4 to 17**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale.

4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figure 3**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.



- 4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.
- 4.1.4 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be present than have been identified through geophysical survey.
- 4.1.5 Gradiometer survey may not detect all services present on site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g., CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on site.

## 4.2 Gradiometer survey results and interpretation

- 4.2.1 The geophysical survey has identified features covering an extensive area of the site. Multiple areas of archaeological activity have been identified, predominantly in the south-east of the site. Two fields across the east and south at LP\_013 and LP\_015 are dominated by an increased magnetic response. This is likely due to modern agricultural activity associated with fertilisation. This has limited the effectiveness of the survey in these areas and some archaeological features might not be visible in the data.
- 4.2.2 In the southern portion of the site in LP\_015, a series of strongly positive linear anomalies have been recorded above the increased magnetic response at **4000 – 4005 (Fig. 15 – 17)**. Most of these anomalies appear to be grouped on a co-axial orientation trending either north-east to south-west or north-west to south-east, with a width between 2.5 – 3 m and length of up to 320 m. These strongly positive linear anomalies are likely boundary ditches, that once sub-divided the area into smaller land parcels.
- 4.2.3 Whilst the majority of the anomalies across LP\_015 are interconnected at **4000**, there are a small number of strongly positive, fragmented, linear anomalies that appear to have been separated from **4000** but are likely still associated (**Figure 17**). The anomaly at **4001** appears to be a continuation of **4000**, trending south-west into LP\_016, that has been broken up by a modern field boundary. Whilst linear anomalies at **4002 – 4005** are located immediately east of LP\_016 running parallel to **4000** on a north-east to south-west orientation. Further anomalies with similar magnetic properties have been identified further south-east at **4006** and **4007**. Anomalies **4002 – 4005** and **4007** all appear to be an extension of **4000** and are likely similar boundary ditches. The isolated curvilinear anomaly at **4006** has been identified as archaeological due to its strong magnetic properties and close proximity to the surrounding boundary ditches.
- 4.2.4 The anomalies at **4000 – 4007** appear to form the fragmented remains of a field system. Given their co-axial orientation and straight, perpendicular form, the anomalies could be Romano-British in origin. These findings would match up with similar Iron Age/ Romano-British 'brickwork' field systems recorded in the surrounding area in previous archaeological works. The fragmented anomalies at **4002 – 4005** appear parallel to one another and may form the remains of a 5 m wide trackway. It is also possible that these remains correspond with the cropmarks previously recorded within the site.
- 4.2.5 A series of positive linear anomalies have been identified in the southern portion of LP\_005 at **4008 – 4011 (Figure 9)**. The anomaly at **4008** is 2.5 m wide and 47 m long orientated east to west. The linear anomaly dissipates in an area of increased magnetic response, immediately east, before becoming visible again at **4009** and continuing east for an additional 22 m. A strongly positive linear anomaly also extends south-south-east from the magnetic response at **4010**, for 46 m with a similar width to **4008**. The final linear in this series is located 33 m south of **4008** at **4011**. This strongly positive anomaly is 2 m wide



and 50 m long, orientated east to west. Anomaly **4011** appears to be truncated by a former field boundary at **4032**, immediately east. The anomalies are possibly archaeological ditches of an unknown origin.

- 4.2.6 Due to their size, form, and orientation the anomalies at **4008 – 4011** are likely the remains of former field boundaries not recorded on first-edition OS mapping. Whilst **4011** may be a continuation of a former field boundary at **4032**, anomaly **4010** is orientated parallel to **4032** possibly forming the eastern limit of a trackway. It is also possible that these anomalies represent enhanced trends relating to modern agricultural practices or are remnants of known mining activity in the area.
- 4.2.7 Located in the south-western corner of LP\_008 is a weakly positive linear anomaly at **4012** (**Figure 11**). The anomaly is 2 m wide and 130 m long, orientated north-north-east to south-south-west. The anomaly is trending in a different orientation to both the current ploughing regime seen on site and any former field boundaries listed on first edition OS mapping. As a result, **4012** has been categorised as possibly archaeological and may be representative of a former boundary ditch of unknown origin.
- 4.2.8 In the south-eastern corner of LP\_008, a series of positive linear anomalies have been identified at **4013** and **4014** (**Figure 11**). Anomaly **4013** is made up of several positive linears forming an 'F' shape. It consists of the western limb 3 m wide and 60 m long, orientated north-east to south-west, with two perpendicular linear anomalies orientated north-west to south-east of similar width and length. The two north-west to south-east linear anomalies could conceivably continue further north-west, however, it is unclear due to the presence of increased magnetic response at **4052**. The linear anomaly directly south-east of **4013** at **4014** is trending north-east to south-west and may have once been connected to or a continuation of **4013** due to its close proximity and similar orientation.
- 4.2.9 Similar to **4012**, anomalies **4013** and **4014** are oriented differently to both the current ploughing regime recorded on site and any former field boundaries listed on first-edition OS mapping. As a result, they have been characterised as possibly archaeological in origin and may be representative of ditches. However, due to the presence of increased magnetic disturbance to the west, a firmer interpretation cannot be applied
- 4.2.10 In the south-western corner of LP\_011 a weakly positive linear anomaly has been recorded at **4015** (**Figure 11**). Anomaly **4015** is 3 m wide and 38 m long, orientated east to west, with its eastern end terminating against a recorded former field boundary at **4043**. It is likely that this anomaly is the remains of a ditch possibly relating to a former field boundary not recorded on first-edition OS mapping. It is also possible that **4015** is representative of a modern drain or enhanced ploughing trend.
- 4.2.11 Across the site are multiple areas of weak, positive, parallel, linear anomalies at **4016 – 4028** (**Fig. 5, 7, 9, 11, 13, 15** and **17**). The average distance between lines is 7 m, and they are often of a curved form. These anomalies have been interpreted as areas of ridge and furrow and some are thought to be medieval due to their curved form and spacing.
- 4.2.12 A series of positive linear anomalies were evident across the site, **4029 – 4049** (**Fig. 5, 7, 9, 11, 13, 15** and **17**). These anomalies are predominantly on either a north to south, or an east to west, alignment, and are on average 2 – 3 m wide. They correlate in location to former field boundaries as evident on OS six-inch 1888-1913 maps. Most of the former boundaries identified in the northern half of the site were last recorded on mapping dated in 1931. By 1948 the few remaining boundaries had been removed in favour of quarrying across the site, illustrated in aerial mapping from that time.
- 4.2.13 In addition to the large-scale increased magnetic response identified in LP\_015 and LP\_16, this survey has recorded several more isolated areas of data with similar characteristics.



The disturbance identified centrally within LP\_001 (**4050**) is likely the result of highway infrastructure associated with the creation of a lay-by immediately south (**Figure 5**).

- 4.2.14 Further increased magnetic response, and ferrous anomalies were evident across the site at **4051 – 4053 (Figs 5, 7, 9 and 11)** and are likely associated with modern mining activity or build-up of magnetic material. Numerous large dipolar anomalies in the north-west of the site indicate ferrous material, also thought to relate to mining activity.
- 4.2.15 Throughout the survey area, magnetically strong dipolar anomalies arranged on multiple linear alignments have been identified at **4054 – 4058**. These indicate modern services, such as pipes or cables.
- 4.2.16 Numerous weak linear trends were identified across the site. However, the high levels of disturbance from associated mining activity have prevented any confident interpretation of the features. Evidence of modern agriculture has also been identified in the form of ploughing and field drains.

## 5 DISCUSSION

### 5.1 Results

- 5.1.1 The gradiometer survey has been successful in detecting anomalies of archaeological origin in the south and south-eastern portions of the site. These relate to a ditched field system. In addition to these, several weaker anomalies have been interpreted as possible archaeology and have the potential to relate to former field boundaries.
- 5.1.2 Across the southern half of the site are the remains of a large field system, in the form of strongly positive interconnected linear ditches, with a possible former trackway. Given the straight-lined rectangular fields that this system demonstrates, it is likely to be Iron Age/Romano-British in origin. This date is further supported by the medieval ridge and furrow in the area being on a different alignment. This system likely forms part of known Iron Age to Romano-British field systems that have been identified throughout the area through crop marks and archaeological investigations. These are characterised by rectangular fields with common boundaries along one axis, forming a 'brickwork' pattern in the plan.
- 5.1.3 Numerous additional anomalies have been identified across the site as possible archaeology. The majority of these are too weak or disturbed by increased magnetic disturbance to offer a confident interpretation. Most of these anomalies are likely linear ditches forming the remains of former field boundaries not recorded on first-edition OS mapping. It is also possible that they could equally relate to more modern agricultural or mining activity.
- 5.1.4 The site's agricultural past is also evidenced by areas of ridge and furrow across the site. Often these are widely spaced and slightly curving, suggesting a medieval date which would remain in keeping with other instances found in the surrounding area. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on mid-19th-century OS mapping.
- 5.1.5 There are several instances of increased magnetic response located across the site. Fields LP\_013, LP\_014 and LP\_015 are dominated by an increased magnetic response, likely due to modern agricultural activity associated with fertilisation. Further disturbance has been identified across the northern areas expected to be the result of mining activity. This has



limited the effectiveness of the survey in these areas and some archaeological features might not be visible in the data.

- 5.1.6 The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drains, and modern services.



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### Online resources

- Archaeological Data Service <https://archaeologydataservice.ac.uk/archsearch/browser.xhtml>  
(Accessed November 2022)



British Geological Survey online viewer <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>  
(Accessed November 2022)

Google Earth website <http://earth.google.com> (accessed November 2022)

Historic England (HE) <https://historicengland.org.uk> (accessed November 2022)

Heritage Gateway website <https://www.heritagegateway.org.uk/gateway/> (accessed November 2022)

National Library of Scotland (NLS) <https://maps.nls.uk/geo/explore/> (accessed November 2022)



## APPENDICES

### Appendix 1: Gradiometer Survey Equipment and Data Processing (Sensys)

The magnetic data for this project were acquired using a non-magnetic cart fitted with eight SenSys FGM650/3 magnetic gradiometers. The instrument has four sensor assemblies fixed horizontally 1 m apart allowing four traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 0.6 m separation and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of  $\pm 8 \mu\text{T}$  over  $\pm 1000 \text{ nT}$  range. All of the data are then relayed to a CS35 tablet, running the MONMX program, which is used to record the survey data from the array of FGM650/3 probes at a rate of 20 Hz. The program also receives measurements from a GPS system, which is fixed to the cart at a measured distance from the sensors, providing real time locational data for each data point.

The cart-based system relies upon accurate GPS location data which is collected using a Leica Captivate system with a rover and base station. This receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015) for geophysical surveys.

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.01 m intervals along traverses spaced up to 0.25m apart.

### Post-processing

The magnetic data collected during the survey is downloaded from the system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

Typical data and image processing steps may include:

- GPS DeStripe – Determines the median of each transect and then subtracts that value from each data point in the transect within the defined window. May be used to remove the striping effect seen within a survey caused by directional effects, drift, etc.
- Discard Overlaps - Intended to eliminate a track(s) that have been collected too close to one another. Without this, the results of the interpolation process can be distorted as it tries to accommodate very close points with potentially differing values.
- GPS Base Interpolation – Sets the X & Y interval of the interpolated data and the track radius (the area around each datapoint that is included in the interpolated result).

Typical displays of the data used during processing and analysis:

- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during the analysis of the data.



- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies. (XY plots can be made available upon request)



## Appendix 2 Geophysical interpretation

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural, and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Possible archaeology – used for features which give a response, but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

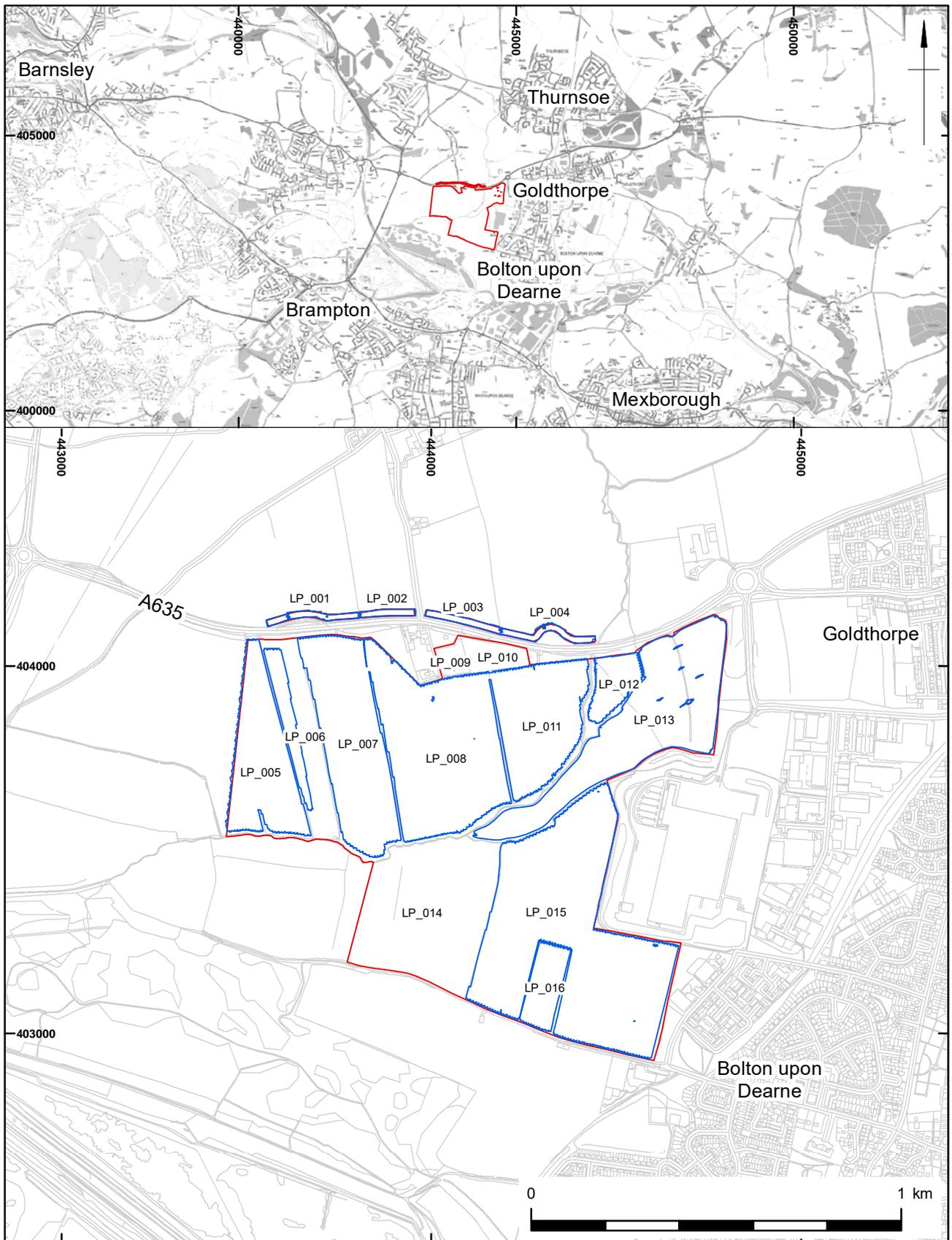
The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

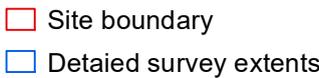
- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative, or broad bipolar (positive and negative) anomalies.

## Summary for wessexar1-510885

OASIS ID (UID)	wessexar1-510885
Project Name	Geophysical Survey at Land at Goldthorpe, Barnsley, South Yorkshire
Sitename	Land at Goldthorpe, Barnsley, South Yorkshire
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	Land at Goldthorpe, Rotherham, South Yorkshire
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	Wessex Archaeology
Project Dates	27-Sep-2022 - 06-Oct-2022
Location	Land at Goldthorpe, Barnsley, South Yorkshire NGR : SE 44203 03510 LL : 53.5264015527136, -1.33468595202417 12 Fig : 444203,403510
Administrative Areas	Country : England County : South Yorkshire District : Barnsley Parish : Barnsley, unparished area
Project Methodology	<p>The cart-based gradiometer system used a Carlson BRX7 GNSS receiver, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS). Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceeds European Archaeologiae Consilium recommendations (Schmidt et al. 2015).</p> <p>The detailed gradiometer survey was undertaken using four SenSys FGM650/3 magnetic gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart both hand-pushed and towed by an ATV. Data were collected with an effective sensitivity of <math>\pm 8 \mu\text{T}</math> over <math>\pm 1000 \text{ nT}</math> range at a rate of 100 Hz, producing intervals of 0.02 m along transects spaced 4 m apart.</p>

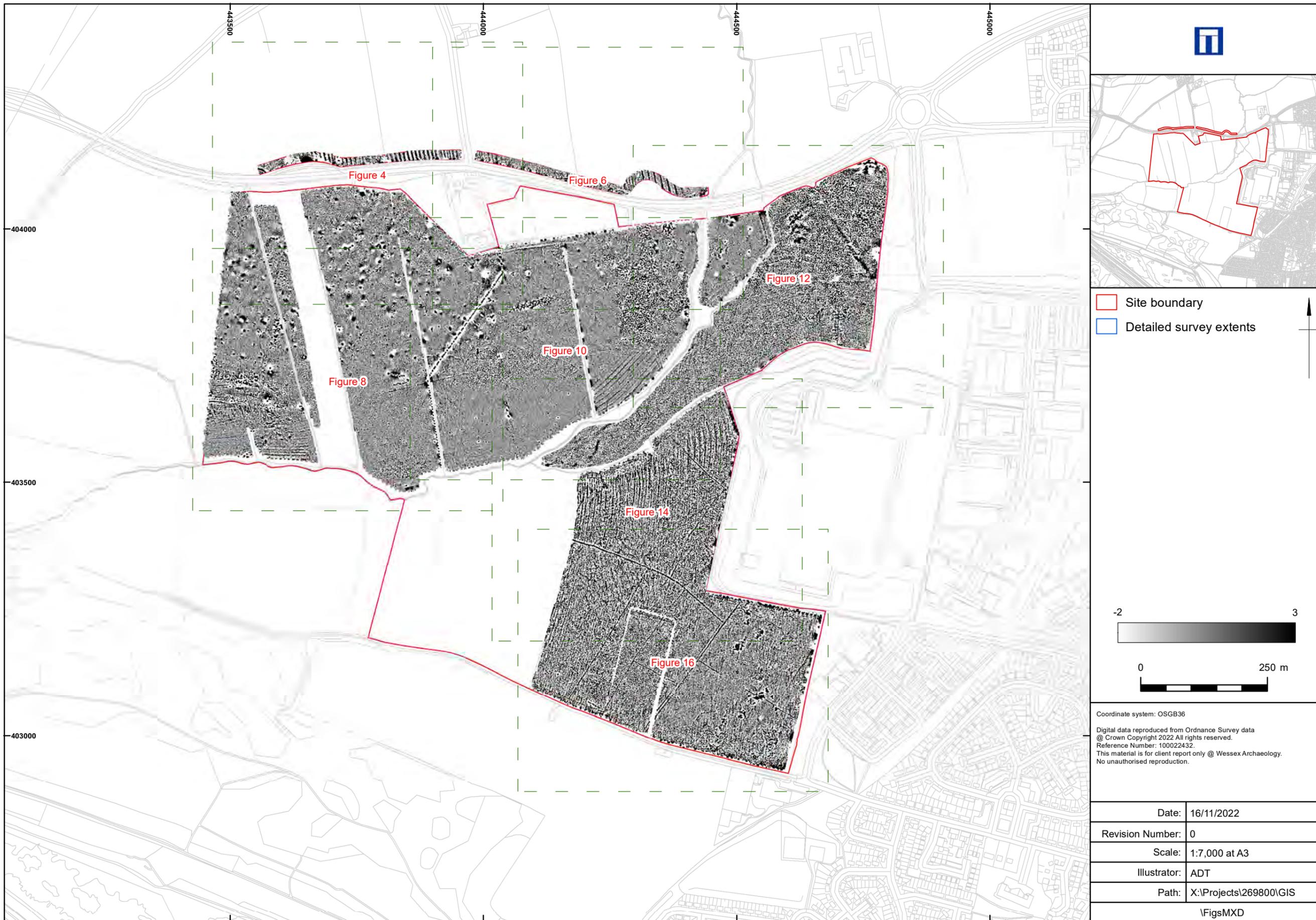
Project Results	<p>The detailed gradiometer survey has been successful in detecting anomalies of archaeological origin in the south and south-eastern portions of the site likely representative of a ditched field system. In addition to these, several weaker anomalies have been interpreted as possible archaeology and have the potential to relate to former field boundaries.</p> <p>Across the southern half of the site are the remains of a large field system has been recorded. Similar to other fields systems recorded in the surrounding area it is likely to be Iron Age/Romano-British in origin. Numerous additional anomalies have been identified across the site as possible archaeology. The majority of these are too weak or disturbed by increased magnetic disturbance to offer a confident interpretation. Most are likely ditches forming the remains of former field boundaries not recorded on first-edition OS mapping. It is also possible that they could equally relate to more modern agricultural or mining activity. Evidence of historic cultivation has also been recorded in the form of ridge and furrow across the site. Often these are widely spaced and slightly curving, suggesting a medieval date. Post-medieval agriculture is seen in the form of former boundaries that correlate with those recorded on mid-19th-century OS mapping. Several instances of increased magnetic response have been identified across the site. Some fields are dominated by an increased magnetic response, likely due to modern agricultural activity associated with fertilisation. Further disturbance has been identified across the northern areas expected to be the result of mining activity in the area. This has limited the effectiveness of the survey in these areas and some archaeological features might not be visible in the data. The remaining anomalies are thought to be modern or natural in origin. The modern anomalies include ploughing, drains, and modern services.</p>
Keywords	
Funder	
HER	South Yorkshire Archaeology Service - noRev - LITE
Person Responsible for work	
HER Identifiers	
Archives	



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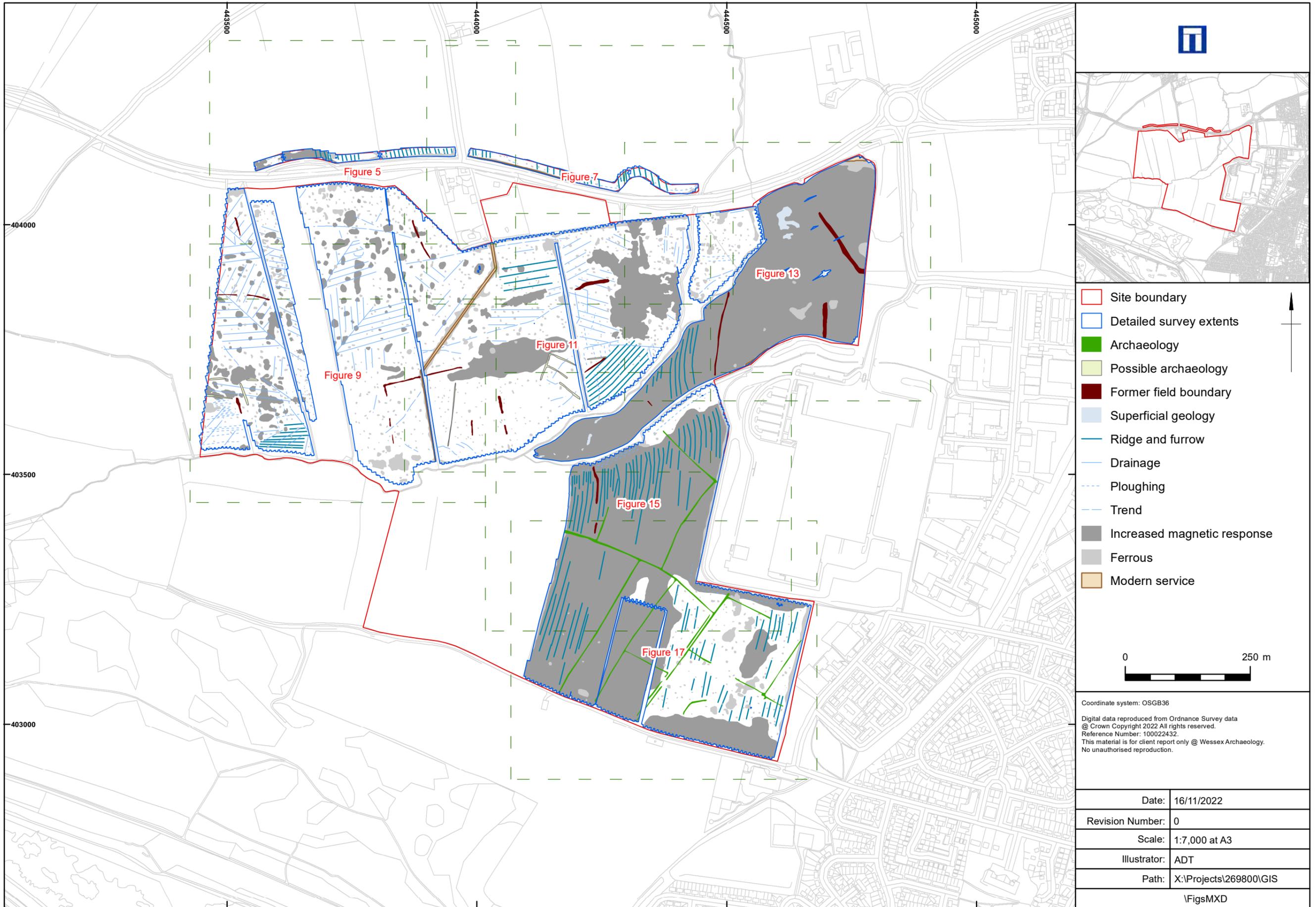
Site location and survey extent

Figure 1



Detailed gradiometer survey results: overall greyscale plots

Figure 2



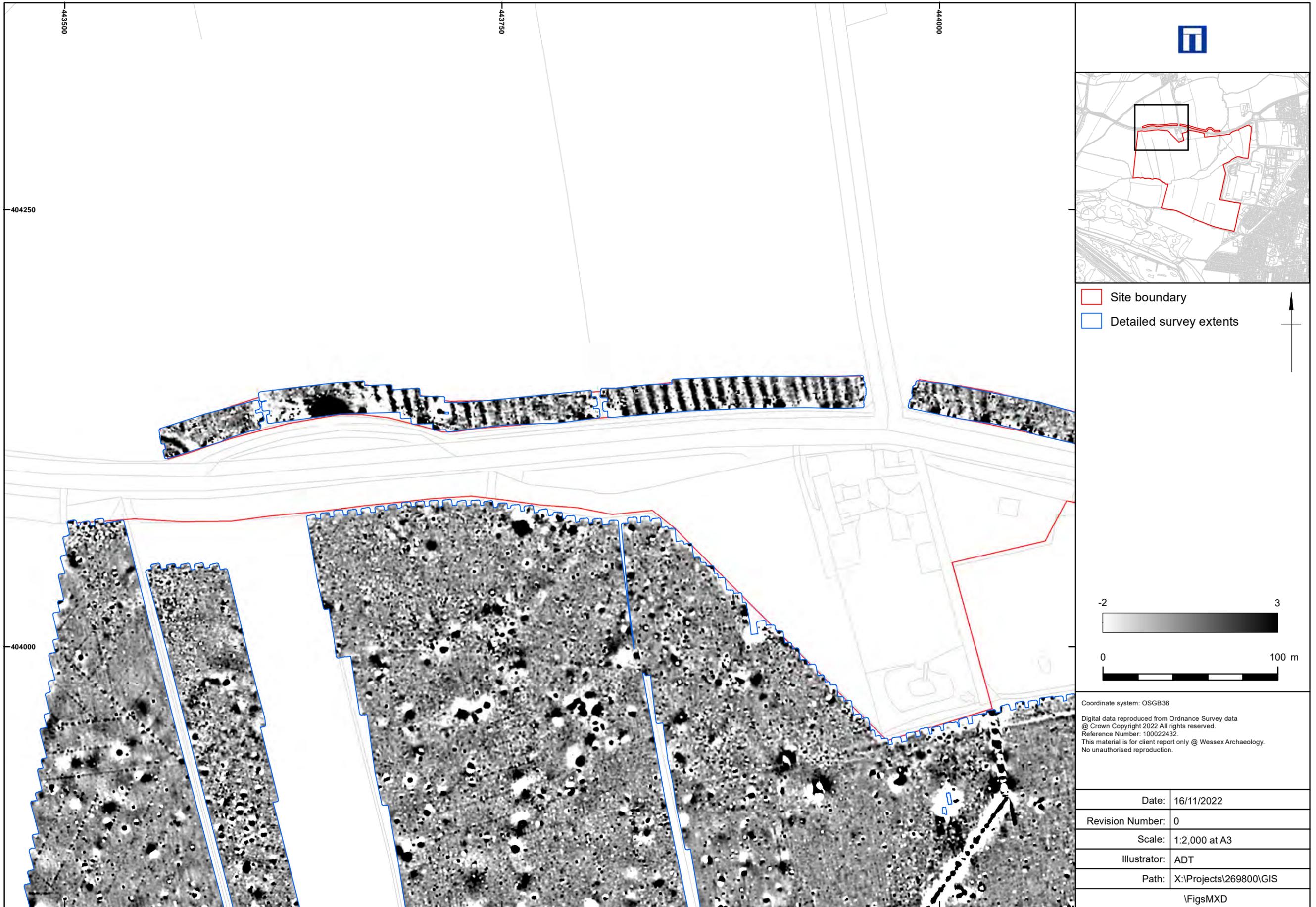
- Site boundary
- Detailed survey extents
- Archaeology
- Possible archaeology
- Former field boundary
- Superficial geology
- Ridge and furrow
- Drainage
- Ploughing
- Trend
- Increased magnetic response
- Ferrous
- Modern service

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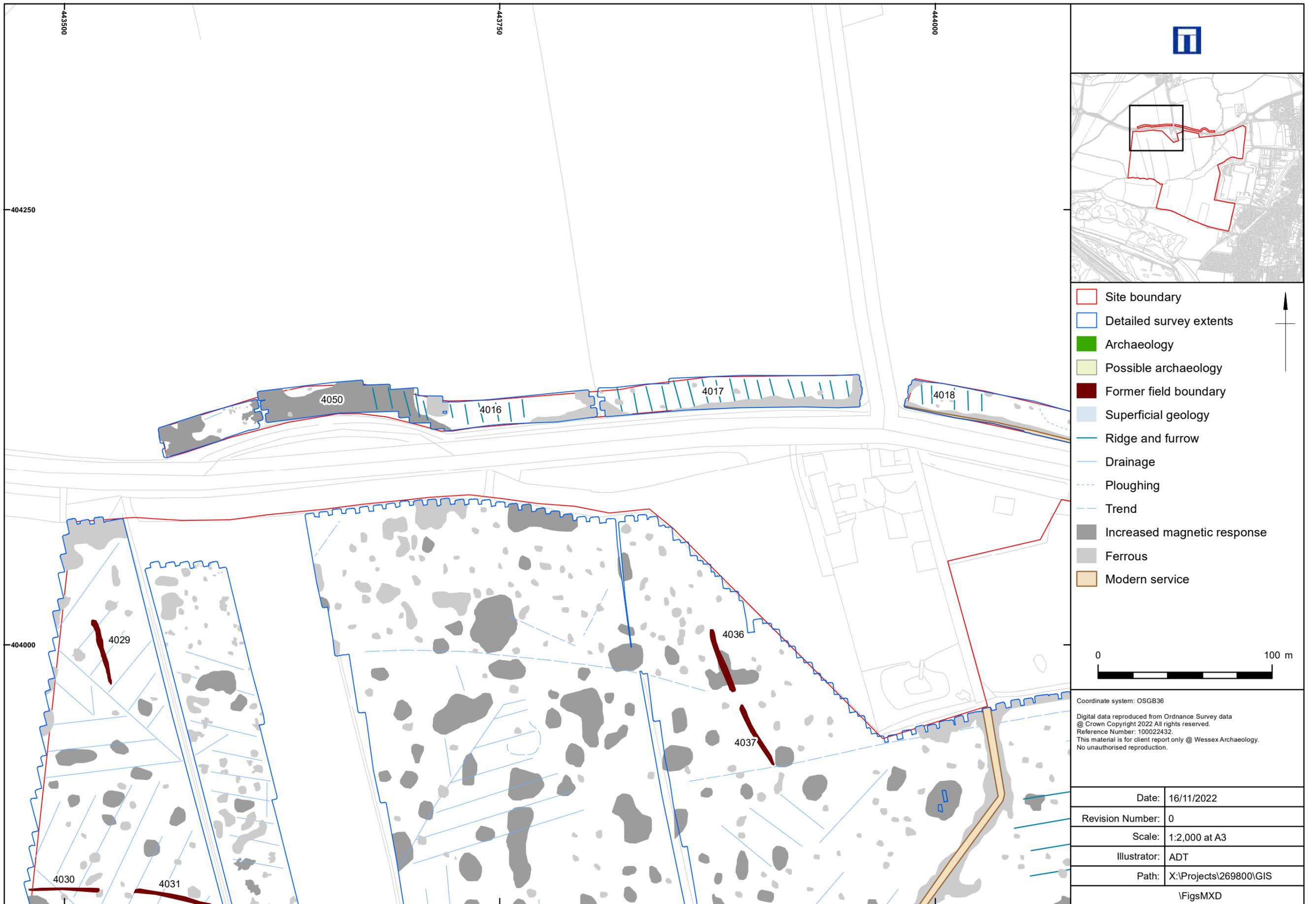
Detailed gradiometer survey results: overall interpretation

Figure 3



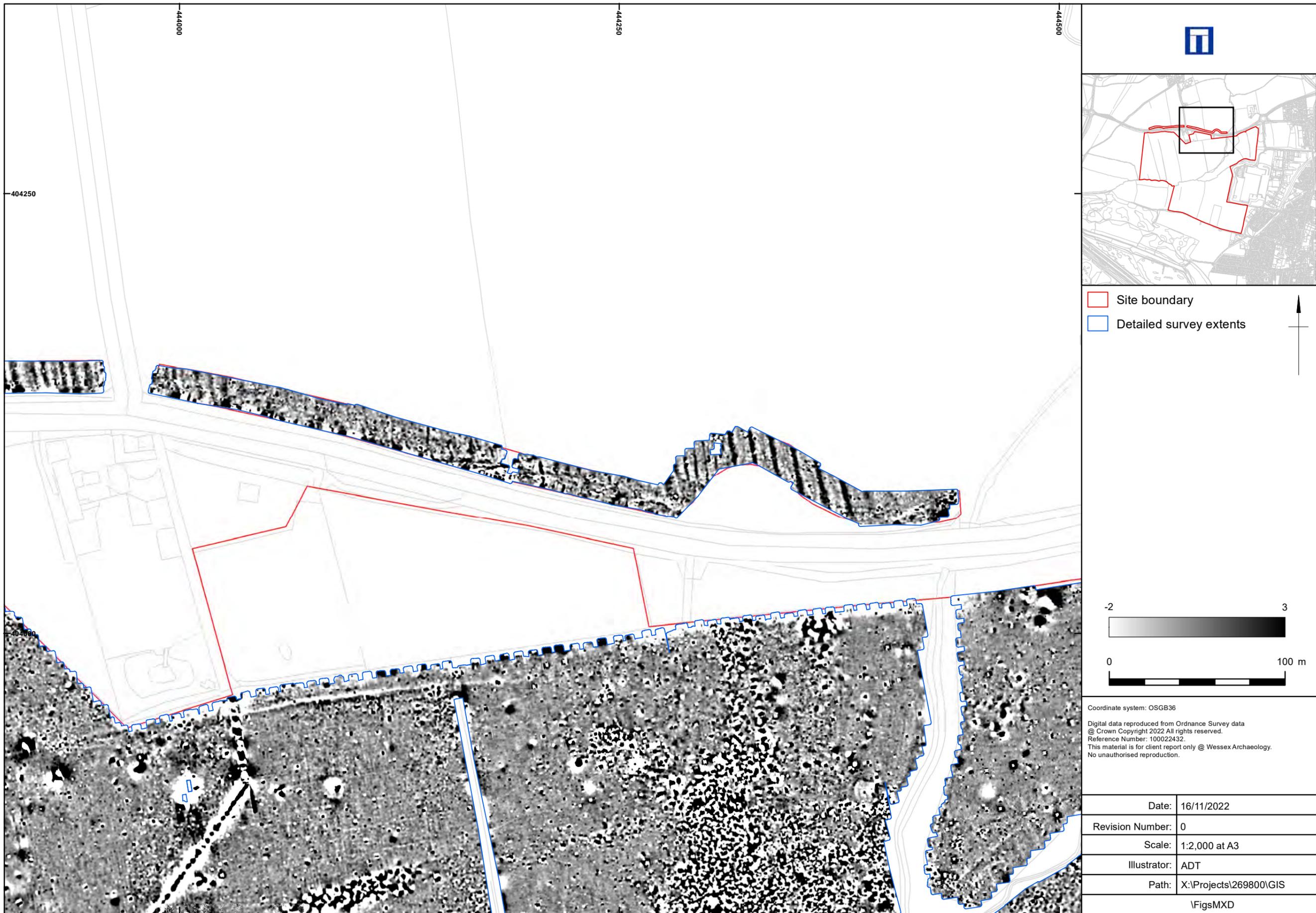
Detailed gradiometer survey results: greyscale plot (north-west)

Figure 4



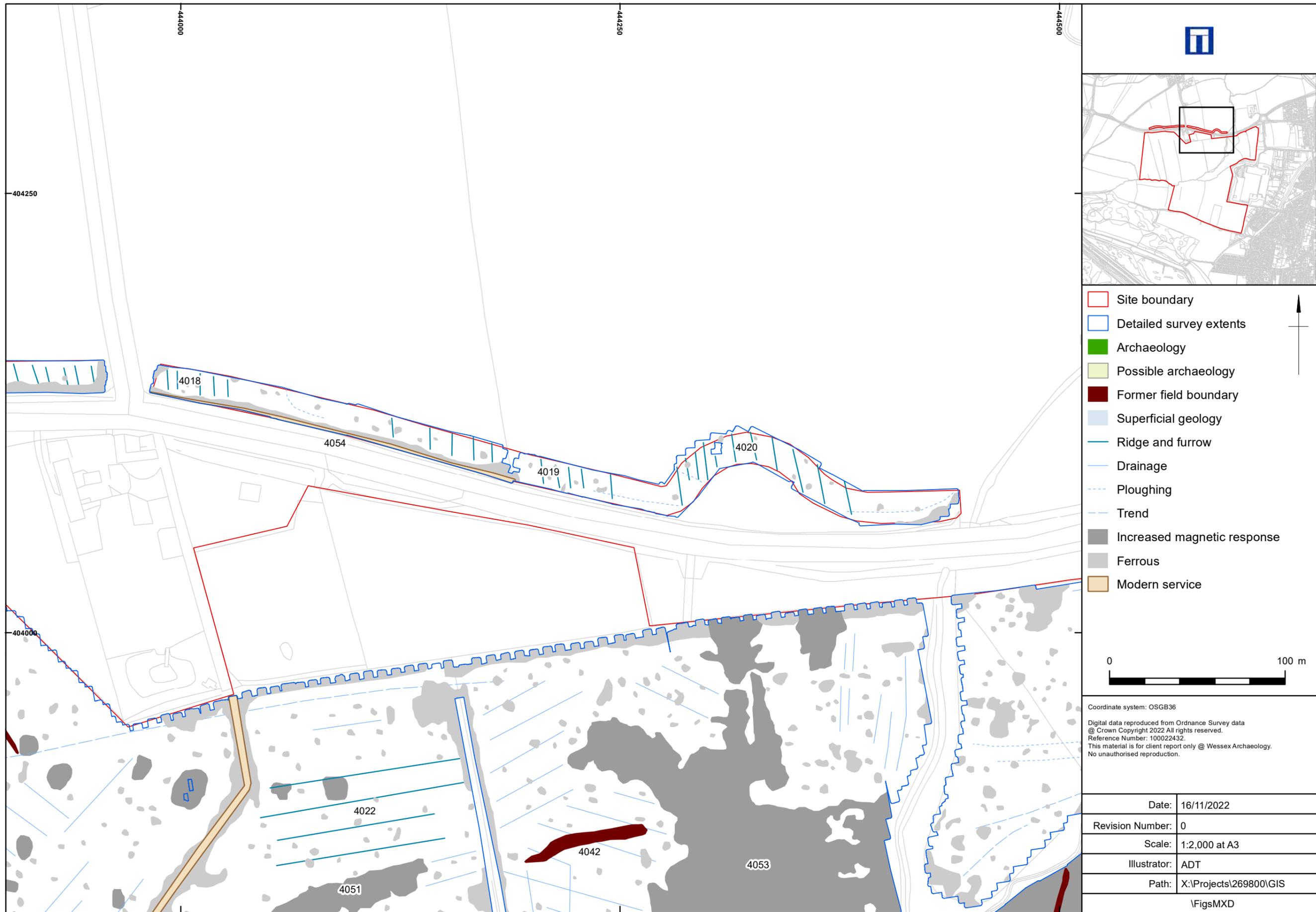
Detailed gradiometer survey results: interpretation (north-west)

Figure 5



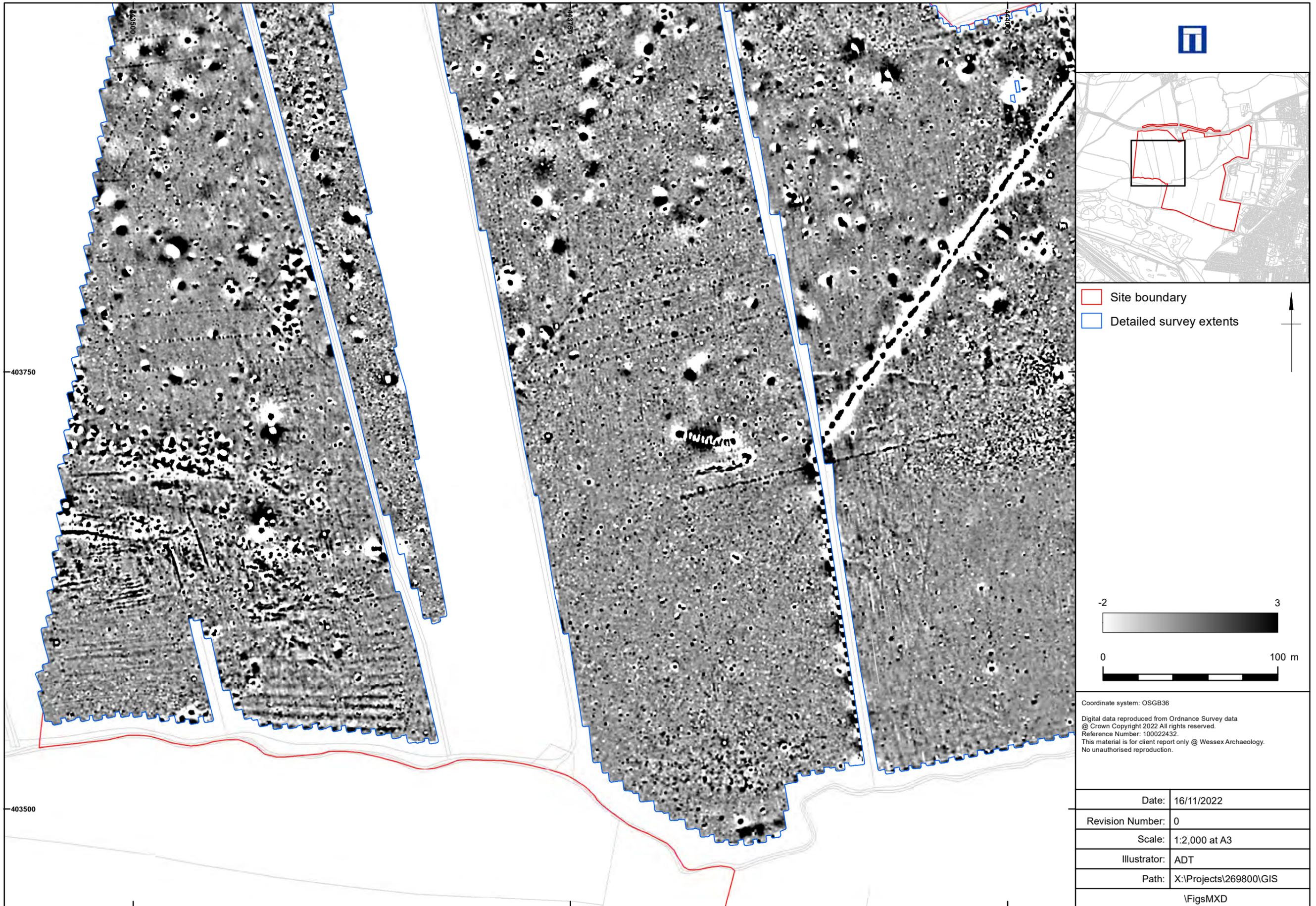
Detailed gradiometer survey results: greyscale plot (north-east)

Figure 6



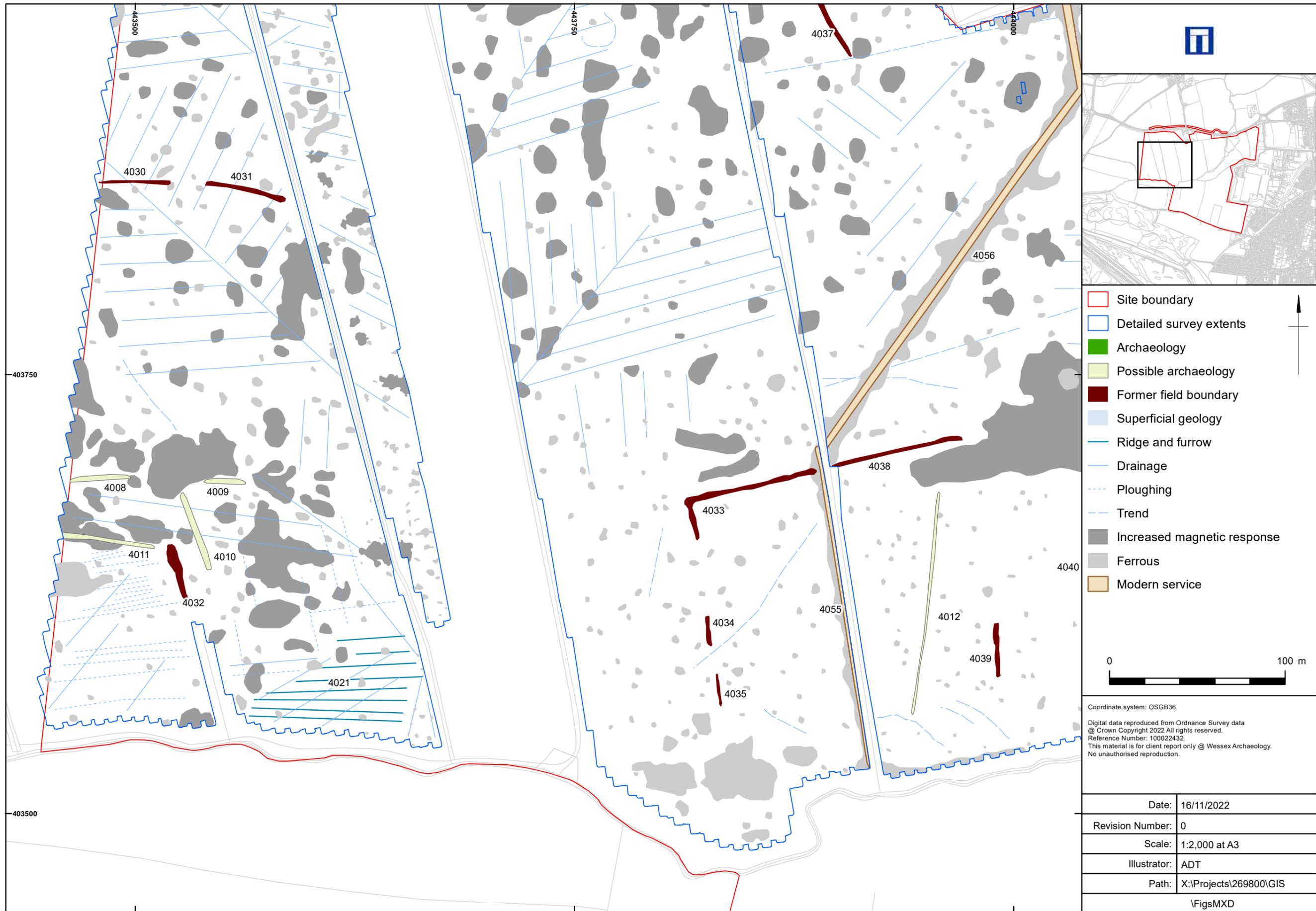
Detailed gradiometer survey results: interpretation (north-east)

Figure 7



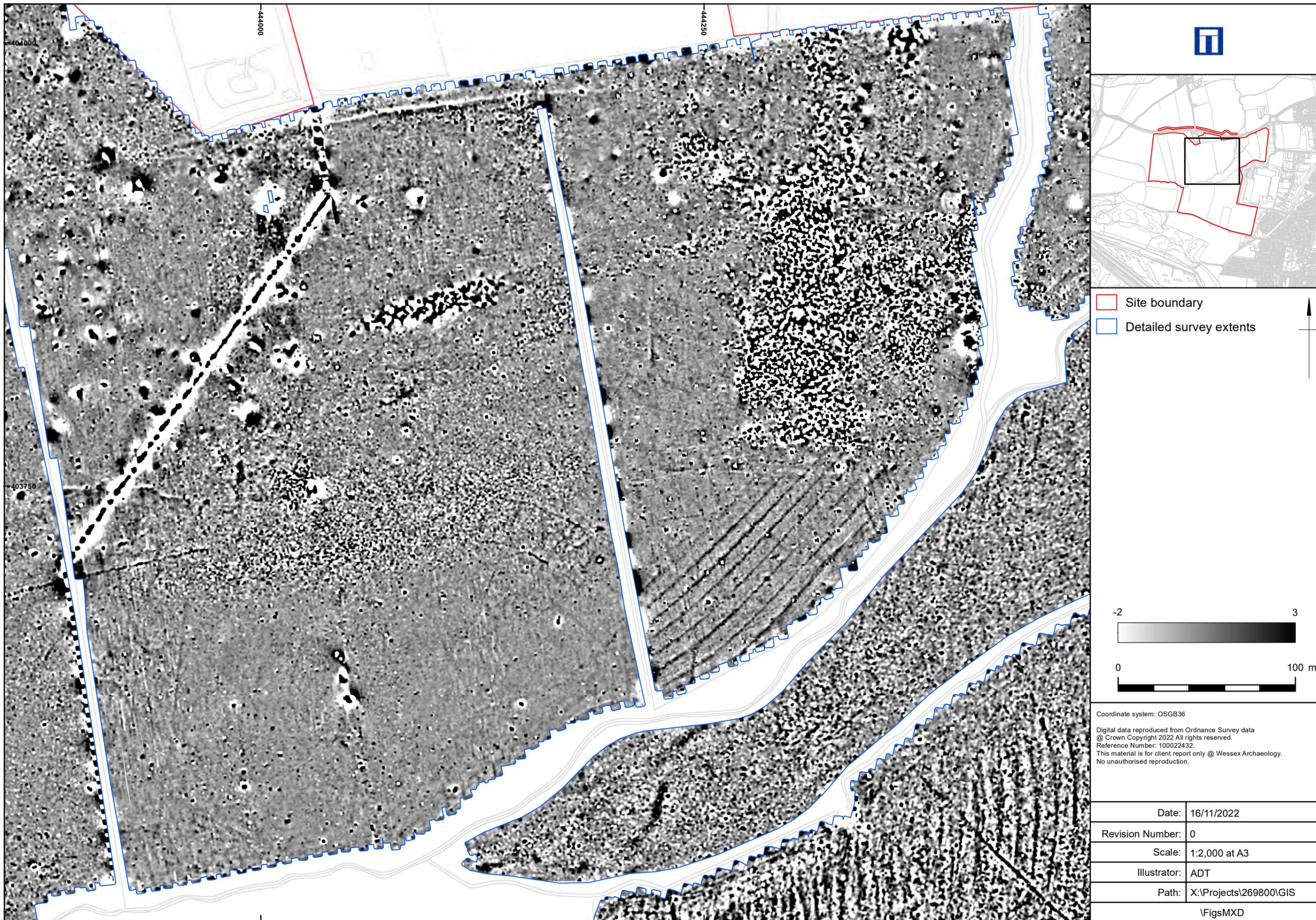
Detailed gradiometer survey results: greyscale plot (west)

Figure 8



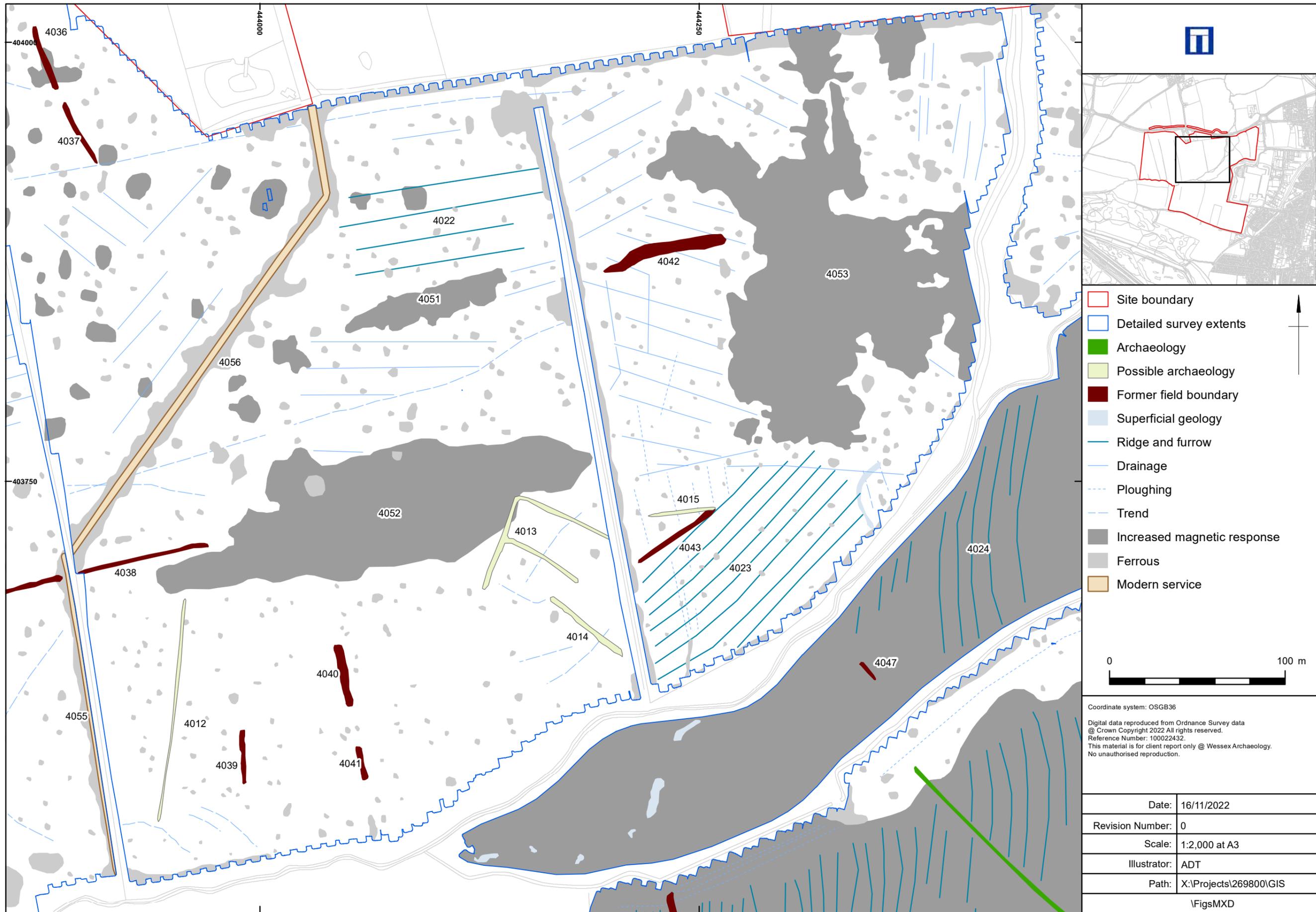
Detailed gradiometer survey results: interpretation (west)

Figure 9



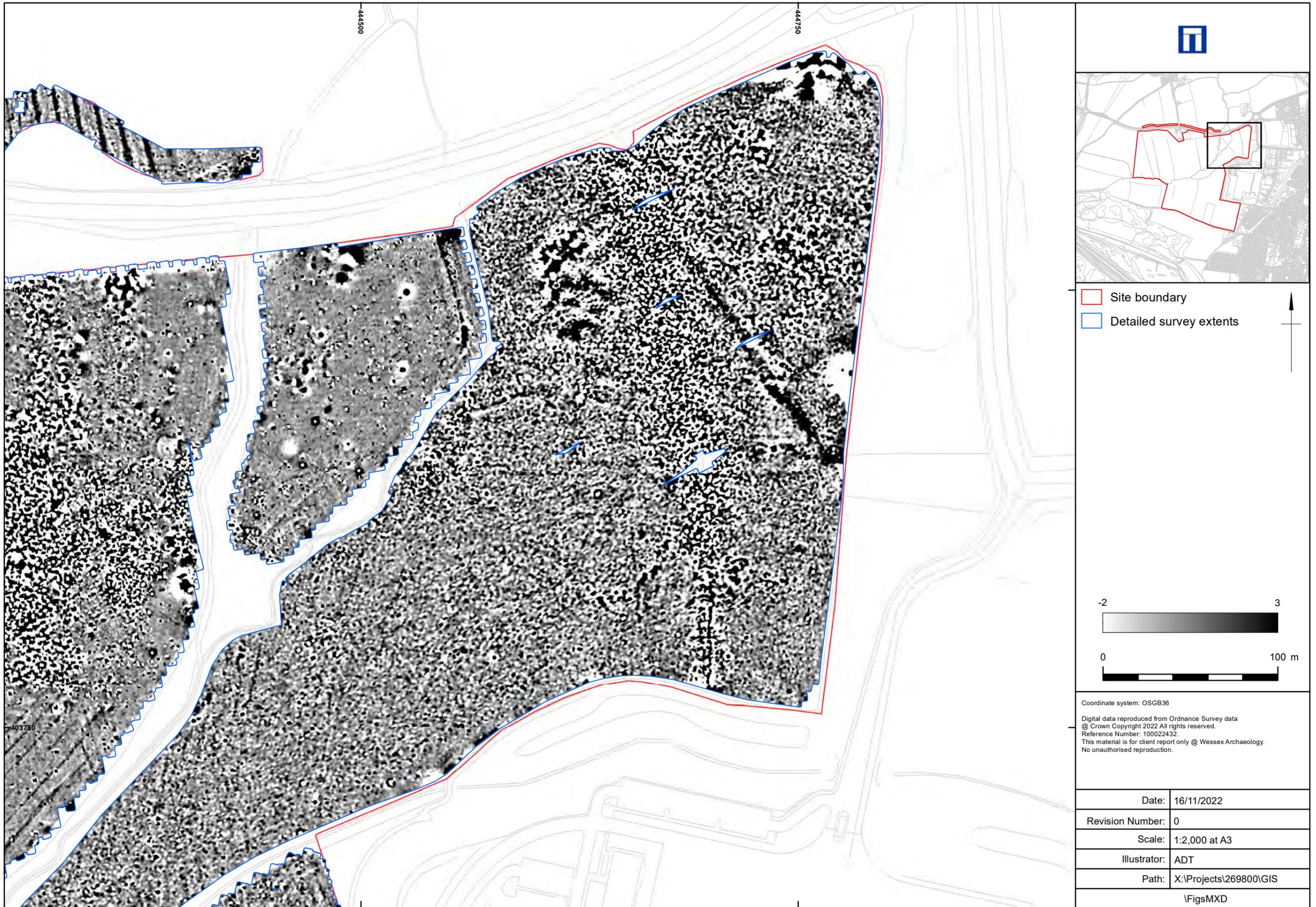
Detailed gradiometer survey results: greyscale plot (centre)

Figure 10



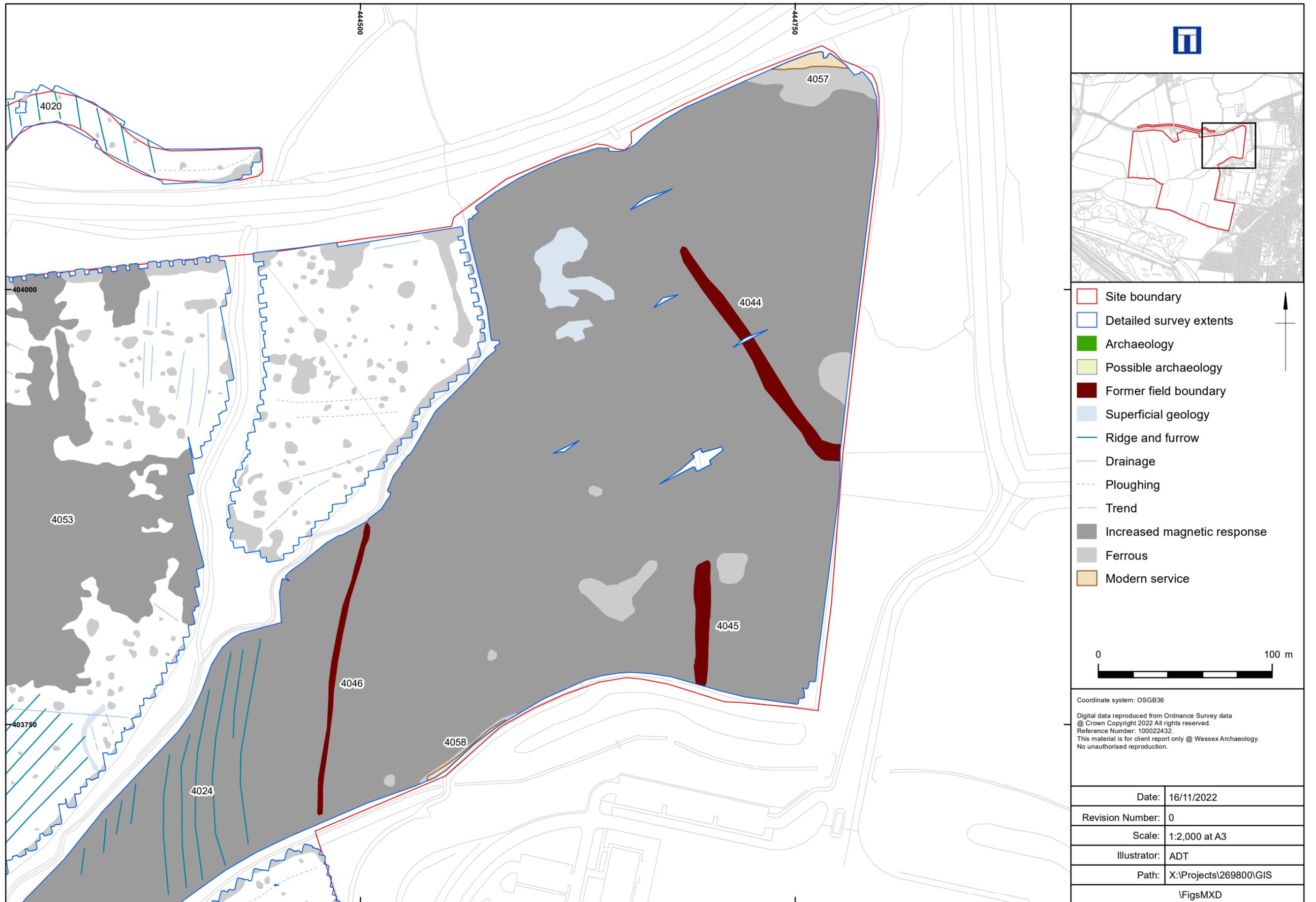
Detailed gradiometer survey results: interpretation (centre)

Figure 11



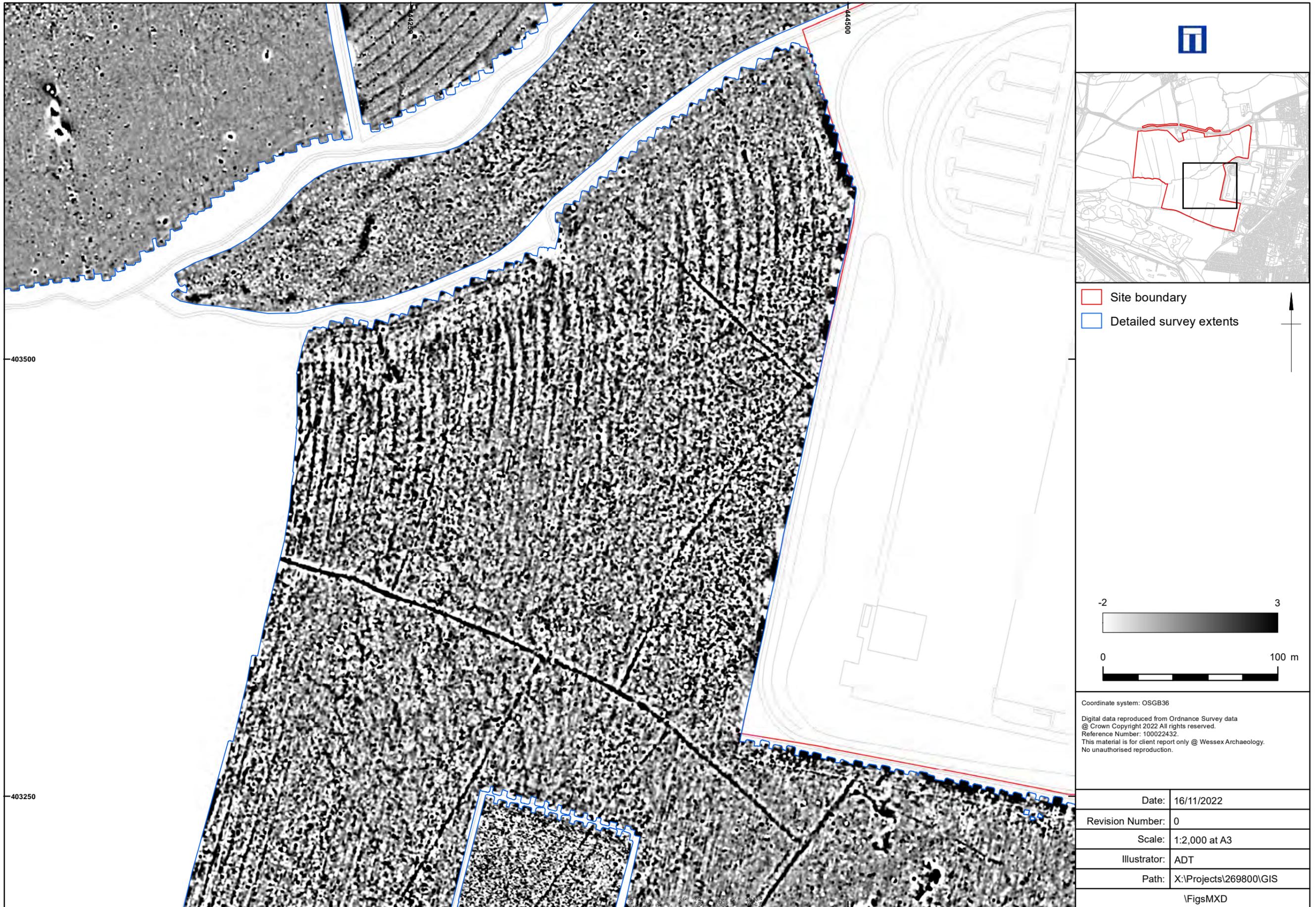
Detailed gradiometer survey results: greyscale plot (east)

Figure 12

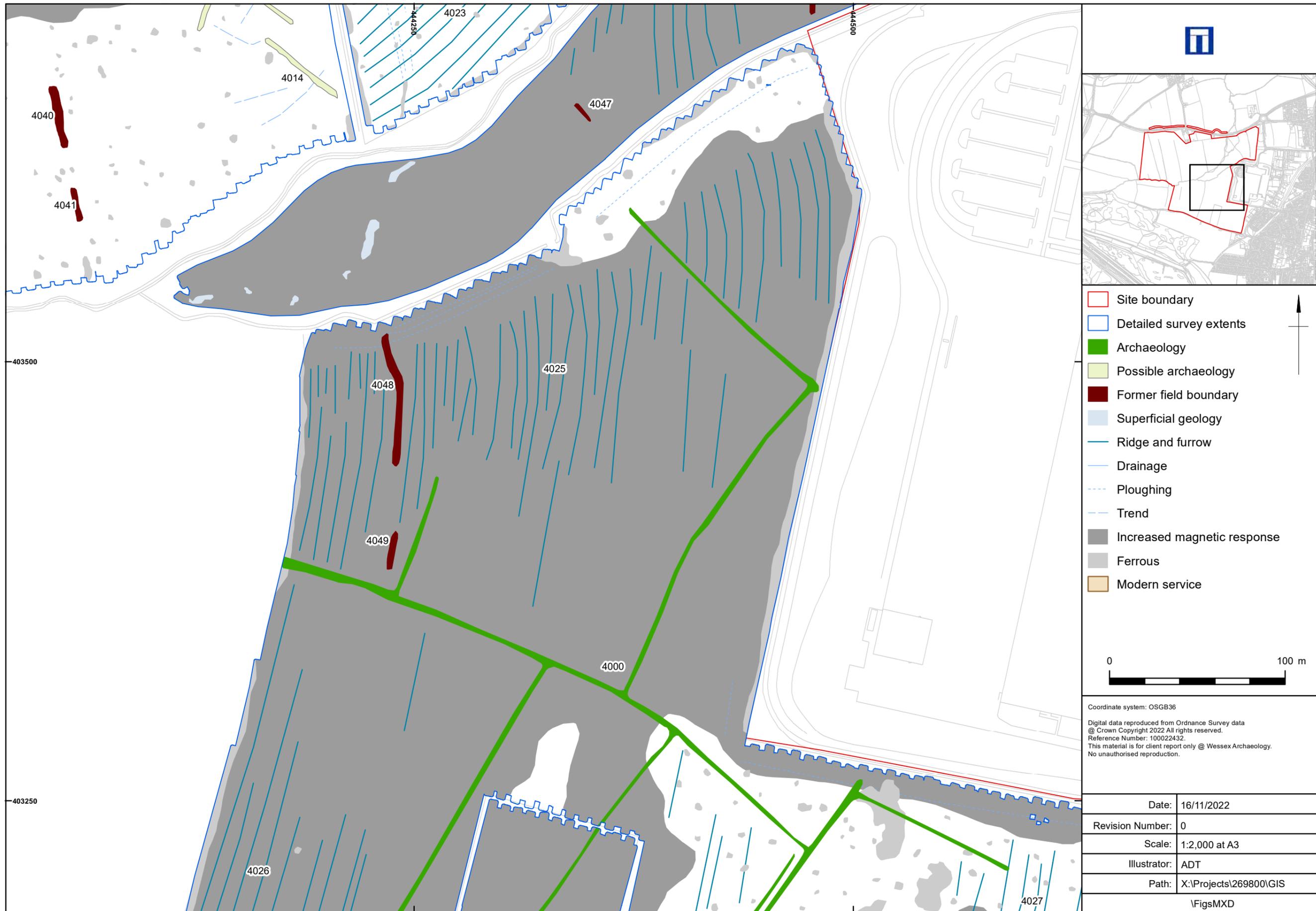


Detailed gradiometer survey results: interpretation (east)

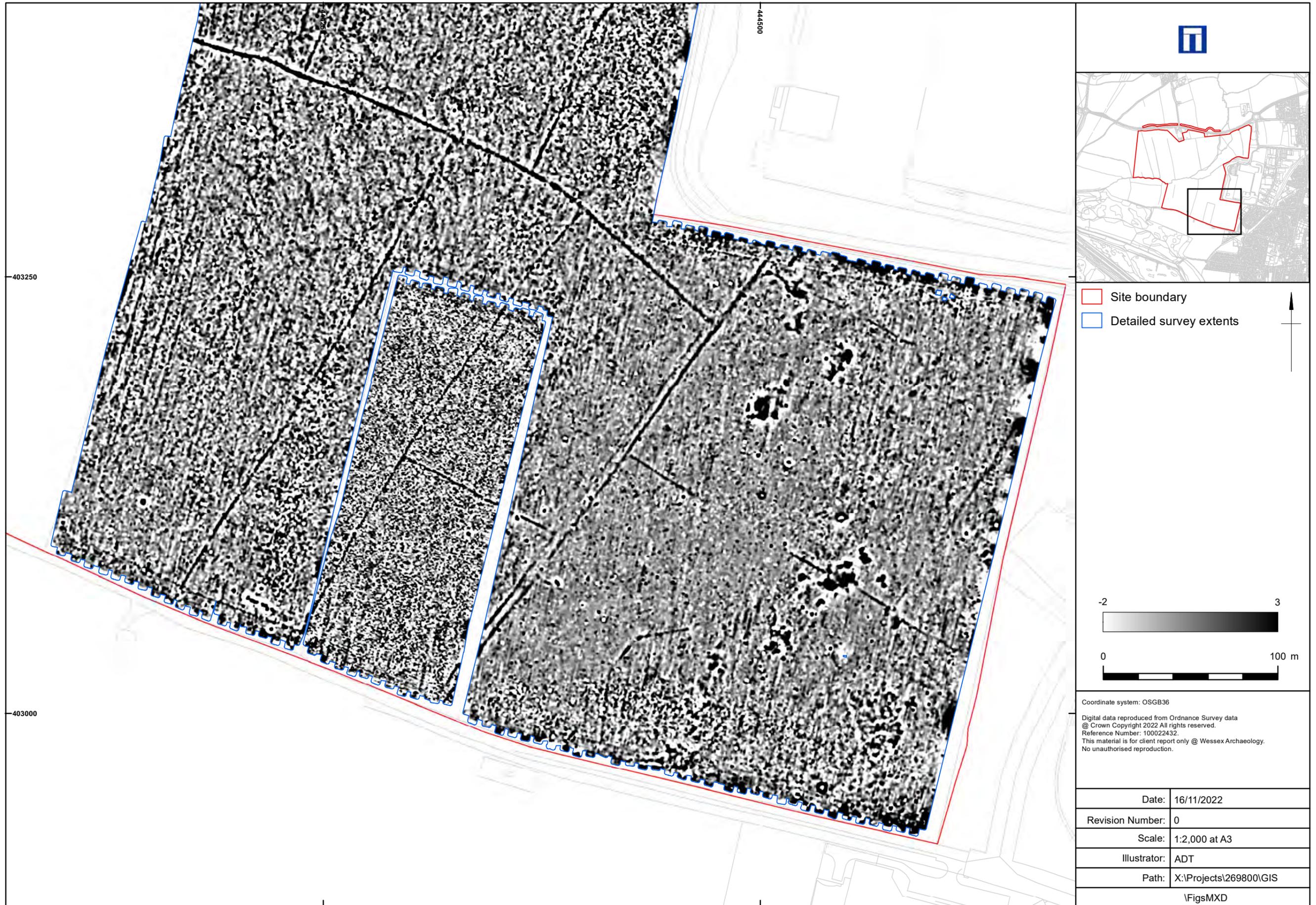
Figure 13



Detailed gradiometer survey results: greyscale plot (centre-south)

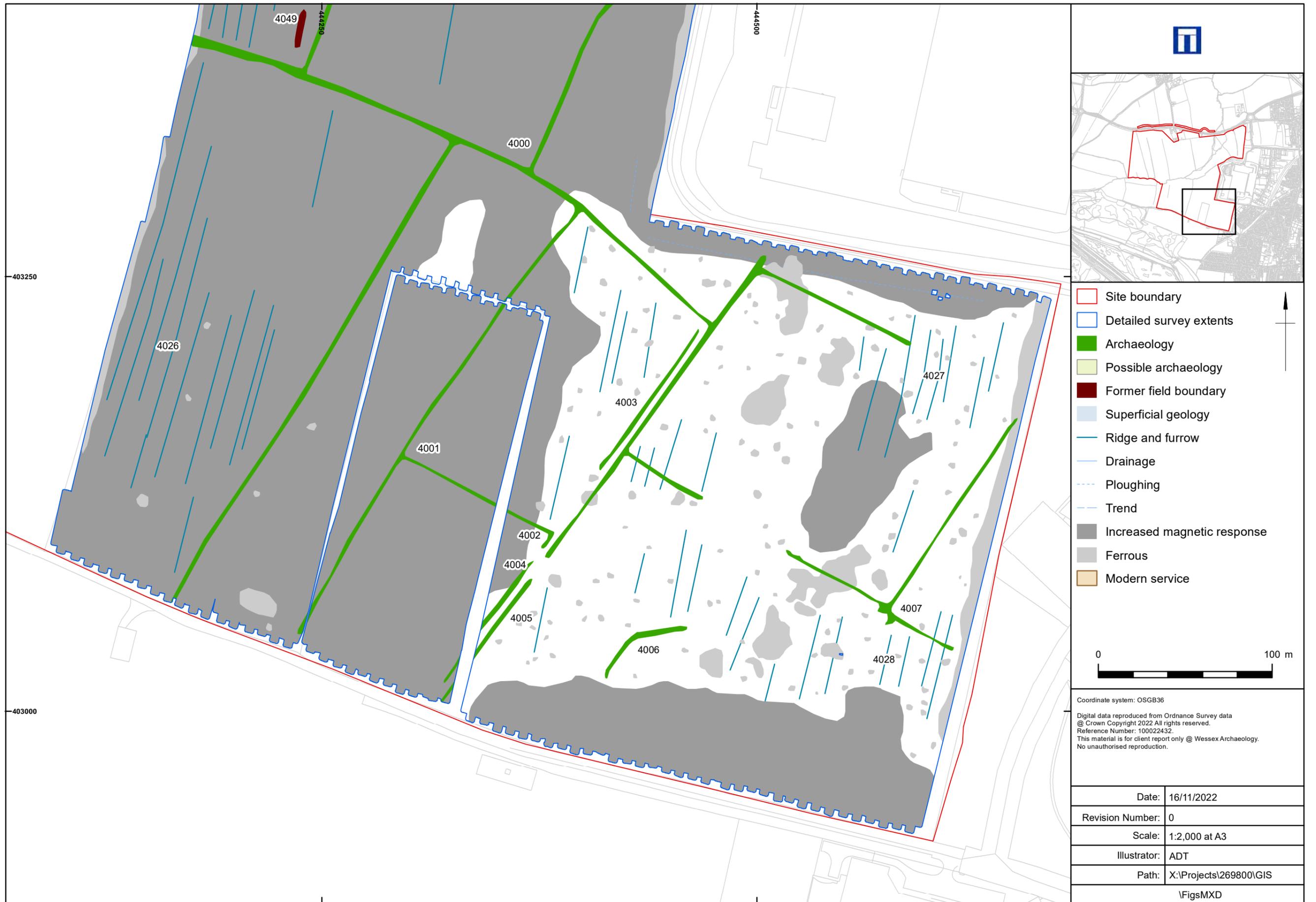


Detailed gradiometer survey results: interpretation (centre-south)



Detailed gradiometer survey results: greyscale plot (south)

Figure 16



Detailed gradiometer survey results: interpretation (south)

Figure 17



Wessex Archaeology Ltd registered office Portway House, Old Sarum Park, Salisbury, Wiltshire SP4 6EB  
Tel: 01722 326867 Fax: 01722 337562 info@wessexarch.co.uk www.wessexarch.co.uk



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