Cayton Solar
South Stainley, North Yorkshire

Detailed Gradiometer Survey Report

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Contents

List of Figures

Summary

A detailed gradiometer survey was conducted over land off Water Lane, South Stainley, North Yorkshire (centred on NGR 42944 463291). The project was commissioned by Arcus Consultancy Services Ltd with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of a planning application for the development of the site as a Solar Farm.

The site comprises arable fields located off Water Lane, South Stainley, covering an area of 62.2 ha. The geophysical survey was undertaken from 15/08/2022 to 19/08/2022. The survey has been successful in detecting anomalies of archaeological origin across the site, particularly an area of settlement and possibly associated field system.

An enclosure in the north-east of the site contains two anomalies thought to relate to round houses. This is thought to be Iron Age or Romano-British in date. Surrounding the enclosure, and across the majority of the site, are the remains of a large field system. While it cannot be confirmed from the geophysics data alone, it is likely this is associated with the settlement activity.

When assessed alongside the anomalies found during the 2018 ASWYAS survey of the area, it appears the wider site contains three areas of settlement or enclosure that are likely linked by the field system. There is no evidence of large-scale or dense settlement, so it is possible this represents agricultural activity with a small area of settlement.

The site's agricultural past is also evidenced by areas of ridge and furrow across the site. The majority of these are widely spaced and 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.

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

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The fieldwork was undertaken by Jo Instone-Brewer, Jack Trueman, Amy Dunn and Davor Cakanic. 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.

Cayton Solar
South Stainley, North Yorkshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by Arcus Consultancy Services Ltd to carry out a geophysical survey at land off Water Lane, South Stainley, North Yorkshire (centred on NGR 429938 463047) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of a planning application (Planning ref.: 19/02259/EIAMAJ) for the development of the site as a solar farm.

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 west of the village of South Stainley and 8 km north of Harrogate, in the county of North Yorkshire.

1.3.2 The survey comprises 62.2 ha of agricultural land, currently utilised for pasture and silage. The site is bounded by further agricultural land on all sides and is centrally divided by Water Lane.

1.3.3 The site is on a slight incline sloping from 79 m above Ordnance Datum (aOD) at the northern edge to 88 aOD at the southern edge.

1.3.4 The solid geology comprises Dolomite Limestone of the Cadeby Formation with overlying superficial geological deposits of clay, sand, and gravels of the Vale of York Formation (BGS 2022).

1.3.5 The soils underlying the site are likely to consist of typical stagnogley soils of the 711p (Dunkeswick) association (SSEW SE Sheet 2 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The archaeological and historical background was assessed in a prior desk-based assessment (DBA) (Arcus 2018), which considered the recorded historic environment resource within a 1 km study area of the proposed development. The DBA used information from the North Yorkshire Historic Environment Record (HER) and the National Heritage List for England (NHLE). The following background is not exhaustive but is summarised from aspects of the DBA that are considered relevant to the interpretation of the geophysical survey data.

2.2 Archaeological and historical context

2.2.1 The NHLE returned no nationally designated heritage assets within the site, although there are 3 scheduled monuments and 13 Grade II listed buildings within the 1 km study area.

2.2.2 The scheduled monuments include a medieval village (NHLE 1017657) and round barrow (NHLE 101758) near Markington to the north, and a Cistercian grange and medieval settlement (NHLE 1020747) located adjacent to the west-south-west of the site.

2.2.3 The scheduled Bronze Age round-barrow is the only indication of prehistoric activity within the area. However, numerous recordings of prehistoric sites throughout this area of Yorkshire indicate that there was prehistoric activity in the wider area. There is a potential undated earthwork identified in the southern portion of the site, which could be of prehistoric date.

2.2.4 There are no records of Romano-British activity in the study area. However, Aldborough Roman site is located several miles to the north-east of the site.

2.2.5 There are several indications of medieval activity in the surrounding area. The scheduled Cistercian grange and a medieval settlement at High Cayton (NHLE 1020747) comprise the earthworks and buried remains of a medieval village and a monastic grange of Fountains Abbey. The remains of the grange at Cayton survive well. The well-preserved remains of the specialist activities of fish farming and pottery production are significant as they will retain important evidence of the economy of the abbey. The grange site is also significant as it was one of the earliest of the granges of Fountains Abbey and is important for understanding the development of the grange economy both for the abbey itself and the wider development of monastic economies throughout the country.

2.2.6 The earliest reference to the village of Cayton is in the Domesday Book in 1087. It was part of the manor of Knaresborough and covered approximately 90 ha of land. The village of Wallerthwaite is also regarded as a medieval village. Multiple instances of ridge and furrow ploughing have also been recorded to the east of the survey area along Stainley Beck.

2.2.7 Several instances of ridge and furrow have been recorded along Stainley Beck to the east. Medieval sites would likely be concentrated around the grange and settlements, and one of these lies adjacent to the west-southwest of the site.

2.2.8 Post-medieval activity is prevalent in the form of listed buildings and farmhouses. Five Grade II listed buildings are located 600 m south-east of the survey area. These buildings are within the grounds of Cayton Hall and include the cart shed, stables, the larder, and a sundial shaft. Further listed buildings are located adjacent to the scheduled grange and settlement at High Cayton. These are Grade II listed and are associated with local agricultural activity. Remains of part of a railway dating to the 19th and early 20th century and some associated infrastructure have also been recorded within the vicinity.

2.2.9 Only one modern feature has been identified by the HER, an aircraft crash site (MNY26605). Modern sites would likely still be visited so the potential to encounter modern features is very low. A review of cartographic sources shows the site as agricultural field enclosures similar to the modern field alignment though several of the fields have been combined into larger modern fields, specifically, the fields in the eastern portion of the Site. Several tracks and paths are running through the site from High Cayton Farm.

2.3 Previous investigations related to the proposed development

Geophysical survey

2.3.1 An earlier phase of this project was undertaken by Archaeological Services WYAS in 2018, consisting of a detailed gradiometer survey immediately west of the site. The survey comprised 21 ha of land and was successful in identifying several former field boundaries and two square-shaped enclosures, indicative of settlement activity.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 15 – 19 August 2022. Field conditions at the time of the survey were overcast throughout the period of survey. An overall coverage of 56.73 ha was achieved, and 3.1 ha of the maize crop was unsurveyable located in the southern portion of LP_11.

3.1.2 The methods and standards employed throughout the geophysical survey conform to that set out in the Written Scheme of Investigation (WSI) (Wessex Archaeology 2022), as well as 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 Leica Captivate RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS) and Leica Geosystems. 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 eight SenSys FGM650/3 gradiometers spaced at 0.5 m intervals and mounted on a non-magnetic cart. Data were collected with an effective sensitivity of 0.03 nT at a rate of 10 Hz, producing intervals of 0.15 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 (±5 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 1:7000 (**Figures 2** to **3**) and 1:2,000 (**Figures 4** to **17**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image.

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 the 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 An area of positive linear and rectilinear anomalies have been identified in the LP_1 at **4000** – **4004** (**Figure 4**). The anomaly at **4000** forms a rectangular shape covering 70 m east – west by 78 m north – south. This anomaly is 2.5 – 3.5 m wide, becoming wider and more magnetically enhanced on its eastern side, possibly suggesting a different backfill to the ditch feature. The anomaly at **4000** forms an enclosure around several internal features.

4.2.2 Within the enclosure at **4000** are two curvilinear and penannular anomalies at **4001** and **4002**. The anomaly at **4001** appears more complete, having a diameter of 14 m and width of 2 m, with a 5 m in its eastern side. The anomaly at **4002** forms more of a crescent, suggesting a poorer state of preservation. This has a diameter of 13 m and width of 2 m. These anomalies likely relate to roundhouses or associated drip gullies.

4.2.3 Also within the enclosure at **4000** are several internal divisions, with examples at **4003** and **4004**. These likely form ditched segregated areas within the main enclosure, although there is no clear pattern to them beyond a shared alignment.

4.2.4 The anomalies at **4000** – **4004** consist of sharp, straight ditches with almost right-angled corners, characteristic of Romano-British construction. While the curvilinear internal anomalies indicate settlement activity in the form of roundhouses.

4.2.5 To the north and south of the settlement activity at **4000** – **4004** are several positive linear anomalies (**4005** – **4010**). To the south of the settlement activity is a positive linear anomaly

at **4005** that is 3 m wide and 110 m long, with an additional linear branching out to the west for 30 m. This is indicative of a boundary ditch. This likely extends to the west at **4006** and **4007** forming a 175 m long anomaly.

4.2.6 To the north of the enclosure (**4000**) is a 'T-shaped' positive linear anomaly at **4008**. The majority of the linear is orientated east – west for 60 m with a south-east extension that is 15 m long. It is possible this anomaly extends further west for 50 m, although it is very weak. Similarly to the anomalies at **4005** – **4007**, this likely relates to boundary ditch. Another extension of the anomaly may be present 200 m to the west at **4009** where a 45 m long north-east to south-west aligned anomaly has been identified. However, the large gap between the anomalies makes any relationship unclear. An additional, weaker 'L-shaped' anomaly has been interpreted immediately north of **4009** at **4010**. The anomaly is likely associated with **4009**, running parallel to it, and may form a 2.5 m wide track.

4.2.7 The anomalies at **4005** – **4010** appear to form the fragmented remains of a field system. It is not possible to determine from the geophysical data alone whether this is related to the settlement activity at **4000** – **4004** as there is no clear shared alignment or relationship between the anomalies. While it is possible the boundaries form link between the Romano-British settlement activity and further activity identified by ASWYAS (2018) 200 m to the west, it is equally possible the anomalies relate to a medieval or post-medieval field system.

4.2.8 Several other positive linear anomalies have been identified across the site that appear to form part of a wider field system (**4011** – **4027**). These are all 2 – 2.5 m wide and aligned on a roughly north-east to south-west by north-west to south-east co-axial system that appears to be an extension of the activity in LP_1 (**4005** – **4010**).

4.2.9 In the centre of the site (LP_8, **Figure 13**) is a rectilinear anomaly formed of several fragmented linear anomalies (**4011** – **4014**). This covers 105 m north-west to south-east by 150 m north-east to south-west, although it likely continues further to the north-east. The northern boundary of this feature (**4014**) appears to continue to the south-west at **4015**. The anomaly at **4015** potentially continues to be seen in the 2018 ASWYAS data, where the boundary continues south towards a rectangular enclosure.

4.2.10 A similar anomaly is present 170 m north-west of the northern boundary (**4014**) at **4016**. This is parallel to the other anomalies and extends 85 m. It appears to continue for a total of 340 m as four fragmented linear anomalies to the south-west in LP_7 (**Figure 11**) at **4017** – **4020**.

4.2.11 Towards the south, in LP_9 (**Figure 15**), is another positive linear anomaly at **4021**. This continues south into LP_10 at **4022** and **4023**, forming a 290 m long north – south aligned anomaly. To the west is a north-east to south-west aligned anomaly at **4024**. This likely once formed part of the same field boundary as the anomaly at **4021** but is not seen in its entirety within the data. The anomaly at **4024** continues west in the 2018 ASWYAS data, towards a rectangular enclosure, forming a 110 m long anomaly.

4.2.12 Two further linear anomalies thought to relate to ditched boundary features have been identified in the north of the site. In the north-west (LP_5, **Figure 11**), a positive anomaly has been identified at **4025**. This extends 105 m south-south-west before turning south-east for 45 m. While this anomaly is isolated from the other anomalies, the similar alignment and form suggests it is part of the same field system. In the north of the site, within LP_3 (Figure 6), an anomaly at **4026** is orientated south-east to north-west is 140 m long. An additional anomaly has also been recorded on a similar trajectory directly south-east at 4027. The two are separated by the former field boundary at **4039**. This anomaly continues in the ASWYAS (2018) data to the south-east, towards a rectangular enclosure.

4.2.13 Combined, the anomalies at **4011** – **4027** appear to form a large field system across the site. While it is not possible to provide an accurate date from the geophysical data alone,

there does not appear to be any correlation with the current arrangement of fields or any from available historic mapping. There do appear to be a relationship with the settlement activity in the north-east of the site (**4000** – **4004**) and enclosures identified by the 2018 ASWYAS survey. While the fragmented nature of the anomalies, caused by modern boundaries and plough damage, means there is no clear continuation between the boundaries and settlement activity, it is likely they are contemporaneous.

4.2.14 Across the site there are numerous linear and curvilinear anomalies that have been interpreted as possible archaeology. These may be weak, isolated, or not share any clear relationship or pattern with surrounding anomalies and features.

4.2.15 In the eastern portion of LP_3 an area of weakly positive anomalies has been identified at **4028** (**Figure 8**). Two sub-rounded linear anomalies appear to form the extents of a rectilinear formation. the eastern anomaly is slightly curving orientated north-west to south-east, measuring 2 m wide and 48 m long, while the western has more of an 'F-shaped' form of similar size. Although there are a lot of geological deposits visible in the area, these anomalies could form the eastern and western/northern extents of an enclosure of unknown date. A firmer interpretation is difficult given their weak magnetic properties and surrounding geological and agricultural anomalies. Given, however, the proximity to other enclosures in the area, it is still conceivable that the anomalies are archaeological in origin.

4.2.16 Across the north of the site are several linear anomalies interpreted as possible archaeology. In the north-east of the site (LP_2, **Figure 5**) are two parallel weakly positive anomalies at **4029**. These are 75 m long north – south by 1.5 m wide and separate by 1.8 m. While these may relate to archaeological ditch features, they share an alignment with the modern agricultural activity in the field so are considered more likely to be associated with this. They also appear to extend from an area of natural geological variation to the south, so could form part of this. Immediately west of the parallel anomalies is another weakly positive north-south aligned anomaly at **4030**. This is 65 m long by 2.5 m wide, turning to the north-west at its northern end. Similarly to the anomalies at **4029** this could be an archaeological boundary feature but could equally relate to modern agricultural activity or natural variation.

4.2.17 In the southern half of LP_3 (**Figure 8**) a gently curving linear has been identified at **4031**. The positive anomaly is 70 m in long east – west by 2 m in wide. The anomaly is likely a ditch and may be an archaeological in origin. Large geological bands highlighted directly north, appear to terminate at **4031**. This termination could indicate that the anomaly relates to a former field boundary, not recorded on first edition mapping. The anomaly is also orientated towards and in the proximity of, the settlement activity previously discovered 70 m to the east, therefore, indicating a potential connection between the two. Directly to the south is a small area of increased magnetic response at **4032**. The curving anomaly is orientated north – south, measuring 50 m long by 11 m wide. While it is possible this relates to archaeological activity, the strong magnetic values suggest a modern agricultural origin is more likely.

4.2.18 Two parallel weakly positive anomalies have been identified in the north-east of LP_7 (**Figure 9**) at **4033**. Both anomalies are 68 m long by 1.5 m wide, orientated east – west. The anomalies are indicative of ditch features, which could combine as a possible trackway. It is these are a continuation of the anomaly at **4031**, 94 m directly east, as they appear to be on a similar orientation. However, they could equally relate to modern agricultural activity.

4.2.19 It the north-west of LP_7 is another weakly positive linear anomaly at **4034**. This is 70 m long north-east to south-west by 1.5 m wide. This is indicative of a ditch feature and may relate to an archaeological boundary. However, it could equally relate to modern agricultural activity.

4.2.20 There are several weakly positive penannular anomalies across the north of the site (**4035** – **4038**). These all have the potential to be ring ditch features, possibly relating to small enclosures or round houses. However, their weak magnetic response and relative isolation from any associated anomalies make confident interpretation difficult. It is equally possible that these represent natural geological variation or agricultural activity.

4.2.21 The anomaly at **4035** is in the west of the site (LP_6, **Figure 11**). It is 15 m in diameter with a width of 1.5 m and an open north-western side. The anomalies at **4036** and **4037** are both in LP_7 (**Figure 11**). The anomaly at **4036** is the better formed at 8 m in diameter with a width of 1 m and a 3 m opening to the south. The anomaly at **4037** forms a 10 m diameter crescent open to the north. The anomaly at **4038** is in LP_ 1 (**Figure 5**) and represents the highest potential to be archaeological due to its proximity to the settlement activity at **4000** – **4004**. The anomaly is 10 m in diameter with a width of 1 m and is open to the east.

4.2.22 Several former field boundaries have been identified centrally across the site in LP_3 and LP_9. All of these are first recorded on 1856 OS mapping, although appear to have been removed or modified at different periods since. In LP_3 (**Figure 7**) the anomaly **4039** is 200 m long, orientated north-west to south-east, and is still recorded on the 1956 OS mapping but no longer visible on satellite mapping dated 2002 (Google Earth 2022). The boundary at **4040** is 30 m long west-west-north to east-east-south and is last visible on 1914 OS mapping. In LP_9 (**Figure 15**), two parts of a boundary last recorded on OS mapping in 1946 are noted at **4041** and **4042**. They are 135 m long in total north – south.

4.2.23 Across the site there are multiple areas of weak, positive, parallel, linear anomalies. The average distance between lines is 6 m, and they are often of a curved form. These anomalies have been interpreted as areas of ridge and furrow and are thought to be medieval due to their curved form and spacing. The orientations of these anomalies do alternate across the site. The vast majority are orientated either east – west (**4043** – **4050**) or north – south (**4051** – **4055**). There are additional instances where ridge and furrow have been recorded orientating north-east to south-west (**4056** – **4057**) and north-west to south-east (**4058**).

4.2.24 Several modern agricultural anomalies have also been identified within the site in the form of ploughing and modern land drains. The land drains are identifiable via their linear form and weak dipolar magnetic properties.

4.2.25 Throughout the site there are several instances magnetically strong anomalies. Most notable are caused by pylons located in LP_2, LP_6, and LP_7 at **4059** – **4065**.

4.2.26 There are multiple large bands of low magnitude anomalies across the site. Due to their lack of clear shape or pattern, these have been interpreted as natural geological variation. The most dominant example of this can be seen centrally in LP_3 and LP_8.

5 DISCUSSION

5.1 Results

5.1.1 The gradiometer survey has been successful in detecting anomalies of archaeological origin across the site, particularly an area of settlement and possibly associated field system.

5.1.2 An enclosure in the north-east of the site contains two penannular anomalies thought to relate to round houses or drip gullies associated with round houses. This is thought to be Iron Age or Romano-British in date. Surrounding the enclosure, and across the majority of the site, are the remains of a large field system. While it cannot be confirmed from the geophysics data alone, it is likely this is associated with the settlement activity.

5.1.3 When assessed alongside the anomalies found during the 2018 ASWYAS survey of the area, it appears the wider site contains three areas of settlement or enclosure that are likely linked by the field system. There is no evidence of large-scale or dense settlement, so it is possible this represents agricultural activity with a small area of settlement.

5.1.4 There are numerous anomalies that have been identified across the site. The majority of these are too weak or isolated to offer confident interpretation. The anomalies include a possible enclosure, several possible boundary features, and four possible ring ditches. While it is possible these relate to the surrounding settlement and field system, they could equally relate to natural features or later agricultural activity.

5.1.5 The site's agricultural past is also evidenced by areas of ridge and furrow across the site. The majority of these are widely spaced and 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.

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

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Cartographic and documentary sources

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 1, Soils of Northern England.* Southampton.

Online resources

Archaeological Data Service (acceded September 2022) http://archaeologydataservice.ac.uk/advice/FilelevelMetadata.xhtml#Geophysics and Remote Sensing

British Geological Survey Geology of Britain Viewer (acceded September 2022) http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Google Earth website http://earth.google.com (acceded September 2022)

Historic England (HE) https://historicengland.org.uk (acceded September 2022)

Heritage Gateway website https://www.heritagegateway.org.uk/gateway/ (acceded September 2022)

National Library of Scotland (NLS) https://maps.nls.uk/geo/explore/ (acceded September 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 ±8 µT over ±1000 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 FMG650/3 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 subdivided 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.

Appendix 3 OASIS form

Project Details:

Project name	The project title				
Type of project	Detailed gradiometer survey (Field evaluation)				
Project description	The detailed gradiometer survey has been successful in detecting anomalies of archaeological origin. In the north-east of the site, an enclosure of Romano-British origin with internal divisions has been identified. Penannular anomalies have also been recorded within the enclosure, thought to pertain to prehistoric ring ditches. Indicative of multi-phased settlement activity. Across the remainder of the survey, several additional anomalies have been identified as archaeological in origin. Further ditch-like features have been identified, likely former field divisions associated with archaeological activity in the area. Those near the enclosure are likely associated and may represent protective boundary ditches. Multiple linear and curvilinear anomalies have been highlighted as possible archaeology across the site. In the north-east of LP_3, a series of weakly positive anomalies have been identified, forming a rectilinear shape. This assortment may combine to form an additional enclosure of unknown age. It may also be possible that these anomalies are geological in origin. Additional possibly archaeological anomalies have also been interpreted in the form of possible ring ditches and former field boundaries not recorded on first edition OS mapping. Several isolated instances of increased magnetic responses have been identified, resulting from pylons present on site. Additional disturbances located along the periphery of certain fields are likely the result of ferrous material present in current field boundaries. Additionally, former field boundaries, geological and ferrous debris, ridge and furrow, drainage and modern ploughing have also been identified.				
Project dates	**Start:** 15-08-2022		**End:** 19-08-2022		
Previous work	DBA and Geophysical Survey				
Future work	Unknown				
Project Code: 268160	**HER event no.**	If relevant	**OASIS form ID:**	wessexar1-509254	
	NMR no.	N/A			
	SM no.	N/A			
Planning Application Ref.	19/02259/EIAMAJ				
Site Status	None				
Land use	Agricultural				
Monument type	N/A	**Period**	N/A		

Project Location:

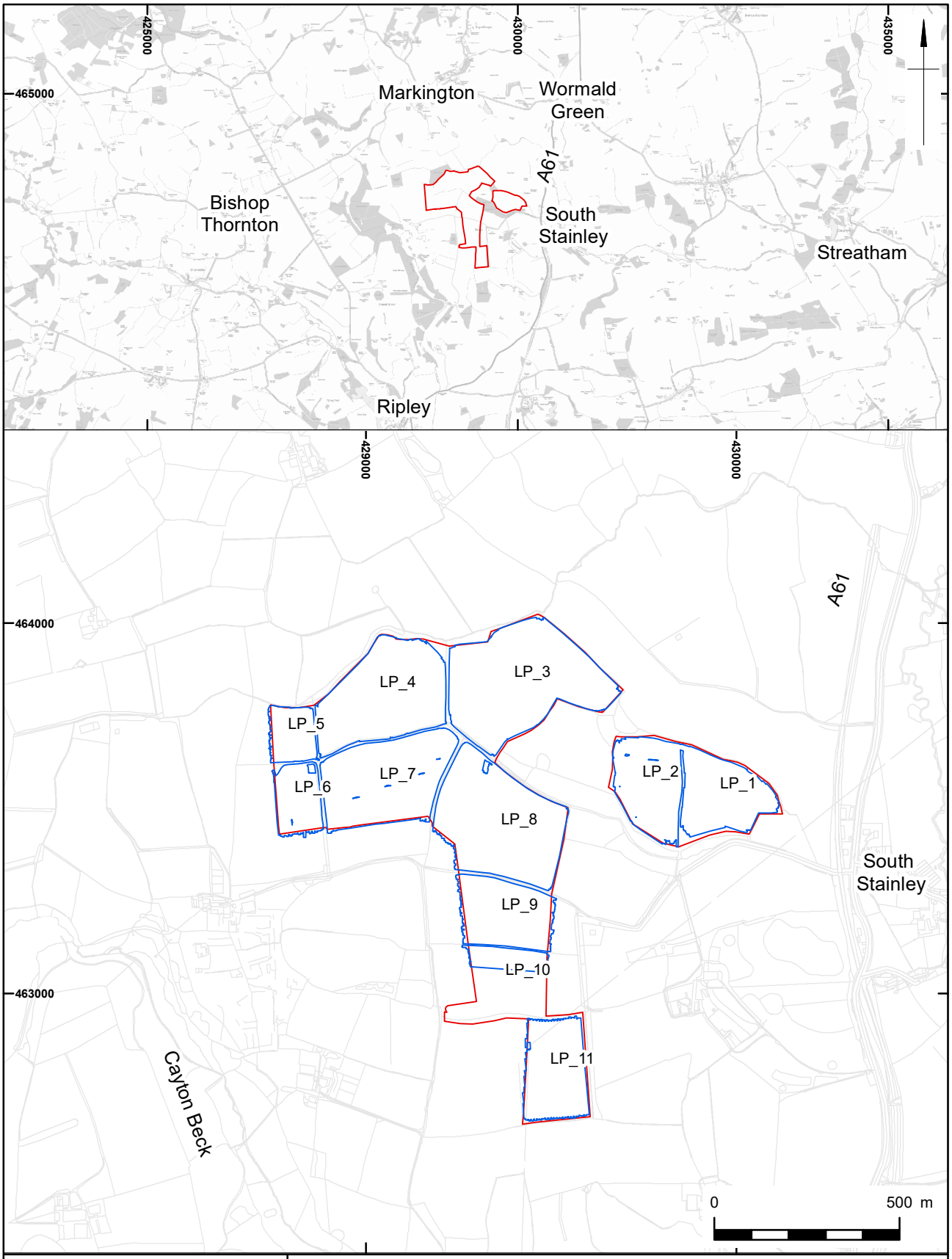
Site Address	Land off Water Lane, South Stainley, North Yorkshire			**Postcode**	HG3 3LY
County	North Yorkshire	**District**	Harrogate	**Parish**	South Stainley and Clayton
Study Area	62.2 ha	**Height OD**	20 – 25 m aOD	**NGR**	429938 463047

Project Creators:

Name of Organisation	Wessex Archaeology		
Project brief originator	Arcus Consultancy Services Ltd	**Project design originator**	Tom Richardson
Project Manager	Tom Richardson	**Project Supervisor**	Alastair Trace
Sponsor or funding body	Arcus Consultancy Services Ltd	**Type of Sponsor**	Private

Project Archive and Bibliography:

Physical archive	N/A	**Digital Archive**	Geophysical survey and report	**Paper Archive**	N/A
Report title	Cayton Solar, South Stainley, North Yorkshire			**Date**	2022
Author	Wessex Archaeology	**Description**	Unpublished report	**Report ref.**	268160.04



Site boundary

Detailed survey extents

Coordinate system: OSGB36

Date:	08/09/2022	Revision Number:	0
Scale:	1:75,000 & 1:15,000 at A4	Illustrator:	ADT
Path:	X:\Projects\268160l\GIS\MXD		

Site location and survey extent

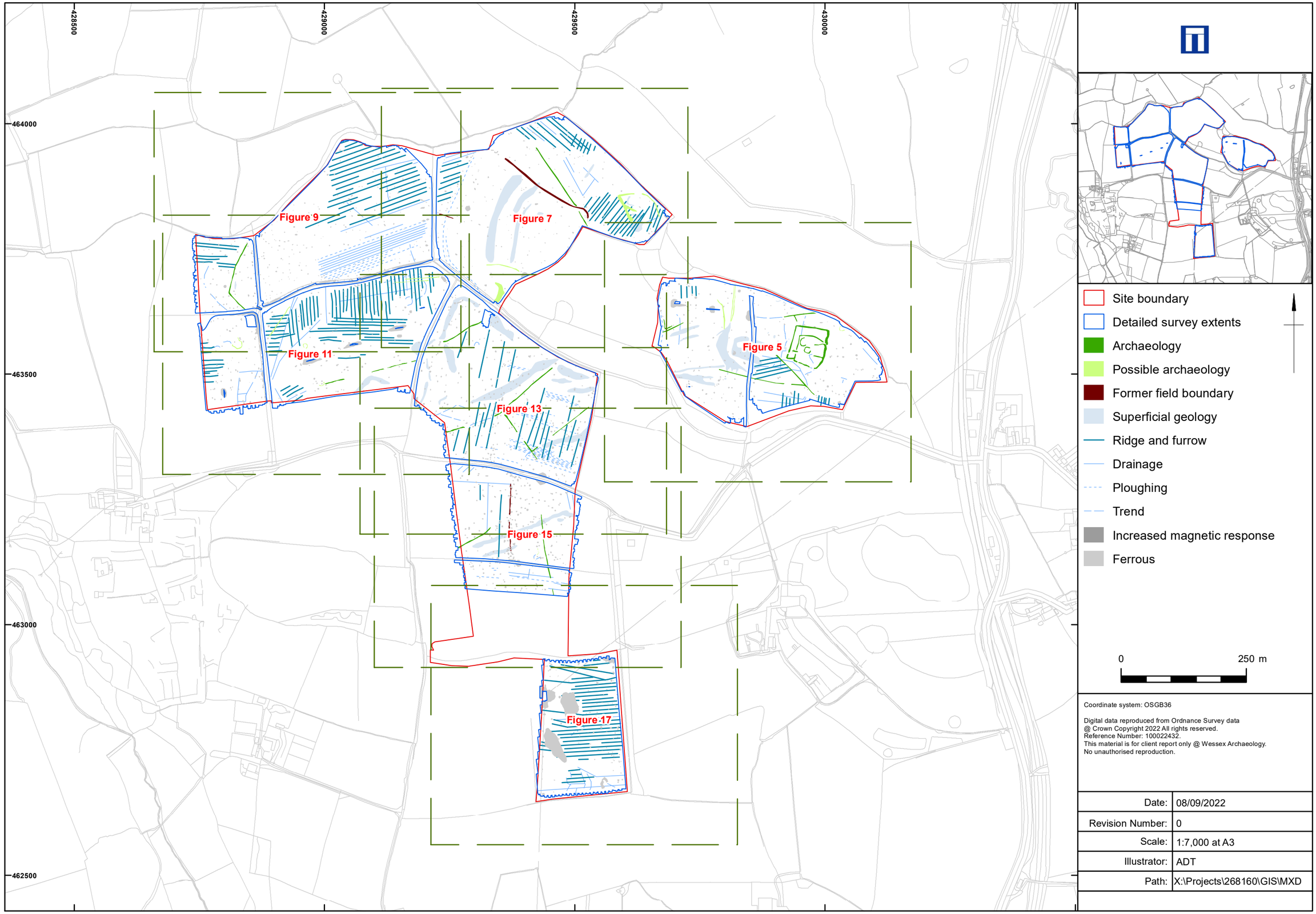
Figure 1

428500
429000
429500
430000
464000
463500
463000
462500
Figure 8
Figure 6
Figure 10
Figure 4
Figure 12
Figure 14
Figure 16
Site boundary
Detailed survey extents
-2
3
0
250 m
Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
Scale:	1:7,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

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

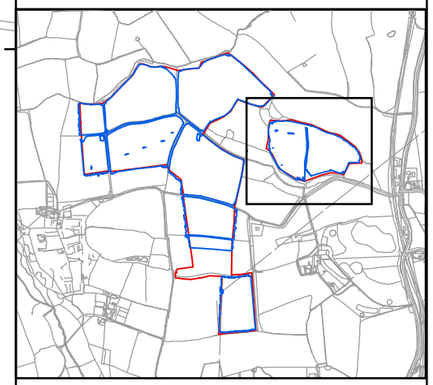
0 250 m

Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
Scale:	1:7,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: overall interpretation

Figure 3



Site boundary

Detailed survey extents

-2

3

0

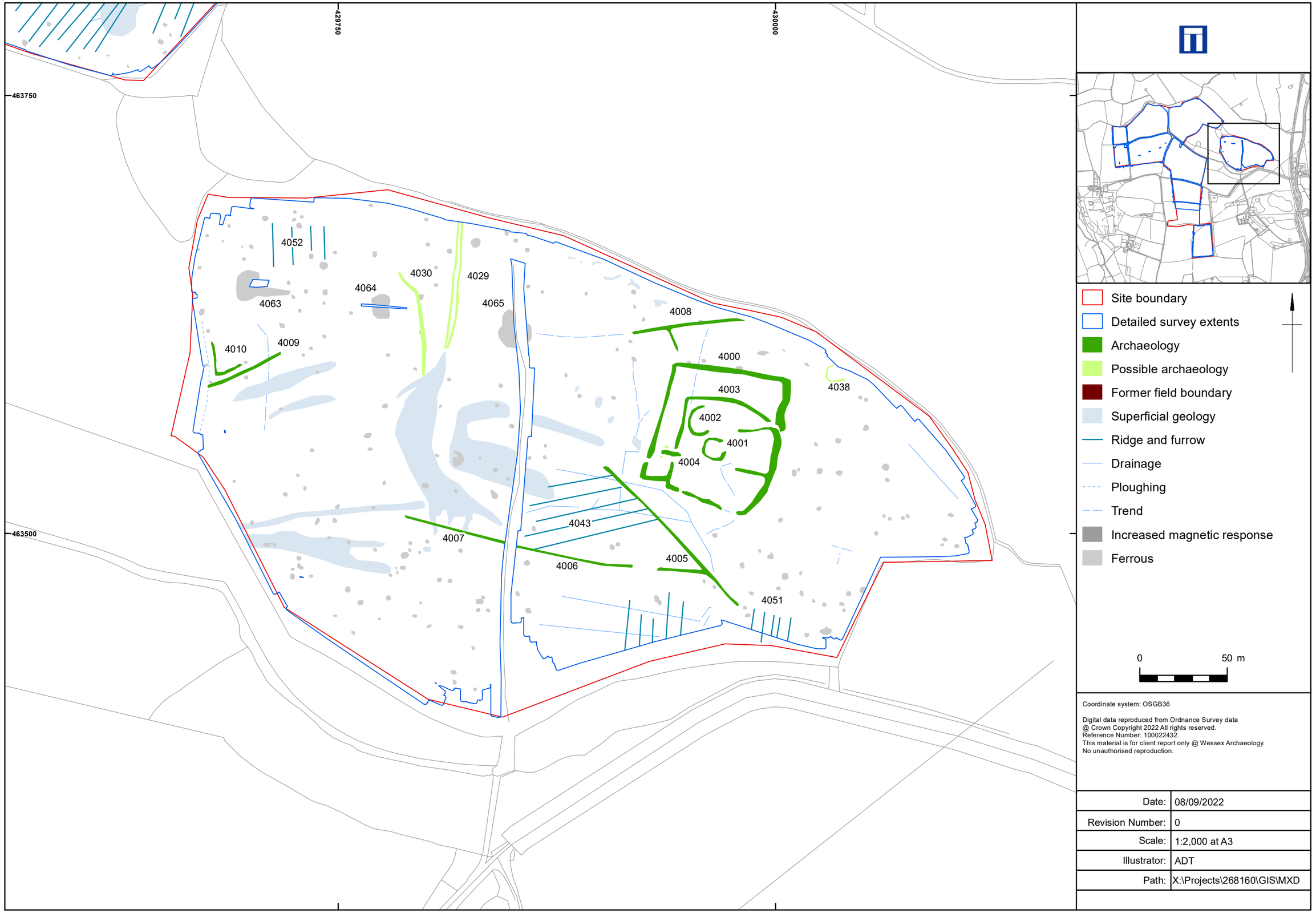
50 m

Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: greyscale plot LP_1 and LP_2

Figure 4



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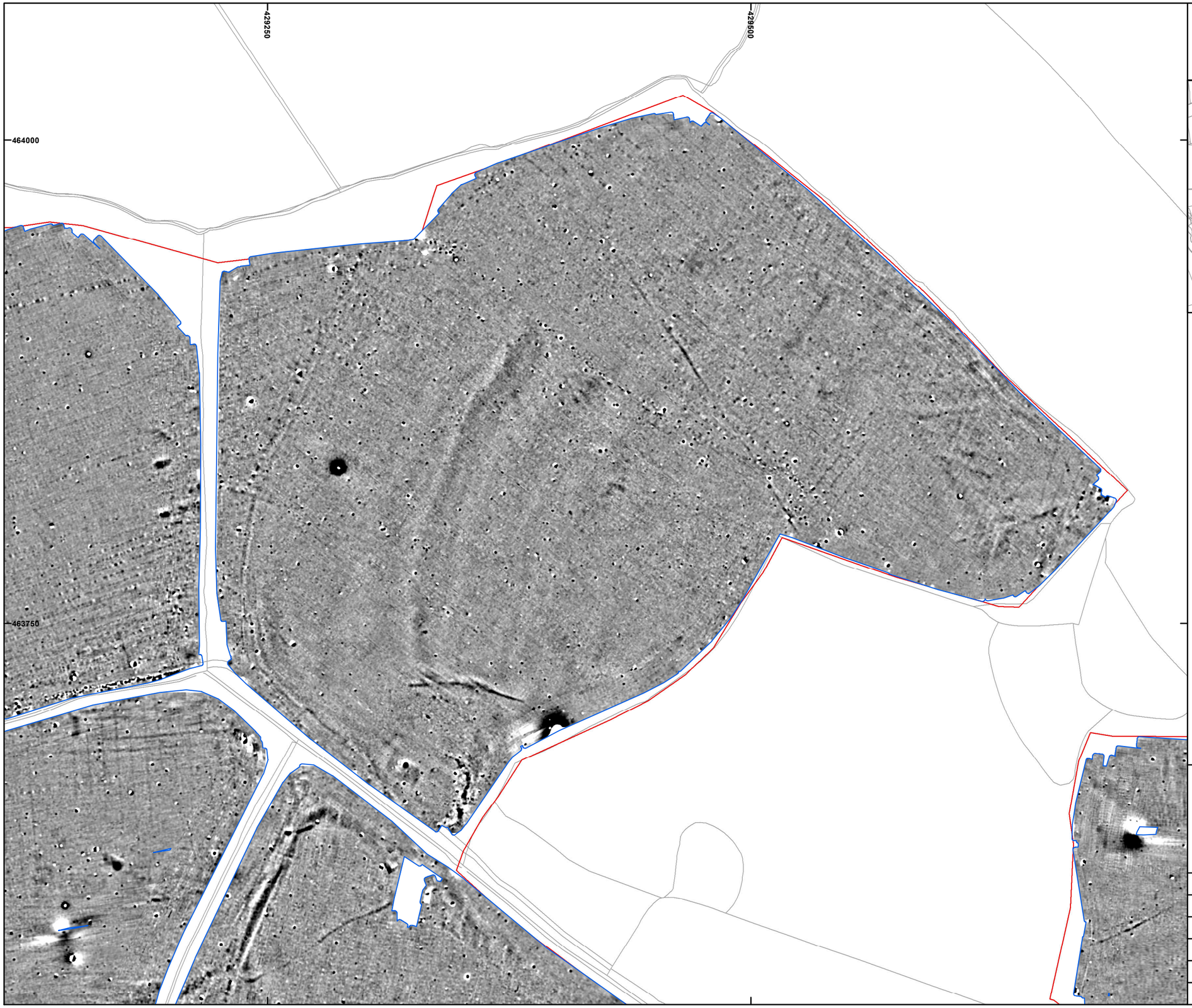
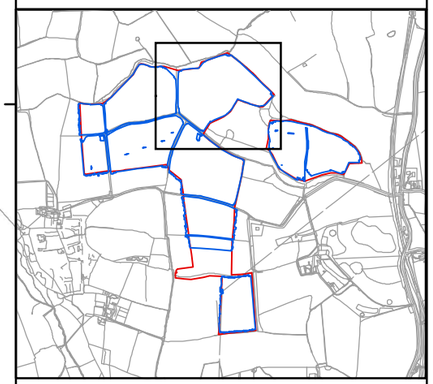
Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: interpretation LP_1 and LP_2

Figure 5





Site boundary

Detailed survey extents

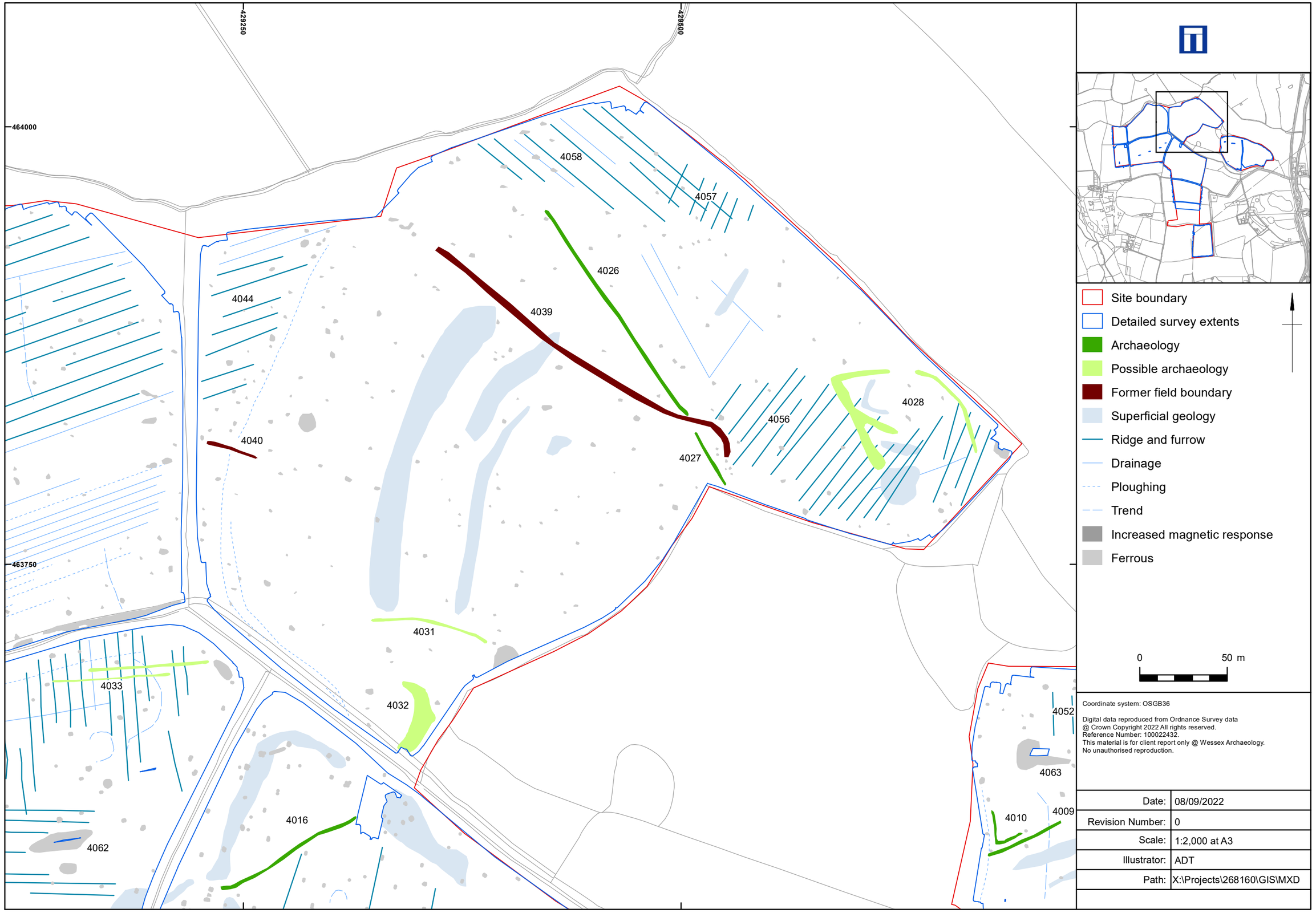
-2 3

0 50 m

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: greyscale plot LP_3

Figure 6



Detailed gradiometer survey results: interpretation LP_3

Figure 7

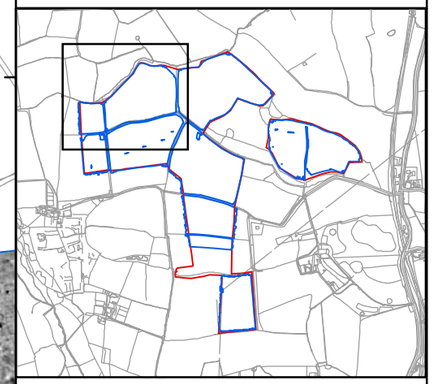
428750

429000

429250

464000

463750



Site boundary

Detailed survey extents

-2

3

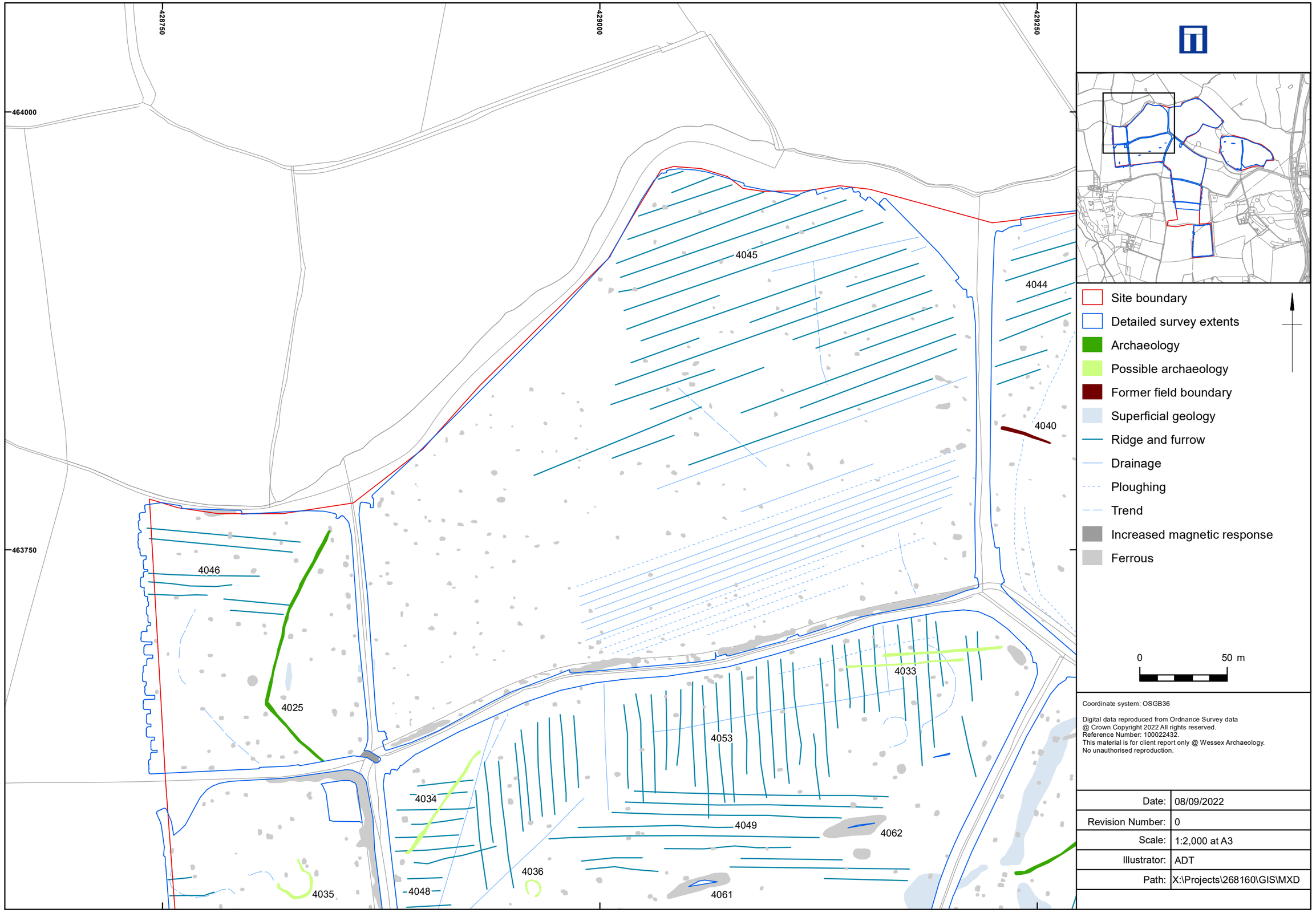
0

50 m

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: greyscale plot LP_4 and LP_5

Figure 8



Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
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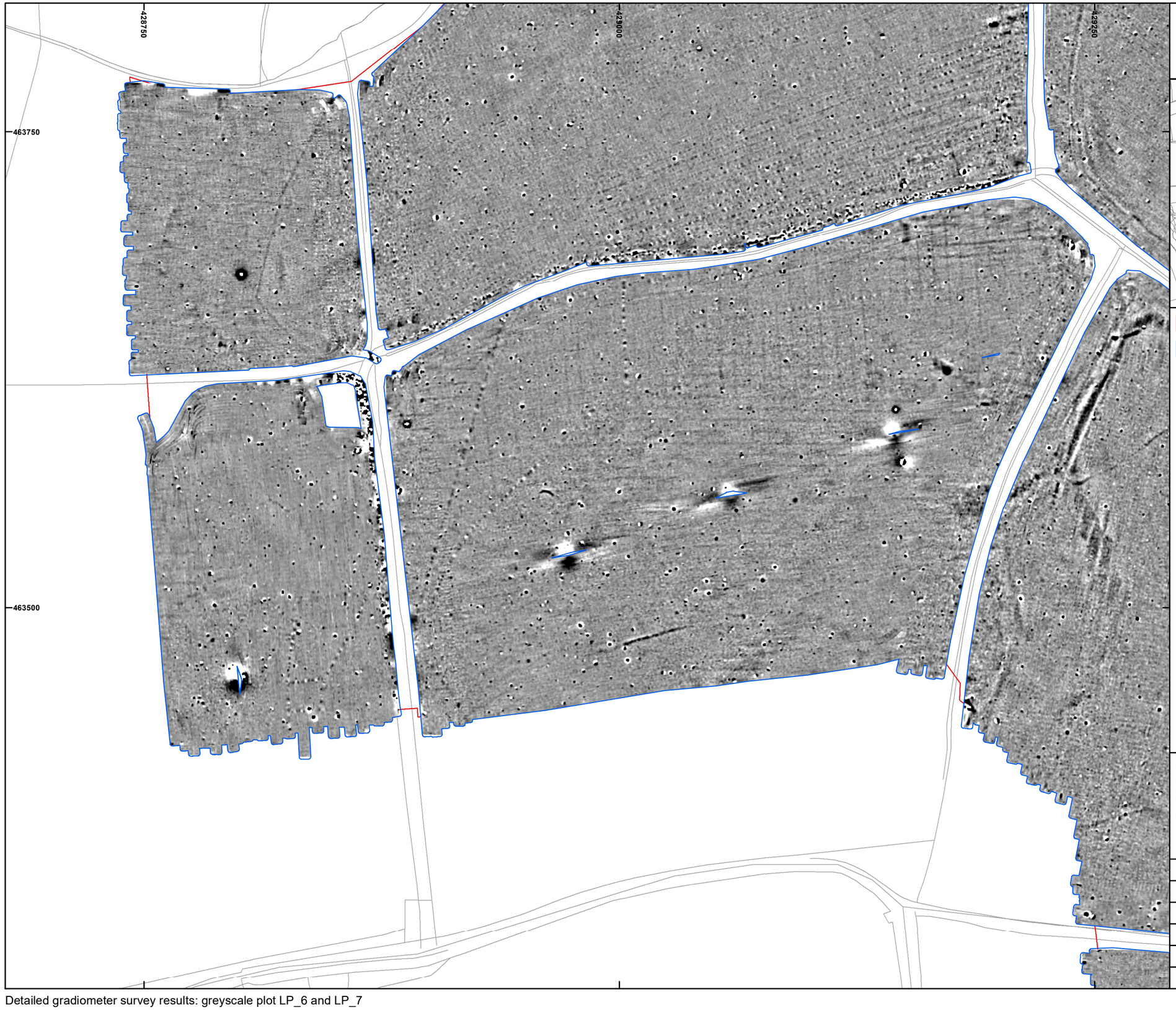
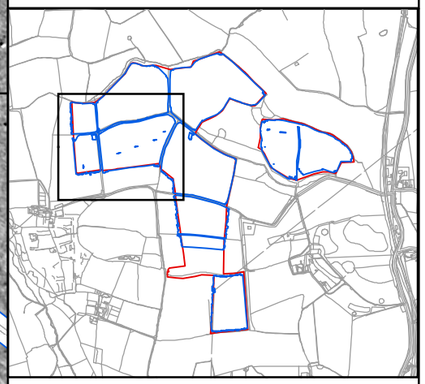
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: interpretation LP_4 and LP_5

Figure 9





Site boundary

Detailed survey extents

-2

3

0

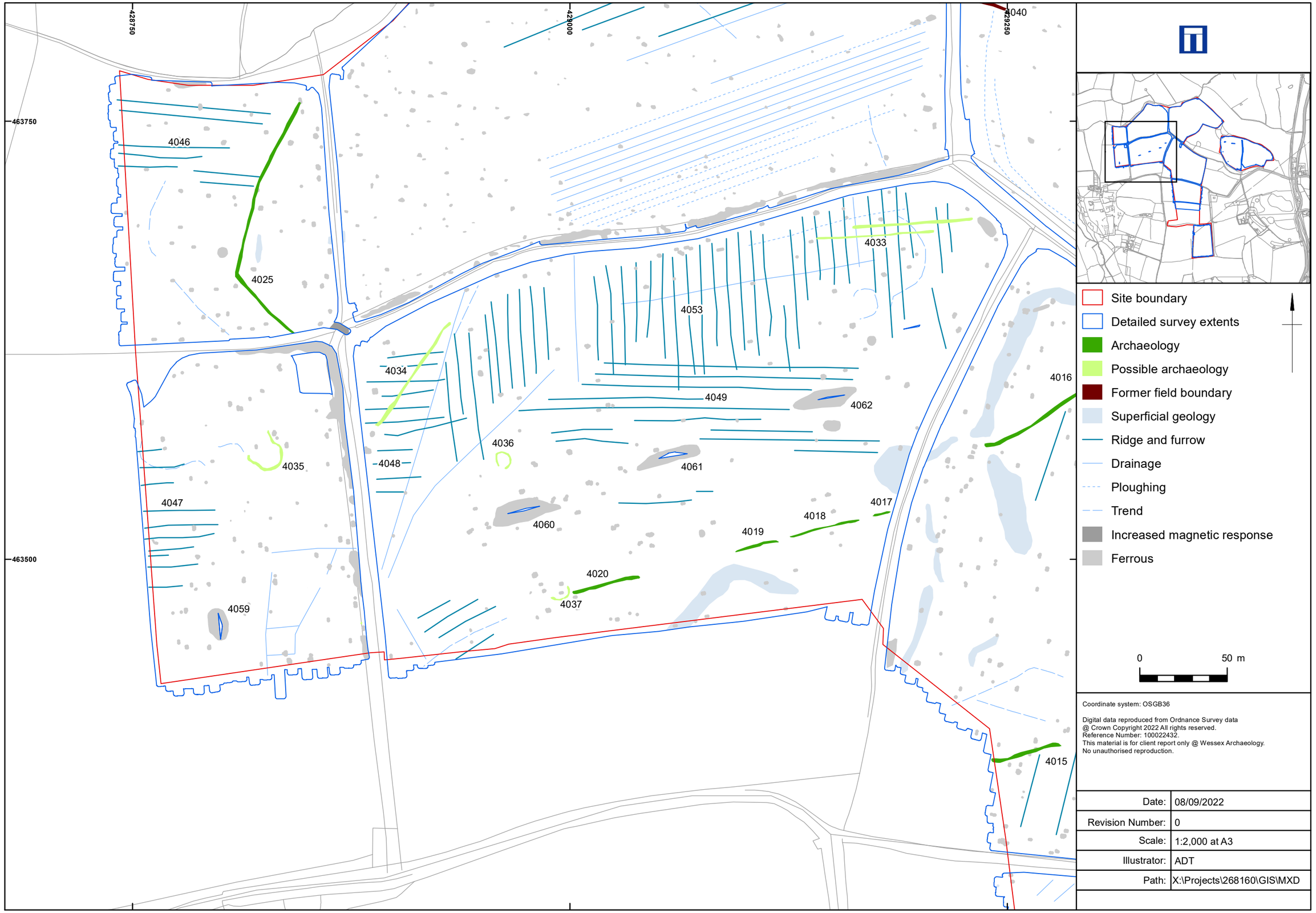
50 m

Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: greyscale plot LP_6 and LP_7

Figure 10



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Date:	08/09/2022
Revision Number:	0
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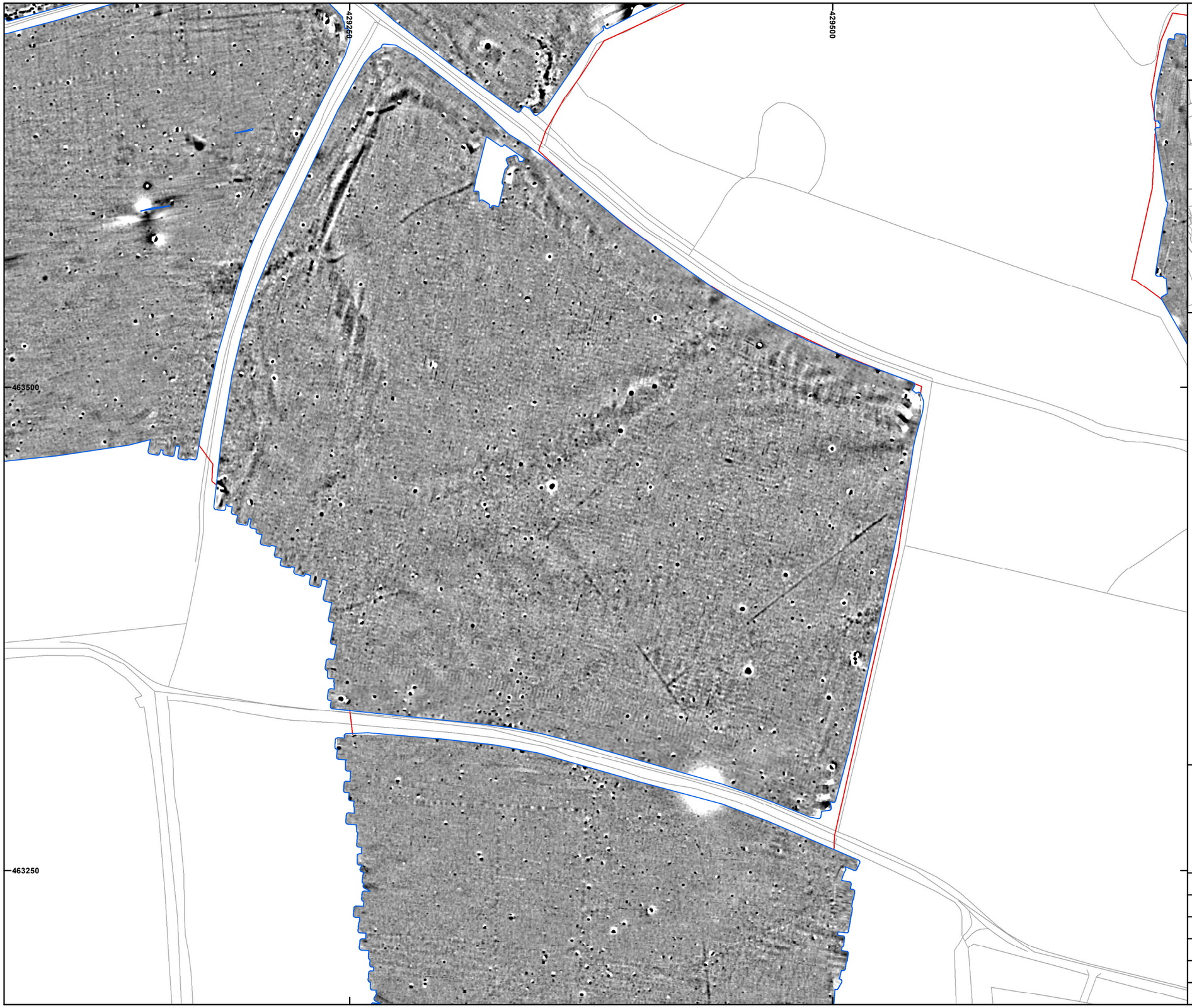
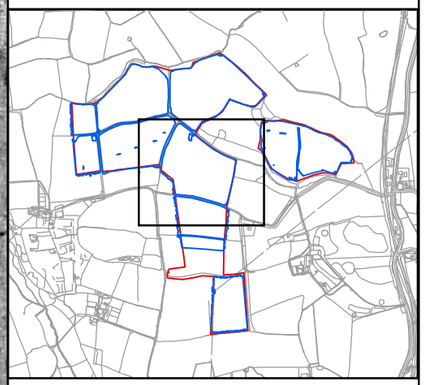
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: interpretation LP_6 and LP_7

Figure 11





Site boundary

Detailed survey extents

-2

3

0

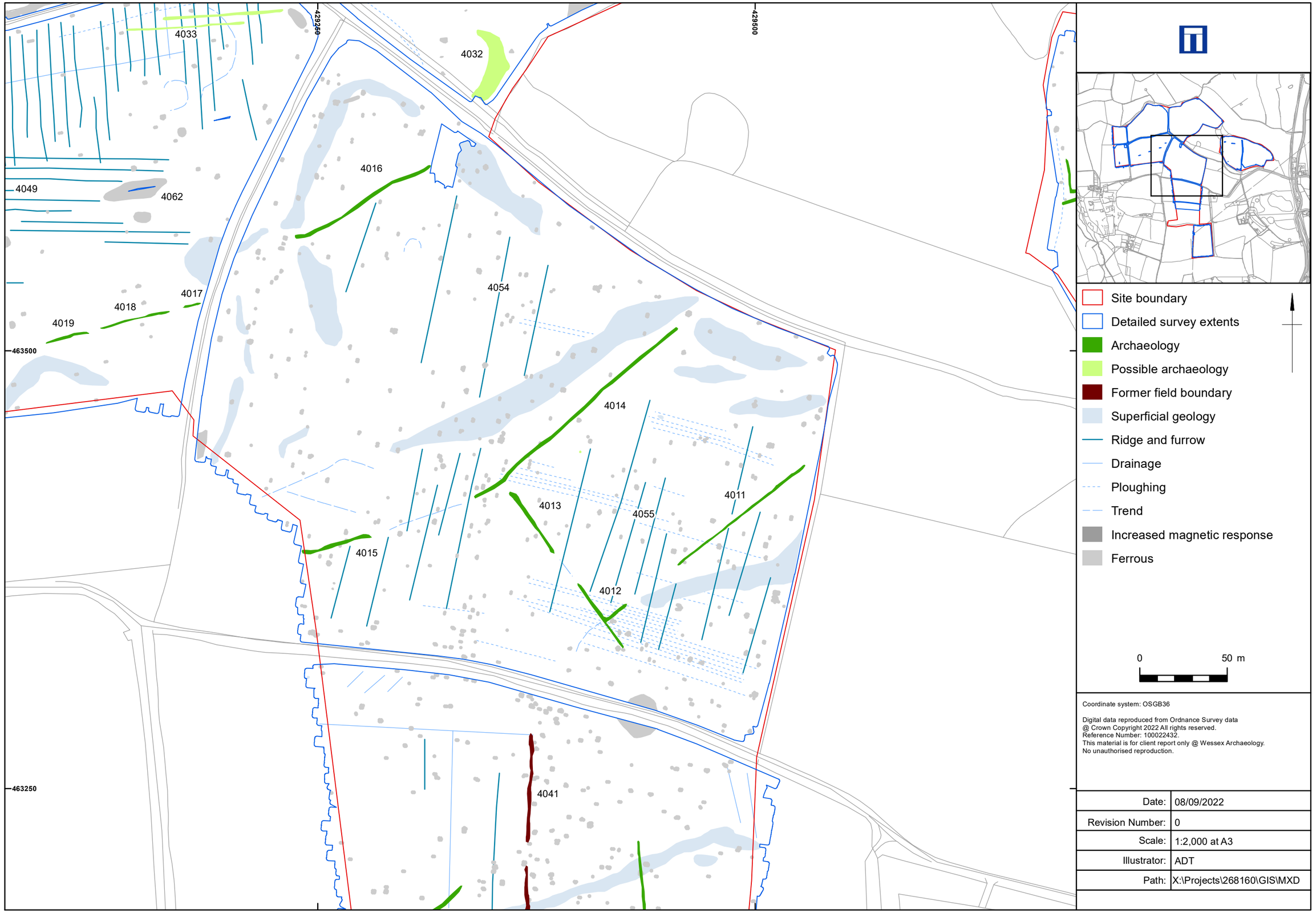
50 m

Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: greyscale plot LP_8

Figure 12



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Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: interpretation LP_8

Figure 13

Site boundary

Detailed survey extents

-2

3

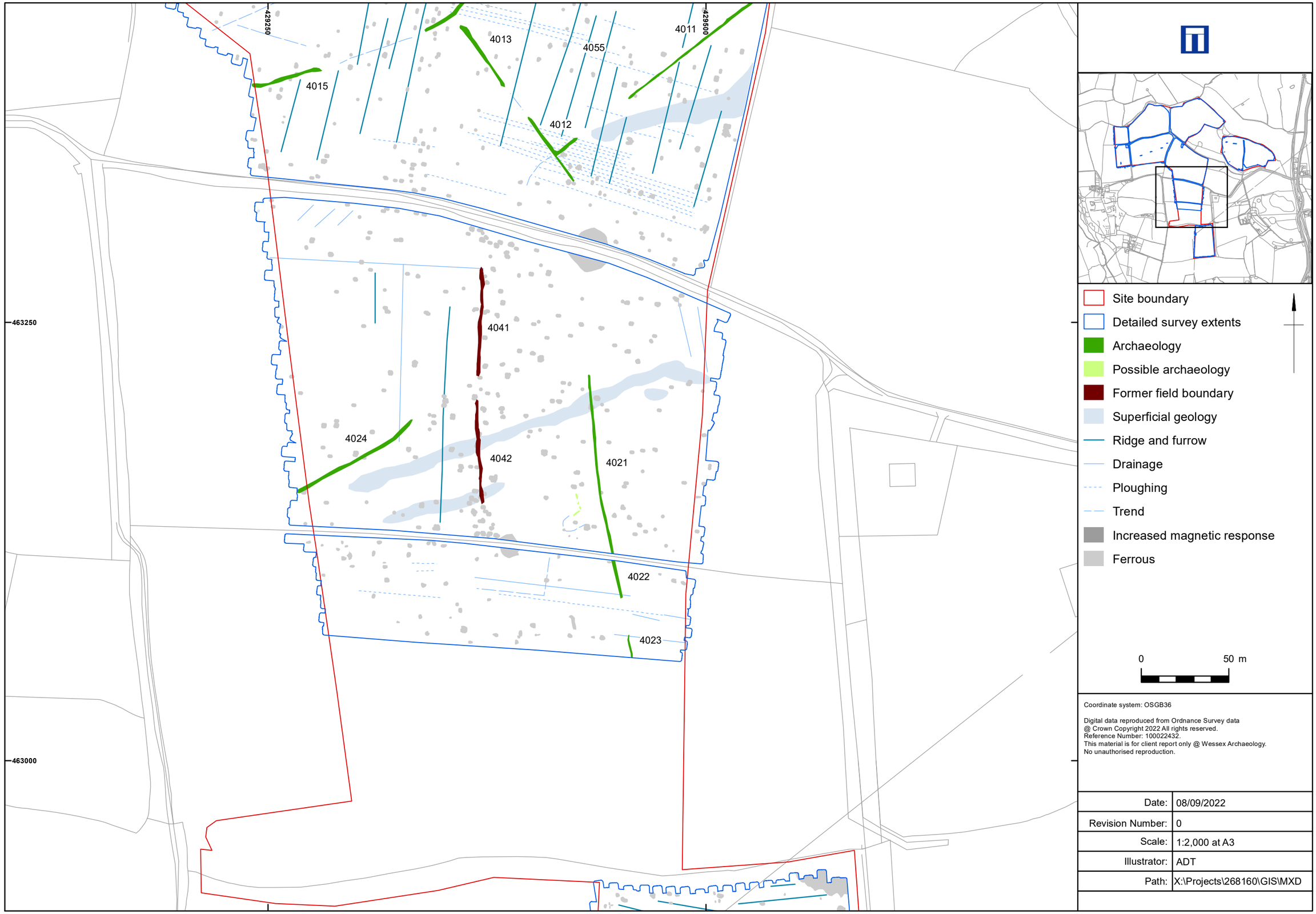
0

50 m

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

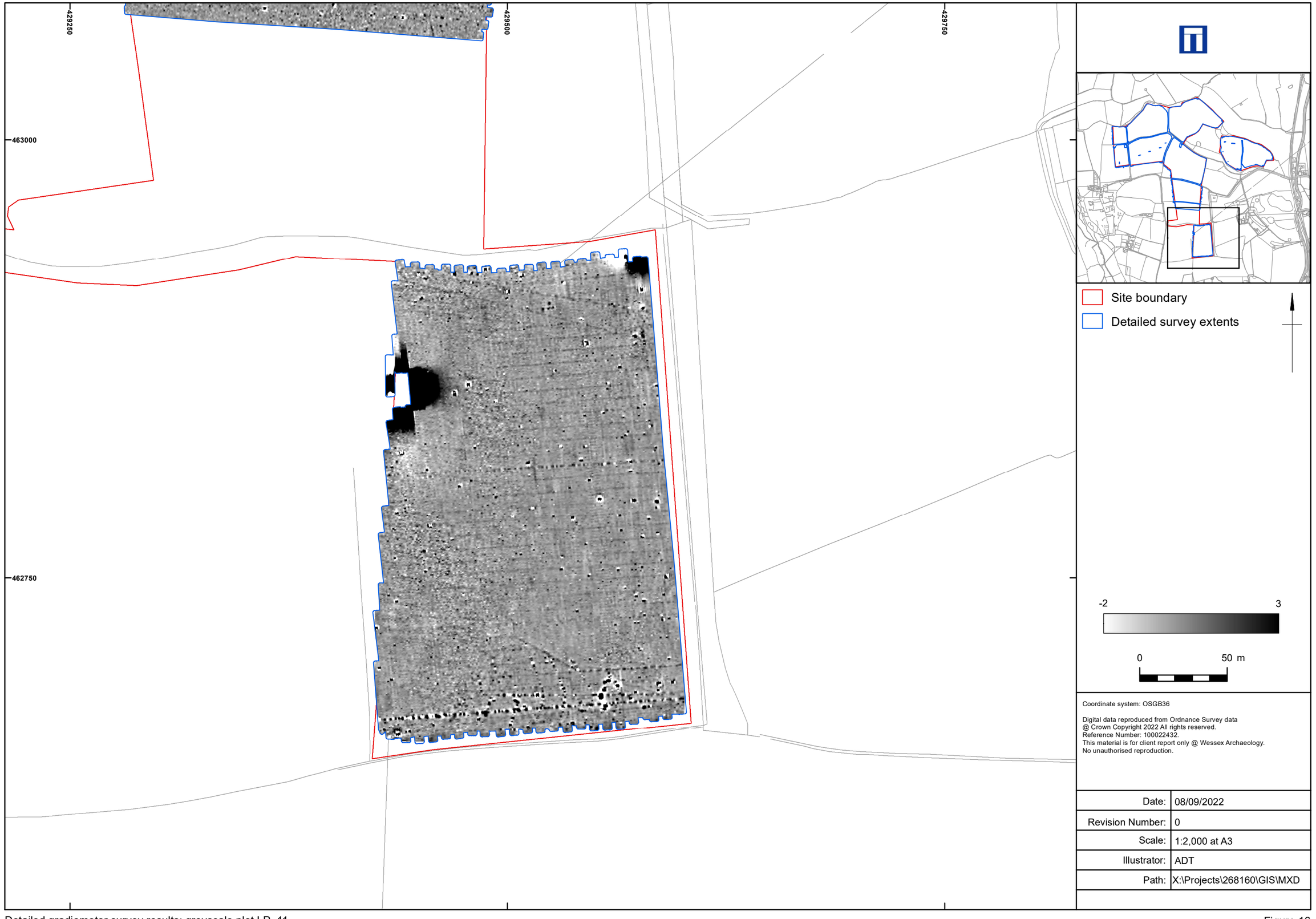
Detailed gradiometer survey results: greyscale plot LP_9 and LP_10

Figure 14



Detailed gradiometer survey results: interpretation LP_9 and LP_10

Figure 15



Site boundary

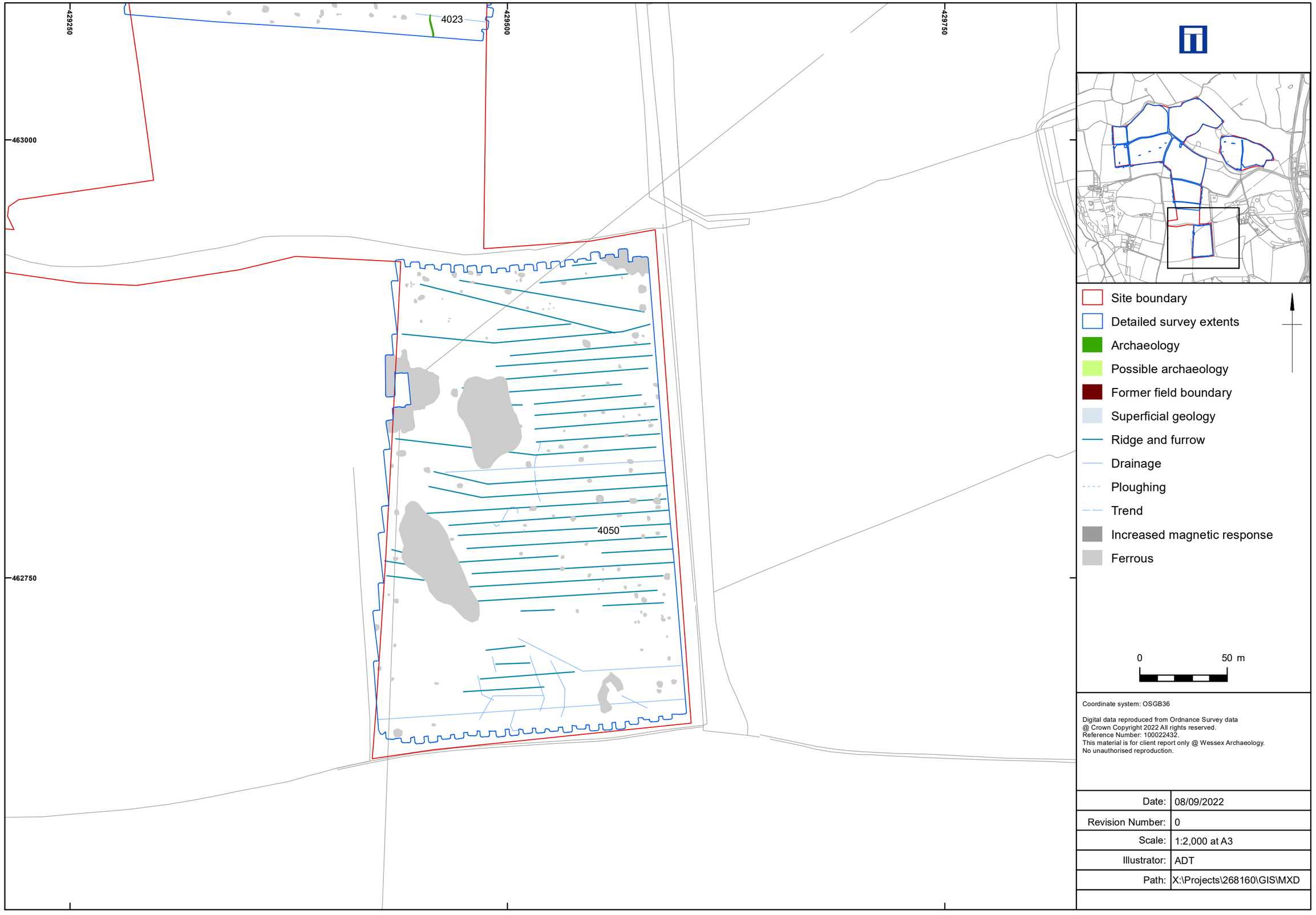
Detailed survey extents

Coordinate system: OSGB36

Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: greyscale plot LP_11

Figure 16



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Date:	08/09/2022
Revision Number:	0
Scale:	1:2,000 at A3
Illustrator:	ADT
Path:	X:\Projects\268160\GIS\MXD

Detailed gradiometer survey results: interpretation LP_11

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