



# Land south of Halifax Road, Pendle, Lancashire

Detailed Gradiometer Survey Report

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County Lancashire

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## Summary

A detailed gradiometer survey was conducted over land south of Halifax Road, Pendle, Lancashire (centred on NGR SD 86041 36511). The project was commissioned by The CDS Group (Bedford) with the aim of establishing the presence, or otherwise, and nature of historical mine entrances and any other detectable archaeological features in support of a planning application for the development of the site as a new cemetery, with associated landscaping, infrastructure and burial area.

The site comprises pastoral fields located south of Halifax Road, Nelson, covering an area of 5.62 ha. The geophysical survey was undertaken on the 02 and 25 May, and 08 June 2023.

The geophysical survey has identified several areas in the south and east of the site containing anomalies which may be associated with mine workings, however other explanations such as agricultural, general land management, manholes and rubbish disposal are also likely.

In the south-west of the site structural features, likely foundations, and associated demolition material have been detected within a wider area of rubble. It is likely these are the remains of structures recorded on historical OS mapping. It is not clear whether these structures were associated with mine working due to their proximity to proposed mine entry shafts. They may equally represent unrecorded structures possibly associated with agricultural activity.

In the east of the site a highly magnetic large square, structural feature has been detected. It is possibly the concrete foundations of a large building or other structure such as a large footing, or cap, related to a mineshaft entry.

Several large ferrous responses have been detected in the south of the site, with two of these near a recorded mapped mineshaft. Whilst these anomalies have the potential to be a small metal mineshaft cap, given the continued use of the site including landscaping and drainage, these anomalies are likely manhole covers or modern metallic waste.

An area of highly magnetic rubble or disturbed ground has been detected in the very east of the site. This may be related to debris from former mine works. However, it is equally likely that this is spread of rubble or waste material because of construction of nearby allotments or housing that fringe the perimeter of the site.

Two areas of highly magnetic responses have been detected in the north and west of the site. In the north are the remnants of allotments built between 1955 and 1965-67 and demolished between 1965-67 and 2000. In the west are the remains of demolished tennis courts which were built between 1913-14 and 1929-30 and demolished between 1955 and 1965-67.

Several former field boundaries have also been recorded throughout the site that demonstrate the previous division of the land.

The only other anomalies of note all pertain to modern features such as services, drainage, and footpaths.



## **Acknowledgements**

Wessex Archaeology would like to thank The CDS Group for commissioning the geophysical survey. The assistance of Eliot Winter is gratefully acknowledged in this regard.

The fieldwork was undertaken by Amy Dunn, Jack Trueman, Phoebe Baker and Zhaxi Luobu. Alastair Trace and Lydia Jones processed the geophysical data. Jack Trueman and Lydia Jones interpreted the geophysical data. Lydia Jones wrote the report and prepared the illustrations. The geophysical work was quality controlled by Brett Howard. The project was managed on behalf of Wessex Archaeology by Patricia Edwards.



# Land South of Halifax Road, Pendle, Lancashire

## Detailed Gradiometer Survey Report

### 1 INTRODUCTION

#### 1.1 Project background

1.1.1 Wessex Archaeology was commissioned by The CDS Group to carry out a geophysical survey at the Land south of Halifax Road, Pendle, Lancashire (centred on NGR SD 86041 36511) (**Figure 1**). The survey forms part of an ongoing programme of works being undertaken in support of a planning application for the development of the site as a cemetery, along with associated landscaping, infrastructure, and burial areas.

#### 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 460 m south of the centre of Little Marsden and 2 km north-east of Burnley in the county of Lancashire.

1.3.2 The survey comprises 5.62 ha of rough grassland used for animal grazing. The site is bounded by residential buildings and Halifax Road to the north, allotments and housing to the east, further rough grassland and housing to the south, and residential housing to the west.

1.3.3 The site is on a slight incline sloping from 211 m above Ordnance Datum (aOD) at the western edge to 240 m aOD at the eastern edge.

1.3.4 The solid geology comprises Dandy Rock - Sandstone of the Pennine Lower Coal Measures Formation with overlying superficial deposits of Diamicton Till (BGS 2023).

1.3.5 The soils underlying the site have not been mapped, likely due to the urban environment and subsequent man-made changes around, and within, the site (SSEW SE Sheet 3 1983).

### 2 ARCHAEOLOGICAL BACKGROUND

#### 2.1 Introduction

2.1.1 A desk study assessment was prepared by The CDS Group (2023) for land adjacent to Halifax Road, Nelson which completed a geological assessment and historical map assessment. The following background summarises the historical map assessment and uses other publicly available information i.e. National Heritage List for England (NHLE), Heritage Gateway.

#### 2.2 Summary of the archaeological resource

2.2.1 Within a 500 m radius around the site, there are 12 designated assets all of which consist of Grade II listed buildings. They are a mixture of post-medieval residential buildings, places of worship and agricultural buildings. The closest to the site is Clay Cottage (NHLE: 1273064) 100 m to the south-west.



- 2.2.2 Historical map regression shows that the site is first recorded on the 1848 Ordnance Survey (OS) map (OS Lancashire and Furness 1:10,560) and consists of rural land with several farms along its boundaries. It is split into five different fields, with a pathway recorded transecting the east of the site, north – south. A well is recorded immediately outside the southern boundary of the site. Two quarries marked as ‘old’ and so decommissioned at the time of the map survey are recorded 100 m to the south. A colliery is recorded 490 m to the south-east of the site close to Marsden Height.
- 2.2.3 By the 1891 – 1893 OS mapping (Lancashire LVI.11 25 inch) two quarries are marked as ‘Old’ whilst two are recorded as active quarries.
- 2.2.4 The 1895 OS mapping (OS Lancashire and Furness 1:10,560) records a small reservoir 100 m to the north-east of the site. The colliery is now marked as ‘Coalpit House’, so it is not clear if it was still an active colliery.
- 2.2.5 In the 1913 – 14 OS mapping (Lancashire and Furness 1:10,560) the site is still agricultural in nature and some residential properties are recorded along the northern border.
- 2.2.6 By the 1929 – 30 OS mapping (Lancashire and Furness 1:10,560) a series of tennis courts had been built in the east of the site and some field boundaries had been removed meaning the site was two or three fields rather than five. The quarries to the south of the site are recorded as disused.
- 2.2.7 Two small buildings are recorded in the south of the site in the 1930 – 1931 OS mapping (Lancashire and Furness LVI.11 25 inch). They are no longer recorded on the 1946 OS mapping (Lancashire Sheet 34/83 1:25,000).
- 2.2.8 The tennis courts are still visible in the 1955 OS mapping (1:10,000). By the 1965 – 1967 OS mapping (1:10,000) the tennis courts had been removed and allotments built in the north of the site. Further residential properties had been constructed around the site and more allotments had been built just outside the site’s eastern boundary.
- 2.2.9 Satellite imagery from 2000 (Google Earth 2023) shows that the allotments in the north of the site had been removed between the 1965 – 1967 OS mapping (1:10,000) and the year 2000.
- 2.2.10 The Coal Authority website (2023) records a ‘Mine Entry - Shaft’ on the southern boundary of the site, and ‘Probable Shallow Coal Mine Workings’ run parallel and immediately outside of the sites northern and southern boundaries.

### **3 METHODOLOGY**

#### **3.1 Introduction**

- 3.1.1 The geophysical survey was undertaken by Wessex Archaeology’s in-house geophysics team on 02 and 25 May, and 08 June 2023. Field conditions at the time of the survey were overcast and sunny. The ground was saturated and overgrown in parts on the 02 May 2023 meaning that further survey was required over subsequent dates. An overall coverage of 4.48 ha was achieved. 1.14 ha were unsurveyable mainly due to dense tall vegetation, trees and steep topography.
- 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 presence, or lack of, historical mine entrances and the nature of any other detectable archaeological resource within the specified area using appropriate methods and practices; and
- To inform either the scope and nature of any further 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 BRX-7 RTK GNSS instrument, 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 survey was conducted using four Sensys FGM650/3 magnetic gradiometers spaced at 1 m intervals and mounted on a non-magnetic cart. 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 The detailed gradiometer survey has identified magnetic anomalies across the site. Results are presented as a series of greyscale plots and archaeological interpretations at a scale of 1:1,500 (**Figures 2 to 3**). 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 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.
- 4.1.6 Gradiometer survey may not also detect the entrance to all mineshafts present on site. This report and accompanying illustrations should not be used as the sole source for the detection and location of mineshaft entries and appropriate equipment and survey should be used to confirm locations.

## 4.2 Gradiometer survey results and interpretation

- 4.2.1 A group of orthogonally arranged strong positive anomalies have been detected in the south of the site (**Figure 3**) at **4000**. The first is 21 m long and between 0.8 – 2.5 m wide, oriented west to south-east. Immediately to the south of this, at its eastern end, are two strong positive linear anomalies. Together they measure 8.9 m long and between 0.3 m – 1.8 m wide. They are both oriented south-south-west to north-north-east. Combined these anomalies are arranged at a defined right-angle to each other. This well-defined, orthogonal formation and strong magnetic response indicates a structural feature. On the 1930 – 1931 OS mapping (Lancashire and Furness LVI.11 25 inch) two buildings are recorded in approximately this location. Directly to the east of the possible structural remains is a strong positive amorphous anomaly (**4001**) measuring 4 m x 5 m. This is indicative of a feature with strong magnetic properties, and could be associated with a mine cover. However, it may equally be a large piece of magnetic rubble associated with the demolition of the structures at **4000**.
- 4.2.2 An area of strong dipolar anomalies has been detected at **4002** surrounding **4000 – 4001** (**Figure 3**). It covers an area of 29 m x 28 m and looks to continue to the south outside of the surveyed area. The magnetic properties of **4002** are typical of a spread of highly magnetic material, such as rubble. Whilst not the properties typically exhibited by a mine shaft, there is the potential for this being waste associated with the mine workings. However, given the location of the surrounding structural elements it more likely represents demolition material.
- 4.2.3 In the east of the site, a square shaped, strong positive anomaly has been detected at **4003** (**Figure 3**). The anomaly has strong magnetic properties illustrated by the large magnetic 'halo' surrounding it. It covers an area of 19 m x 21 m and consists of outer linear anomalies between 1.5 m – 3 m wide which surrounds several linear anomalies 18 m long and 0.5 m – 2.5 m wide. The inner anomalies are spaced between 1 m and 3 m apart. It is oriented south-south-west to north-north-east. It is typical of a structural feature, such as concrete foundations or a reinforced concrete slab. It is not recorded on any historical mapping. Given its size it is possible it is the foundation of a building or other structure, such as a large footing or a mine cap related to mining activity. However, given its strength is similar to the magnetic properties of the tennis courts to the east (**4017**) it may be more modern in nature. Further investigation would be needed to determine its origins.



- 4.2.4 Various discrete areas of strong increased magnetic response have been detected in the south of the site at **4004 – 4009 (Figure 3)**. They have diameters between 9 m – 11 m. The magnetic properties are typical of anomalies with a high iron content, and as such have a magnetic ‘halo’. The anomalies recorded at **4004** and **4005** are 17 m and 12 m to the north-east of the recorded ‘Mine Entry – Shaft’ on The Coal Authority website (2023). It is possible due to their proximity that they are related to mine workings. However, as they are both positioned close to a dipolar linear anomaly interpreted as a drain, it is more likely they are buried manhole covers. It would be expected that a mine entry would be surrounded by a spread of highly magnetic responses caused by waste and ground disturbance, which is not the case for **4004 – 4007**. Further to the east **4008** and **4009** are close to an area of magnetic disturbance and are located in proximity to a drain, therefore again indicating the possibility they may be manhole covers. Given the continued use of the site, landscaping to the west and north and construction of housing on some of the perimeters, there is also the possibility these anomalies are large pieces of modern metallic waste.
- 4.2.5 A strong positive linear anomaly has been detected at **4010** in the north of the site (**Figure 3**). It is between 1 m – 3 m wide and 44 m long and oriented north-east to south-west. It terminates at a current field boundary at its south. It is in the same location as a field boundary recorded between the 1848 and 1929 – 1930 OS mapping and is the remnants of this. It is located within a large area of magnetic disturbance associated with former allotments (seen on 1965 – 1967 OS mapping) and may have been reused as a boundary within the allotments.
- 4.2.6 A linear positive anomaly has been detected at **4011** on the same orientation as, and directly to the south of, **4010 (Figure 3)**. It is 101 m long and 0.5 m wide and traverses the site. There is no field boundary mapped in this location but given its position and orientation it is considered likely to be a continuation of **4010**.
- 4.2.7 A weak linear positive anomaly has been detected in the north-east of the site at **4012 (Figure 3)**. It corresponds with a field boundary mapped on the 1848 (OS Lancashire and Furness 1:10,560) and no longer mapped by the 1895 (OS Lancashire and Furness 1:10,560) mapping.
- 4.2.8 In the north of the site an area of highly magnetic series of dipolar anomalies have been detected at **4013 (Figure 3)**. Together they form an area measuring 110 m x 53 m. Whilst it is mainly made up of discontinuous hard to define anomalies, within it are various more distinct linear anomalies. The clearest of these are at **4014 – 4015**. They are 34 m and 25 m long respectively. Together they form the western and northern sides of a sub-rectangular shape covering 32 m x 27 m, with the eastern boundary being formed by the former field boundary (**4010**) and southern boundary being formed by an area of more amorphous, discontinuous highly magnetic responses. Between the 1929 – 1930 and 1965 – 1967 OS mapping, allotments were built in this area. The first satellite imagery from 2000 shows no allotments, therefore they were demolished at some point between 1965 and 2000. The more complete linear anomalies within **4013**, such as **4014** and **4015**, are considered likely to be the remnants of pathways and edges of beds.
- 4.2.9 In the west of the site at **4016** a sub-rectangular area of highly magnetic responses has been detected (**Figure 3**). It covers an area of 72 m x 34 m. In the 1931 OS mapping tennis courts are first recorded in this location. The tennis courts are no longer depicted on mapping from the 1960s.
- 4.2.10 An area of strong increased magnetic discontinuous responses has been detected close to the eastern boundary of the site at **4017 (Figure 3)**. It covers an area of 50 m x 30 m and may continue past the eastern boundary of the survey. This response is typical of disturbed ground and magnetic rubble. It is likely this has been caused by the construction debris from allotments 15 m to the east and / or housing 25 m to the north. There is the possibility



that this is related to waste from mine workings, but further investigation would be needed to understand its origins.

- 4.2.11 A strong dipolar linear anomaly has been detected in the east of the site aligned on a north-west to south-east orientation at **4018 (Figure 3)**. It corresponds with a footpath recorded from the 1848 (OS Lancashire and Furness 1:10,560) map onwards and is visible as still in use on satellite imagery (Google Earth, 2023) and noted at the time of survey. Its magnetic properties however are typical of a buried drain, and it has been interpreted as this.
- 4.2.12 Strong dipolar linear anomalies have been detected along the northern boundary of the site (**Figure 3**). They are oriented south south-west and north north-east and north-west to south-east respectively. They are typical of modern services.
- 4.2.13 Various positive and negative, and dipolar, narrow linear anomalies have been detected across the site (**Figure 3**). These are considered most likely to represent drainage, and footpaths.

## 5 DISCUSSION

- 5.1.1 The geophysical survey has identified several areas in the south and east of the site containing anomalies which may be associated with mine workings, however other explanations such as agricultural, general land management, manholes, and rubbish disposal are also likely.
- 5.1.2 In the south-west of the site structural features, likely foundations, and associated demolition material have been detected. It is likely these are the remains of structures recorded on historical OS mapping. It is not clear whether these structures were associated with mine working due to their proximity to proposed mine entry shafts. They may equally represent unrecorded structures possibly associated with agricultural activity.
- 5.1.3 In the east of the site a highly magnetic large square, structural feature has been detected. It is possibly the concrete foundations of a large building or other structure such as a large footing, or cap, related to a mineshaft entry.
- 5.1.4 Several large ferrous responses have been detected in the south of the site, with two of these near a recorded mapped mineshaft. Whilst these anomalies have the potential to be a small metal mineshaft cap, given the continued use of the site including landscaping and drainage, these anomalies are likely manhole covers or modern metallic waste.
- 5.1.5 An area of highly magnetic rubble or disturbed ground has been detected in the very east of the site. This may be related to debris from former mine works. However it is equally likely that this is spread of rubble or waste material as a result of construction of nearby allotments or housing that fringe the perimeter of the site.
- 5.1.6 Two areas of highly magnetic responses have been detected in the north and west of the site. In the north are the remnants of allotments built between 1955 and 1965 – 67 and demolished between 1965 – 67 and 2000. In the west are the remains of demolished tennis courts which were built between 1913 – 14 and 1929 – 30 and demolished between 1955 and 1965 – 67.
- 5.1.7 Several former field boundaries have also been recorded throughout the site that demonstrate the previous division of the land.
- 5.1.8 The only other anomalies of note all pertain to modern features such as services, drainage, and footpaths.





## REFERENCES

### Bibliography

Chartered Institute for Archaeologists [CIfA] 2014 *Standards and guidance for archaeological geophysical survey*. Reading, CIfA. CDS Group 2023 *A Phase 1 Desk Study Assessment Report for Pendle Borough Council*. Bedfordshire

Schmidt, A., Linford, P., Linford, N., David, A., Gaffney, C., Sarris, A. and Fassbinder, J. 2015. *Guidelines for the use of geophysics in archaeology: questions to ask and points to consider*. EAC Guidelines 2, Belgium: European Archaeological Council.

### Online resources

British Geological Survey 2022. *Geology of Britain Viewer*  
<http://mapapps.bgs.ac.uk/geologyofbritain/home.html> (accessed May 2023).

Google Earth website <http://earth.google.com> (accessed May 2023)

Historic England (HE) <https://historicengland.org.uk> (accessed May 2023)

Old Maps Online <http://oldmapsonline.org> (accessed May 2023)

National Library of Scotland (NLS) <https://maps.nls.uk/geo/explore/> (accessed May 2023)

The Coal Authority 2023. <https://mapapps2.bgs.ac.uk/coalauthority/home.html> (accessed May 2023)

### Cartographic resources

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 3, Soils of Midland and Western England*. Southampton.



## APPENDICES

### Appendix 1 Survey equipment and data processing

The magnetic data for this project were acquired using a non-magnetic cart fitted with four 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 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 in order 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 datapoint 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 (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 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.





## 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.



## **Appendix 3 OASIS form**



## Summary for wessexar1-516828

OASIS ID (UID)	wessexar1-516828
Project Name	Geophysical Survey at Land south of Halifax Road, Pendle
Sitename	Land south of Halifax Road, Pendle
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Project Identifier(s)	279510
Planning Id	
Reason For Investigation	Planning requirement
Organisation Responsible for work	Wessex Archaeology
Project Dates	02-May-2023 - 08-Jun-2023
Location	Land south of Halifax Road, Pendle NGR : SD 86041 36511 LL : 53.824678023167365, -2.213539512569708 12 Fig : 386041,436511
Administrative Areas	Country : England County : Lancashire District : Pendle Parish : Brierfield
Project Methodology	<p>The magnetic data for this project were acquired using a non-magnetic cart fitted with four 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.</p> <p>The gradiometers have an effective resolution of <math>\pm 8 \mu\text{T}</math> over <math>\pm 1000 \text{ nT}</math> 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.</p> <p>The cart-based system relies upon accurate GPS location data which is collected using a Leica Captivate system with 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.</p> <p>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.</p>





Project Results	<p>The geophysical survey has identified several areas in the south and east of the site containing anomalies which may be associated with mine workings, however other explanations such as agricultural, general land management, manholes and rubbish disposal are also likely.</p> <p>In the south-west of the site structural features, likely foundations and associated demolition material have been detected within a wider area of rubble. It is likely these are the remains of structures recorded in historical OS mapping. Whilst not the properties typically exhibited by a mine shaft, as there would normally be a larger area of magnetic disturbance, there is the potential for this being a building associated with mine workings. Other origins such as an agricultural building are also likely.</p> <p>In the east of the site a highly magnetic large square structural feature has been detected. It is possibly the concrete foundations of a large building or other structure such as a large footing, or cap, related to a mine and its entry. Other modern origins related to landscaping or a building are possible however further investigation would be needed.</p> <p>Several large ferrous responses have been detected in the south of the site, with two close to a recorded mapped mine shaft. Whilst these anomalies have the potential to be a small metal mine shaft covers, given the continued use of the site including landscaping and drainage, these anomalies are likely manhole covers or large pieces of modern metallic waste.</p> <p>An area of highly magnetic rubble or disturbed ground has been detected in the very east of the site. This may be related to former mine works, equally however, this may be caused by waste from nearby allotments or housing developed around the perimeters of the site.</p> <p>Two areas of highly magnetic responses have been detected in the north and west of the site. In the north are the remnants of allotments built between 1955 and 1965-67 and demolished between 1965-67 and 2000, as recorded in OS historical mapping and satellite imagery. In the west are the remains of demolished tennis courts which were built between 1913-14 and 1929-30 and demolished between 1955 and 1965-67 as recorded in historical OS mapping.</p> <p>Modern services have been detected in the north of the site.</p> <p>Several narrow linear trends have been detected across the site which are considered to be the result of drainage and footpaths.</p>
Keywords	
Funder	
HER	Lancashire SMR - noRev - LITE
Person Responsible for work	
HER Identifiers	
Archives	



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Figure 1: Site location and boundary				



- Site boundary
- Detailed survey extent



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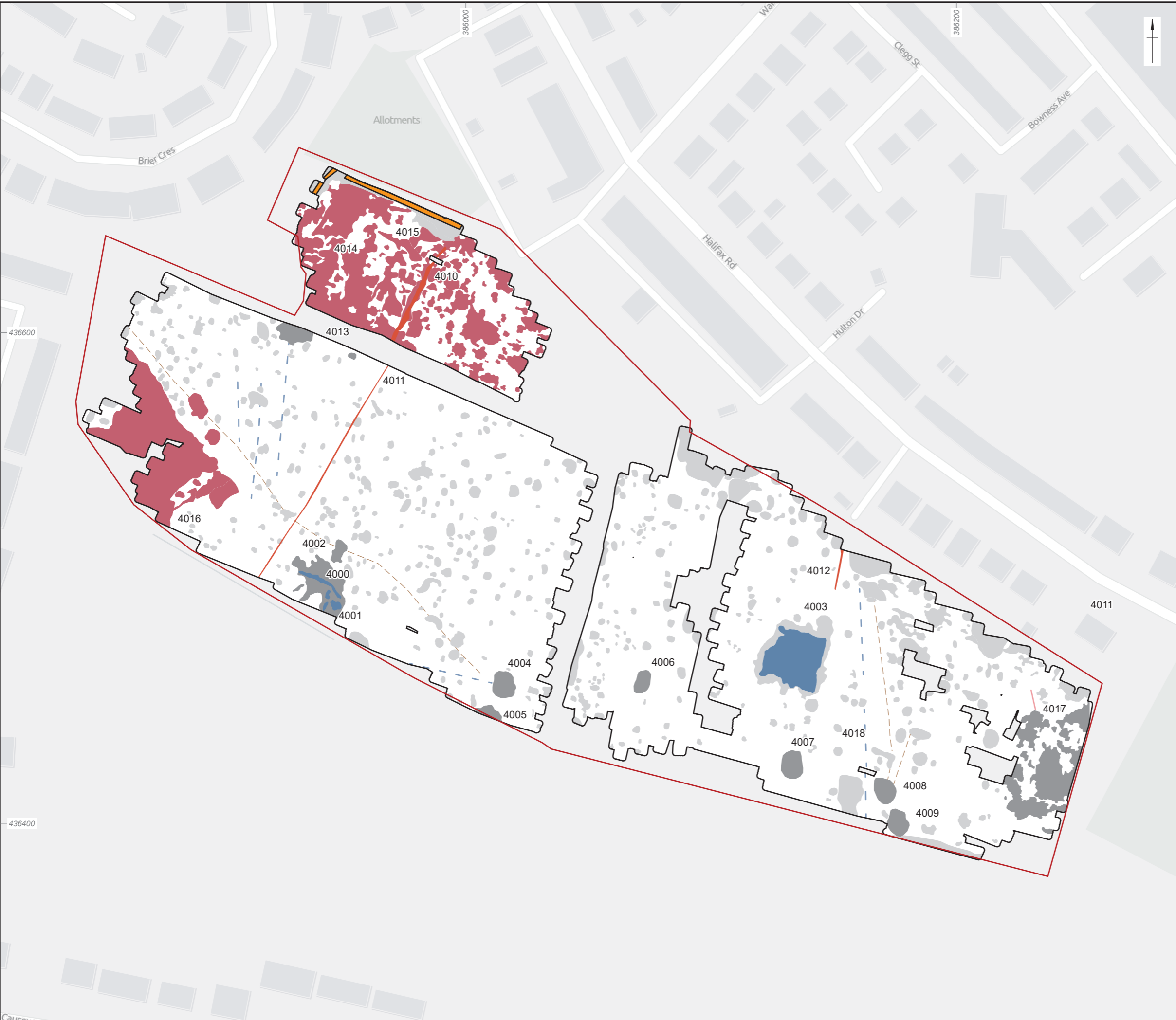
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Figure 2: Detailed gradiometer survey: greyscale plot



- ▭ Site boundary
- Detailed survey extent
- Archaeology
- Former field boundary
- Historic landscape feature
- Modern service
- Increased response
- Ferrous
- Footpath
- Drain
- Trend



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Figure 3: Detailed gradiometer survey: interpretation





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