

# LAND OFF BEETHAM ROAD, MILNTHORPE, CUMBRIA

## Archaeological Desk-Based Assessment and Geophysical Survey



Client:  
Oakmere Homes (Northwest) Ltd

NGR 337893 478973

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August 2021



| <b>The Site</b> |                                   |
|-----------------|-----------------------------------|
| Site Name       | Land off Beetham Road, Milnthorpe |
| County          | Cumbria                           |
| NGR             | 337893 478973                     |

| <b>Client</b> |                               |
|---------------|-------------------------------|
| Client Name   | Oakmere Homes (Northwest) Ltd |

| <b>Planning</b>          |   |
|--------------------------|---|
| Pre-planning?            | Yes   |
| Planning Application No. | -   |
| Condition number         | -   |
| Proposal                 | Housing development   |
| Local Planning Authority | South Lakeland District Council   |
| Planning Archaeologist   | Jeremy Parsons, Historic Environment Officer,<br>Cumbria County Council |

| <b>Desk-Based Assessment</b>                |                  |
|---|------------------|
| Relevant Record Office(s)/Archive Centre(s) | Cumbria (Barrow) |
| Relevant HERs                               | Cumbria          |

| <b>Archiving</b>                            |         |
|---|---------|
| Relevant Record Office(s)/Archive Centre(s) | Barrow  |
| Relevant HER                                | Cumbria |

| <b>Staffing</b>                     |                           |
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| Date geophysical survey carried out | 21-22/07/2021             |

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## Summary

Prior to the submission of a planning application for a proposed housing development on land off Beetham Road, Milnthorpe, Cumbria Greenlane Archaeology was commissioned to carry out a desk-based assessment and geophysical survey of the site. The project was commenced in February 2021 and completed in July and August 2021. The site area is located to the south of the centre of Milnthorpe in an area containing a range of archaeological remains, the earliest of which comprises a Bronze Age cremation cemetery. The majority of the known archaeological remains are of later date, and include stray finds of Roman and later date and a range of features of post-medieval date.

An examination of the historic maps and lidar data and a site visit revealed a collection of earthworks that evidently correspond to former field boundaries. The geophysical survey also showed these up and associated historic ploughing, but did not reveal any other features of definite archaeological interest, although various anomalies were discovered. No specific constraints to further archaeological work were identified, although a gas pipe is known to run across the southern end of the site, high voltage overhead cables run over part of the centre, and it is evident that the southern end at least has been subject to more recent ploughing and improvement.

In view of the archaeological evidence from the wider area, and taking into account the results of a site visit, there is some potential for previously unknown remains of archaeological interest to be present within the proposed development area, potentially of Bronze Age, medieval and post-medieval date. It is apparent, however, that the area has been previously impacted on by a range of things, including the existing gas pipe and another buried pipe revealed in the geophysical survey at the north end. The earthworks relating to the former field system are of some interest and could be medieval or older in origin. Some of the anomalies identified in the geophysical survey might also be of archaeological interest.

## Acknowledgements

Greenlane Archaeology would like to thank Oakmere Homes (Northwest) for commissioning the project, in particular Mark Brown, Technical Manager at Oakmere Homes, for his assistance. Additional thanks are due to the staff of the Cumbria Archive Centre in Kendal.

# **1. Introduction**

## **1.1 Circumstances of the Project**

1.1.1 The circumstances of the project are set out in the tables on the inside cover of this report.

## **1.2 Location, Geology, and Topography**

1.2.1 The site occupies an area of approximately 8.1ha adjacent to the south side of Milnthorpe, Cumbria to the east of the A6, between 10m and 50m above sea level (Figure 1; Ordnance Survey 2010). Milnthorpe is located at the top of the Kent estuary in the north-east corner of Morecambe Bay, in the South Lakeland district of Cumbria, and roughly nine miles south-west of Kendal (Ordnance Survey 2010). The underlying geology of the area comprises Dinantian Carboniferous limestone which outcrops in places but is covered by glacial tills in the vicinity of the site (Moseley 1978, plate 1). The landscape is characterised by gently undulating pasture, conspicuous limestone hills and outcrops (Countryside Commission 1998, 64).

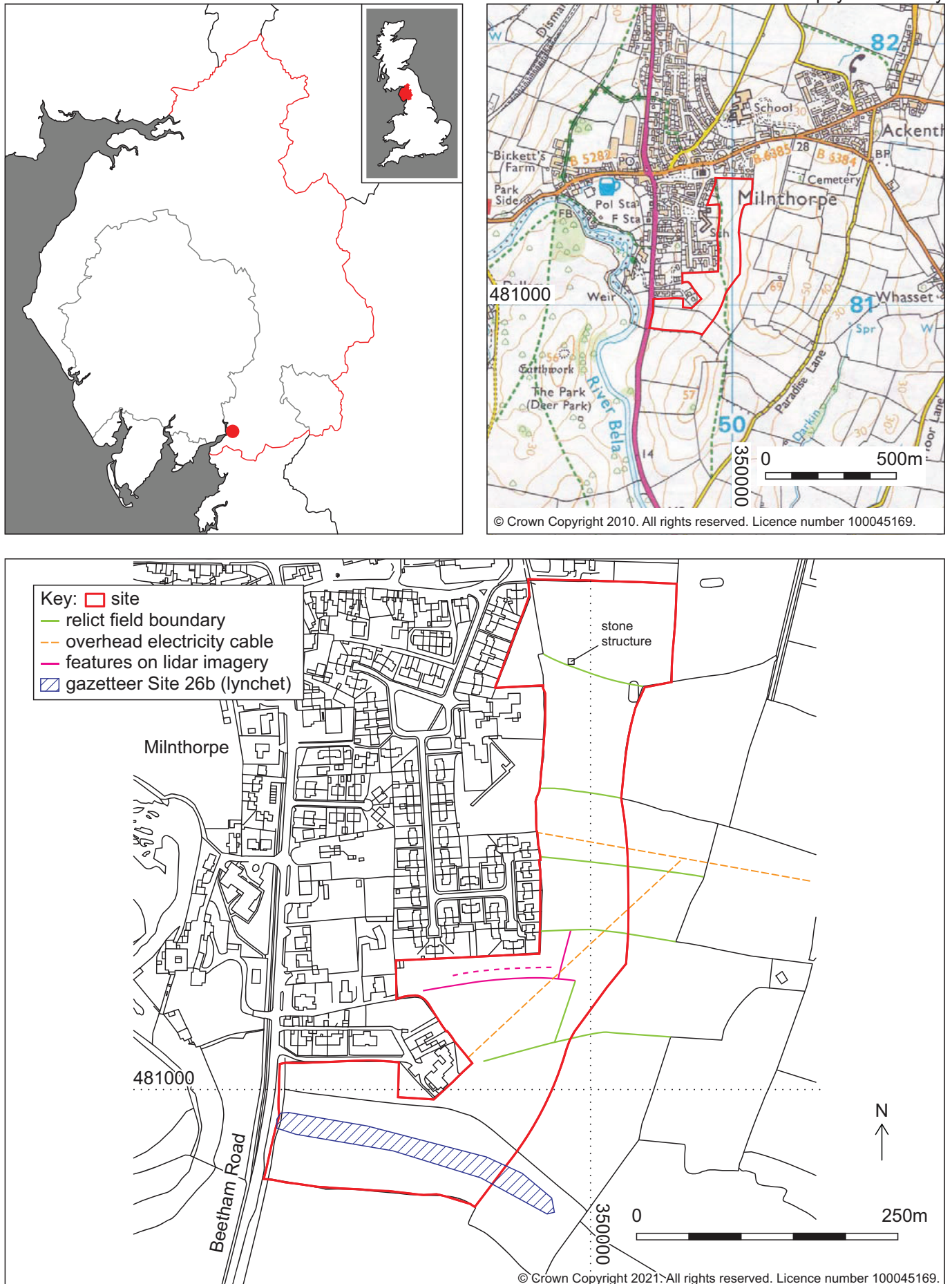


Figure 1: Site location

## 2. Methodology

### 2.1 Desk-Based Assessment

2.1.1 A desk-based assessment was carried out in accordance with the guidelines of the Chartered Institute for Archaeologists (CIfA 2020a). This principally comprised examination of early maps of the site and published secondary sources. A number of sources of information were used during the compilation of the desk-based assessment:

- **Record Office/Archive Centre:** the majority of original and secondary sources relating to the site are deposited in the relevant Record Office(s) or Archive Centre(s), as specified in the cover sheet of this report. Of principal importance are early maps of the site. These were examined in order to establish the development of the site, date of any structures present within it, and details of land use, in order to set the site in its historical, archaeological, and regional context. In addition, any details of the site's owners and occupiers were acquired where available;
- **HER:** this is the primary source of information recording previously known archaeological discoveries. For each site a grid reference, description, and related sources were obtained for inclusion in the gazetteer (see *Appendix 2*). In addition, details of previous archaeological work carried out within the study area was also obtained from the HER;
- **Online Resources:** where available relevant sources were also consulted online;
- **Greenlane Archaeology:** Greenlane Archaeology's office library includes maps, local histories, and unpublished primary and secondary sources. These were consulted where relevant, in order to provide information about the history and archaeology of the site and the general area.

### 2.2 Site Visit

2.2.1 A brief site visit, equivalent to an English Heritage Level 1 survey (Historic England 2016), was carried out covering the proposed development area and other areas that might be affected. Particular attention was paid to the identification of features of historical or archaeological interest, but other relevant features were recorded such as later aspects of the site that may have impacted on the earlier remains or could constrain further investigation. Colour digital photographs showing the general arrangement of the site and any features of interest were taken.

### 2.3 Geophysical Survey

2.3.3 See *Appendix 6* for details of the methodology used in the geophysical survey.

### 2.4 Archive

2.4.1 The archive of the project will be deposited with the relevant Record Office or Archive Centre, as detailed on the cover sheet of this report, together with a copy of the report. The archive has been compiled according to the standards and guidelines of the CIfA guidelines (CIfA 2020b). In addition, details will be submitted to the Online AccesS to the Index of archaeological investigationS (OASIS) scheme. This is an internet-based project intended to improve the flow of information between contractors, local authority heritage managers and the general public. A copy of the report will be provided to the client and to the relevant Historic Environment Record, as detailed on the cover sheet of this report.

### 3. Results

#### 3.1 Introduction

3.1.1 A total of 32 sites of archaeological interest are recorded within the study area in the Historic Environment Record (Figure 2); no additional sites were identified during the desk-based assessment and site visit (*Appendix 2*; summarised in Table 1 below) although a range of earthworks evidently corresponding to former field boundaries were revealed in the lidar data and site visit. Unfortunately, the original location of many of smaller finds, including several recorded by the Portable Antiquities Scheme, are not located accurately on the HER (**Sites 2, 18, 19, 20, 21, 22, 23, 28, 29, 30, and 31**). This amounts to more than a third of the sites recorded on the HER within the study area. In addition, lynchets recorded in the HER are not well located (**Site 24**; note that this site is possibly the same as **Site 26**). The date of the earthworks often remains speculative (**Sites 24, 26, 27, and 32**). The possible 'statues' recorded by the Portable Antiquities Scheme are also of uncertain date (**Sites 28, 29, and 30**; note that these entries may in fact be duplicates, although they have different PAS numbers and are variously listed as Roman or medieval but probably post-medieval in date). Sites included in the gazetteer that relate to periods of the study area's history are individually mentioned in the site history (see *Section 4* below).

| Site No. | Type                    | Period                     | Site No. | Type                  | Period                 |
|----------|-------------------------|----------------------------|----------|-----------------------|------------------------|
| 1        | Find spot (pipe tamper) | Post-medieval              | 17       | Inn                   | Post-medieval          |
| 2        | Find spot (pottery)     | Medieval and post-medieval | 18       | Find spot (coin)      | Roman                  |
| 3        | Cremation cemetery      | Bronze Age                 | 19       | Find spot (coin)      | Roman                  |
| 4        | Weavers workshop        | Post-medieval              | 20       | Find spot (lead seal) | Post-medieval          |
| 5        | Warehouse cottages      | Post-medieval              | 21       | Find spot (bulla)     | Medieval               |
| 6        | Warehouse               | Post-medieval              | 22       | Find spot (pommel)    | Medieval               |
| 7        | Warehouse               | Post-medieval              | 23       | Find spot (hook)      | Medieval/post-medieval |
| 8        | Barn                    | Post-medieval              | 24       | Earthwork (lynchets)  | Uncertain              |
| 9        | Sand pit                | Post-medieval              | 25       | Mill                  | Post-medieval          |
| 10       | Church                  | Post-medieval              | 26       | Earthwork (lynchets)  | Medieval/post-medieval |
| 11       | Inn                     | Post-medieval              | 27       | Earthwork (ringwork)  | Medieval               |
| 12       | Market cross            | Medieval                   | 28       | Find spot (statue)    | Roman/post-medieval    |
| 13       | Vicarage                | Post-medieval              | 29       | Find spot (statue)    | Medieval/post-medieval |
| 14       | Inn                     | Post-medieval              | 30       | Find spot (statue)    | Medieval/post-medieval |
| 15       | Post office             | Post-medieval              | 31       | Find spot (mount)     | Medieval               |
| 16       | Butcher's shop          | Post-medieval              | 32       | Earthwork (enclosure) | Uncertain/Iron Age     |

**Table 1: Summary of sites of archaeological interest within the study area**

#### 3.2 Desk-Based Assessment

3.2.1 The results of the desk-based assessment have been used to produce two main elements. Firstly, all available maps of the area were compiled into a map regression, demonstrating how the site physically developed. The second purpose of the desk-based assessment is to produce a background history of the site. This is intended to cover all periods, in part to provide information that can be used to assess the potential of the site, but more importantly to present the documented details of any sites that are known.



3.2.2 Once this information has been compiled the significance of those sites of archaeological interest within the study area, their potential, and the degree to which they are likely to be affected is considered and based on this possible mitigation work is then suggested.

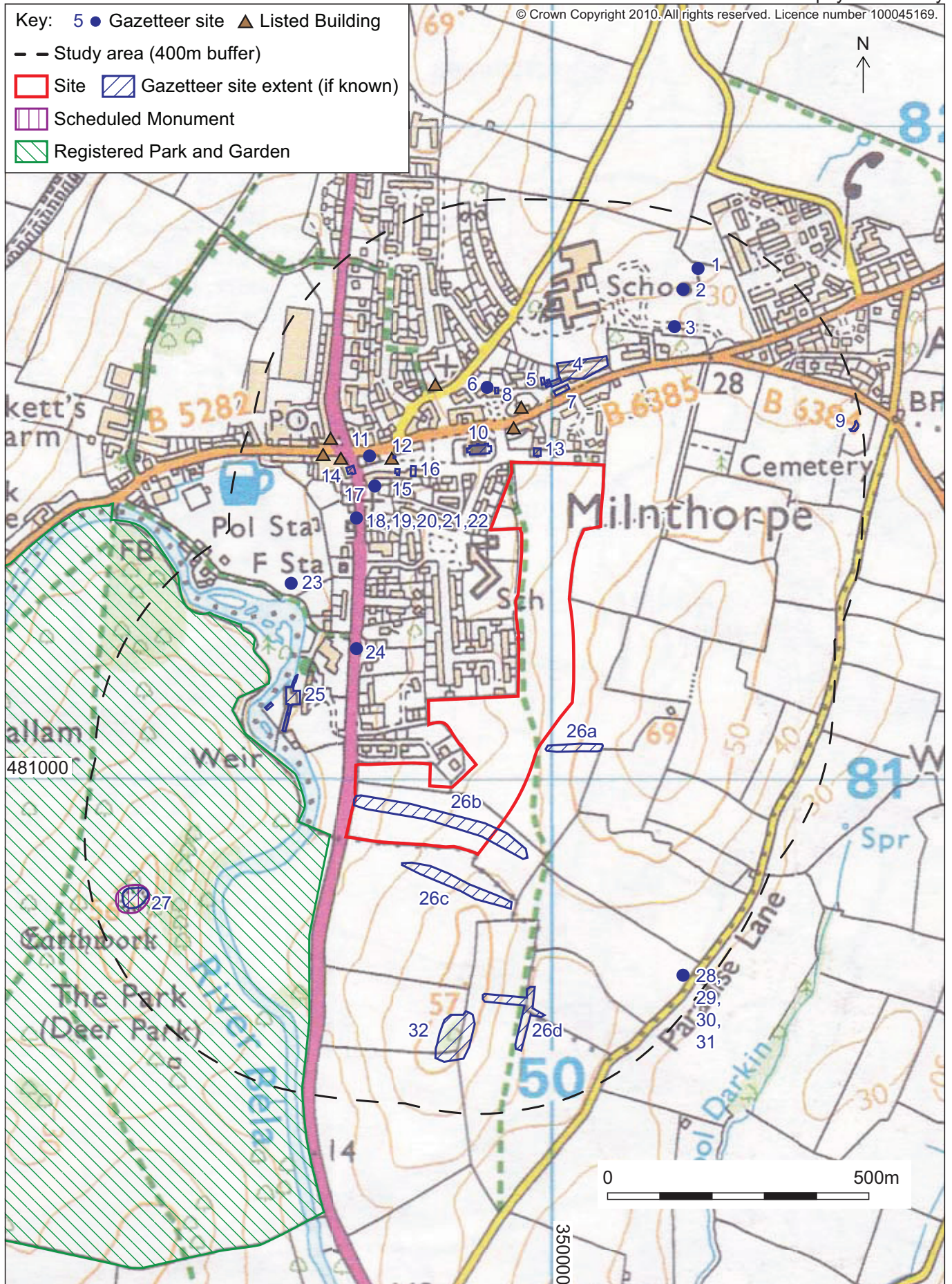


Figure 2: Site gazetteer



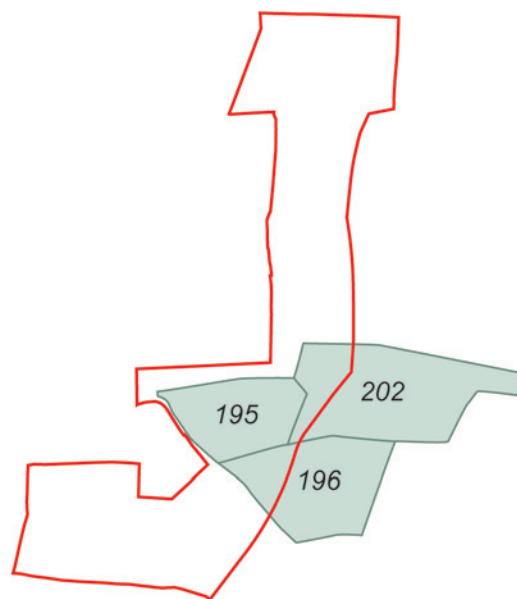
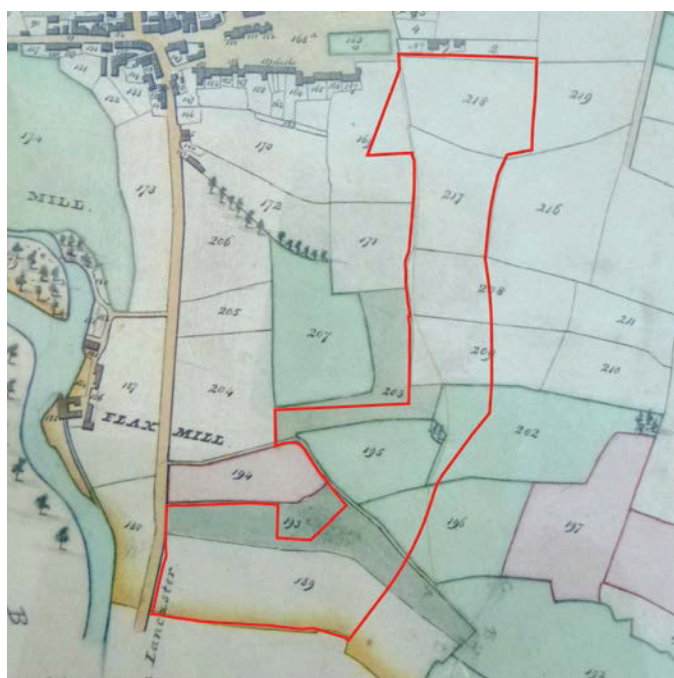
### 3.3 Map Regression

3.3.1 **Introduction:** early maps of the area tend to be relatively lacking in detail, including Jefferys' *Map of Westmorland* (1770), so the earliest useful maps therefore only date from the 19<sup>th</sup> century. There is no tithe map as the area was not subject to tithe; according to explanatory text within the reference book that accompanies Mount's *Plan of the Township of Milnthorpe*, there is no tithe map for this area since tithes in the large ecclesiastical parish of Heversham were commuted at the time of the enclosure award in 1815 (CAC(K) WD/D/Acc.950/49 1826b).

3.3.2 **Mount's map 1826:** this is the earliest detailed map of the area and shows the land holdings of the estate of George Wilson of Dallam Tower, with these parcels of land indicated by pink and green colouring (Plate 2; CAC(K) WD/D/Acc.950/49 1826a). A reference book accompanies the map, giving details of these landholdings; however, large parts of the map (including the north end of the site) are not coloured since they do not form part of the Dallam Tower estate. Details of only three of the plots inside the site boundary are recorded in the accompanying reference (CAC(K) WD/D/Acc.950/49 1826b): plots 195, 196 and 202 (summarised in Table 2).

| Reference number | Description    |
|------------------|----------------|
| 195              | Arnthwaite     |
| 196              | Far Arnthwaite |
| 202              | Fir Field      |

**Table 2: Summary of sites of archaeological interest within the study area**



**Plate 1 (left): Extract from a Plan of the Township of Milnthorpe map of 1826**

**Plate 2 (right): Extract from a Plan of the Township of Milnthorpe map of 1826, redrawn to highlight reference numbers**

3.3.3 **Ordnance Survey, 1862:** the site is shown to occupy several open fields on the first edition 1:10,560 Ordnance Survey map, surveyed in 1857, and a path or track runs north/south across the middle of the site (Plate 3).

3.3.4 **Ordnance Survey, 1899:** the 1899 edition of the Ordnance Survey map was revised in 1896-7 and shows much the same layout as the 1862 edition apart from two small wooded areas in the corners of two fields (one to the north of the area and one to the south) are no longer shown (Plate 4).



Plate 3 (left): Extract from the Ordnance Survey map of 1862

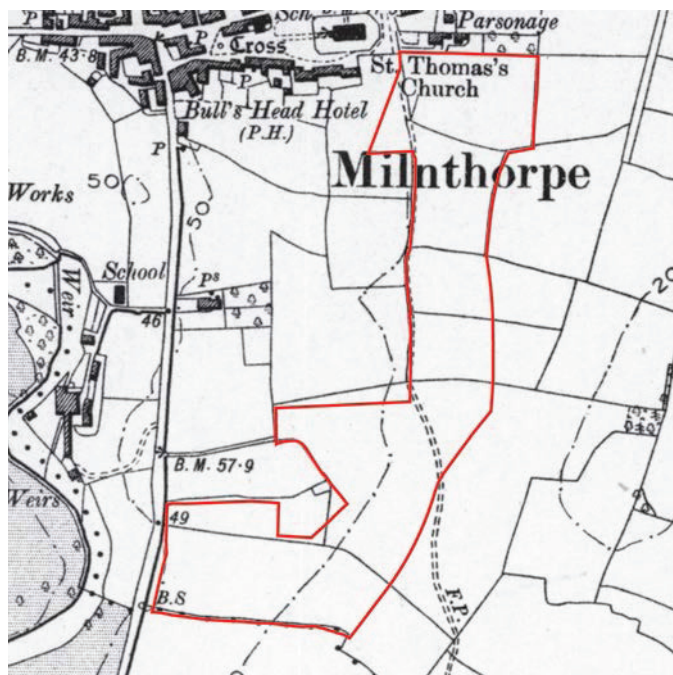


Plate 4 (right): Extracts from the Ordnance Survey maps of 1899

3.3.5 **Ordnance Survey, 1914:** the revision date of the 1914 edition of the Ordnance Survey mapping is 1911. Field boundaries have been altered slightly to the north, near the parsonage; however, overall the site layout is much the same as that shown on the earlier maps albeit it in more detail due to the differences in scale at which the two editions were produced (Ordnance Survey 1914; Plate 5; cf. Plate 4).

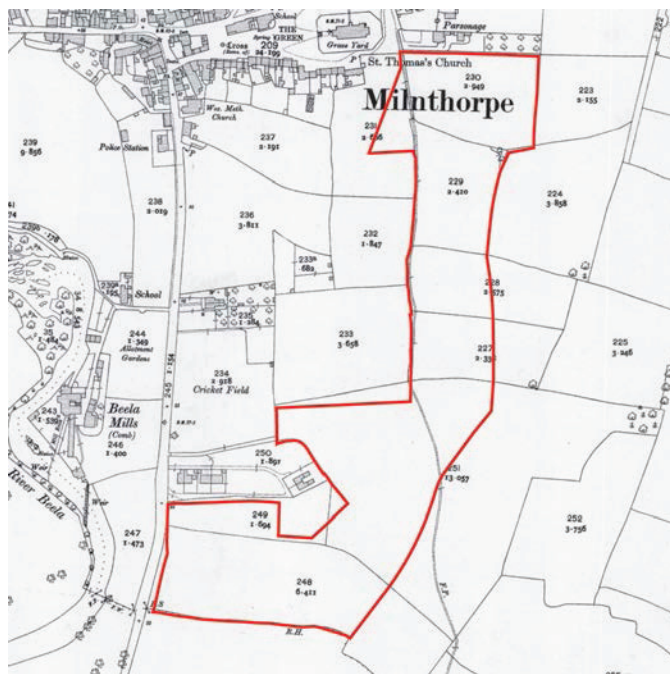


Plate 5: Extract from the Ordnance Survey map of 1914



## 3.4 Lidar

3.4.1 **Lidar**: lidar imagery of the site is freely available online (Houseprices.io 2021). Some earthworks, evidently early field boundaries shown on the historic mapping, are visible across the fields to the south of the area (Plate 6). The lynchet identified as part of **Site 26** is visible in the field to the far south.



Plate 6: Lidar imagery of the site

## 3.5 Site Visit

3.5.1 **Site Arrangement and Character**: the site essentially comprises two fields. A smaller almost rectangular one at the south end orientated east/west (Plate 7), and a much larger irregularly-shaped one to the north orientated north/south, that was originally evidently several fields, the boundaries now completely or largely removed (Plate 8 to Plate 10). A small triangular section at the north-west corner still forms a separate field, but was essentially inaccessible due to dense vegetation. The area is generally undulating, rising up to a slope along the east side and is bounded by a mixture of hedges and fences, with the latter particularly present along the west side where there is modern housing. The southern field has evidently been ploughed and improved and had been cut just before the site visit (Plate 7), while the northern field was used as grazing and had a few large trees remaining on the line of the former field boundaries and a small copse in the north-east corner. Several of the former field boundaries survive as very obvious earthworks in the central area (Plate 11 to Plate 13) and across the north end, with stone stiles remaining in some cases at the north end (Plate 14).



**Plate 7 (left): General view of the southern field, from the west**



**Plate 8 (right): General view of the south end of the northern field, from the south-west**



**Plate 9 (left): General view of the north end of the northern field, from the south**



**Plate 10 (right): General view of the centre of the northern field, from the north**





**Plate 11 (left): Former field boundaries surviving as earthworks in the central area of the northern field, viewed from the west**



**Plate 12 (right): Former field boundaries surviving as earthworks in the central area of the northern field, viewed from the south-east**



**Plate 13 (left): Former field boundary surviving as an earthwork at the north end of the northern field, viewed from the south-west**



**Plate 14 (right): Surviving stile at the north end of the northern field, viewed from the south**

3.5.2 **Constraints:** the central part of the site was crossed by overhead power lines running north-east/south-west and north-west/south-east (Plate 15). At the north end of the site a small square stone structure was located against one of the former field boundaries. It was not clear what this was but it is possibly a capped well (Plate 16).





**Plate 15 (left): Pole supporting overhead power lines, viewed from the north-east**

**Plate 16 (right): Stone structure at the north end of the site, viewed from the north**

## 3.6 Geophysical Survey

3.6.1 The extent of the geophysical survey is shown in Figure 3. The survey examined parts of two pasture fields, based on the proposed development boundary, however, coverage was limited in places due to the presence of dense vegetation and a gap was left in the data to minimise strong interference from a gas pipe that crosses the site. A number of anomalies were identified and the most significant of these are discussed by area in more detail below. In addition to the features identified, in both areas, it is noted that the remaining trends cannot be reliably interpreted and the possibility that some of the trends could be related to the remnants of subsurface features cannot be completely discounted.

3.6.2 **Area 1:** there are a number of trends that correspond with historic / relict field boundaries and responses related to several regimes of ridge and furrow.

- **Anomaly A** is related to a gas pipe;
- **Anomaly B** is suggestive of a pipe, drain or possibly a cable;
- **Anomalies C** could be subsurface features, such as pipes, drains or cables, or could be a product of other modern features / material;
- There are possible linear trends within **Anomaly D**, perhaps responses within the disturbance that coincidentally form a linear / curvilinear pattern or related to features / variations which underlie the spread of modern material;
- **Anomaly E** could relate to random modern material or be caused by (relatively modern) sub-surface remains;
- **Anomaly F** is probably also related to agricultural activity or could be associated with a drainage feature and will not be archaeologically significant;

3.6.3 **Area 2:** there are numerous trends across the area; the strong responses in the north of the area are related to a gas pipe.

- **Anomaly G** could relate to natural features / variations but a lynchet is believed to be present in this field, which has not been clearly identified by the magnetic survey, and it is possible that **Anomaly G** could be related to the remains of this feature;
- **Anomaly H** could relate to a non-metallic drain or other modern feature.
- **Anomaly I** is relatively well-defined and could be a subsurface feature but it has the same alignment as the adjacent field boundary and is probably related to an agricultural feature / activity.

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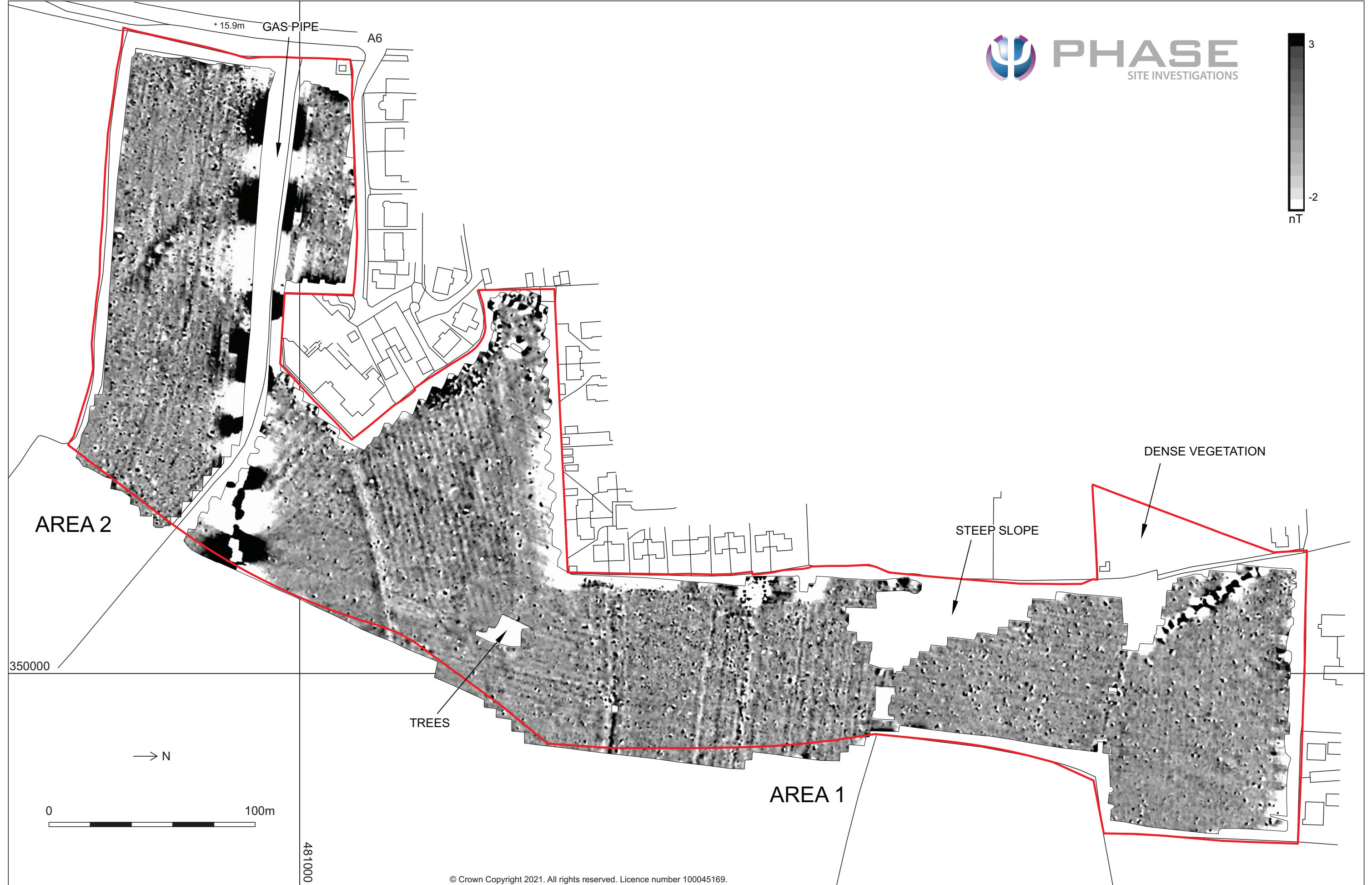


Figure 3: Location of site showing magnetic gradient response

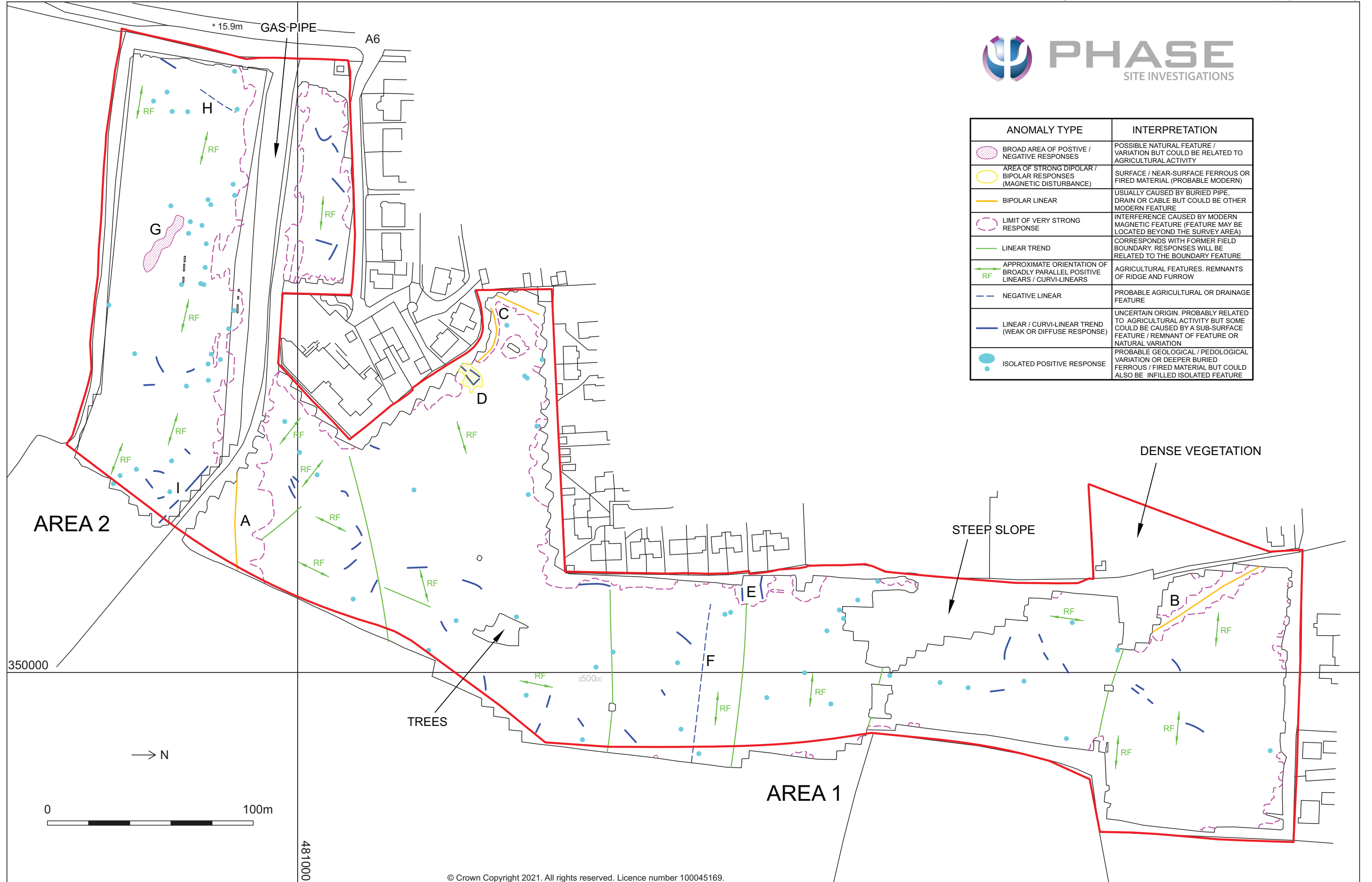


Figure 4: Interpretation of magnetic gradient data



## 4. Site History

### 4.1 Background History

4.1.1 The background history to the site helps our understanding of the development and use of the site, where known, making use of the map evidence presented above where relevant. The background to the site is intended to place the results of the project in its local context and in order to do so a brief discussion of the earlier history of its wider environs is also necessary.

### 4.2 Prehistoric Period (c11,000 BC – 1<sup>st</sup> century AD)

4.2.1 While there is limited evidence for activity in the county in the period immediately following the last Ice Age, this is typically found in the southernmost part on the north side of Morecambe Bay. Excavations of a small number of cave sites have found artefacts of Late Upper Palaeolithic type and the remains of animal species common at the time but now extinct in this country (Young 2002; Smith *et al* 2013). The county was also clearly inhabited during the following period, the Mesolithic (c8,000 – 4,000 BC), as large numbers of artefacts of this date have been discovered during field-walking and eroding from sand dunes along the coast, but these are typically concentrated in the west coast area and on the uplands around the Eden Valley (Cherry and Cherry 2002). Slightly closer to the site, however, a large number of finds of this date were discovered during excavations carried out in the 1970s in the park belonging to Levens Hall, and, although largely ignored at the time, they were subsequently published (Cherry and Cherry 2000). In addition, a small amount of Mesolithic material has been found at the north end of Windermere during excavations on the Roman fort site (see for example Finlayson 2004). These discoveries, particularly those at Levens, demonstrate that further remains of similar date are likely to exist in the local area and that river valleys, lakesides, and coastal areas are a common place for such remains to be discovered (Middleton *et al* 1995, 202; Hodgkinson *et al* 2000, 151-152).

4.2.2 In the following period, the Neolithic (c4,000 – 2,500 BC), large scale monuments such as burial mounds and stone circles begin to appear in the region and one of the most recognisable tool types of this period, the polished stone axe, is found in large numbers across the county, having been manufactured at Langdale to the north-west (Hodgson and Brennand 2006, 45). One was found during archaeological excavations on Sizergh Fell, apparently deliberately placed into a limestone gryke (Edmonds and Evans 2007), and another is recorded near Levens (Cherry and Cherry 1987; Fell 1987). During the Bronze Age (c2,500 – 600 BC) monuments, particularly those thought to be ceremonial in nature, become more common still, and it is likely that settlement sites thought to be Iron Age or Romano-British in date have their origins in this period. Sites of this date are represented to the north by a collection of remains on Sizergh Fell and in the area around Levens, including a settlement and various mounds, which have been subject to survey and excavation on a number of occasions (Anon 1904; Hughes 1904a, 71 and 76-9; 1904b, 201-204; 1912b, 404; RCHME 1936, 157; Fell 1953; Edmonds *et al* 2002; Evans and Edmonds 2003; Edmonds and Evans 2007). Burials, in the form of cremations, are a relatively common find of the Bronze Age, and, as well as a Beaker burial on Sizergh Fell (Fell 1953), more recently include a small cremation cemetery revealed during archaeological work in advance of developments at Dallam School in Milnthorpe (Platell *et al* 2013; see *Section 4.6; Site 3*). Stray finds of metalwork of the period are also known, and include an early Bronze Age cast-flange axe head recorded next to the River Kent (PAS LVPL 288). Sites that can be specifically dated to the Iron Age (c600 BC – 1<sup>st</sup> century AD) are very rare in the wider region, which include a possible Iron Age earthwork enclosure in the study area (**Site 32**), and it is likely that some or all of the settlement sites probably originating in the Bronze Age continued to be occupied into this period (Hodgson and Brennand 2006, 34). One of the most well-known types of site of the Iron Age is the hillfort, and while there are several examples around Morecambe Bay and extending towards Kendal, few have seen any excavation or are properly dated (Elsworth 2014). Levens is unique in Cumbria in having excavated Iron Age burials, discovered in the village in 2002 (OA North 2002; 2004a), although the cemetery appears to be very small. There is also likely to have been a considerable overlap between the end of the Iron Age and the beginning of the Romano-British period; it is evident that in this part of the country, initially at

least, the Roman invasion had a minimal impact on the native population in rural areas (Philpott 2006, 73-74), something that is apparent at the settlement on Sizergh Fell, which had at least some finds thought to date to the 2<sup>nd</sup> or 3<sup>rd</sup> century AD (Hughes 1912a; a brooch of similar style from Langbank crannog in Scotland was dated to the 1<sup>st</sup> century AD; Alexander 2000, 157 and 159).

### 4.3 Romano-British to Early Medieval Period (1<sup>st</sup> century AD – 11<sup>th</sup> century AD)

4.3.1 The area has relatively minimal evidence for activity from the Roman period, the nearest known Roman forts being at Watercrock on the south side of Kendal to the north and Lancaster to the south, although Roman finds, particularly coins, are relatively well-known from the wider area (Shotter 2004). Coin find spots in the study area include **Site 18** and **19**. Whether the Roman military had a greater influence over the north side of Morecambe Bay via crossing the sands and establishing a fort in Furness is still debated; there is some evidence that they did but further proof is still needed (Elsworth 2007). The 'native' style settlement on Sizergh Fell continued to be occupied into the Roman period (see *Section 4.2.2* above), and it seems likely that the impact of Roman rule was less substantial in rural areas. The nearest fort, at Watercrock, was identified at an early date (Potter 1979, 143) but was not excavated until the middle of the 20<sup>th</sup> century and later, which revealed evidence for activity from the late 1<sup>st</sup> to 4<sup>th</sup> century (*op cit*, 176-180). Recent archaeological work in the environs of the fort has found evidence for associated activity, perhaps part of an extended *vicus*, as has been revealed at other Roman forts in the area (Elsworth and Mace forthcoming).

4.3.2 The early medieval period is not well represented in the area in terms of physical archaeological remains, which is a common situation throughout the county. Place-name evidence from the area indicates a strong Anglian and Norse influence. The name Milnthorpe is thought to comprise the old English *miln* meaning mill, and the Scandinavian *thorpe* meaning secondary settlement (Field 2005, 25).. An alternative meaning suggested is 'the hamlet with a mill' (Smith 1967, 95, quoted in CCCEH c2002, 3). Heversham, by contrast, is thought to have Anglian origins, while even more local place-names to the site – the fields containing the element 'Arnthwaite' (see *Section 3.3.2* above) show a Norse influence, deriving from a personal name and the word for clearing. Later activity in this period is rare, but a small group of 11<sup>th</sup> century coins was found during excavations for a grave within the tower of the church at Beetham in 1834. They '*had been placed in a block of ashlar hollowed out for their reception*', so it was thought that they could be used to date the foundation of at least part of the current building (Bintley 1870, 260).

4.3.3 An account of human remains found to the south of the River Bela in Beetham was taken as evidence for a battle in the area in the early medieval period (Nicholson 1832, 23), although no evidence to corroborate was provided. Interestingly, four skeletons were also found near Levens in 1911, while laying pipes for a water supply (Hughes 1912b, 404), and these *may* belong to the early medieval period on account of their approximately east/west orientation and lack of other context. Some of the earthworks recorded in the HER are also possibly medieval (**Sites 24, 26, and 27**).

### 4.4 Medieval Period (11<sup>th</sup> century AD – 16<sup>th</sup> century AD)

4.4.1 At the time of the Norman Conquest Milnthorpe was in the manor of Heversham which was held by Tostig, the Earl of Northumbria (CCCEH c2002, 4-5). The manor was divided and granted to the Lords of Kendale and in 1160 the Milnthorpe moiety whose caput was at Milnthorpe manor or court was passed from William de Lancaster to Alexander de Wyndsore. Milnthorpe was retained by the Wyndsore family until 1385 during which time it was granted a market charter, in 1280 (*ibid*).

4.4.2 Milnthorpe mill was located in part of the manor of Heversham that was granted to St Mary's Abbey, York, by Ivo do Taillebois in 1094. The mill was referred to as Heversham Mill as it was originally part of the Heversham manor; this would appear to be the mill on the Bela at Milnthorpe (**Site 25**), which was owned by the Church and first mentioned in 1460. There is as yet no evidence to suggest where Milnthorpe's medieval cornfields were located (*ibid*).

4.4.3 Milnthorpe also had an early port; the de Wyndsore's made use of this to campaign in Ireland where they claimed ownership of land. The importance of this port is testified by the abundance of fortified towers along the Kent estuary, principally to guard against Scottish invasions and possibly Irish pirates too (*ibid*).

4.4.4 The market cross is recorded as medieval (**Site 12**), although it has been altered, and various medieval pottery (**Site 2**) and other stray finds (**Site 21, 22, 31**) are recorded in the HER.

## 4.5 Post-medieval Period (16<sup>th</sup> century AD – present)

4.5.1 The port at Milnthorpe ensured that trade flourished in and around the town which became the main port for Westmorland. The wharf was located one mile west of Milnthorpe on the Arnside road (CCCEH c2002, 4-5).

4.5.2 Several mills were known to exist in the 17<sup>th</sup> century; a paper mill was located near to the old bridge and before that there was an iron forge on the same site. There were several flax and paper mills on the River Bela; the best surviving example is the Bela Mill built in the early 19<sup>th</sup> century and devoted to the manufacture of twine, sacking and canvas; in 1886 it turned to the manufacture of combs (*ibid*).

4.5.3 Milnthorpe had an early history of land enclosure; many of the tiny plots termed 'parrocks' are irregular in shape, suggesting piecemeal reclamation. The neater rectangular plots located to the north of the town are thought to be typical of the 17<sup>th</sup> century (*ibid*).

4.5.4 The HER records several post-medieval sites of interest within the study area, including a weavers workshop (**Site 4**), warehouses and cottages (**Sites 5, 6, and 7**), barn (**Site 8**), sandpit (**Site 9**), church (**Site 10**), inns (**Sites 11, 14, and 17**), vicarage (**Site 13**), post office (**Site 15**), butcher's shop (**Site 16**), and mill (**Site 23**). Various stray finds of probable post-medieval date are also recorded by the Portable Antiquities Scheme.

## 4.6 Previous Archaeological Work

4.6.1 Several previous pieces of archaeological work are recorded on the HER within the study area (see Figure 5):

- **Fallen Tree, Dallam Tower Estate:** an archaeological evaluation on a tree throw on the edge of the ringwork (**Site 27**) on Castle Hill, Dallam Park, which is assumed to be medieval, did not reveal any archaeological features, deposits or artefacts which may have further characterised or dated the earthwork (Oxford Archaeology North 2003a);
- **Land Adjacent to Cross Keys Yard, Milnthorpe:** a desk-based assessment and watching brief was carried out on land adjacent to Cross Keys Yard by Oxford Archaeology North (2003b). The watching brief recorded a modern brick culvert and an earlier stone built one within a post-medieval soil horizon, which yielded 18<sup>th</sup> and 19<sup>th</sup> century pottery finds;
- **The Square, Milnthorpe:** desk-based assessment and watching brief (Oxford Archaeology North 2004b). This revealed that the site had been levelled relatively recently removing earlier deposits and so only the natural geology was encountered and a small number of unstratified post-medieval finds;
- **Dallam School, Milnthorpe:** an archaeological evaluation, excavation and full analysis was conducted in advance of a development at Dallam School, Milnthorpe (Archaeological Services, University of Durham 2005a; 2005b; 2011) following the discovery of cremated human remains, the results of which are published (Platell *et al* 2013). An urned Early Bronze Age cremation burial, radiocarbon dated to c1950-1750 cal BC, was identified during the evaluation (ASUD 2005a), and three Late Bronze Age cremations within 2m of each other were identified 15m to the east during the excavation (ASUD 2005b), two of which were placed in urns, dated to c1420-1260 cal BC, and the last of which was unurned and dated to c1120-920 cal BC (Platell *et al* 2013). There was no evidence to suggest that the cemetery was ever covered by a barrow

mound or ring cairn and although a stone-filled ditch was found in close proximity, this was linear and did not enclose the cemetery, and its relationship to the burials is unknown (Platell *et al* 2013). A later watching brief for the new all-weather sports pitch in 2009 recorded medieval and later pottery but no archaeological features (ASUD 2009).

- **18 Harmony Hill, Milnthorpe:** a rapid desk-based assessment and archaeological evaluation was carried out by Greenlane Archaeology (2008) prior to the construction of a new dwelling at 18 Harmony Hill. The enclosure map of 1803 shows the plot is to the rear of four cottages, which have subsequently been demolished, and the evaluation revealed a 17<sup>th</sup>/18<sup>th</sup> century pit and thick subsoil that contained domestic refuse of 18<sup>th</sup> and 19<sup>th</sup> century date. Residual fragments of medieval pottery of late 15<sup>th</sup> to early 16<sup>th</sup> century date were also recovered from the fill of the pit;
- **Former Depot, Harmony Hill, Milnthorpe:** a desk-based assessment, visual inspection and archaeological evaluation was carried out of a former depot on Harmony Hill by Oxford Archaeology North (2008a) in July 2008. The site was formerly a weaver's shop and paddock belonging to the Dallam Tower Estate, dating from at least the early 19<sup>th</sup> century and demolished by the second half of the 19<sup>th</sup> century. A 30m long evaluation trench within the eastern side of the proposed development area revealed no archaeological features;
- **General Teaching Block, Dallam School, Milnthorpe:** a desk-based assessment, visual inspection and archaeological evaluation was carried out by Oxford Archaeology North (2008b) in May 2008 regarding a proposed scheme for the erection of a teaching block at Dallam School. The area was undeveloped in the 19<sup>th</sup> century and remained unimproved pasture until construction of the school in 1968. An undated possible posthole was recorded in one of the four evaluation trenches;
- **The Old Bakehouse, 2c Main Street, Milnthorpe:** Oxford Archaeology North (2011) carried out a desk-based assessment and watching brief during groundworks associated with the redevelopment of The Old Bakehouse, 2c Main Street (also referred to as 3 Beetham Road). Maps reveal a building on the site during the early part of the 19<sup>th</sup> century, which was added to in the second half of the 19<sup>th</sup> century, but this additional building was demolished between 1920 and 1969. The watching brief identified masonry walls for a cellar of 19<sup>th</sup> or possibly early 20<sup>th</sup> century date.



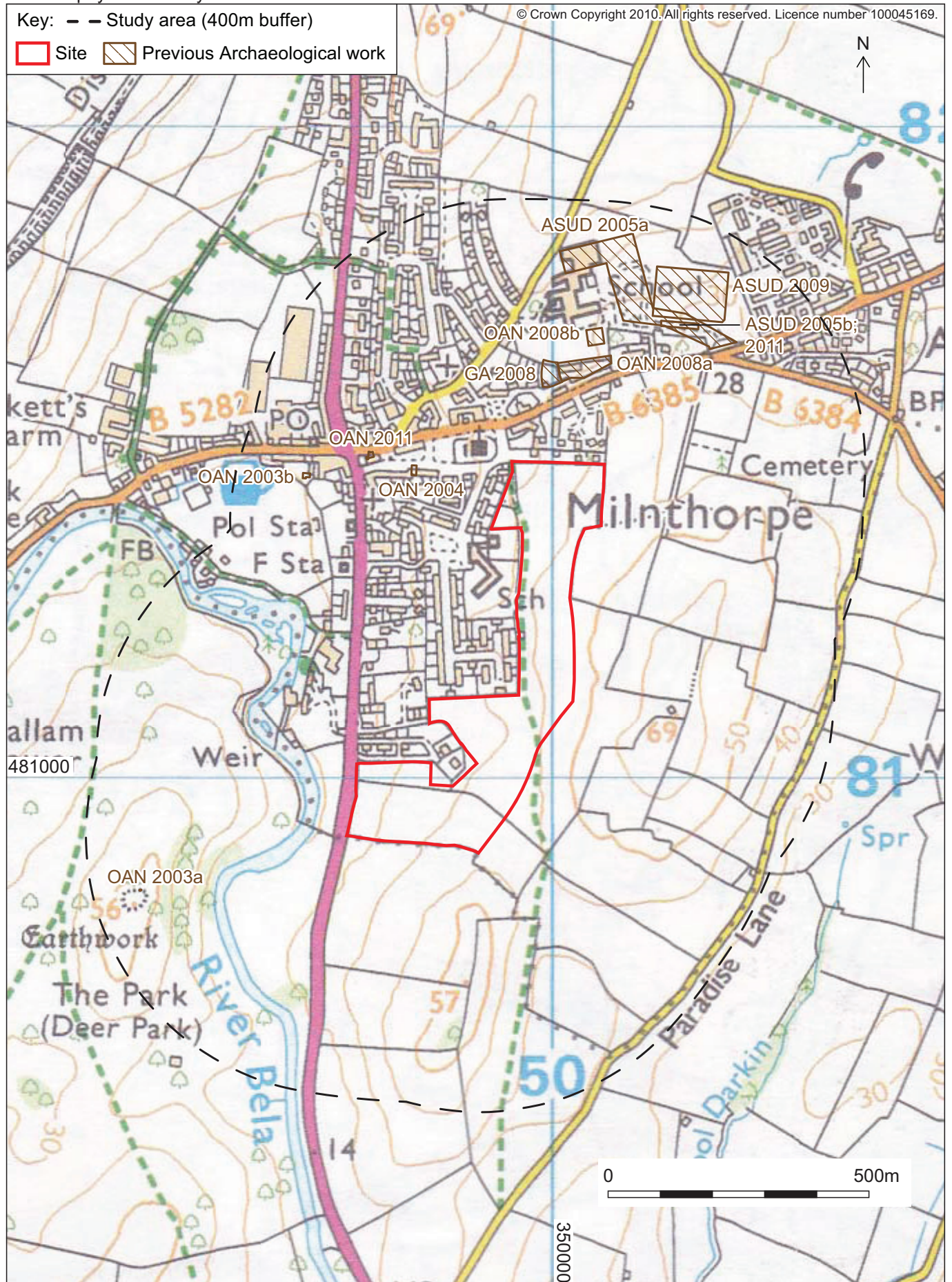


Figure 5: Previous archaeological work

## 5. Discussion

### 5.1 Introduction

5.1.1 The discussion of the results of the desk-based assessment is intended to determine the archaeological significance and potential of any known remains (above or below ground) and the potential for any as yet unidentified remains being present. The system used to judge the significance of the remains identified within the development area, or those thought to have the potential to be present within the development area, is based on the criteria used to define Scheduled Monuments (DCMS 2013, Annex 4; *Appendix 1*). Of the 32 sites identified within the study area, only part of **Site 26** lies inside the site area and is therefore likely to be affected by subsequent groundworks. The site area is also situated within a wider area of known archaeological interest, so there is clearly potential for further remains of archaeological interest to be discovered, which are otherwise unknown at present.

### 5.2 Significance of Known Resource

5.2.1 The centre of Milnthorpe, to the north-west of the site, is a Conservation Area. The market cross (**Site 12**; Historic England 2021b) is a Listed Building and there are five more Listed Buildings in the study area, towards the centre of the village, within the conservation area. The ringwork (**Site 27**) located in Dallam Park is a Scheduled Monument (Historic England 2021e) and lies within a registered park for Dallam Tower (see *Appendix 5*). None of these are within close proximity to the site, however, and none of the other heritage assets listed on the HER have any formal designation.

5.2.2 The level of significance of the one known site of archaeological interest (**Site 26**) within or adjacent to the proposed development area is categorised, according to each criterion, as high, medium, or low, and an average of these has been used to produce an overall level of significance for the site (see Table 3 below: H=high, M=medium, L=low). As can be seen in Table 3, it is considered to be of low significance.

| Site                           | 26       |
|--------------------------------|----------|
| <i>Period</i>                  | L        |
| <i>Rarity</i>                  | L        |
| <i>Documentation</i>           | L        |
| <i>Group value</i>             | M        |
| <i>Survival/condition</i>      | M        |
| <i>Fragility/Vulnerability</i> | M        |
| <i>Diversity</i>               | L        |
| <i>Potential</i>               | L        |
| <b>Significance</b>            | <b>L</b> |

**Table 3: Significance by site**

5.2.3 **Geophysical survey:** the majority of the anomalies identified by geophysical survey are suggestive of modern material, agricultural activity (including ridge and furrow) and natural variations as summarised in *Section 3.6* and detailed in *Appendix 6*. However, the possibility that some of the trends could be related to the remnants of subsurface features cannot be completely discounted. Moreover, parts of the site are dominated by very strong responses (notably in the south adjacent to the route of a gas pipe that crosses the site) or magnetic disturbance from modern features/material, and the strength of these responses could mask other subsurface features in the area, should any such features be present.

### 5.3 Potential for Unknown Archaeological Remains

5.3.1 Details of the archaeological remains present within the study area are presented in the results of the desk-based assessment (*Section 3*; *Appendix 2*). The potential for as yet unidentified archaeological remains to be present, however, is based on the known occurrence of such remains in the study area



and also in the local environs (see *Section 4*). Where there are no remains known within the study area the potential is based on the known occurrence within the wider local area. The degree of potential is examined by period and the results are presented in Table 4 below; in each case the level of potential is expressed as low (L), medium (M), or high (H).

| Period                  | Present in study area? | Potential |
|-------------------------|------------------------|-----------|
| Late Upper Palaeolithic | N                      | L         |
| Mesolithic              | N                      | L         |
| Neolithic               | N                      | L         |
| Bronze Age              | Y                      | L         |
| Iron Age                | Y                      | L         |
| Roman                   | Y                      | L         |
| Early Medieval          | N                      | L         |
| Medieval                | Y                      | M         |
| Post-medieval           | Y                      | H         |

**Table 4: Degree of potential for unknown archaeological remains by period**

5.3.2 In consideration of Table 4 it is worth noting that several of the find spots are not located accurately in the HER (**Sites 2, 18, 19, 20, 21, 22, 23, 28, 29, 30, and 31**), amounting to more than a third of the number of sites recorded on the HER within the study area, including the only Roman artefacts known within the study area. It should also be noted that the earthworks have not seen archaeological excavation and as such their date is uncertain.

## 5.4 Disturbance

5.4.1 The southern field has clearly been subject to repeated ploughing and no doubt other improvements such as drainage, and this is likely to have impacted on any below-ground archaeological remains that might be present. The north edge of this and running into the southern end of the field to the north is crossed by the known line of a gas pipe running approximately east/west, which will have caused considerable disturbance to any buried remains of archaeological interest that might have been present. Similarly, a smaller pipe running approximately north-west/south-east across the north-west corner of the site revealed in the geophysical survey will have had a similar effect. The large field to the north has not obviously been improved, although the geophysical survey shows that it has been subject to historic ploughing across large parts of its area. It is also crossed by overhead high voltage cables and the installation of the supporting posts for this is likely to have caused some disturbance. A substantial gas pipe was already known to cross the southern part of the site, on an east/west alignment, and this was clearly shown in the geophysical survey, as was another, smaller, pipe at the north end of the site area. These will both have caused substantial disturbance to any below-ground remains that might be present.

## 5.5 Impact

5.5.1 Given the steep and uneven nature of the site it is likely that any building work would require substantial changes to the ground levels and therefore severely impact on any archaeological remains that might be present.

## 5.6 Discussion and Conclusion

5.6.1 While there is considerable evidence for archaeological remains in the wider area, including a small Bronze Age cremation cemetery to the north and the wider area of the medieval town of Milnthorpe, the evidence for features and finds of archaeological significance within the site area is relatively low. It is clear that parts of the former field system shown in historic mapping and the lidar data still remain, visible as both earthworks on site and shown in the geophysical survey, and elements of this could date from the medieval period or even earlier. The geophysical survey showed a small number of other anomalies of possible archaeological interest, although the exact origin of these is currently

unknown, as well as picking up areas of disturbance in the form of the gas pipe and another service of unknown type.

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## Appendix 1: Significance Criteria

After DCMS 2013

- i) *Period*: all types of monuments that characterise a category or period should be considered for preservation;
- ii) *Rarity*: there are some monument categories which in certain periods are so scarce that all surviving examples which retain some archaeological potential should be preserved. In general, however, a selection must be made which portrays the typical and commonplace as well as the rare. This process should take account of all aspects of the distribution of a particular class of monument, both in a national and regional context;
- iii) *Documentation*: the significance of a monument may be enhanced by the existence of record of previous investigation or, in the case of more recent monuments, by the supporting evidence of contemporary written records;
- iv) *Group Value*: the value of a single monument (such as a field system) may be greatly enhanced by its association with related contemporary monuments (such as a settlement and cemetery) or with monuments of different periods. In some cases, it is preferable to protect the complete group of monuments, including associated and adjacent land, rather than to protect isolated monuments within the group;
- v) *Survival/Condition*: the survival of a monument's archaeological potential both above and below ground is a particularly important consideration and should be assessed in relation to its present condition and surviving features;
- vi) *Fragility/Vulnerability*: highly important archaeological evidence from some field monuments can be destroyed by a single ploughing or unsympathetic treatment; vulnerable monuments of this nature would particularly benefit from the statutory protection which scheduling confers. There are also existing standing structures of particular form or complexity whose value can again be severely reduced by neglect or careless treatment and which are similarly well suited by scheduled monument protection, even if these structures are already listed historic buildings;
- vii) *Diversity*: some monuments may be selected for scheduling because they possess a combination of high quality features, others because of a single important attribute;
- viii) *Potential*: on occasion, the nature of the evidence cannot be specified precisely but it may still be possible to document reasons anticipating its existence and importance and so to demonstrate the justification for scheduling. This is usually confined to sites rather than upstanding monuments.

## Appendix 2: Site Gazetteer

**Site Number: 1****NGR:** 350223 481782**HER No:** 19430**Sources:** HER; Portable Antiquities Scheme Database LVPL81; CCCEH 2002, 13**Designation:** none**Site Type:** find spot (pipe tamper)

**Description:** a copper alloy pipe tamper was found by Mrs Joy Wilson at Milnthorpe, South Lakeland, in c. March 1989. The tamper is a crude bronze figure of a woman lifting her skirts above the waist. The tamper part of the figure is missing. The artefact is therefore incomplete but its state of preservation is good. The artefact was identified from a photograph (Portable Antiquities Database).

**Period:** post-medieval**Site Number: 2****NGR:** 350200 481750**HER No:** 43431**Sources:** HER; Archaeological Services, University of Durham 2009**Designation:** none**Site Type:** find spot (pottery)

**Description:** pottery finds, Dallam School; a watching brief was maintained in 2009 during groundworks for a new all-weather sports pitch measuring approximately 0.8 ha. No archaeological features were found, but 11 sherds of medieval pottery, including four sherds with yellow/green or green glaze, and 32 sherds of post-medieval domestic and utilitarian pottery, including stoneware and transfer-printed ware, were recovered from the topsoil and subsoil. Five fragments of clay tobacco pipe and two nails of 18<sup>th</sup> or 19<sup>th</sup> century date were also found.

**Period:** medieval and post-medieval**Site Number: 3****NGR:** 350187 481693**HER No:** 41439**Sources:** HER; Archaeological Services, University of Durham 2005a; 2005b; 2011; Oxford Archaeology North 2008b**Designation:** none**Site Type:** cremation cemetery

**Description:** an isolated pit containing ash, bone and Grooved Ware pottery from an Early Bronze Age cremation was found during an evaluation excavation in 2005. No related features were found in the excavated vicinity. No further analysis, such as age-at-death or sex of the individual, was thought possible due to the poor nature of its preservation (Archaeological Services, University of Durham 2005a). A cluster of three cremation burials [were] identified during a second phase of investigation prior to the proposed extension of the existing school. Two of the cremations were placed in urns and were typologically dated to the Late Bronze Age. The undated remains of a possible stone-filled boundary ditch, and a pit containing an undiagnostic flint flake, were also found in close proximity to the burials and may be contemporaneous. Detailed analysis of these remains is anticipated and full publication of the results is proposed. On the basis of these finds, the date of the earlier burial found has been revised and is now thought to be Late Neolithic (Archaeological Services, University of Durham 2005b). Four trenches were excavated in May 2008 at SD 5006 8167 in advance of a planning application to build a new teaching block. The only feature found was a possible posthole of unknown date (Oxford Archaeology North 2008b). One of the cremations contained pyre remnants which included a large



quantity of charcoal. Analysis found this to mainly consist of oak, with smaller amounts of hazel. Large numbers of false oat-grass tubers were also present, which may have been gathered as kindling or could indicate the pyre was partly composed of turves. An unidentified bone item was present in one of the cremations. An unstratified cremated dog bone was also recovered, which is unusual for the period but not later ones. There was no evidence of a barrow or ring-cairn, suggesting it was a flat grave cremation cemetery. A stone-filled ditch was found in close proximity but it was linear and did not enclose the cemetery. The evidence, including the occurrence of other bone items, suggests this burial rite may belong to a north-western English tradition (Archaeological Services, University of Durham 2011).

**Period:** Bronze Age

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**Site Number: 4**

**NGR:** 350020 481620

**HER No:** 42180

**Sources:** HER; Greenlane Archaeology 2008; Oxford Archaeology North 2008a; Ordnance Survey 1862; Ordnance Survey 1914

**Designation:** none

**Site Type:** weavers' workshop

**Description:** Harmony Hill Weavers Shop, Milnthorpe; site of a former weavers' shop and paddock recorded on Mount's map of 1826 belonging to the Dallam Tower estate (Greenlane Archaeology 2008, 8). Later Ordnance Survey maps show the site had been cleared by c1859 and partially occupied by sheep pens by 1914. Modern maps label the site 'Council Yard'. An evaluation trench was excavated down to bedrock in 2008 in advance of its redevelopment for residential use. No evidence of its former use was found, although post-medieval pottery and a probable sheep's tooth were identified in the topsoil (Oxford Archaeology North 2008a).

**Period:** post-medieval

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**Site Number: 5**

**NGR:** 350000 481610

**HER No:** 42178

**Sources:** HER; Greenlane Archaeology 2008

**Designation:** none

**Site Type:** warehouse cottages

**Description:** 18 Harmony Hill / Warehouse Cottages; extant dwelling. It formally adjoined a cottage to the north-west and a row of three or four cottages (depending on which historic map viewed) to the east, as shown on cartographic evidence from 1803. Estate documents of 1820 and 1833 record the sale of 'Red Warehouse [HER no. 42179 - **Site 7**] and Cottages', and the various censuses record the cottages (said to be located on Rotten Row in 1861, and called Mayor's Cottages in 1891 (presumed to be a reference to the Mayor family who had lived in one or two of the cottages for the last 40 years), and Warehouse Cottages in 1901) as occupied by multiple families employed as sack makers, linen and handloom weavers, and later as various kinds of dealers, post messengers and paper makers. A possible toilet block is shown in the garden area to the rear on the Ordnance Survey map of 1898. A deed of 1962 states the recent demolition of the four adjoining cottages, with the remaining cottage first named as 18 Harmony Hill in a death certificate of 1973 (Greenlane Archaeology 2008, 7-11).

The excavation of two evaluation trenches at SD 50000 81625 in February 2008, in advance of groundworks for a new dwelling, found garden soils dating to the late 17<sup>th</sup> or early 18<sup>th</sup> century, suggesting the cottages had been built approximately 100 years before first shown on the enclosure map of 1803. The only feature identified was a pit containing three small fragments of residual medieval pottery (Greenlane Archaeology 2008, 13-17).

**Period:** post-medieval

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**Site Number: 6****NGR:** 349900 481600**HER No:** 2681**Sources:** HER; CCCEH 2002, 13**Designation:** none**Site Type:** warehouse**Description:** a warehouse, said to be connected with the port of Milnthorpe [SMR 2680].**Period:** post-medieval

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**Site Number: 7****NGR:** 350020 481600**HER No:** 42179**Sources:** HER; Greenlane Archaeology 2008**Designation:** none**Site Type:** warehouse**Description:** extant building named Red Barn. The site is recorded as a warehouse and small allotment in 1803 owned by R Cragg Trustees. Cragg estate documents of 1820 and 1833 record the sale of 'Red Warehouse and Cottages' [HER no. 42178 - **Site 5**]. Curwen wrote that it was so named because its woodwork was always painted red (Greenlane Archaeology 2008, 8-11).**Period:** post-medieval

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**Site Number: 8****NGR:** 349915 481595**HER No:** 40785**Sources:** HER; Ordnance Survey 1862**Designation:** none**Site Type:** barn**Description:** barn shown on the first edition Ordnance Survey**Period:** post-medieval

---

**Site Number: 9****NGR:** 350460 481535**HER No:** 14014**Sources:** HER; Oxford Archaeology North 2008b; Ordnance Survey 1898**Designation:** none**Site Type:** sand pit**Description:** Ackenthwaite Sand Pit.**Period:** post-medieval

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**Site Number: 10****NGR:** 349880 481500**HER No:** 43887**Sources:** HER; CCCEH 2002, 9; Pevsner 1967, 277**Designation:** none**Site Type:** church**Description:** St Thomas's Church was constructed in 1837 on an area of subdivided common land. It was remodelled in 1883. The parish church was at Heversham before this date.

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**Period:** post-medieval

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**Site Number: 11**

**NGR:** 349720 481495

**HER No:** 43757

**Sources:** HER; Oxford Archaeology North 2011

**Designation:** none

**Site Type:** inn

**Description:** Royal Bank Inn; Blount's map of 1826 shows a block of unnamed buildings at the junction of Main Street and The Square. The block has a single number (the number possibly relating to the Poor Law assessment for paying for the workhouse) which suggests the buildings were related or had a single owner. The second edition Ordnance Survey map of 1898 shows these and some new structures built in the block. One building to the north is labelled Inn, and the Valuation Book of 1910 describes it as No 144, the Royal Bank Inn and Assembly. Rooms, owned by a Mrs Mary Hodgson. Later Ordnance Survey maps show the area has been much altered since. A watching brief was undertaken on groundworks for a commercial development in 2008-2010. Masonry walls of a cellar were found, either relating to the inn/building shown on Blount's map or a later structure.

**Period:** post-medieval

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**Site Number: 12**

**NGR:** 349757 481492

**HER No:** 2495

**Sources:** HER; Collingwood 1926, 32; Curwen 1930; Bingham 1987; Oxford Archaeology North 2004; CCCEH 2002, 13; Historic England 2021b

**Designation:** Listed Building (1349040)

**Site Type:** market cross

**Description:** medieval market cross with foot shackles. According to the Listed Buildings list, though, the shaft and base are possibly 18<sup>th</sup> century, top probably 19<sup>th</sup> century addition or repair. Sandstone mounted on limestone steps. Single round shaft on octagonal base surmounted by ball on octagonal corniced top. In 1823 there is reference to 'the new cross'. It was taken down in 1845 and re-erected on top of a lock-up built on its site during the construction of the railway when there was rioting locally. The lock-up was taken down in 1862 and the cross replaced on the ground in its original position. Listed Building Grade II. The location for the post-medieval weekly market was linked to the original market cross, seen on Jeffrey's map of 1770, opposite the Cross Keys Inn. Shortly after the rebuilding of the Cross Keys Inn c1821, the market square cross was described as 'the new cross', suggesting it had been moved or replaced (Bingham 1987, 63); the market cross has had several alterations during the last two centuries. During the mid-19<sup>th</sup> century, it was dismantled and a prison cell was erected beneath it (Oxford Archaeology North 2004, 13).

**Period:** medieval

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**Site Number: 13**

**NGR:** 349975 481500

**HER No:** 43888

**Sources:** HER; CCCEH 2002, 9

**Designation:** none

**Site Type:** vicarage

**Description:** the vicarage was constructed c1840.

**Period:** post-medieval

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**Site Number: 14****NGR:** 349687 481472**HER No:** 40463**Sources:** HER; Oxford Archaeology North 2004, site 6; Oxford Archaeology North 2008b, 37**Designation:** none**Site Type:** inn

**Description:** Curwen records that somewhere about 1758 Thomas Hudleston came here and with his work as Innkeeper he combined that of butcher. A succession of innkeepers followed, until in 1847 Isaac Rawlinson [of 7 The Square (HER no. 40462 - **Site 15**)] took the position, and for some time he kept the Post Office here. In 1854 the inn was put up for sale (Oxford Archaeology North 2004, 37).

**Period:** post-medieval

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**Site Number: 15****NGR:** 349762 481472**HER No:** 40462**Sources:** HER; Oxford Archaeology North 2004, site 8; Oxford Archaeology North 2008b**Designation:** none**Site Type:** post office

**Description:** Jane Rawlinson lived in this property in 1910, and continued to live on The Square, presumably in this house, until at least 1929. The directory of 1885 shows that she operated the Post Office from her house, having succeeded Isaac Rawlinson who retired as postmaster the previous year. Bingham records that the property dates from at least the eighteenth century, and that 'from c1850-1880 Ewan Rawlinson, Chelsea Pensioner and village postman, lived here'. This appears to be an error, and should read Isaac in place of Ewan (Oxford Archaeology North 2004).

**Period:** post-medieval

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**Site Number: 16****NGR:** 349785 481475**HER No:** 40461**Sources:** HER; Oxford Archaeology North 2004; 2008b**Designation:** none**Site Type:** butcher's shop

**Description:** site of a former post-medieval commercial building within the medieval market place at Milnthorpe, destroyed by a gas explosion. Acquired by the adjacent business and redeveloped in 2003. Between at least 1873 and 1929, trade directories record that 11 The Square was a butcher's premises, owned by the Rawlinson's of 7 The Square and occupied by the Clark family. A watching brief in 2003 showed that the construction and demolition of the post-medieval building had potentially removed any earlier, medieval, material that may have existed on the site (Oxford Archaeology North 2004).

**Period:** post-medieval

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**Site Number: 17****NGR:** 349728 481449**HER No:** 40464**Sources:** HER; Oxford Archaeology North 2004, site 7; 2008b**Designation:** none

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**Site Type:** inn

**Description:** Curwen records that 'behind the present Bull's Head, where the shop now is, was the site of this old Inn'. The premises were advertised for let in 1843, when the Inn, brewhouse, barn, stables and slaughterhouse were to let. When it was advertised for let again in 1848, Thomas Rawlinson was the tenant (Oxford Archaeology North, 37).

**Period:** post-medieval

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**Site Number: 18**

**NGR:** 349700 481400

**HER No:** 42862

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-D96E91

**Designation:** none

**Site Type:** find spot (coin)

**Description:** denarius of Antoninus Pius (AD151). Obverse description: Laureate bust facing right. Obverse inscription: 'IMP CAES T AEL HADR ANTONINVS AVG PIVS P P'. Reverse description: deity standing with staff in left hand. Reverse inscription: 'TR POT XV COS IIII PAX'.

**Period:** Roman

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**Site Number: 19**

**NGR:** 349700 481400

**HER No:** 42863

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-D97CA2

**Designation:** none

**Site Type:** find spot (coin)

**Description:** denarius of Faustina I (141+). Obverse description: bust facing right. Obverse inscription: 'DIVA FAVSTINA'. Reverse description: Vesta. Reverse inscription: 'AVGVSTA'.

**Period:** Roman

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**Site Number: 20**

**NGR:** 349700 481400

**HER No:** 42866

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-2DB251

**Designation:** none

**Site Type:** find spot (lead seal)

**Description:** late 18<sup>th</sup> century Russian lead cloth seal, stamped 1789.

**Period:** post-medieval

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**Site Number: 21**

**NGR:** 349700 481400

**HER No:** 42871

**Sources:** HER

**Designation:** none

**Site Type:** find spot (bulla)

**Description:** Papal Bulla of Urban VI (1378-1389 AD). Obverse inscription reads 'SPA SPE' (St Paul and St Peter). Paul is depicted on the left with Peter on the right. They are both surrounded by beaded borders, said to possibly imitate a halo.

**Period:** medieval

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**Site Number: 22****NGR:** 349700 481400**HER No:** 42876**Sources:** HER; Portable Antiquities Scheme Database LANCUM-8F8A62**Designation:** none**Site Type:** find spot (pommel)**Description:** cast copper alloy undecorated so-called 'wheel' pommel. Dated to the medieval period (c.1200-1300 AD). It is a hollow cast and has two rectangular perforation[s] in the outer rim, exactly opposite each other.**Period:** medieval

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**Site Number: 23****NGR:** 349600 481300**HER No:** 42873**Sources:** HER; Portable Antiquities Scheme Database LANCUM-D61DC3**Designation:** none**Site Type:** find spot (hook)**Description:** cast copper alloy looped hook dating from the late medieval to early modern period, i.e. c. AD1500-1900. It is very short, its hooked and looped end still intact and undamaged.**Period:** medieval/post-medieval

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**Site Number: 24****NGR:** 349700 481200**HER No:** 2513**Sources:** HER; CCCEH 2002, 13**Designation:** none**Site Type:** earthwork (lynchets)**Description:** Lynchets in Milnthorpe parish recorded by Tom Clare. Apparently corrected as SMR 45304 (Site 26).**Period:** uncertain

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**Site Number: 25****NGR:** 349600 481120**HER No:** 2678**Sources:** HER;

Marshall and Davies-Shiel 1969, 254; Davies-Shiel and Gavin 2006; CCCEH 2002, 7,13; Ordnance Survey 1862; 1899

**Designation:** none**Site Type:** mill**Description:** there were several flax and paper mills on the river Bela, the best surviving specimen is the Bela Mill, built in the early 19<sup>th</sup> century and devoted to the manufacture of twine, sacking and canvas; in 1886 it was turned over to comb manufacture. According to T Clare, it is now a paper mill. The wide iron wheel is 14 ft in diam., and is typical of the south of the region. Named 'Beetha Mill (Flax)' on the first edition Ordnance Survey map of 1862, and 'Beela Mill' on the second edition map of 1899. Named 'Bela Mills' on modern Ordnance Survey maps.**Period:** post-medieval

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**Site Number: 26**

**NGR:** 349877 480827

**HER No:** 45304 -

**Sources:** HER; Oakey *et al* 2015; Historic England 2021c

**Designation:** none

**Site Type:** earthwork (lynchets)

**Description:** a series of lynchets or field boundaries identified during the National Mapping Programme element of the Historic England National Archaeological Identification Survey (Upland Pilot: Lakes and Dales). Potentially medieval or post-medieval in date. This is apparently a corrected version of SMR 2513 (**Site 24**).

**Period:** medieval/post-medieval

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**Site Number: 27**

**NGR:** 349360 480820

**HER No:** 2492

**Sources:** HER; RCHME, 1936, 104; Collingwood 1926,30; CCCEH 2002, 3; Oxford Archaeology North 2003a; Historic England 2021e

**Designation:** Scheduled Monument (1021248)

**Site Type:** earthwork (ringwork)

**Description:** earlier described on scheduling as possible beacon, watchtower, or medieval building, but now thought to be a ring cairn. Circular earthwork, 31.2 m in diam. The monument stands c 2.0 m high on all sides except the west. Its height above the surrounding land surface varies between 2-4 m. Traces of a bank on the perimeter are most prominent on the south side where it is broken at several points and stands 0.35 m high. No indications of any internal structures. The mound appears to be made up of river boulders from the nearby River Bela. Ridge and furrow terminates abruptly on the north side of the monument. Oxford Archaeology North was commissioned by the Dallam Tower Estate to undertake an archaeological evaluation within the area of a tree throw located on the northern edge of a circular earthwork, listed on the SMR as being of prehistoric origin. Following its cleaning by hand, the tree throw pit unfortunately did not reveal any archaeological features, deposits or artefacts which may further characterise or date the earthwork (OAN 2003a). The monument includes a medieval ringwork located in Dallam Park on a prominent hilltop known as Castle Hill 380m south east of Dallam Tower (Historic England 2021e). It is strategically situated to overlook the lowest bridging point of the River Bela and the village of Milnthorpe. Although no documentary evidence exists relating to the construction of the ringwork it is thought to be a precursor to the 14<sup>th</sup> century Dallam Tower. The ringwork includes a sub-circular earth and stone mound measuring up to 42m east-west by 35m north-south. It has a flat top which has been created by raising the mound above the surrounding landscape only slightly on the north side but between 2m and 4m elsewhere. The top of the mound measures 27m by 22m and it contains an earth and stone bank up to 0.35m high around its eastern, southern and western edges. The monument lies within land on the Parks and Gardens Register where it [the park] is known as Dallam Tower (Historic England 2021a).

**Period:** medieval

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**Site Number: 28**

**NGR:** 350200 480700

**HER No:** 42864

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-2B19C2

**Designation:** none

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**Site Type:** find spot (statue)

**Description:** cast lead alloy foot of statue or vessel, which is incomplete. The foot is L shaped and hollow inside, with a slightly curved back and front. Possibly Roman, probably Post Medieval. Seems to be duplicated in SMR 42865 and/or 42867, although there are different LANCUM numbers.

**Period:** Roman/post-medieval

---

**Site Number: 29**

**NGR:** 350200 480700

**HER No:** 42865

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-2B2622

**Designation:** none

**Site Type:** find spot (statue)

**Description:** Lead alloy cast foot of a statue or vessel. The foot is [sic] incomplete, broken at the leg. It is L shaped with a rounded heel, and slightly concave base, with a hollow inside. Possibly Medieval, probably Post Medieval. Seems to be a duplicate of 42864 and/or 42867, although there are different LANCUM numbers.

**Period:** medieval/post-medieval

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**Site Number: 30**

**NGR:** 350200 480700

**HER No:** 42867

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-2B3117

**Designation:** none

**Site Type:** find spot (statue)

**Description:** Cast lead alloy foot of a statue or vessel, which is broken at the leg. The foot is L shaped, with a slightly concave base, and rounded heel, it is hollow inside. Possibly medieval, probably post medieval. Seems to be a duplicate of 42864 and/or 42865, although there are different LANCUM numbers.

**Period:** medieval/post-medieval

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**Site Number: 31**

**NGR:** 350200 480700

**HER No:** 42875

**Sources:** HER; Portable Antiquities Scheme Database LANCUM-FAD820

**Designation:** none

**Site Type:** find spot (mount)

**Description:** Leaded bronze bird figured mount. Broken into two fragments which would have fitted together, still incomplete. There is decoration on both sides.

**Period:** medieval

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**Site Number: 32**

**NGR:** 349848 480607

**HER No:** 45303

**Sources:** HER; Oakey *et al* 2015; Historic England 2021d

**Designation:** none

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**Site Type:** earthwork (enclosure)

**Description:** Archaeological Identification Survey (Upland Pilot: Lakes and Dales). The site was ground-truthed by the Historic England survey team, but not subject to measured survey. 'A possible Iron Age or Roman enclosure occupying the corner of a field at SD 4985 8061 to the south of Milnthorpe. The enclosure was seen as an earthwork defined by a slight ditch on the northern and western sides (where it extends into the modern field and has been subjected to ploughing) and a more substantial bank on the eastern and southern sides which coincide with the modern field boundary. This more substantial surviving part of the enclosure bank bulges into the adjacent fields to the south and east and has traces of a possible second inner bank. The enclosure measures 35m x 65m. It appears to be incorporated into the subsequent medieval/post-medieval field boundaries which extend north and west from it' ([http://www.pastscape.org.uk/hob.aspx?hob\\_id=1574696](http://www.pastscape.org.uk/hob.aspx?hob_id=1574696)).

**Period:** uncertain/Iron Age

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## Appendix 3: Scheduled Monument Summary

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### Ringwork in Dallam Park 380m south east of Dallam Tower (Historic England 2021e)

|                                |                                     |
|--------------------------------|-------------------------------------|
| Heritage Category:             | Scheduled Monument                  |
| List Entry Number:             | 1021248                             |
| Date first listed:             | 19-Mar-1973                         |
| Date of most recent amendment: | 03-Sep-2004                         |
| County:                        | Cumbria                             |
| District:                      | South Lakeland (District Authority) |
| Parish:                        | Beetham                             |
| National Grid Reference:       | SD 49361 80817                      |

DETAILS: The monument includes a medieval ringwork located in Dallam Park on a prominent hilltop known as Castle Hill 380m south east of Dallam Tower. It is strategically situated to overlook the lowest bridging point of the River Bela and the village of Milnthorpe. Although no documentary evidence exists relating to the construction of the ringwork it is thought to be a precursor to the 14th century Dallam Tower.

The ringwork includes a sub-circular earth and stone mound measuring up to 42m east-west by 35m north-south. It has a flat top which has been created by raising the mound above the surrounding landscape only slightly on the north side but between 2m and 4m elsewhere. The top of the mound measures 27m by 22m and it contains an earth and stone bank up to 0.35m high around its eastern, southern and western edges. The monument lies within land on the Parks and Gardens Register where it [the park] is known as Dallam Tower, GD1655.

All posts and fencing surrounding young trees are excluded from the scheduling, although the ground beneath these features is included.

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## Appendix 4: Listed Building Summary

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### **MARKET CROSS (Historic England 2021b)**

|                          |                                     |
|--------------------------|-------------------------------------|
| Heritage Category:       | Listed Building                     |
| Grade:                   | II                                  |
| List Entry Number:       | 1349040                             |
| Date first listed:       | 21-Nov-1952                         |
| Statutory Address:       | MARKET CROSS, THE SQUARE            |
| County:                  | Cumbria                             |
| District:                | South Lakeland (District Authority) |
| Parish:                  | Milnthorpe                          |
| National Grid Reference: | SD 49758 81493                      |

#### Details:

Market Cross. Shaft and base possibly 18<sup>th</sup> century, top probably 19<sup>th</sup> century addition or repair. Sandstone mounted on limestone steps. Single round shaft on octagonal base surmounted by ball on octagonal corniced top. Set on three hexagonal steps. In 1823 there is reference to "the new cross", it was taken down in 1845 and re-erected on top of a lock-up built on its site during the construction of the railway when there was rioting locally. The lock-up was taken down in 1862 and the cross replaced on the ground in its original position.

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## Appendix 5: Park and Garden Summary

### DALLAM TOWER (Historic England 2021a)

|                          |                                     |
|--------------------------|-------------------------------------|
| Heritage Category:       | Park and Garden                     |
| Grade:                   | II                                  |
| List Entry Number:       | 1000664                             |
| Date first listed:       | 01-Jul-1985                         |
| County:                  | Cumbria                             |
| District:                | South Lakeland (District Authority) |
| Parish:                  | Beetham                             |
| County:                  | Cumbria                             |
| District:                | South Lakeland (District Authority) |
| Parish:                  | Milnthorpe                          |
| National Grid Reference: | SD 49190 80818                      |

**DETAILS:** A deer park of the early 18<sup>th</sup> century but probably with earlier origins and gardens of 19<sup>th</sup> century date with 17<sup>th</sup> century origins.

**HISTORIC DEVELOPMENT:** The site has been occupied since the early medieval period when a defensive structure was situated at the highest point of the park. There is a plan of 1614 showing a house with formal gardens on the east and west sides (CL 1982) but the present building dates from the early 18<sup>th</sup> century, when the estate was owned by Daniel Wilson. Estate maps were made in 1733, possibly to mark the completion of the house, and in 1799. The house and park are in private ownership (1997).

**LOCATION, AREA, BOUNDARIES, LANDFORM, SETTING:** Dallam Tower is situated on the south-west side of the village of Milnthorpe and the c75ha site slopes down to the River Bela which runs along the north-east and east sides of the site. The north side of the site overlooks the estuary of the River Kent at the point at which it is joined by the Bela. The setting is predominantly rural and agricultural with Milnthorpe to the north-east and the village of Beetham c0.5km to the south-east. The boundary is formed by a stone wall running alongside Beetham Road on the south-east side; to the north of this the boundary is marked by a fence along the banks of the Bela. The northern boundary is marked by a wall along the side of the B6385 running between a footbridge over the Bela at the west end of Park Road in Milnthorpe, to Milnthorpe Bridge (listed grade II), so that the curve of the river is within the park. The southern boundary of the park on the 1733 map ran from a point c300m north of South Lodge to the deer shelter from which point it turned north-eastwards to the banks of the Bela. This line appears to be preserved in a line of mature trees running across the park. In 1799 the boundary line was in the same place, but the current boundary, which appears on Greenwood's county map of 1824 and subsequently the Ordnance Survey first edition surveyed 1857, runs from the south entrance eastwards to the Bela in the form of a sunken fence with a stone wall on the inner (northern) face. A mixture of walls and fencing mark the boundaries not aforementioned.

The 1733 map shows the boundary of the deer park as a pale on the west side with a bow opposite the main entrance to the Tower and a gated entrance to the park north of this. The remaining boundary, which did not extend as far as the riverbank on the north side, is shown as walls apart from a curve of the river on the east side which had a pale along its edge.



**ENTRANCES AND APPROACHES:** There are two entrances, both with stone-built lodges. On the north-west side a drive leads south from the B6385, which originated as a turnpike in 1813, past North Lodge, through a gateway with stone gate piers. It runs southwards to the Tower and continues south of the Tower as an avenue to South Lodge which is on a minor road between Beetham and the B6385. The part of the drive south of the Tower is on the line of a drive shown on the 1733 map. North Lodge is shown on the 1857 Ordnance Survey map but South Lodge is not; it does however appear on the Ordnance Survey map of 1920 and appears to be a building of mid to late 19<sup>th</sup> century date similar to North Lodge, suggesting that the latter may have been rebuilt. The main entrance during the 18<sup>th</sup> century, shown on the estate maps of 1733 and 1799, was from a bridge over the Bela off Park Road at the west end of Milnthorpe, which led to drives running south-west to the Tower and south across the park. The bridge is now a footbridge and the drives survive as footpaths.

**PRINCIPAL BUILDING:** Dallam Tower (listed grade I) is dated 1722 on the rainwater heads and is shown in a drawing on the 1733 estate map. It was extended and a portico added to the main entrance in 1826. Attached to the north-west side is a stable block with a courtyard of early 19<sup>th</sup> century date which is shown on the same site but in a different form on the 1733 map. On the 1799 map it occupies a similar footprint to that of today. Attached on the south side of the Tower is a service range, including a former brewhouse (listed grade II), on the site of buildings shown on the 1799 map.

**GARDENS AND PLEASURE GROUNDS:** The gardens and pleasure grounds are on the west side of the Tower. The east front of the Tower has a grassed terrace sloping gently down to the main drive where a formal walled forecourt is shown on the 1733 map, but not on that of 1799. The present arrangement, with a loop from the drive leading to the main entrance, is much as shown on the 1799 map.

The gardens consist of an irregular, sub-triangular area on the west side of the screen formed by the Tower and attached service buildings, bounded by ornamental woodland on the west and north sides. The extent and basic form of garden and woodland conforms broadly with what is shown on the 1733 and 1799 maps. A terrace with a walkway runs from south to north along the west front of the Tower and turns to run westwards at the angle formed by the Tower and stable block at the north end of the garden, continuing as a slightly curved terraced walk for a distance of c 80m where the land drops away at the edge of woodland. The terraced walks overlook a sunken lawn which is reached from two grassed ramps aligned with entrances to the Tower. The western edge of the lawn is fringed with mature ornamental trees which were probably planted in the later C19 and beyond this the land rises sharply. A walk cut into the slope runs through this planted bank along the western edge of the garden.

Attached to the south side of the stable block is a conservatory (listed grade I) of early 19<sup>th</sup> century date, attributed to George Webster of Kendal. It has curving roofs and is glazed with vertical cast-iron glazing bars and overlapping glass panes between cast-iron uprights decorated with rosettes. The position of the walkways conforms with paths shown on both the 1733 and 1799 maps. That running west from the conservatory is shown as an avenue of pines, with the same curved shape to the walk shown on the 1733 map visible today. At that time there was a curved wall alongside the avenue.

Some 60m north-west of the Tower, west of the stable block, there is an earthen mound concealing a cover for 20<sup>th</sup> century drainage systems.

The circular base of a fountain which is shown on the 1857 Ordnance Survey map is situated in a sunken lawn c30m south-west of the Tower. In the extreme south-east corner of the sunken lawn, c60m from the Tower, there is an area called the Japanese Garden which consists of rockwork and a pool planted with dwarf conifers and Japanese maples. Rustic steps lead down from the terrace and the pool is fed by a stream which runs in a series of steps through ornamental rockwork and planting along the slopes south-west of the lawn. This area was laid out by Lady Bromley-Wilson in 1930.

The south and south-west sides of the garden are fringed by specimen trees including conifers and pines which were probably planted in the late 19<sup>th</sup> century and early 20<sup>th</sup> century. A path leads south through this area and continues up a slope to a linear earthwork (possibly the line of a former boundary) which

runs north/south for a distance of c20m; near the top of the slope, c100m south of the Tower, the path cuts through this feature and continues to the kitchen garden.

On the north-west and west sides of the garden is Crow Wood which conforms broadly to a wooded area shown on the 1733 map. Overgrown paths lead through the north-west part of the wood to an icehouse (listed grade II), c 200m north-west of the Tower. This is a well-preserved stone structure lined with bricks, probably of 19<sup>th</sup> century date, though it is not shown on any Ordnance Survey maps.

North of the stable block is an area planted with shrubs. A curving ha-ha surmounted by cast-iron railings runs from a point at the north-eastern corner of the stable block westwards along the edge of the garden and Crow Wood, separating the area from the parkland. This appears to be on the line of a tree-lined drive or road shown on the 1733 map.

**PARK:** Parkland extends on the north, east and south sides of the Tower and gardens. To the north a curve of the River Bela is included within the park, the area having been imparked between the time of the 1857 and 1920 Ordnance Survey maps. Another curving stretch of the river is included within the park on the south-east side of the site, and this is shown on the 1733 map. The rolling land rises to a high point c500m south-east of the Tower where there is a circular earthwork, the remains of a medieval fortification (SM CU149), from which extensive views can be obtained in all directions. An eyecatcher called St Anthony's Tower is visible on top of a hill beyond Milnthorpe, c1.5km to the north-east. To the north-west there are views of the Kent estuary. Both the 18<sup>th</sup> century maps show the earthwork planted with trees and plantations along the banks of the Bela; these survive in fragmentary form, particularly in the area immediately east of the earthwork which is shown as a rectangular plantation on the 1733 map. The park is planted with scattered trees including some large mature specimens. Some 600m south-east of the Tower there is a deer shelter called the Buck House which is shown on the 1799 map but not that of 1733. The park is used for pasture and supports a herd of fallow deer.

**KITCHEN GARDEN:** The walled kitchen garden is situated c200m south-west of the Tower, on the west side of a track which leads north from the main drive to the former home farm. It is entered from a path leading south from the garden where there is a doorcase (listed grade II), dated 1685, brought here in the late 19<sup>th</sup> century or early 20<sup>th</sup> century from Nether Levens Hall. This is flanked by yews and approached through a cast-iron canopy designed to prevent the yew branches hanging down in front of the entrance. A doorway in the northern wall provides a second entrance. The garden has a wall with an outer face of stone and an inner face of brick on the east side, and a wall to the north which has areas of scribed stucco, brick and stone. A gardener's house and sheds are built against the outer face of this wall and two glasshouses survive against the inner face. The western side of the garden is formed by a natural limestone cliff, and partial remains of a wall survive on the south side.

Another walled garden is shown on early editions of the Ordnance Survey map on the north side of the present garden but only the footings of beds and glasshouses now (1997) survive.

Walled gardens and orchards are shown on the 1799 map on the east side of the main drive c250m south of the Tower.

## **Appendix 6: Geophysical Survey Report**



**PHASE**  
SITE INVESTIGATIONS

**Land off Beetham Road, Milnthorpe  
Cumbria**

**Archaeological geophysical survey**

**Project No. ARC/3019/1135**

**August 2021**

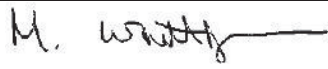
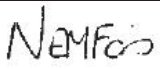




# Land off Beetham Road, Milnthorpe Cumbria

## Archaeological geophysical survey

Project No. ARC/3019/1135

| Report prepared by |   | Report checked by |   |
|--------------------|---|-------------------|---|
| Name               | Mark Whittingham<br>BSc MA MCIFA  | Name              | Nicola Fairs<br>BSc MSc DIC CGeol FGS   |
| Signature          |  | Signature         |  |
| Date               | 17/08/21  | Date              | 17/08/21  |

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## 1. SUMMARY

Phase Site Investigations Ltd was commissioned to carry out a magnetic gradient survey at land off Beetham Road, Milnthorpe, Cumbria. The aim of the survey was to help establish the presence / absence, extent, character, relationships and date (as far as circumstances and the inherent limitations of the technique permits) of archaeological features within the survey area.

The survey was undertaken using a Phase Site Investigations Ltd multi-sensor array cart system (MACS). The MACS comprised 8 Foerster 4.032 Ferex CON 650 gradiometers with a control unit and data logger. The MACS data was collected on profiles spaced 0.5 m apart with readings taken at between 0.1 and 0.15 m intervals.

The majority of the anomalies identified by this survey relate to modern material / objects, agricultural activity (including ridge and furrow) and natural variations. There are a number of linear / curvi-linear anomalies of uncertain origin but these do not form any clear patterns or relationships that would indicate an archaeological origin and they are considered more likely to be associated with agricultural activity, drainage features or natural features / variations. However, as their cause cannot be confirmed with certainty the possibility that some of the trends could be related to parts of sub-surface features cannot be completely discounted.

Parts of the site are dominated by very strong responses (notably in the south adjacent to the route of a gas pipe that crosses the site) or magnetic disturbance from modern features / material. It should be recognised that the strength of these responses could mask anomalies from other sub-surface features in the area, should any such features be present.

## 2. INTRODUCTION

### 2.1 Overview

Phase Site Investigations Ltd was commissioned by Greenlane Archaeology Ltd to carry out an archaeological geophysical survey at land off Beetham Road, Milnthorpe, Cumbria utilising magnetic gradiometers.

The aim of the survey was to help establish the presence / absence, extent, character, relationships and date (as far as circumstances and the inherent limitations of the technique permits) of archaeological features within the survey area.

The location of the site is shown in drawing ARC\_3019\_1135\_01.

### 2.2 Site description

The site is situated on the southern edge of Milnthorpe, Cumbria (approximate centre at NGR SD 500 811) and covered an area of approximately 8.1 ha.

The site encompassed parts of two pasture fields. There was a general slope upwards from west to east but there were a number of undulations, breaks of slope and steep slopes across the site. A number of historic / relict field boundaries were visible as topographic features.

The geology of the site consists of limestone of the Dalton Formation overlain by glacial till (British Geological Survey, 2021).

### 2.3 Archaeological background

This geophysical survey will help inform an archaeological desk-based assessment (Greenlane Archaeology Ltd, *in prep.*). Historic maps shown in the archaeological desk-based indicate that the site was formerly sub-divided into a number of smaller fields. Lidar imagery shown in the desk-based assessment also shows an earthwork interpreted as a lynchet, which is part of number of known earthworks recorded within and adjacent to the site. The possible lynchet is the only known archaeological / heritage feature within the site boundary but the desk-based assessment highlights that,

*‘The site is also situated within a wider area of known archaeological interest, so there is clearly potential for further remains of archaeological interest to be discovered, which are otherwise unknown at present.’*

### 2.4 Scope of work

The survey area was specified by the client, based on a proposed development boundary.

Coverage was limited in places due to the presence of dense vegetation and a gap was left in the data to minimise strong interference from a gas pipe that crossed the site. An area of approximately 6.75 ha was covered by the magnetic survey, the extents of which are shown in drawing ARC\_3019\_1135\_02.

No other problems were encountered during the survey which was carried out between 21 July and 22 July 2021.



### 3. SURVEY METHODOLOGY

#### 3.1 Magnetic survey

The survey was undertaken using a Phase Site Investigations Ltd multi-sensor array cart system (MACS).

The MACS comprised 8 Foerster 4.032 Ferex CON 650 gradiometers with a control unit and data logger. The Foerster gradiometers do not require balancing as each sensor is automatically 'zeroed' using the control unit software.

The MACS utilises an RTK GNSS system which means that survey grids do not have to be established. Instead an area is surveyed over a series of continuous profiles and the position of each data point is recorded using an RTK GNSS system. The sensors have a separation of 0.5 m which means that data was collected on profiles spaced at 0.5 m apart. Readings were taken at between 0.1 m and 0.15 m intervals.

Data is collected on zig-zag profiles along the full length or width of a field, although fields can be sub-divided if they are particularly large. Marker canes are set-out along field boundaries at set intervals and these are used to align the profiles. The survey profiles are usually offset from field boundaries, buildings and other metallic features by several metres to reduce the detrimental effect that these surface magnetic features have on the data. The location of the MACS data is converted direct to Ordnance Survey co-ordinates using the UK OSTN 15 projection. As the survey is referenced direct to Ordnance Survey National Grid co-ordinates temporary survey stations are not established.

#### 3.2 Data processing and presentation

The MACS data was stored direct to a laptop using in-house software which automatically corrects for instrument drift and calculates a mean value for each profile. A positional value is assigned to each data point based on the sensor number and recorded GNSS co-ordinates. The data is gridded using in-house software and parameters are set based on the sensor spacing and mean values. No additional processing is required. The gridded data is then displayed in Surfer 9 (Golden Software) and image files of the data are created.

The data was exported as greyscale raster images (PNG files). Data for the entire site is presented at a scale of 1:2500 and plots for individual fields / areas (or parts of fields / areas) with accompanying interpretations are shown at a scale of 1:1250. All greyscale plots were clipped at -2 nT to 3 nT. Greyscale plots have been 'smoothed' using a visual interpolation but the data itself has not been interpolated.

The data has been displayed relative to a digital Ordnance Survey base plan provided by the client as drawing '*Promap-1477813-1579102-720-0\_site boundary.dwg*'. The base plan was in the Ordnance Survey National Grid co-ordinate system and as the survey grids / data were referenced directly to National Grid co-ordinates the data could be simply superimposed onto the base plan in the correct position.

X-Y trace plots were examined for all of the data and overlain onto the greyscale plot to assist in the interpretation, primarily to help identify dipolar and bipolar responses that will probably be associated with surface / near-surface iron objects. However, X-Y trace plots have not been presented here as they do not show any additional anomalies that are not visible in the greyscale data. A digital drawing showing the X-Y trace plot overlain on the greyscale plot is provided in the digital archive.

All isolated responses have been assessed using a combination of greyscale and X-Y trace plots. There are a large number of 'iron spike', isolated dipolar anomalies present in the data. There is no evidence to suggest that they are associated with archaeological features and so these have not been shown in the interpretation.

Anomalies associated with agricultural regimes are present in the data but each individual anomaly has not been shown on the interpretation. Instead the general orientation of the regime is indicated.

The data was examined over several different ranges during the interpretation to ensure that the maximum information possible was obtained from the data.

The anomalies have been categorised based on the type of response that they exhibit and an interpretation as to the cause(s) or possible cause(s) of each anomaly type is also provided.

A general discussion of the anomalies is provided for the entire site and then the results are discussed on an area by area basis. A discussion of the general categories of anomaly which have been identified by the survey is provided in Appendix 1.5.

***The geophysical interpretation drawing must be used in conjunction with the relevant results section and appendices of this report.***

## 4. RESULTS

### 4.1 General

The data quality across the majority of the survey area is very good allowing the data to be viewed at a narrow range of readings to better identify weak anomalies. There are several areas that have a more disturbed magnetic background or strong responses but these are due to the presence of magnetic material in the topsoil / sub-surface or surface ferrous objects, rather than low data quality.

The data shows a uniform magnetic background in parts of the survey area and a strongly variable background in other areas. The latter are probably associated with geological variations and features, including sand and gravel glaciofluvial / alluvial deposits and possible palaeochannel deposits. The variable background associated with geological variations has made it difficult to identify individual responses within them.

### 4.2 Area 1

**Basic topography:** General slope upwards from west to east with a number of undulations, breaks of slope and steep slopes across the site. A number of historic / relict field boundaries were visible as topographic features.

**Area description:** Part of a larger pasture field. Firm underfoot. Bounded by fencing and hedges to the north and west, hedges to the south with no fixed boundary to the east. Areas of dense vegetation and a steep slope were present in the north of the area.

**Summary of anomalies:** Numerous isolated dipolar and small bipolar responses, that are all thought to be associated with modern material. These have not been shown on the interpretation.

A linear bipolar anomaly associated with a sub-surface metal gas pipe. Several additional bipolar linear / curvi-linear anomalies are present, which could be related to additional buried services, such as pipes, drains or cables but some of which could be related to other modern features.

An area of magnetic disturbance associated with relatively modern features / material.

Very strong responses associated with strongly magnetic relatively modern features / material. These responses can extend for some distance beyond the feature and in some cases the feature causing the strong response may be located beyond the survey area.

Several series of broadly parallel, positive linear responses associated with regimes of ridge and furrow.

Several linear / curvi-linear trends correspond with the position of former field boundaries and will be related to these features.

A negative linear anomaly is present that will probably be related to agricultural or drainage activity / feature.

Trends of uncertain origin.

Numerous isolated positive responses, the majority of which are probably geological / pedological in origin or related to relatively modern deeper buried ferrous / fired material.

**Further discussion / additional information:**

**Anomaly A** is related to a gas pipe. **Anomaly B** is suggestive of a pipe, drain or possibly a cable. **Anomalies C** are bipolar responses but it is not certain if these are related to sub-surface features, such as pipes, drains or cables, or if they are a product of other modern features / material.

A small area of magnetic disturbance is present and there are suggestion of linear trends within the magnetic disturbance (**Anomaly D**). It is not known if these trends are a product of responses within the disturbance, that coincidentally appear to form a linear / curvi-linear pattern, or if they may be related to features / variations which underlie the spread of modern material. If there are sub-surface features present then these will also be relatively modern. An area of strong response (**Anomaly E**) adjacent to the west of the survey area contains several alignments of bipolar responses (shown as trends), again it is not certain if these are related to random modern material or are caused by (relatively modern) sub-surface remains.

There are a number of trends that correspond with historic / relict field boundaries and responses related to several regimes of ridge and furrow. A negative trend (**Anomaly F**) is present that is aligned with adjacent former field boundaries and agricultural regimes and is probably also related to agricultural activity, although it could also be associated with a drainage feature. Anomaly F will not be archaeologically significant.

The remaining trends within the survey area are all too weak and short to reliably interpret. They do not form any obvious patterns or relationships that would indicate that they are associated with sub-surface features and so it is likely that they are simply a product of agricultural activity or natural variations. However, as their cause cannot be determined with certainty the possibility that some of the trends could be related to the remnants of sub-surface features cannot be completely discounted.

### 4.3 Area 2

- Basic topography:** General slope upwards from west to east.
- Area description:** Part of a larger pasture field. Firm underfoot. Bounded by hedges to the north, south and west, with no fixed boundary to the east.
- Summary of anomalies:** Numerous isolated dipolar and small bipolar responses, that are all thought to be associated with modern material. These have not been shown on the interpretation.
- Very strong responses associated with strongly magnetic relatively modern features / material. These responses can extend for some distance beyond the feature and in some cases the feature causing the strong response may be located beyond the survey area.
- A series of positive linear / curvi-linear responses associated with a regime(s) of ridge and furrow.



A broad area of positive / negative responses. Responses of this type are usually related to natural features / variations but could also be related to an agricultural features, such as a lynchet.

A negative linear anomaly is present that is probably related to agricultural or drainage activity / feature.

Trends of uncertain origin.

Numerous isolated positive responses, the majority of which are probably geological / pedological in origin or related to relatively modern deeper buried ferrous / fired material.

**Further discussion / additional information:**

The strong responses in the north of the area are related to a gas pipe that will run adjacent to the northern field boundary.

The broad area of positive / negative responses (**Anomaly G**) could be related to natural features / variations but a lynchet is believed to be present in this field, which has not been clearly identified by the magnetic survey, and it is possible that Anomaly G could be related to the remains of this feature.

A negative trend (**Anomaly H**) in the west of the area could be related to a non-metallic drain or other modern feature.

There are numerous trends across the area. **Anomaly I** is relatively well-defined and could be caused by a sub-surface feature but it has the same alignment as the adjacent field boundary and is probably related to an agricultural feature / activity. The remaining trends within the survey area are all too weak and short to reliably interpret. They do not form any obvious patterns or relationships that would indicate that they are associated with sub-surface features and so it is likely that they are simply a product of agricultural activity or natural variations. However, as their cause cannot be determined with certainty the possibility that some of the trends could be related to the remnants of sub-surface features cannot be completely discounted

## 5. DISCUSSION AND CONCLUSIONS

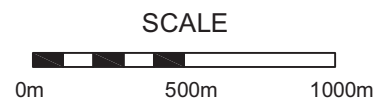
The majority of the anomalies identified by this survey relate to modern material / objects, agricultural activity (including ridge and furrow) and natural variations. There are a number of linear / curvi-linear anomalies of uncertain origin but these do not form any clear patterns or relationships that would indicate an archaeological origin and they are considered more likely to be associated with agricultural activity, drainage features or natural features / variations. However, as their cause cannot be confirmed with certainty the possibility that some of the trends could be related to parts of sub-surface features cannot be completely discounted.

Parts of the site are dominated by very strong responses (notably in the south adjacent to the route of a gas pipe that crosses the site) or magnetic disturbance from modern features / material. It should be recognised that the strength of these responses could mask anomalies from other sub-surface features in the area, should any such features be present.

*It should be noted that a geophysical survey does not directly locate sub-surface features - it identifies variations or anomalies in the background response caused by features. The interpretation of geophysical anomalies is often subjective and it is rarely possible to identify the cause of all such anomalies. Not all features will produce a measurable anomaly and the effectiveness of a geophysical survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that a geophysical survey will identify all sub-surface features. Confirmation on the identification of anomalies and the presence or absence of sub-surface features can only be achieved by intrusive investigation.*



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| Scale [A4 Sheet] | Drawing          | Status |
| AS SHOWN         | ARC_3019_1135_01 | FINAL  |

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|--------|---|

|      |   |
|------|---|
| Site | LAND OFF OF BEETHAM ROAD<br>MILNTHORPE, CUMBRIA |
|------|---|


|       |                   |
|-------|-------------------|
| Title | SITE LOCATION MAP |
|-------|-------------------|

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 Direction of north  
 taken from drawing  
 'Promap-1477813-1579102-720-0\_site  
 boundary.dwg'

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**KEY**

— APPROXIMATE SITE BOUNDARY



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| LAND OFF OF BEETHAM ROAD<br>MILNTHORPE, CUMBRIA    |                    |                 |
| Title  |                    |                 |
| LOCATION OF SITE SHOWING<br>MAGNETIC GRADIENT DATA |                    |                 |
| Job No   |                    |                 |
| ARC_3019_1135                                      |                    |                 |
| Surveyed   | JW, MS             | Drawn MS        |
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Site  
**LAND OFF OF BEETHAM ROAD  
 MILNTHORPE, CUMBRIA**

Title  
**GREYSCALE PLOT OF  
 MAGNETIC GRADIENT DATA: NORTHERN  
 AND CENTRAL PARTS OF AREA 1**

Job No  
**ARC\_3019\_1135**

|          |        |       |            |
|----------|--------|-------|------------|
| Surveyed | JW, MS | Drawn | MS         |
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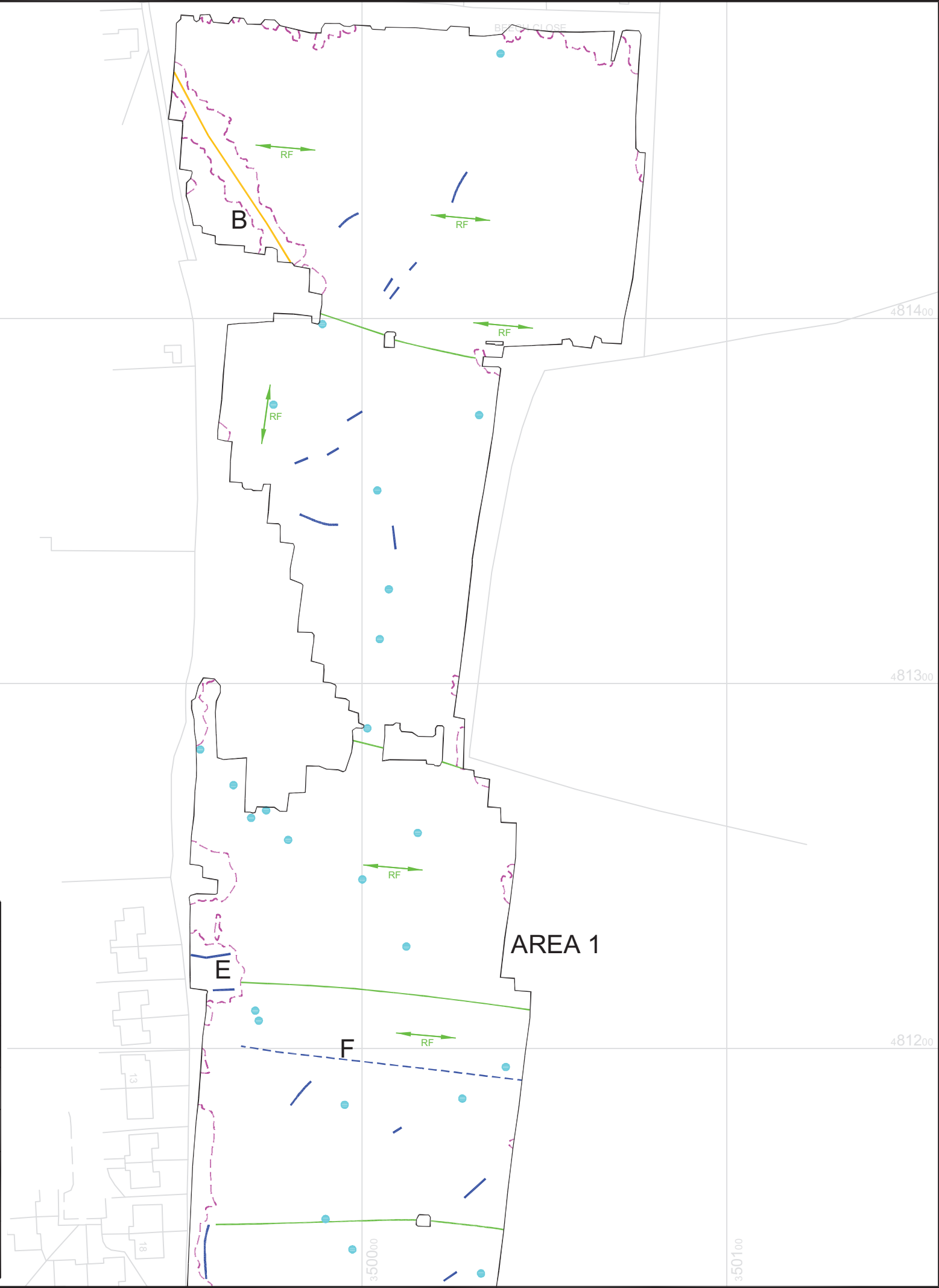
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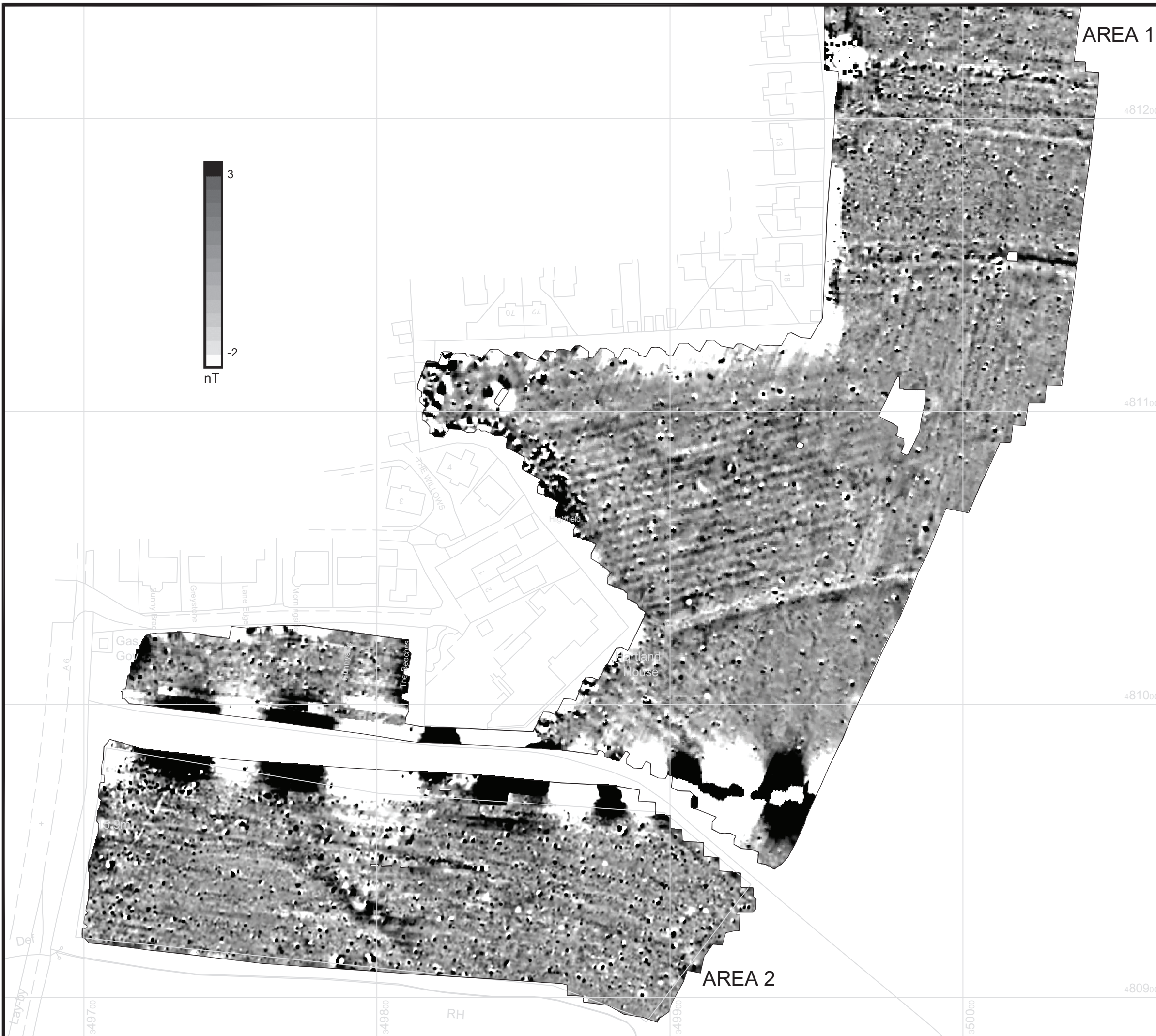
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|        |               |
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| Job No | ARC_3019_1135 |
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|----------|--------|-------|------------|
| Surveyed | JW, MS | Drawn | MW         |
| Chk.     | NF     | Date  | 22/07/2021 |

| ANOMALY TYPE   | INTERPRETATION  |
|--|---|
| BIPOLAR LINEAR   | USUALLY CAUSED BY BURIED PIPE, DRAIN OR CABLE BUT COULD BE OTHER MODERN FEATURE   |
| LIMIT OF VERY STRONG RESPONSE  | INTERFERENCE CAUSED BY MODERN MAGNETIC FEATURE (FEATURE MAY BE LOCATED BEYOND THE SURVEY AREA)  |
| LINEAR TREND   | CORRESPONDS WITH FORMER FIELD BOUNDARY. RESPONSES WILL BE RELATED TO THE BOUNDARY FEATURE   |
| APPROXIMATE ORIENTATION OF BROADLY PARALLEL POSITIVE LINEARS / CURVI-LINEARS | AGRICULTURAL FEATURES. REMNANTS OF RIDGE AND FURROW   |
| NEGATIVE LINEAR  | PROBABLE AGRICULTURAL OR DRAINAGE FEATURE   |
| LINEAR / CURVI-LINEAR TREND (WEAK OR DIFFUSE RESPONSE)                       | UNCERTAIN ORIGIN. PROBABLY RELATED TO AGRICULTURAL ACTIVITY BUT SOME COULD BE CAUSED BY A SUB-SURFACE FEATURE / REMNANT OF FEATURE OR NATURAL VARIATION |
| ISOLATED POSITIVE RESPONSE   | PROBABLE GEOLOGICAL / PEDOLOGICAL VARIATION OR DEEPER BURIED FERROUS / FIRED MATERIAL BUT COULD ALSO BE INFILLED ISOLATED FEATURE                       |





AREA 1

AREA 2

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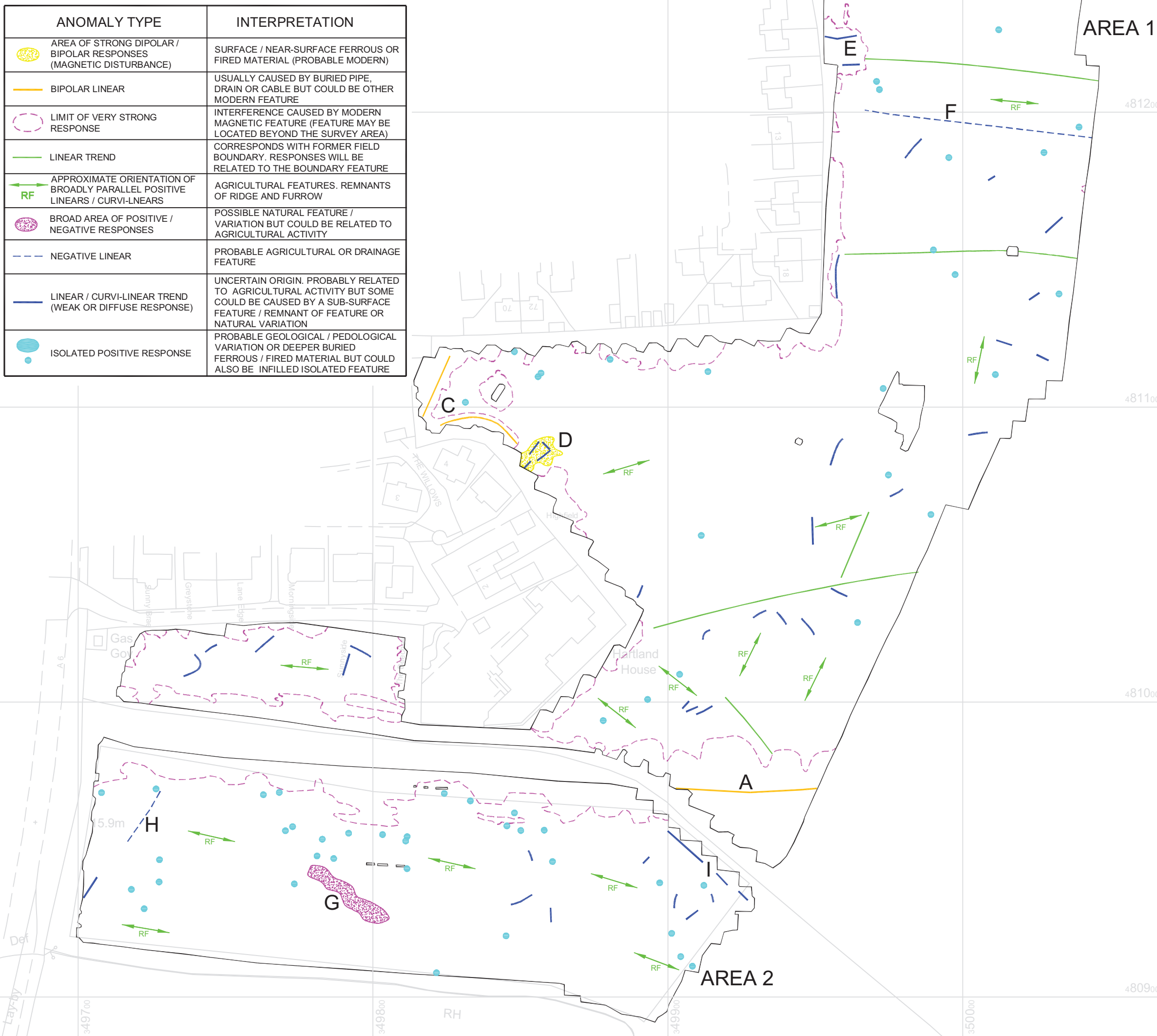
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| Site     | LAND OFF OF BEETHAM ROAD<br>MILNTHORPE, CUMBRIA                                     |         |                  |        |       |
| Title    | GREYSCALE PLOTS OF<br>MAGNETIC GRADIENT DATA: AREA 2<br>AND SOUTHERN PART OF AREA 1 |         |                  |        |       |
| Job No   | ARC_3019_1135   |         |                  |        |       |
| Surveyed | JW, MS  | Drawn   | MS               |        |       |
| Chk.     | MW  | Date    | 22/07/2021       |        |       |



| ANOMALY TYPE   | INTERPRETATION  |
|--|---|
| AREA OF STRONG DIPOLAR / BIPOLAR RESPONSES (MAGNETIC DISTURBANCE)            | SURFACE / NEAR-SURFACE FERROUS OR FIRED MATERIAL (PROBABLE MODERN)  |
| BIPOLAR LINEAR   | USUALLY CAUSED BY BURIED PIPE, DRAIN OR CABLE BUT COULD BE OTHER MODERN FEATURE   |
| LIMIT OF VERY STRONG RESPONSE  | INTERFERENCE CAUSED BY MODERN MAGNETIC FEATURE (FEATURE MAY BE LOCATED BEYOND THE SURVEY AREA)  |
| LINEAR TREND   | CORRESPONDS WITH FORMER FIELD BOUNDARY. RESPONSES WILL BE RELATED TO THE BOUNDARY FEATURE   |
| APPROXIMATE ORIENTATION OF BROADLY PARALLEL POSITIVE LINEARS / CURVI-LINEARS | AGRICULTURAL FEATURES. REMNANTS OF RIDGE AND FURROW   |
| BROAD AREA OF POSITIVE / NEGATIVE RESPONSES                                  | POSSIBLE NATURAL FEATURE / VARIATION BUT COULD BE RELATED TO AGRICULTURAL ACTIVITY  |
| NEGATIVE LINEAR  | PROBABLE AGRICULTURAL OR DRAINAGE FEATURE   |
| LINEAR / CURVI-LINEAR TREND (WEAK OR DIFFUSE RESPONSE)                       | UNCERTAIN ORIGIN. PROBABLY RELATED TO AGRICULTURAL ACTIVITY BUT SOME COULD BE CAUSED BY A SUB-SURFACE FEATURE / REMNANT OF FEATURE OR NATURAL VARIATION |
| ISOLATED POSITIVE RESPONSE   | PROBABLE GEOLOGICAL / PEDOLOGICAL VARIATION OR DEEPER BURIED FERROUS / FIRED MATERIAL BUT COULD ALSO BE INFILLED ISOLATED FEATURE                       |



AREA 1

AREA 2

NOTES

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| Title  |                  |            |
| INTERPRETATION OF<br>MAGNETIC GRADIENT DATA: AREA 2<br>AND SOUTHERN PART OF AREA 1 |                  |            |
| Job No   |                  |            |
| ARC_3019_1135  |                  |            |
| Surveyed   | JW, MS           | Drawn      |
| Chk.   | NF               | Date       |
|  |                  | MW         |
|  |                  | 22/07/2021 |

## **BIBLIOGRAPHY AND REFERENCES**

Greenlane Archaeology Ltd, *in prep.*, Land off Beetham Road, Milnthorpe, Cumbria, Archaeological desk-based assessment and geophysical survey

British Geological Survey, 2021, online resource - [www.bgs.ac.uk](http://www.bgs.ac.uk)

## APPENDIX 1

### Magnetic survey: technical information

#### 1.1 Theoretical background

- 1.1.1 Magnetic instruments measure the value of the Earth's magnetic field; the units of which are nanoTeslas (nT). The presence of surface and sub-surface features can cause variations or anomalies in this magnetic field. The strength of the anomaly is dependent on the magnetic properties of a feature and the material that surrounds it. The two magnetic properties that are of most interest are magnetic susceptibility and thermoremanent magnetism.
- 1.1.2 Magnetic susceptibility indicates the amount of ferrous (iron) minerals that are present. These can be redistributed or changed (enhanced) by human activity. If enhanced material subsequently fills in features such as pits or ditches then these can produce localised increases in magnetic responses (anomalies) which can be detected by a magnetic gradiometer even when the features are buried under additional soil cover.
- 1.1.3 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil may give a negative magnetic response relative to the background level. The strength of magnetic responses that a feature will produce will depend on the background magnetic susceptibility, how rapidly the feature has been infilled, the level and type of human activity in the area and the size and depth of a feature. Not all infilled features can be detected and natural variations can also produce localised positive and negative anomalies.
- 1.1.4 Thermoremanent magnetism indicates the amount of magnetism inherent in an object as a result of heating. Material that has been heated to a high temperature (fired), such as brick, can acquire strong magnetic properties and so although they may not appear to have a high iron content they can produce strong magnetic anomalies
- 1.1.5 The magnetic survey method is highly sensitive to interference from surface and near-surface magnetic 'contaminants'. Surface features such as metallic fencing, reinforced concrete, buildings or walls all have very strong magnetic signatures that can dominate readings collected adjacent to them. Identification of anomalies caused by sub-surface features is therefore more difficult, or even impossible, in the vicinity of surface magnetic features. The presence of made ground also has a detrimental effect on the magnetic data quality as this usually contains magnetic material in the form of metallic scrap and brick. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong magnetic response but smaller features or magnetically weak features are unlikely to be identified.
- 1.1.6 The interpretation of magnetic anomalies is often subjective and it is rarely possible to identify the cause of all magnetic anomalies. Not all features will produce a measurable magnetic response and the effectiveness of a magnetic survey is also dependant on the site-specific conditions. The main factors that may limit whether a feature can be detected are the



composition of a feature, its depth and size and the surrounding material. It is not possible to guarantee that a magnetic survey will identify all sub-surface features.

- 1.1.7 Most high resolution, near surface magnetic surveys utilise a magnetic gradiometer. A gradiometer is a hand-held instrument that consists of two magnetic sensors, one positioned directly above the other, which allows measurement of the magnetic gradient component of the magnetic field. A gradiometer configuration eliminates the need for applying corrections due to natural variations in the overall field strength that occur during the course of a day but it only measures relative variations in the local magnetic field and so comparison of absolute values between sites is not possible.
- 1.1.8 Features that are commonly located using magnetic surveys include archaeological ditches and pits, buried structures or foundations, mineshafts, unexploded ordnance, metallic pipes and cables, buried piles and pile caps. The technique can also be used for geological mapping; particularly the location of igneous intrusions.

## **1.2 Instrumentation**

- 1.2.1 A multi-sensor array cart system (MACS) utilising 8 Foerster 4.032 Ferex CON 650 gradiometers, spaced at 0.5 m intervals, with a control unit and data logger was used for the magnetic survey.

## **1.3 Survey methodology**

- 1.3.1 The MACS utilises an RTK GNSS system which means that survey grids do not have to be established. Instead an area is surveyed over a series of continuous profiles and the position of each data point is recorded using an RTK GNSS system. The sensors have a separation of 0.5 m which means that data was collected on profiles spaced at 0.5 m apart. Readings were taken at between 0.1 m and 0.15 m intervals.
- 1.3.2 Data is collected on zig-zag profiles along the full length or width of a field, although fields can be sub-divided if they are particularly large. Marker canes are set-out along field boundaries at set intervals and these are used to align the profiles. The survey profiles are usually offset from field boundaries, buildings and other metallic features by several metres to reduce the detrimental effect that these surface magnetic features have on the data. The location of the MACS data is converted direct to Ordnance Survey co-ordinates using the UK OSTN 15 projection. As the data is related direct to Ordnance Survey National Grid co-ordinates temporary survey stations are not established.
- 1.3.3 The Foerster gradiometers have a resolution of 0.2 nT but the stability of the cart system significantly reduces noise caused by instrument tilt and movement when compared with a traditional hand-held gradiometer system and the increased data intervals provide a higher resolution data set. The sensors have a range of  $\pm 10,000$ nT and readings are taken at 0.1 nT resolution.

## **1.4 Data processing and presentation**

- 1.4.1 The MACS data is stored direct to a laptop using in-house software which automatically corrects for instrument drift and calculates a mean value for each profile. A positional value is assigned to each data point based on the sensor number and recorded GNSS co-ordinates. The data is gridded using in-house software and parameters are set based on the sensor spacing and mean values. No additional processing is required. The gridded data is then displayed in Surfer 9 (Golden Software) and image files of the data are created.

- 1.4.2 The data was exported as greyscale raster images (PNG files). Data for the entire site is presented at a scale of 1:2500 and plots for individual fields / areas (or parts of fields / areas) with accompanying interpretations are shown at a scale of 1:1250. All greyscale plots were clipped at -2 nT to 3 nT. Greyscale plots have been 'smoothed' using a visual interpolation but the data itself has not been interpolated.
- 1.4.3 The data has been displayed relative to a digital Ordnance Survey base plan provided by the client as drawing '*Promap-1477813-1579102-720-0\_site boundary.dwg*'. The base plan was in the Ordnance Survey National Grid co-ordinate system and as the survey grids / data were referenced directly to National Grid co-ordinates the data could be simply superimposed onto the base plan in the correct position.

## 1.5 Interpretation

- 1.5.1 The anomalies have been categorised based on the type of response that they have and an interpretation as to the cause(s) or possible cause(s) of each anomaly type is also provided. The following anomaly types may be present within the data:

### **Dipolar, bipolar and strong responses**

Dipolar and bipolar responses are those that have a sharp variation between strongly positive and negative components.

In the majority of cases these responses are usually caused by modern ferrous features / objects, although fired material (such as brick), some ferrous or industrial archaeological features and strongly magnetic gravel could also produce dipolar and bipolar responses.

**Isolated dipolar responses** are those that have a single positive and negative element. They are usually caused by isolated, ferrous or fired material on or near to the surface. The objects that cause dipolar responses are usually relatively small, such as spent shotgun cartridges, iron nails and horseshoes (hence they are often referred to as 'iron spikes') or pieces of modern brick or pot. Some types of archaeological artefacts can also produce this type of response but unless there is strong supporting evidence to the contrary they are assumed not to be of archaeological significance.

Bipolar anomalies have strong positive and negative components but are not technically magnetic dipoles. The majority of **isolated bipolar responses** are caused by ferrous or fired material on or near to the surface. These responses tend to be produced from larger objects, compared to dipolar anomalies, or a concentration of smaller objects. Some archaeological features/ activity, including areas of burning or industrial activity can also produce this type of response but unless there is strong supporting evidence to the contrary they are assumed not to be of archaeological significance.

Isolated dipolar and bipolar responses have not been shown on the interpretation as there is no evidence to suggest that they may be archaeological in origin.

**Bipolar linear** anomalies are usually produced by buried pipes / cables that are usually metallic, although in some instances ceramic pipes can also produce popular anomalies. In some instances the anomaly can extend for a significant distance beyond the feature that produces the anomaly. Bipolar anomalies are often very strong and can potentially mask responses from other sub-surface features in the vicinity of the pipe or cable.

Areas containing numerous **strong dipolar / bipolar responses (magnetic disturbance)** are usually caused by greater concentrations of ferrous or fired material and are often found adjacent to field boundaries where such material tends to accumulate. Above



ground metallic or strongly magnetic features, such as fences, gates, pylons and buildings can also produce very strong bipolar responses. If an area of magnetic disturbance is located away from existing field boundaries then it could indicate a former field boundary, several large isolated objects in close proximity, an area where modern material has been tipped or an infilled cut feature, such as a quarry pit. Areas of dipolar / bipolar response can occasionally be caused by features / material associated with archaeological industrial activity or natural deposits that have varying magnetic properties but they are usually caused by modern activity. Responses in areas of magnetic disturbance can sometimes be so strong that archaeological features located beneath them may not be detected.

Very strong responses, notably bipolar anomalies, from modern features can dominate the data for a significant distance beyond the feature. The extent of these areas is usually shown either as part of the bipolar anomaly or as a **limit of very strong response**. It should be noted that this effect extends beyond the feature and so the limit of the response does not correspond to the actual size or location of the feature within it. In many cases where these strong responses are present at the edge of survey area the feature causing the anomaly be actually be located beyond the survey area. It should be recognised that other sub-surface features located within these areas may not be detected.

### Negative linear / curvi-linear anomalies

**Negative linear / curvi-linear anomalies** occur when a feature has lower magnetic readings than the surrounding material and can often be associated with ploughing regimes or plastic / concrete pipes or natural features.

They can also indicate the presence of a feature that cuts into magnetic soils or bedrock and which is infilled with less magnetic material and in certain geologies can be associated with archaeological features.

On this site it is believed that the negative linear anomalies are caused by agricultural activity or drainage features.

### Linear / curvi-linear anomalies (probable agricultural)

In many geological / pedological conditions agricultural features / regimes can produce magnetic anomalies due to the accumulation / alignment of magnetic topsoil. In most cases these are exhibited as a series of **broadly parallel positive linear** anomalies. The majority of these responses are associated with modern ploughing regimes but in some instances, where the responses are broader and more widely spaced, they can indicate the presence of the remnants of ridge and furrow.

Field drain systems can also produce linear anomalies, usually where the drains are made from fired ceramic or infilled with magnetic gravels.

Where a series of parallel anomalies are present then the approximate orientation of the anomalies are shown on the interpretation drawing to indicate the direction of the agricultural regime but for the sake of clarity individual anomalies have not been shown.

Individual anomalies may be shown if the response is not part of a regime.

### Broad area of positive / negative responses

**Broad areas of positive / negative responses** can have a variety of causes. If the areas are generally quite large and irregular in shape then they are usually suggestive of natural features, such as lenses of sand and gravel deposits, palaeochannels or other natural features / variations where the natural material differs from the surrounding sub-surface.



In some instances anomalies of this type can be associated with anthropogenic (usually modern) activity.

### **Linear / curvi-linear trends**

An anomaly is categorised as a **trend** if it is not certain that the response is associated with an extant sub-surface feature. Trends are usually weak, irregular, diffuse or discontinuous and it is usually not certain what their cause is, if they represent significant sub-surface features or even if they are associated with definite features.

It is possible that some of the trends are associated with geological / pedological variations. Others may be produced by artificial constructs within the data, either caused by processing or in some instances by intersecting anomalies (usually different agricultural regimes) that give the appearance of curving or regular shapes. Many trends are a product of weak, naturally occurring responses that happen to form a regular pattern but which are not associated with a sub-surface feature.

In some instances former features that have been severely truncated can still produce broad, diffuse or weak responses even if the underlying feature has been removed. This is due to the presence of magnetic soils associated with the former feature still being present along its route. In other instances the magnetic properties of the soils filling a feature may vary and so the magnetic signature of the feature can change, even if the sub-surface feature itself remains uniform. If a response from a feature becomes significantly weak or diffuse then part of the anomaly may be shown as a trend as it is uncertain if the feature is still present or has been severely truncated or removed.

### **Isolated positive responses**

**Isolated positive responses** can occur if the magnetism of a feature, area or material has been enhanced or if a feature is naturally more magnetic than the surrounding material. It is often difficult to determine which of these factors causes any given responses and so the origin of this type of anomaly can be difficult to determine. They can have a variety of causes including geological variations, infilled archaeological features, areas of burning (including hearths), industrial archaeological features, such as kilns, or deeper buried ferrous material and modern fired material.

The large number of isolated responses and lack of an obvious pattern to their distribution suggests that the majority of these anomalies are probably associated with geological / pedological variations or deeper buried ferrous or fired material. Only the larger or stronger areas of positive response have been shown on the interpretation. The majority, if not all of these responses, will be related to natural variations or relatively modern material but have been shown as their exact cause cannot be determined with certainty.

### **Positive linear / curvi-linear anomalies**

Positive magnetic anomalies indicate an increase in magnetism and if the resulting anomaly is linear or curvi-linear then this can indicate the presence of a man-made feature. **Positive or enhanced linear / curvi-linear** anomalies can be associated with agricultural activity, drainage features but they can also be caused by ditches that are infilled with magnetically enhanced material and as such can indicate the presence of archaeological features. Some natural infilled features can also produce positive anomalies.

There are no significant positive linear anomalies in this data set.

- 1.5.2 Several different ranges of data were used in the interpretation to ensure that the maximum information possible is obtained from the data.
- 1.5.3 X-Y trace plots were examined for all of the data and overlain onto the greyscale plot to assist in the interpretation, primarily to help identify dipolar / bipolar responses that will probably be associated with surface / near-surface iron objects. X-Y trace plots have not been used in the report as they do not show any additional anomalies that are not visible in the greyscale data. A digital drawing showing the X-Y trace plot overlain on the greyscale plot has been provided in the digital archive.
- 1.5.4 All isolated responses have been assessed using a combination of greyscale and X-Y trace plots.
- 1.5.5 Anomalies associated with agricultural regimes are present in the data. The general orientation of these regimes has been shown on the interpretation but, for the sake of clarity, each individual anomaly has not been shown.
- 1.5.6 The greyscale plots and the accompanying interpretations of the anomalies identified in the magnetic data are presented as 2D AutoCAD drawings. The interpretation is made based on the type, size, strength and morphology of the anomalies, coupled with the available information on the site conditions. Each type of anomaly is displayed in separate, easily identifiable layers annotated as appropriate.

## **1.6 Limitations of magnetic surveys**

- 1.6.1 The magnetic survey method requires the operator to walk over the site at a constant walking pace whilst holding the instrument. The presence of an uneven ground surface, dense, high or mature vegetation or surface obstructions may mean that some areas cannot be surveyed.
- 1.6.2 The depth at which features can be detected will vary depending on their composition, size, the surrounding material and the type of magnetometer used for the survey. In good conditions large, magnetic targets, such as buried drums or tanks can be located at depths of more than 4 m. Smaller targets, such as buried foundations or archaeological features can be located at depths of between 1 m and 2 m.
- 1.6.3 A magnetic survey is highly sensitive to interference from surface and near-surface magnetic 'contaminants'. Surface features such as metallic fencing, reinforced concrete, buildings or walls all have very strong magnetic signatures that can dominate readings collected adjacent to them. Identification of anomalies caused by sub-surface features is therefore more difficult or even not possible in the vicinity of surface and near-surface magnetic features.
- 1.6.4 The presence of made ground also has a detrimental effect on the magnetic data quality as this usually contains magnetic material in the form of metallic scrap and brick. Identification of features beneath made ground is still possible if the target feature is reasonably large and has a strong magnetic response but smaller features or magnetically weak features are unlikely to be identified.
- 1.6.5 It should be noted that anomalies that are interpreted as modern in origin may be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.
- 1.6.6 A magnetic survey does not directly locate sub-surface features - it identifies variations or anomalies in the local magnetic field caused by features. It can be possible to interpret the cause of anomalies based on the size, shape and strength of response but it should be recognised that a magnetic survey produces a plan of magnetic variations and not a plan of all



sub-surface features. Interpretation of the anomalies is often subjective and it is rarely possible to identify the cause of all magnetic anomalies. Geological or pedological (soil) variations or features can produce responses similar to those caused by man-made (anthropogenic) features.

- 1.6.7 Anomalies identified by a magnetic survey are located in plan. It is not usually possible to obtain reliable depth information on the features that cause the anomalies.
- 1.6.8 Not all features will produce a measurable magnetic response and the effectiveness of a magnetic survey is also dependant on the site-specific conditions. It is not possible to guarantee that a magnetic survey will identify all sub-surface features. A magnetic survey is often most-effective at identifying sub-surface features when used in conjunction with other complementary geophysical techniques.