Geophysical Survey Report

of

Harras Moor, Whitehaven

Cumbria

For

WYG

On Behalf Of

Homes England

Magnitude Surveys Ref: MSNX389

February 2019

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Draft 1.0	Initial draft to line manager	Lauren Cadman BA Hugo Kesterton BSc	Lauren Cadman BA Chris Nelson MA MPhil	Edward Burton BA PGCE	14 November 2018
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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 22ha area of Harras Moor, Whitehaven, Cumbria. The geophysical results primarily reflect agricultural activity, with drains and multiple historic ploughing regimes having been identified, including ridge-and-furrow and a possible *cord rigg* system. Several historic field boundaries have also been detected. Anomalies of a modern and natural origins have been identified as well, including a discrete area of possible burning or industrial activity, and an area of dipolar responses consistent with a subsurface spread of green waste. A number of anomalies have been classified as 'Undetermined' in origin where a more specific origin cannot be confidently ascribed. While an archaeological origin is possible, these responses may also be resultant from a combination of agricultural, natural, or modern processes.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by WYG on behalf of Homes England to undertake a geophysical survey on a c.22ha area of land at Harras Moor, Whitehaven, Cumbria (NX 986 181) (Figure 1).

1.2. The geophysical survey comprised hand-carried, GNSS-positioned fluxgate magnetometer survey.

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).

1.4. The survey was conducted in line with a Written Scheme of Investigation provided by WYG (Turner 2018).

1.5. The survey commenced on 5 November 2018 took four days to complete. This comprised three days of survey from 5 November 2018 to 7 November 2018, and one additional day on 21 February 2019 to survey three areas which were found to be unsuitable in November 2018 due to the presence of dense vegetation and livestock.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

2.2. Director Graeme Attwood is a Member of CIfA, as well as the Secretary of GeoSIG, the CIfA Geophysics Special Interest Group. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Director Chrys Harris has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of the International Society for Archaeological Prospection.

2.3. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

3. Objectives

3.1. The geophysical survey aimed to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The site is located on the southeast edge of Harras Moor, a village c. 1km southeast of Whitehaven (Figure 1). Survey was undertaken over nine pasture fields, some of which were subdivided into a number of paddocks. The site is bounded by Harras Road to the northeast, houses off Highlands and Laurel Bank to the north, the A595 to the southwest, Caldbeck Road to the south, and Red Lonning to the east (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Grass. Sloped downward to the SW. Contained a central waterlogged area with marshy plants, which could not be surveyed.	Bounded by wooden fencing to the NE and SW, wire fencing to the SE, and a stone wall to the north. A line of telegraph poles crossed the area NW-SE. Three slight ditch-like features were noted in the area aligned NE-SW: two along the north and south edges of the area and one across the centre. The central ditch was too steep to survey and created a narrow obstacle across the area.
2	Grass. Sloped downward to the SW.	Bounded by wire fencing to the NW and SE, and stone walls to the NE and SW. Contained a capped borehole in the west corner and another along the NW edge. A NW-SE aligned bank crossed the area towards the NE edge, and a N-S aligned wire fence and ditch crossed the SW of the area.
3	Cut grass. Sloped downward to the SW. Surveyed in the second tranche (February 2019) once vegetation had been cut.	Bounded by wire fencing to the NW, SW and SE. Contained a stream and a 10m strip of waterlogged ground along the SW boundary, which couldn't be surveyed. Contained a capped borehole along the eastern boundary.
4	Grass and marsh grass. Sloped downward to the SW.	Bounded by wire fencing and contained a borehole against the SE edge. A NW-SE aligned bank crossed the area towards the NE corner.
5	Cut grass. Flat. Surveyed in the second tranche (February 2019) once vegetation had been cut.	Bounded by wire fence to the NW, stone wall to the NE, and trees to the south. A wire fence crossed this area from SW-NE. A deep ditch filled with stones and bricks in the south of the area could not be surveyed. A small patch of waterlogged ground in the north of the area could not be surveyed.
6	Grass paddock. Sloped downward to the SW.	Bounded by wire fencing and contained a ditch aligned east-west running half way through the centre of the paddock. A small part of the paddock was fenced off in the east with plastic poles and ropes.
7	Flat sheep pasture.	Bounded by wire fencing and contained a capped borehole in the southwest corner.

8	Grass paddock. Sloped downward to the SW.	Bounded by wire fencing to the north, east, and west, and temporary fencing to the south.
9	Grass paddock. Sloped downward to the SW.	Bounded by wire fencing to the south, east and west, and temporary fencing to the north.
10	Flat grass.	Bounded by wire fencing.
11	Grass paddock. Sloped downward to the SW. Surveyed in the second tranche (February 2019) once the horses had been removed.	Bounded by wire fencing to the north and east, and trees to the west. A strip of thick vegetation along the west and south of the survey area could not be surveyed. Additionally, three individual trees and a shed were present in the survey area and could not be surveyed over.
12	Flat grass.	Bounded by wire fencing.
13	Flat grass.	Bounded by wire fencing.
14	Flat grass.	Bounded by wire fencing to the north and west, and wooden fencing to the south and east.
15	Flat grass.	Bounded by wire fencing to the north and east, and wooden fencing to the south and west.
16	Flat long grass.	Bounded by hedgerow to the north, road to the south and west, and wire fence to the east.
17	Flat grass.	Bounded by hedgerow to the north, east and south, and wire fencing to the west. Contained a capped borehole at the east end of the field and another at the west end, and a single set of football goalposts at the west end of the field.

4.3. The underlying geology comprises sandstone of the Whitehaven sandstone formation over the east of the site, and Pennine middle coal measures formation of mudstone, siltstone and sandstone in the west of the site (Area 4). Superficial deposits consist of diamicton till, Devensian, with no superficial deposits recorded over the majority of Areas 3, 6 and the eastern half of Area 5 (British Geological Survey, 2018).

4.4. The soils consist of freely draining slightly acid loamy soils over the centre of the site, and slowly permeable seasonally wet acid loamy and clayey soils along the eastern edge and the western half of Area 4 (Soilscapes, 2018).

5. Archaeological Background

5.1. The following section provides a summary of an archaeology and heritage desk-based assessment prepared by WYG (2018), and an examination of freely available historic and modern maps.

5.2. Three potential archaeological features have been recorded within the survey area, including two quarries (19947, 19946) and a possible bronze age stone circle (1178).

5.3. Prehistoric activity within the survey area is limited to the aforementioned Bronze Age stone circle (1178), which according to written accounts was at one time located somewhere in the vicinity of Standing Stones Farm.

5.4. In the vicinity of the survey area there are several recorded sites relating to collieries and associated structures, such as air shafts and transporting equipment, dating from the post-medieval through the industrial period and into the modern period (2752, 2753, 11947, 11948, 11950, 11952, 11957, 11962, 11963, 12442, 12443, 12444, 12838, 12917, 19945).

5.5. Other industrial activity within 1km of the survey area includes: shipbuilding infrastructure (11956,12855), pottery production, (11951, 11971, 12882, 11960) and quarrying, with two small quarries being located within the northern corner of the survey area (19946, 19947).

5.6. An examination of historic maps reveals that only a few changes in the layout of field boundaries within the survey area have occurred. The historic maps also show the gradual expansion of urban developments. Sometime from 1938, OS maps show that Midgey Wood expanded to the northeast, covering Areas 3 and 4; this was cleared by 1957.

6. Methodology

6.1.Data Collection

6.1.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.3. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

6.1.3.1. MS' hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.3.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2.Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3.Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the upper and/or lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plots (Figures 7, 10, 13). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historic maps, and soil and geology maps. Google Earth (2018) was consulted as well, to compare the results with recent land usages.

7. Results

7.1.Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

7.2.Discussion

7.2.1. The geophysical results are presented in consideration historic maps (Figure 4) and satellite imagery (Figure 5).

7.2.2. The fluxgate magnetometer survey has responded well to the survey area's environment, with the exception of an area of strong dipolar responses, consistent with a subsurface spread of green waste material, which extends across the majority of Area 11. Elsewhere on site, magnetic interference has been limited to 'halo' effects of wire fencing at the edges of the survey areas and along a number of buried services. The north-west of site displays a quieter magnetic background than the east and south, where anomalies appear to exhibit a greater magnetic contrast. This may be the result of a change in geology (see section 4.3). A wider plotting range has been used for the figures representing the south of site (Figure 12), to aid in anomaly interpretation.

7.2.3. The geophysical results primarily reflect agricultural activity; this is represented by drainage systems, particularly across lower ground in the west of the site, field boundaries, and a number of historic ploughing regimes of varying alignments, spacings and strengths, particularly towards the east of the site, which may span several periods of use. Specifically, in the south of the site, wider-spaced, broader trends are indicative of a ridge-and-furrow system, while in the north, more ephemeral trends may relate to more recent ploughing. In the centre of the site, in Areas 4, 7, 10, 12, 14 and 15, these give way to remarkably more strongly-enhanced and narrowly-spaced trends at c.1m or less apart. This closer spacing may indicate the presence of a *cord rigg* system. This is a specifically upland phenomenon and may pre-date other ploughing regimes in the survey area; some excavated examples have been dated to the Iron Age.

7.2.4. Several probable and possible field boundaries have been detected across the site, some of which are not recorded in historic mapping. Some are likely to be agricultural in origin, based on their shape and alignment with other agricultural features, but could be more openly interpreted as possible field boundaries or drainage features. As a result, these have been classified more generally as 'Agricultural' in origin. Ploughing

trends across the site respect many of these boundaries, being oriented either parallel with or perpendicular to them, though the possible *cord rigg* in Area 7 follows a slightly different alignment (Figure 4).

7.2.5. No anomalies have been specifically interpreted as probable or possible archaeological sub-surface features, though a number of anomalies in the centre of the site which have been classified as 'Undetermined'. These are situated within an area of strongly-enhanced, narrowly-spaced plough furrows, which partially obscure their response. Therefore, these Undetermined responses may also be resultant from agricultural, natural or modern processes.

7.3.Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.

7.3.1.3. **Ferrous (Discrete/Spread)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of modern metallic disturbance on or near the ground surface. A ferrous spread refers to a concentrated deposition of these discrete, dipolar anomalies. Broad dipolar ferrous responses from modern metallic features, such as fences, gates, neighbouring buildings and services, may mask any weaker underlying archaeological anomalies should they be present.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Undetermined (Weak) –** In Area 7, several weak curvilinear responses [**7a**], [**7b**] have been detected within an area of strongly-enhanced, narrowly-spaced ploughing trends. Examined together, [**7a – 7c**] appear to form potential sub-circular patterns; their vicinity to what was Standing Stones Farm raises the tentative possibility that they relate to an account of a possible stone circle somewhere nearby (see 5.3). However, their broken shape and ambiguous response significantly reduces the confidence with which they can interpreted as potential sub-surface features. Therefore, an 'Undetermined' classification has been ascribed.

7.3.2.2. **Agricultural (Weak) –** In the west of Area 2, a weak linear anomaly [**2a**] has been identified which correlates with a boundary recorded in the 2nd Edition OS map (Figure 4).

7.3.2.3. **Agricultural (Spread) –** A spread response [**2b**] has been detected across the eastern end of Areas 2 and 4, aligned c. NW-SE. [**2b**] collocates with a bank feature observed at the surface at the time of survey; this feature contained traces of brick walling at the surface. This feature corresponds with a boundary marked on an 1849 Enclosure Map running from High Harras to Standing Stones (Turner 2018(b): Appendix F). This section of boundary was not marked on the later 2nd Edition Map or later mapping (Figure 4).

7.3.2.4. **Agricultural (Weak) –** A pair of weak linear anomalies [**2c**], c.3m apart, extend c. NNW-ESE through the east of Area 2 and the centre of Area 4. No corresponding feature is recorded in historic mapping, but their alignment is parallel to an historically recorded field boundary c.150m to the east, the magnetic response of which is also similar in nature to [**2c**]; therefore, [**2c**] most likely reflects a similar historic field boundary.

7.3.2.5. **Agricultural (Strong, Weak)** – Two linear anomalies [**1a**] have been detected aligned north-south at the eastern end of Area 1. These are located within an area of likely drains, but their magnetic response is slightly stronger and broader in shape than those identified as drainage features. There is no corresponding feature in historic mapping or recent satellite imagery; therefore, it is unclear whether this represents a drainage feature or a different agricultural feature such as an unrecorded field boundary.

7.3.2.6. **Agricultural (Strong)** – A pair of strong parallel linear anomalies [**14a**] has been identified in Area 14. [**14a**] parallel with ploughing trends in Areas 10 and 12, and with field boundaries marked on the 2nd Edition OS Map (Figure 4). Given their limited extent, it is unclear whether they represent enhanced plough furrows, drainage features or another undetermined agricultural feature. Therefore, they have been classified more broadly as 'Agricultural'.

7.3.2.7. **Undetermined (Weak) –** A collection of linear and curvilinear anomalies [**1b**] has been identified at the northern edge of Area 1, two of which appear to connect with a nearby service. Their shape is somewhat different from natural responses nearby, suggesting a possible anthropogenic origin, though their proximity and connection with the nearby service suggests they may represent features relating to the service. The limited context and similarity to natural responses nearby has led to their interpretation as 'Undetermined' in origin.

7.3.2.8. **Industrial/Burnt –** A discrete anomaly [**2d**] has been identified in the north-east of Area 2; reference to XY trace plots shows that this is strong but not ferrous in nature, and likely represents burnt or fired material of an unknown origin (Figure 10).

8. Conclusions

8.1. The fluxgate magnetometer survey has responded well to the survey area's environment, with the exception of an area of possible green waste extending across the majority of Area 11. No responses have been confidently interpreted as being archaeological in nature, though some sub-circular patterns of anomalies classified as 'Undetermined' in the centre of the site may tentatively be suggested as possible archaeological features. These have been partially obscured by more enhanced ploughing trends in the same location; so an agricultural, natural or modern origin cannot be entirely dismissed.

8.2. A number of probable and possible historic field boundaries have been detected across the survey area, and several historic ploughing regimes have been identified to the east of the site which may span multiple periods of use. Specifically, these include possible *cord rigg* systems in the centre of the site, a probable ridge-and-furrow system and trends from recent agricultural activity elsewhere.

8.3. Strong natural responses have been identified across the sloping ground in the west of the survey area. A series of drainage systems has been identified across the site, more intensively on lower, sloping ground to the west.

8.4. Two buried services were detected running across the survey area, and a single discrete anomaly indicating the presence of burnt or fired material, has been identified in the north-east corner of the site, though a more precise origin for this has not been identified.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

11. References

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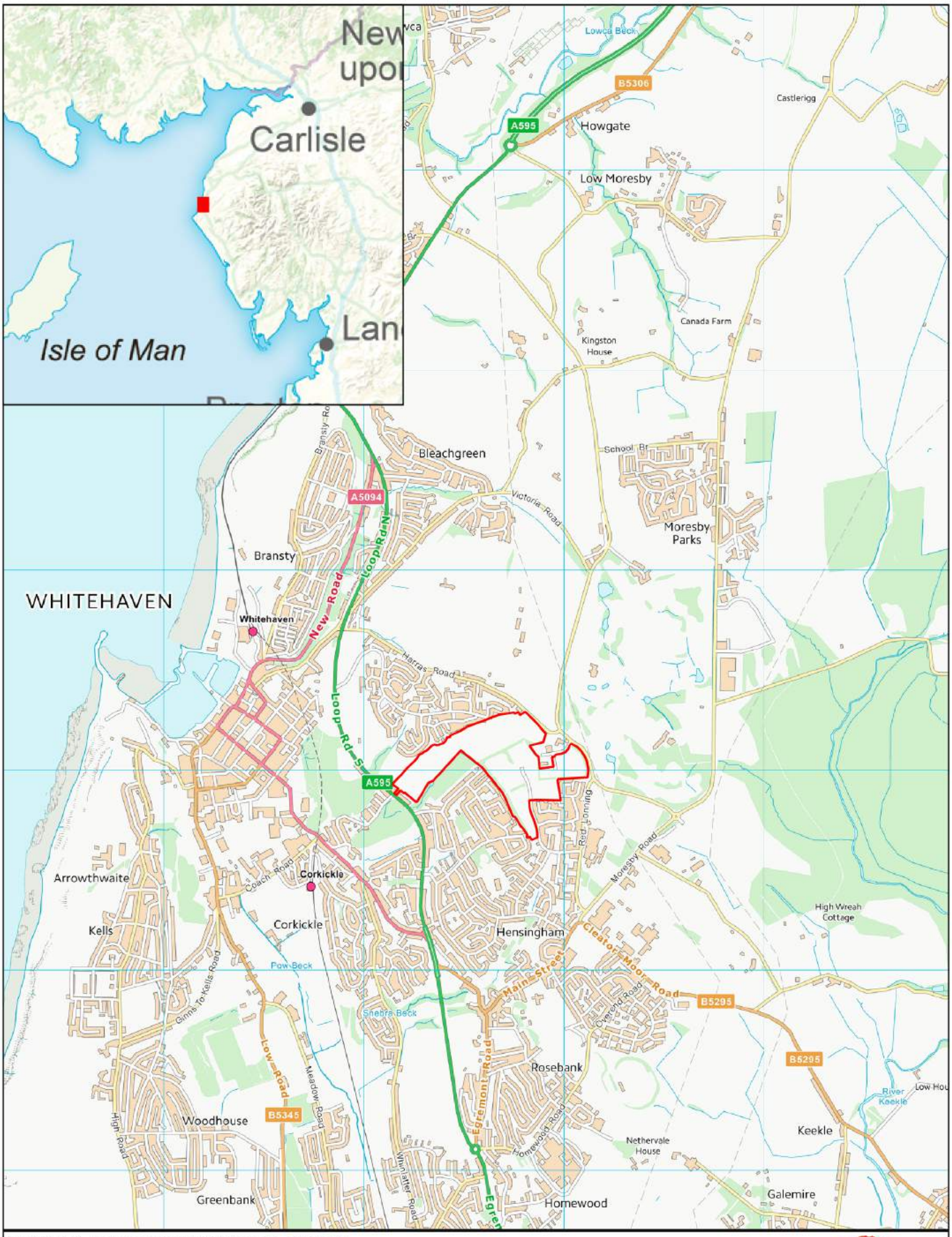


MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

299000

518000

518000

Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

Area 7

Area 8

Area 9

Area 10

Area 11

Area 12

Area 13

Area 14

Area 15

Area 16

Area 17

Harras Park

Harras Moor

HARRAS ROAD

STANDINGS RISE

HILLCREST AVENUE

LOOP ROAD SOUTH

CALDBECK ROAD

RED LONNING

Midgey Wood

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 2 - Location of Survey Areas
1:3,000 @ A3

Site Boundary

Survey Extent

N

0 50 100 150 m

magnitude surveys

298200 298400 298600 298800 299000 299200

518400 518200 518000 517800

Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 9
Area 10
Area 11
Area 12
Area 13
Area 14
Area 15
Area 16
Area 17

Harras Park
HARRAS ROAD
Midgey Wood
STANDINGS RISE
HILLCREST AVENUE
LOOP ROAD SOUTH
CALDBECK ROAD
RED LONNING

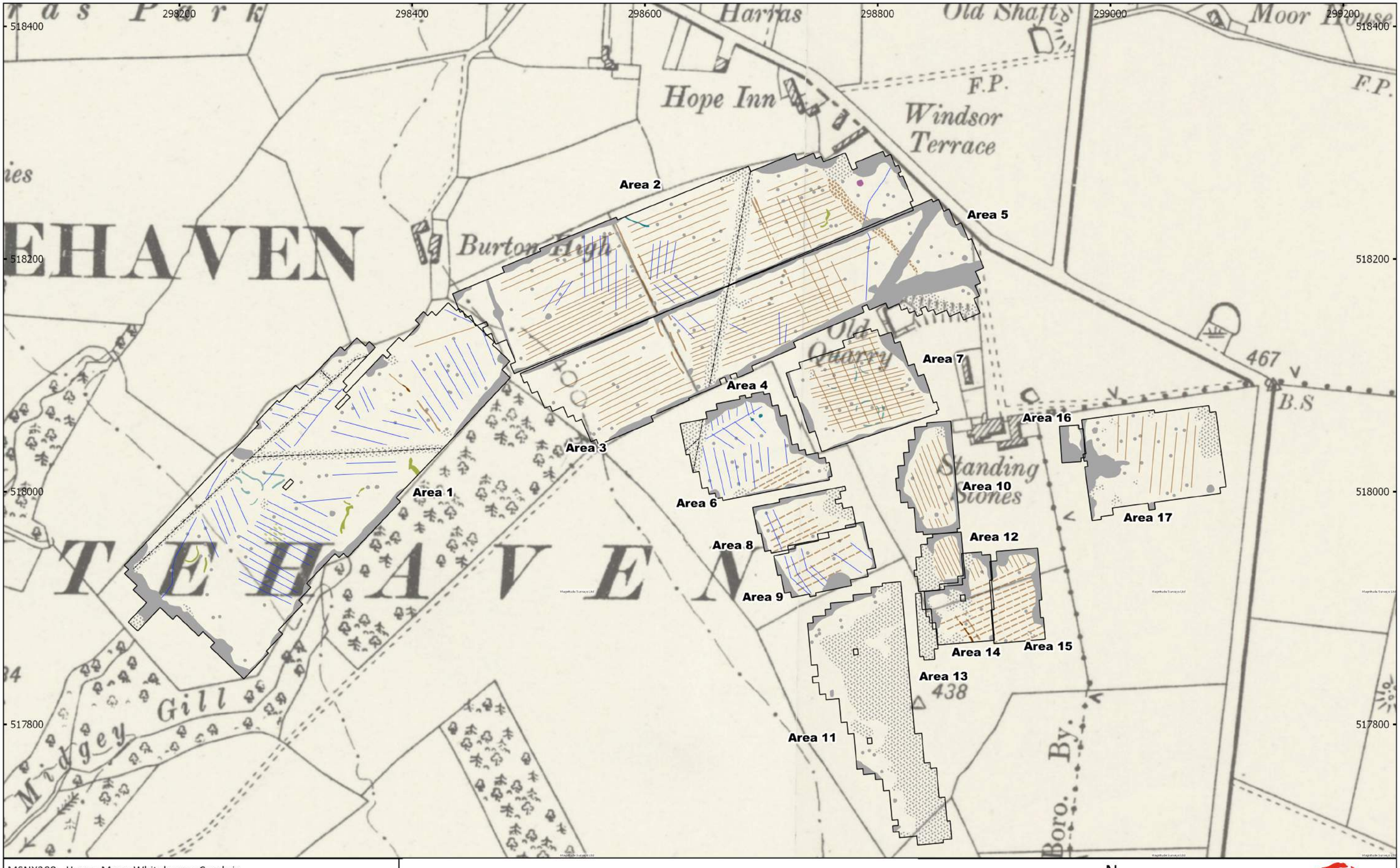
MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 3 - Magnetic Gradient (Overview)
1:3,000 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys



MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 4 - Magnetic Interpretation Over Historic Maps
1:3,000 @ A3

Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 © National Library of Scotland

- Agricultural (Strong)
- Agricultural (Weak)
- Agricultural (Spread)
- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Undetermined (Strong)
- Undetermined (Weak)
- Ferrous (Dipolar)
- Ferrous (Spread)/Magnetic Disturbance
- Service
- Industrial/Burnt
- Natural (Strong)
- Natural (Spread)
- Drainage Feature

N

0 50 100 150 m

magnitude surveys

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 5 - Magnetic Gradient (West)
1:1,500 @ A3

-1 nT 2

N

0 25 50 75 m

magnitude surveys

298100 298200 298300 298400 298500 298600

518100

518000

517900

Crowpark Wood

Midgey Wood

1a

1b

Area 1

Area 3

STANDINGS RISE

CLITHEROE DRIVE

Midgey Wood

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 6 - Magnetic Interpretation (West)
1:1,500 @ A3

- Agricultural (Strong)
- Agricultural (Weak)
- Agricultural (Trend)
- Undetermined (Weak)
- Natural (Strong)
- Natural (Spread)
- Ferrous (Dipolar)
- Ferrous (Spread)/Magnetic Disturbance
- Service
- Drainage Feature

N

0 25 50 75 m

magnitude surveys

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 7 - XY Trace Plot (West)
30nT/cm at 1:1,5 00 @ A3

magnitude surveys

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 8 - Magnetic Gradient (North)
1:1,500 @ A3

magnitude surveys

298400
298500
298600
298700
298800
298900
518200
518100
518000
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 10
Area 12
Area 16
1a
2a
2b
2c
2d
7a
7b
7c
Harras Moor
Midgey Wood
Red Lonning Industrial Estate

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 9 - Magnetic Interpretation (North)
1:1,500 @ A3

- Agricultural (Strong)
- Agricultural (Weak)
- Agricultural (Spread)
- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Undetermined (Strong)
- Undetermined (Weak)
- Ferrous (Dipolar)
- Ferrous (Spread)/Magnetic Disturbance
- Service
- Industrial/Burnt
- Natural (Strong)
- Drainage Feature

N

0 25 50 75 m

magnitude surveys

298400
298500
298600
298700
298800
298900
518200
518100
518000
Area 1
Area 2
Area 3
Area 4
Area 5
Area 6
Area 7
Area 8
Area 10
Area 12
Area 16
Harras Moor
Midgey Wood
Red Lonning Industrial Estate

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 10 - XY Trace Plot (North)
30nT/cm at 1:1,5 00 @ A3

N
0 25 50 75 m

magnitude surveys

298600 298700 298800 298900 299000 299100

518000 517900 517800 517700

Area 6
Area 8
Area 9
Area 10
Area 11
Area 12
Area 13
Area 14
Area 15
Area 17

HIGH GROVE
LINDSTONE GROVE
ROSEDENE AVENUE
ROSEDENE CLOSE
SEAVIEW DRIVE
CALDBECK ROAD
CHATSWORTH DRIVE
SANDRINGHAM AVENUE
JUBILEE ROAD
WINCHESTER DRIVE
RED LONNING

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 11 - Magnetic Gradient (South)
1:1,500 @ A3

-2 nT 3

N

0 25 50 75 m

magnitude surveys

298600 298700 298800 298900 299000 299100

518000 517900 517800 517700

Area 6
Area 8
Area 9
Area 10
Area 11
Area 12
Area 13
Area 14
Area 15
Area 17
14a
Playing Field

HIGH GROVE
LINDSTONE GROVE
RUSKIN DRIVE
WOODLANDS AVENUE
WOODSIDE CLOSE
SEAVIEW DRIVE
CALDBECK ROAD
CHATSWORTH DRIVE
JUBILEE ROAD
WINCHESTER DRIVE
RED LONNING

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 12 - Magnetic Interpretation (South)
1:1,500 @ A3

- Agricultural (Strong)
- Agricultural (Weak)
- Agricultural (Trend)
- Ridge and Furrow (Trend)
- Undetermined (Strong)
- Undetermined (Weak)
- Ferrous (Dipolar)
- Ferrous (Spread)/Magnetic Disturbance
- Service
- Drainage Feature

N

0 25 50 75 m

magnitude surveys

MSNX389 - Harras Moor, Whitehaven, Cumbria
Figure 13 - XY Trace Plot (South)
30nT/cm at 1:1,5 00 @ A3

N

0 25 50 75 m

magnitude surveys