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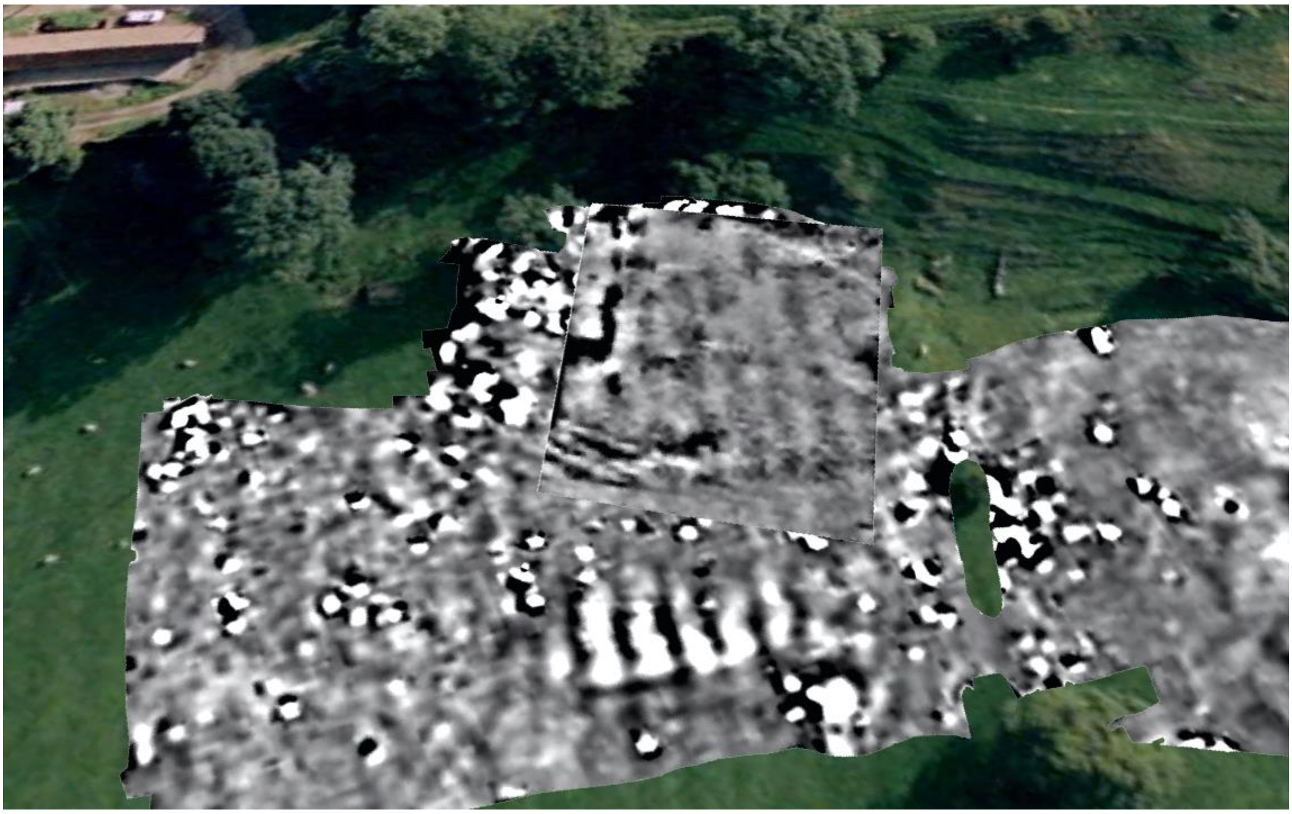
Report on a resistivity and fluxgate gradiometer survey carried out at Park Farm, Kildale, North Yorkshire



in conjunction with the

Hidden Valleys Community Project

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2 Report information

Client	Hidden Valleys Community Project
Report type	Fluxgate gradiometer and resistivity survey
Location	Kildale (Park Farm)
County	North Yorkshire
Central grid reference	NZ 60228 08363
Report number	GB 094b
Date of fieldwork	02/05/2021 and 07/11/2021
Site number	1739
Date of report	19/11/2021
Fieldwork personnel	James Lyall with HVCP volunteers
Report by	James Lyall MA (Hons), MSc

3 Summary

3.1.1 James Lyall (of Geophiz.biz) was commissioned by Roger Inman (of the Hidden Valleys Community Project, henceforth the HVCP) to undertake a magnetic geophysical survey at Park Farm, Kildale, within the North York Moors National Park. At the same time, a group of volunteers from the HVCP carried out a resistivity survey. In order to continue the training aspect of the project, a further day’s resistivity training was carried out in November

3.1.2 The surveys were conducted to test for the presence of a possible chapel, the potential location of which was initially identified by the HVCP using LiDAR, where a platform was noted (see Figure 4). The magnetic survey detected 16 anomalies, the majority of which related to ridge and furrow ploughing. The combined resistivity survey detected 20 anomalies, including part of a rectangular structure.

4 Acknowledgements

The resistivity survey fieldwork was carried out by a group of volunteers from the HVCP. The personnel on day one were Diana Atkinson, John Cartwright, Paul Green, Dave Henderson, Roger Inman, Steve Larkin, Kevin O’Neill, Helen Rowlands, John Rowlands and Elaine Wisdom. Thanks to their sterling efforts, the survey produced a successful result. On day two, the participants were Rebecca Baugh, Mick Garrett, Paul Green, David Harris, Roger Inman, Stephen Larkin, Peter Marsden, Sian Massey, Kevin O'Neill, and John & Helen Rowlands.

4.1.1 The resistivity survey was carried out using equipment kindly donated by Roger Walker (of Geoscan Research). The magnetometer survey was conducted using the Roman Roads Research Association equipment. Both sets of equipment have been gifted specifically for use by community groups, who otherwise would be unable to utilise these valuable resources.

4.1.2 Most importantly, we would like to take this opportunity to thank the landowner, David Cook, firstly for allowing us access to carry out the surveys on his farm, but also for his interest and help, and particularly for his invaluable local knowledge.

5 Aims and objectives

5.1.1 The primary aim of the project was to conduct both magnetometer and resistivity surveys over a small raised platform, initially identified by HVCP volunteers using Environment Agency LiDAR data. It was believed that the platform might relate to a lost chapel site.

6 Methodology

6.1 Technique

6.1.1 The first resistivity survey was conducted using a *Geoscan Research* RM15 resistivity meter. The zigzag traverse method of survey was used. The survey was carried out by taking readings every 50cm along the traverse (walking) axis and every 50cm along the grid axis (thus 3600 readings for each 30m by 30m grid). Because of the low contrast at the time of the survey, the machine was set to detect differences at the 0.1 ohm level. The second survey used the same settings, although this survey used a lower 1m resolution in both directions.

6.1.2 The magnetic survey was conducted using a *Sensys* MXPDA 5 probe fluxgate gradiometer. The machine logs data at 10cm intervals along a 50cm traverse, so 20 readings per square metre are achieved. The machine uses a Trimble R8s GPS to locate each traverse, thus no grids are required.

6.1.3 Survey in the field, report production and archiving were conducted and prepared using the most up to date guidelines, as laid out in David et al (2008) and Schmidt (2013).

6.2 Software

6.2.1 The data from the magnetometer has been processed and presented using QGIS 3.18, an open source Geographic Information System. The data from the resistivity meter was initially processed using Geoplot 4. This report was produced using Microsoft Word 2010 and Adobe Photoshop 7 for further image manipulation. All maps have north pointing to the top of the page, and Google Earth images are used as background map locations for the frontispiece and on Figure 1.

6.3 Location

6.3.1 The site is located at Park Farm (see Figure 1), just over 1.km to the south-west of Kildale village (see Figure 1). It is situated within a pasture field, with ridge and furrow still visible on the ground.

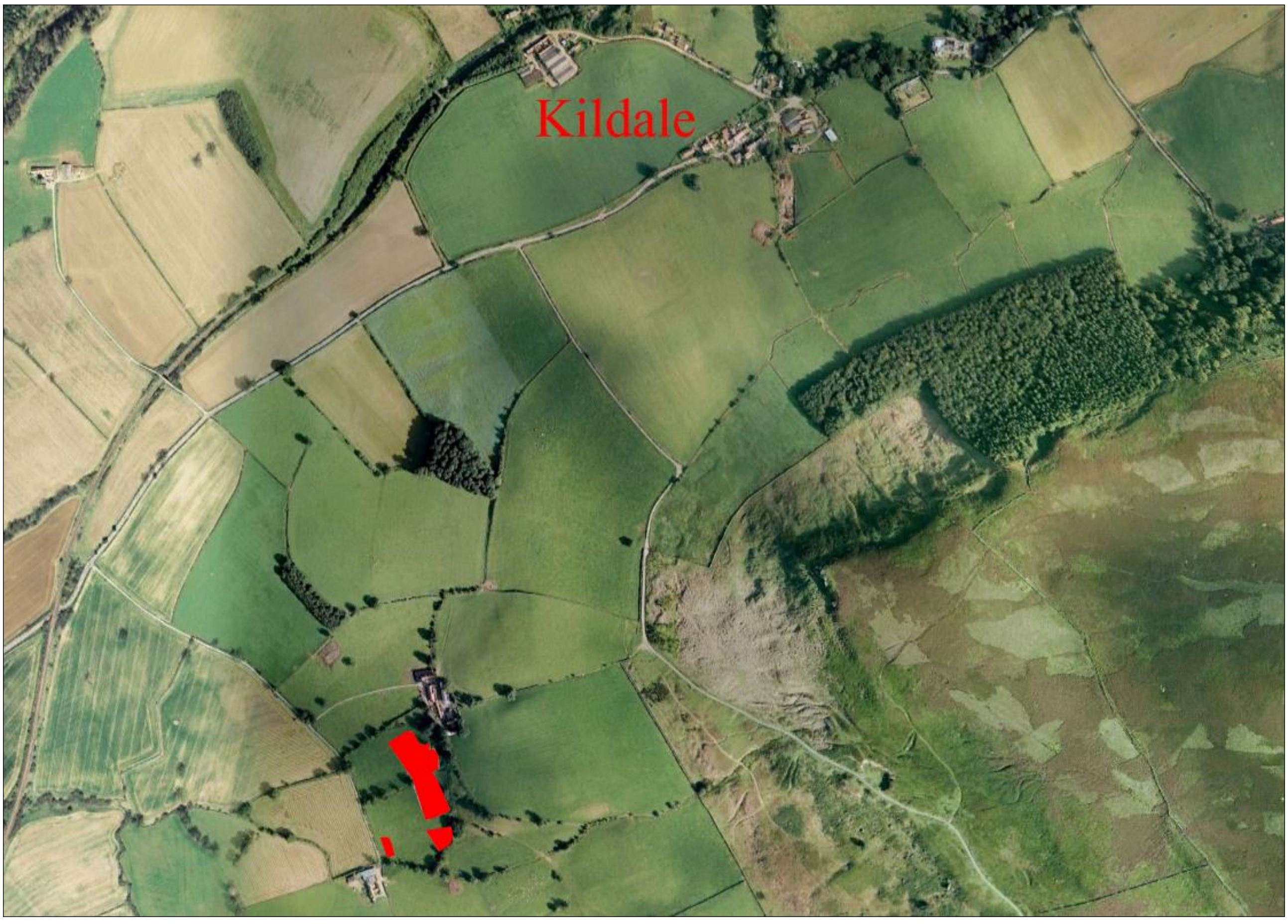

Figure 1 Location of the surveyed area (shaded in red) with Kildale village to the north

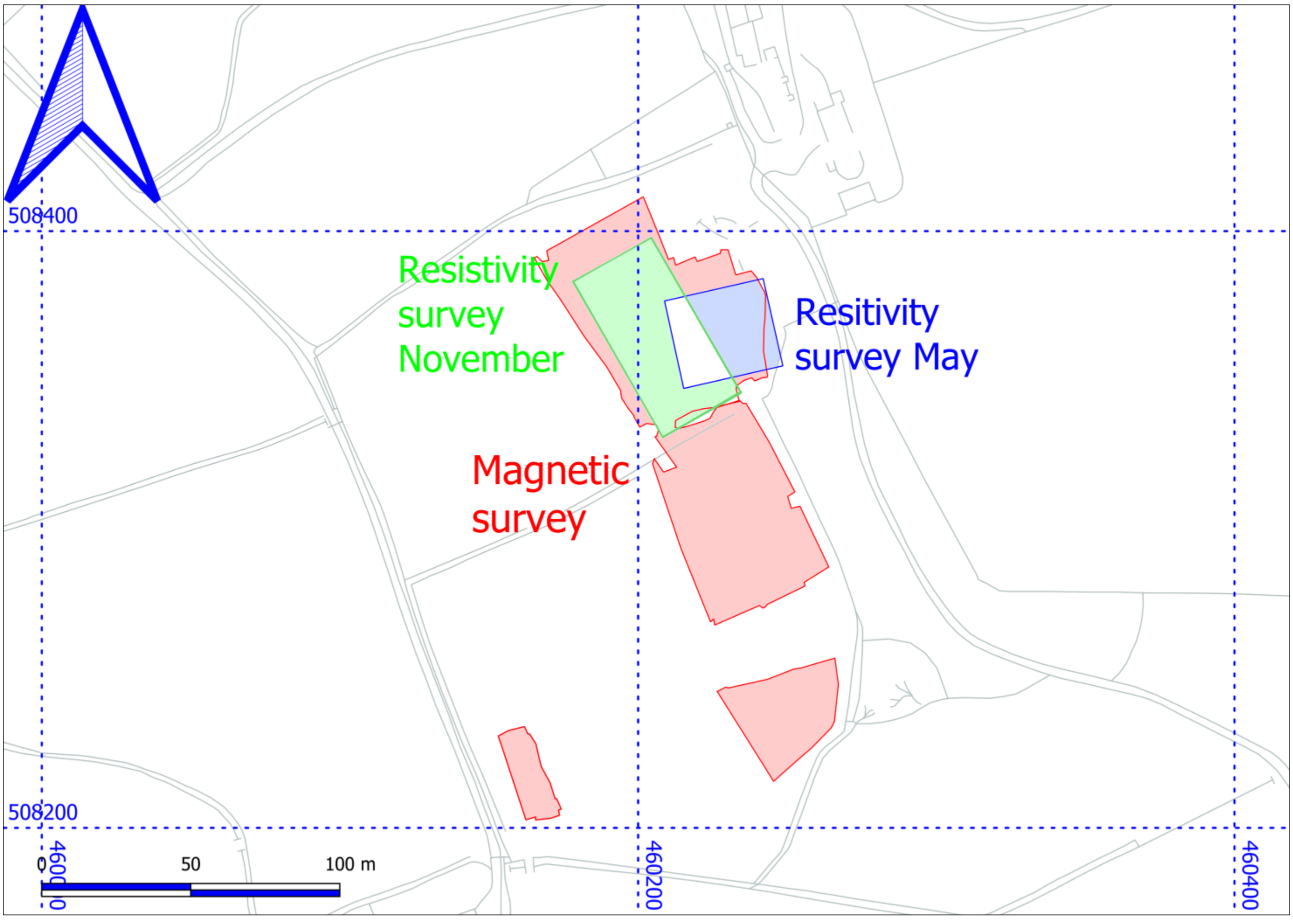

Figure 2 Location of the survey areas located on the Ordnance Survey grid

6.3.2 The location of the surveys is indicated on Figure 2, with the magnetic survey shaded in red, and the initial higher resolution resistivity survey shaded in blue, with the later lower resolution survey shaded in green. The area left white was covered by both resistivity resolution surveys

7 Geology

7.1.1 The underlying solid geology is part of the Redcar Mudstone Formation, comprising sedimentary bedrock (mudstone) formed approximately 201-183 million years ago in the Jurassic period. Any superficial deposits are the Vale of York Formation, comprising a sandy gravelly clay (source http://mapapps.bgs.ac.uk/geologyofbritain/home.html).

8 *LiDAR data*

8.1.1 LiDAR data derived from the Environment Agency was the initial starting point for the HVCP volunteers, when they began looking for the lost chapel (see Figure 3 and Figure 4).

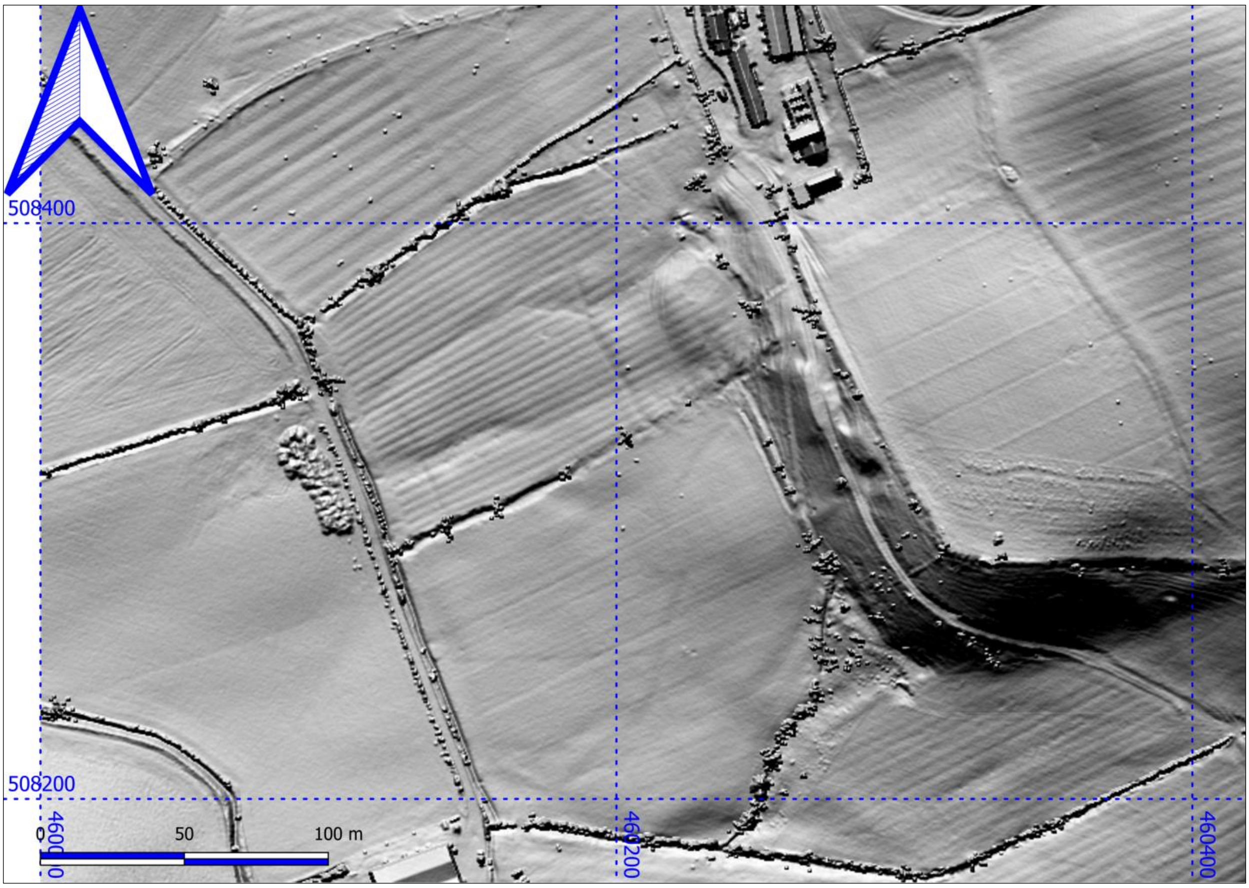

Figure 3 50cm LiDAR hillshaded image derived from Environment Agency data

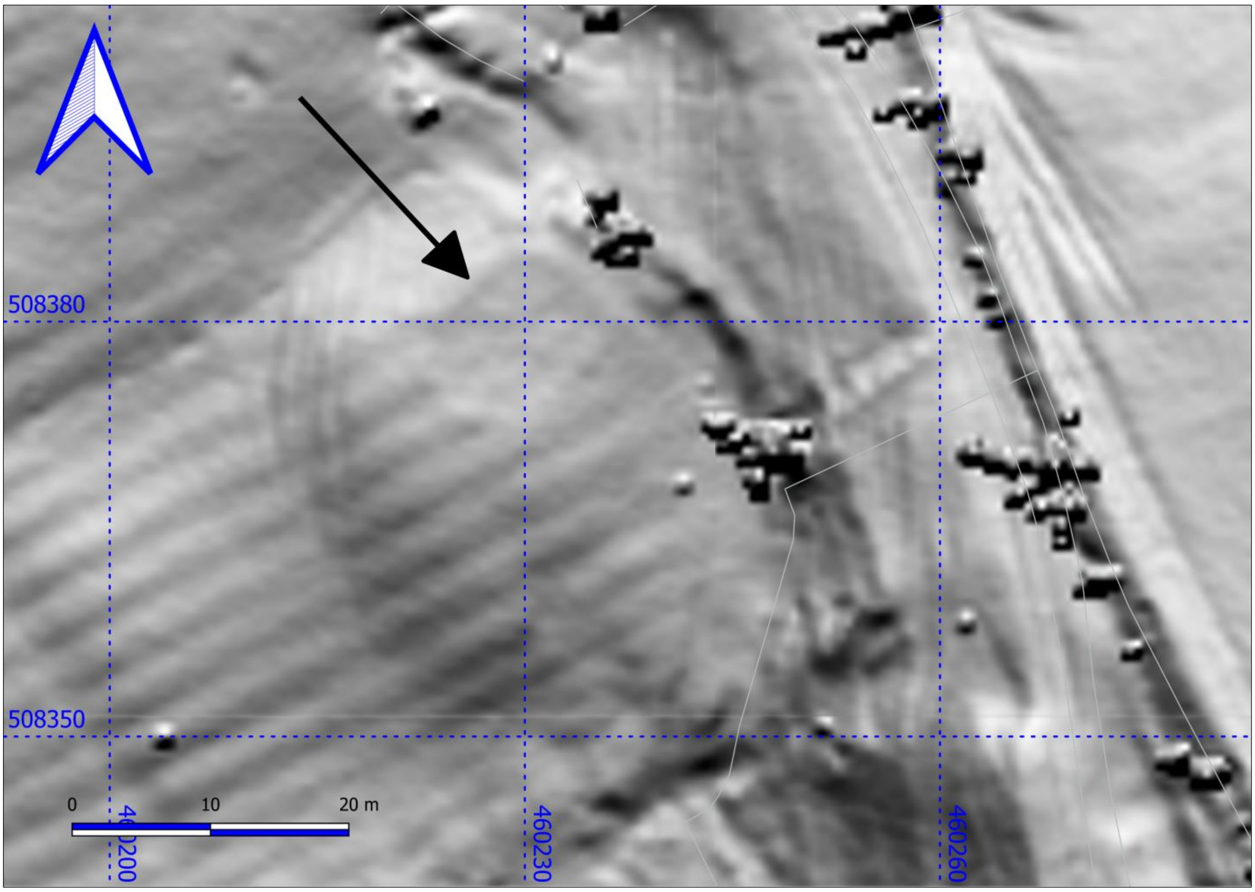

Figure 4 Close up view of the LiDAR data showing the platform and a "hollow" (arrowed)

8.1.2 While the most obvious earthworks are the ridge and furrow of Medieval ploughing, a small platform can be seen in the centre of the area (see Figure 4). Also on this platform was a rectangular "hollow" (arrowed on Figure 4). It is worth noting that the ridge and furrow clearly extends up onto the platform. Note a second less prominent "platform" is present to the west of the main one, and it was this second area which was the subject of the latest resistivity survey.

8.1.3 Information from the Mr. Cook the farmer indicated that the "hollow" was of a relatively recent origin, where some topsoil had been stripped away in order to cover a tank located near the spring just to the north. Mr. Cook also commented that stones were found not far from the surface during the removal of the topsoil. This information would prove to be significant (see Figure 12).

9 Resistivity results and interpretation

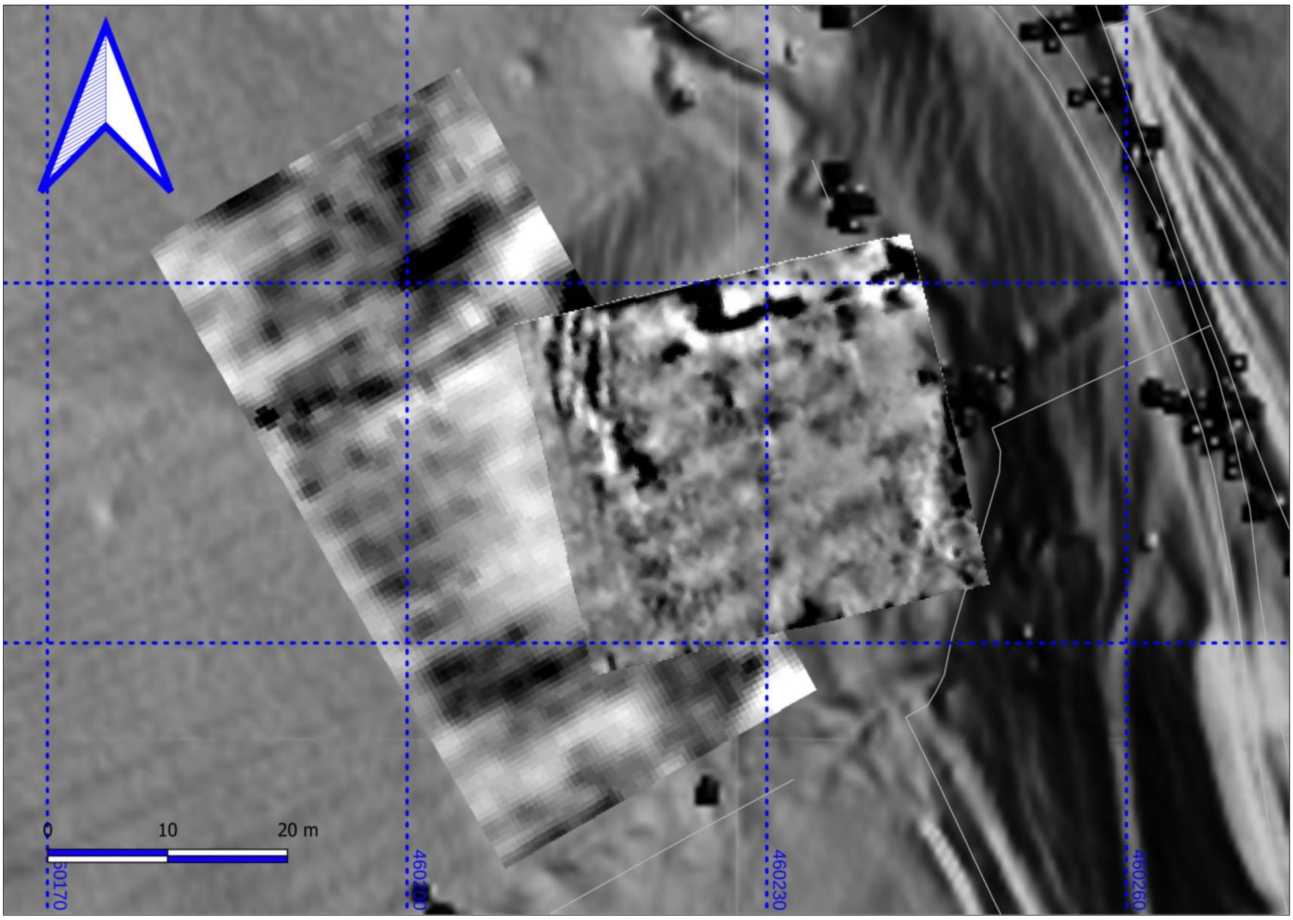

Figure 5 Resistivity greyscale data plotted using the Ordnance Survey coordinate system

9.1.1 The resistivity results (see Figure 5, where they are superimposed onto the LiDAR data, and Figure 14 for a larger scale view) were certainly more informative than the magnetic data (see Figure 7), where a large number of dipolar signals are obscuring most of the entire area of interest. The results are shown at a larger scale on Figure 14 and as interpretation drawings on Figure 6 and Figure 8. Note the different appearance of the two datasets. This is a combination of the resolution of the surveys (4 points per metre as opposed to 1 point per meter in the later survey), and also the difference in soil moisture content, which has a significant effect on the returns from resistivity surveys.

9.1.2 Twenty-two resistivity anomalies representing 20 features were detected (see Figure 6), and these were categorised into four different groups, natural features (coloured blue on Figure 6), Medieval furrows (coloured green) possible drainage (coloured fawn) and a potential structure (coloured red).

9.1.3 Anomaly 1 probably relates to the edge of the slope, which becomes much steeper to the east, and is therefore likely to be geological or natural.

9.1.4 Anomalies 2, 3 and 4 are all visible on the ground as well as in the LiDAR data, and although they could indicate a form of terracing, are more likely to be the result of erosion related to sheep and cattle tracks, heading towards the spring.

9.1.5 Anomalies 5-18 are the remains of ridge and furrow ploughing, and the fact that they are still visible on the ground (see Figure 4 for the LiDAR results) indicate that this field has not been ploughed for a considerable period.

9.1.6 Anomaly 19 (coloured fawn on Figure 6) could be natural, but could also indicate a possible drainage channel, leading the water from the spring downslope. Note that this anomaly can be seen faintly in the LiDAR data heading west beyond the limit of the resistivity survey.

9.1.7 However, it is anomaly 20 (coloured red on Figure 6) which is the most significant. It was composed of three distinct parts (numbered 11a, 11b and 11c on Figure 8), and appeared to form the southern part of a rectangular structure. The higher resistance results (darker on Figure 5), indicate that these could represent the position of walls, or at least the remains of a wall, with the gaps indicating either that the wall has been robbed out or damaged at these locations, or that there could be entrances into the structure.

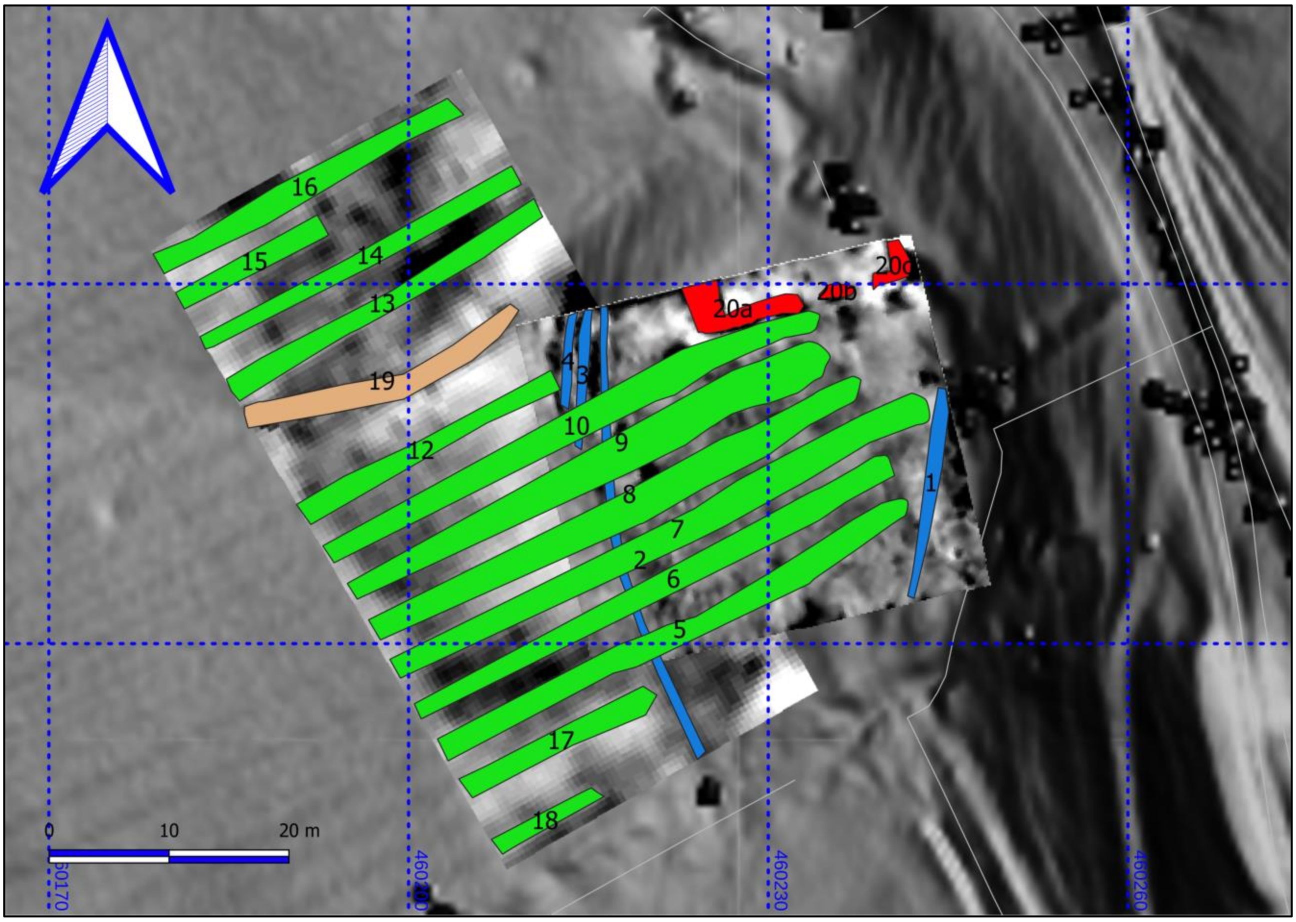

Figure 6 Interpretation of resistivity results

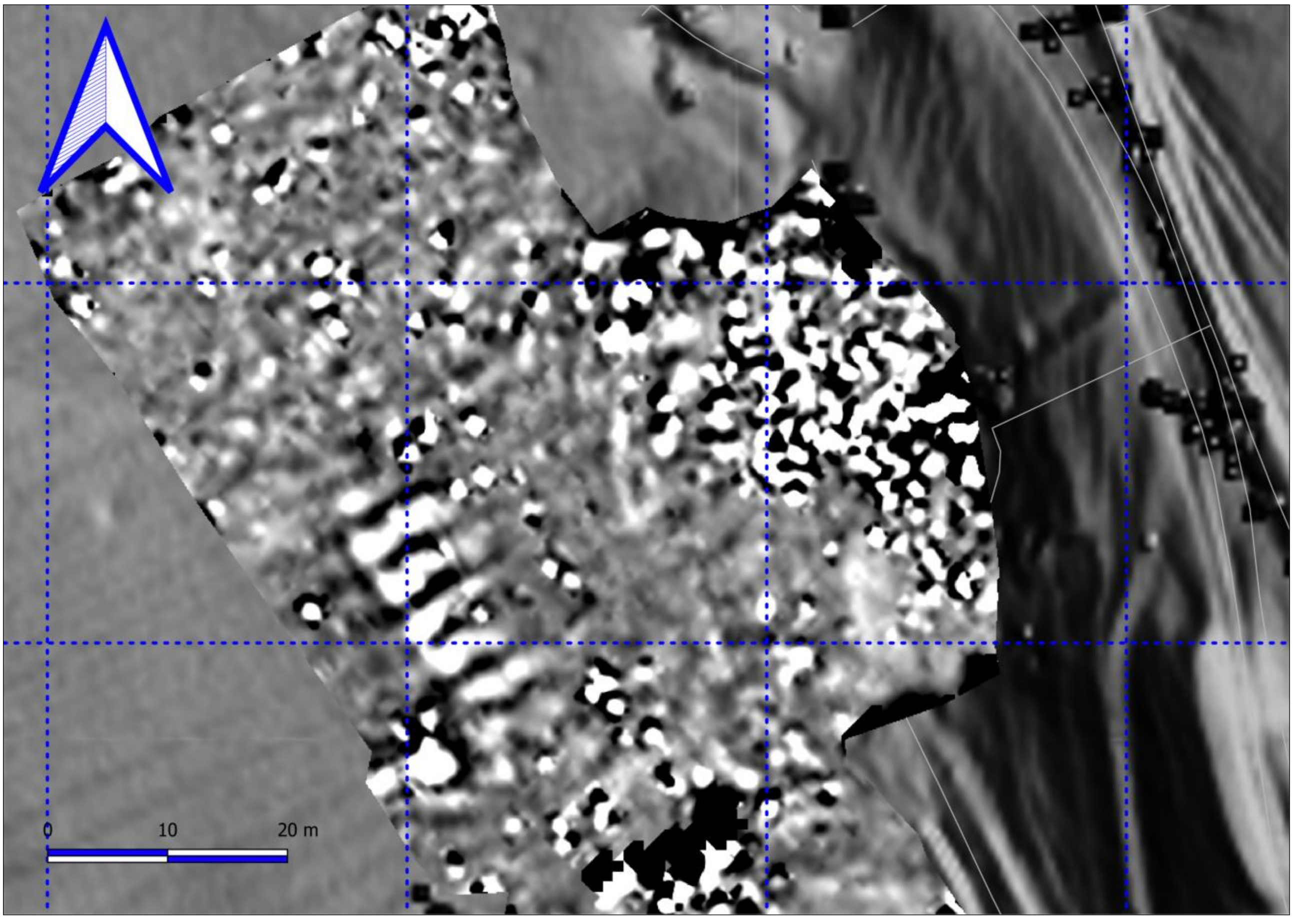

Figure 7 Magnetic survey of the platform area

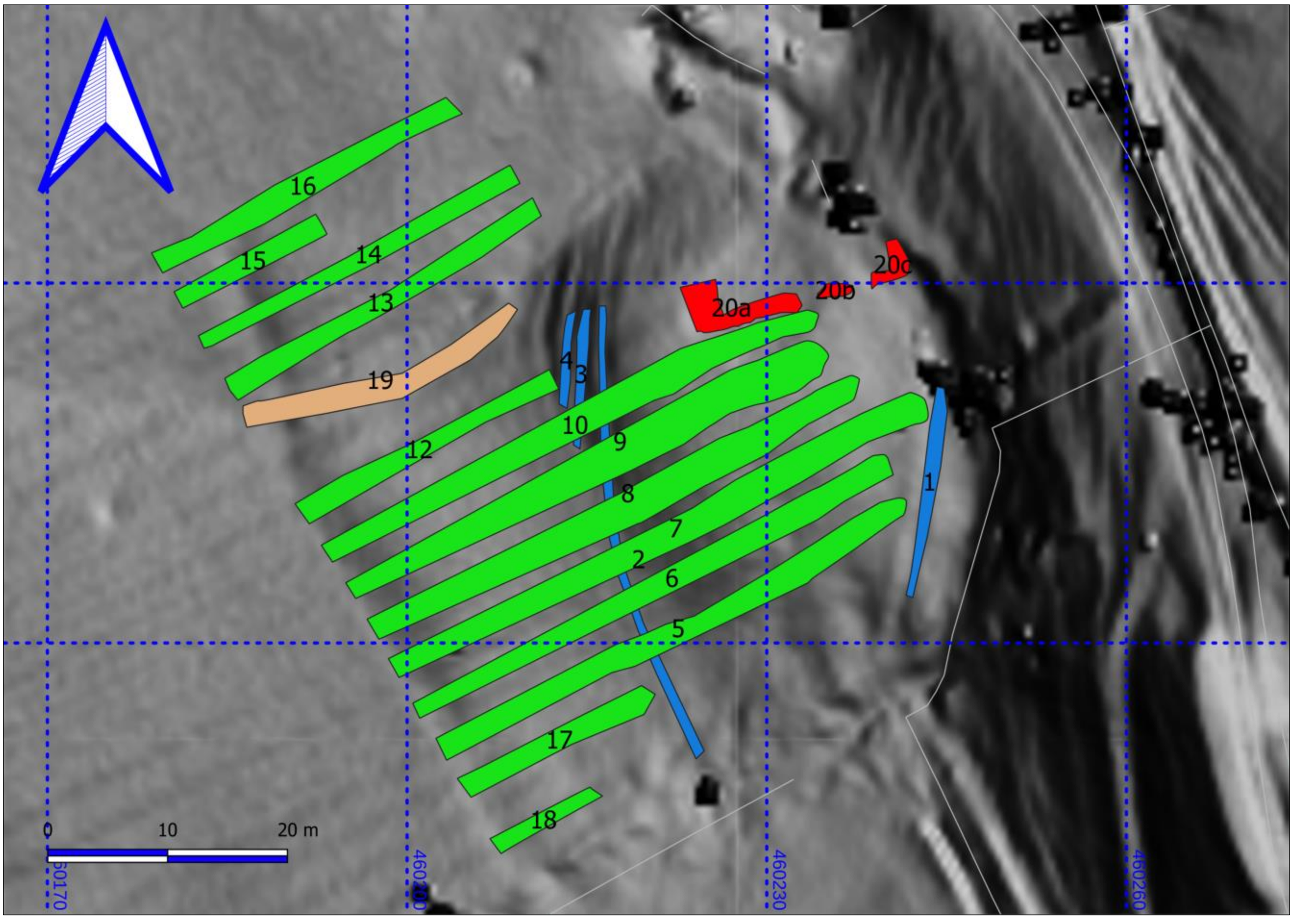

Figure 8 Interpretation of resistivity results superimposed onto the LiDAR data

10 Gradiometer results and interpretation

10.1 Magnetic anomalies

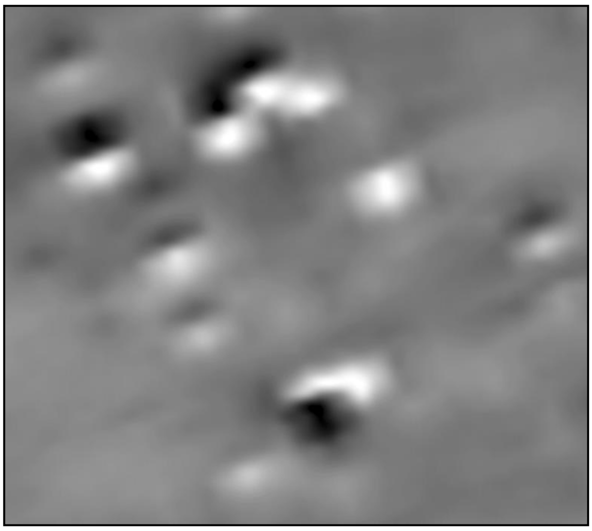

Figure 9 Dipolar anomalies in magnetic data

10.1.1 Features discovered by magnetic survey techniques are referred to as "anomalies", defined as such because they are different from the background magnetic norm. All magnetic survey plots relating to the current survey are plotted with a scale of +-3 nanoTesla (nT).

10.1.2 The large and small black and white areas in the greyscale images (see Figure 9) are dipoles (iron spikes), which indicate the presence of iron or steel objects. These are generally found in the topsoil, and although they could signify the presence of archaeological objects, it is much more likely that they relate to more modern detritus, such as broken ploughshares, iron horseshoes, shotgun cartridges etc.

10.1.3 The survey data is plotted as a greyscale image on Figure 10 (larger scale on Figure 13) and as a digitised interpretation of anomalies on Figure 11.

10.2 The magnetic survey

10.2.1 It is clear from the results of the magnetic survey data (see Figure 10 and Figure 13 for the greyscale plot) that generally (despite the magnetic response ranging from medium to good) there was relatively little in the way of potential archaeological features detected by this method, apart from the furrows in the northern part of the surveyed areas.

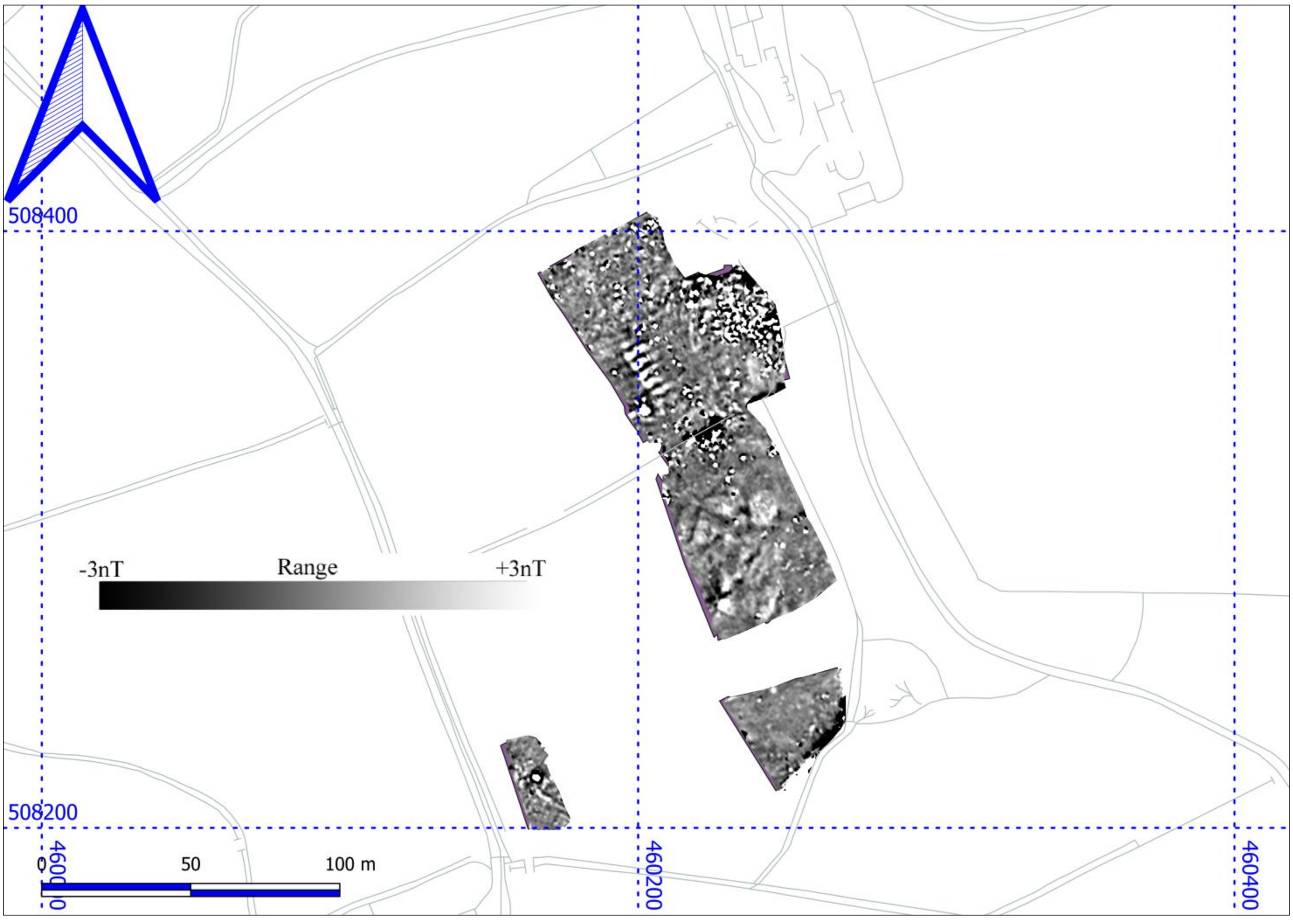

Figure 10 Magnetic greyscale data plotted using the Ordnance Survey coordinate system

10.2.2 Although the main aim of the survey was to cover the area of the platform, this was achieved relatively quickly, so the initial area was extended, and two further areas were also surveyed (see Figure 10), to test for the presence of potential archaeological features in these parts of the field. In the event, the results were inconclusive, in that no obvious archaeological anomalies were detected.

10.3 Disturbed areas (anomalies 12-13)

10.3.1 One of the most disappointing aspects of the magnetic survey was the number of dipolar signals in the main area of interest, across the entire platform. The presence of these very strong anomalies (see Figure 7), meant that there was very little chance for the magnetic survey data to identify the location of any potential structures on the platform. It was discovered that the platform area is used as a campsite, and when one of the HVCP volunteers subsequently tested the area with a metal detector, they found many metal tent pegs as well as other camping related objects, which almost certainly accounts for the density of dipolar signals here.

10.3.2 Anomaly 13 is another area (more localised) of dipolar activity, around a small stand of trees and bushes (part of a field boundary).

Figure 11 Interpretation of magnetic anomalies

10.4 Ridge and furrows (anomalies 15-25)

10.4.1 Linear anomalies 15-25 were 11 features which match the location of the furrows noted in the LiDAR data. However, it is worth noting that the magnetic signature of each of the anomalies was not the same along their lengths (see Figure 7), there is a distinct area where the magnetic response of the material filling the furrows is considerably enhanced. Currently there is no explanation for this, although it seems to occur just off of the slope.

10.5 Natural? anomalies (14-15)

10.5.1 The large amorphous area (numbered 14 on Figure 11) is almost certainly caused by a change in the underlying geology.

10.5.2 The only anomaly which could be of a possible archaeological origin was detected in the small test area in the south-western part of the field. Here a linear anomaly enters the area, but does not extend across the whole extent. Because of the limited nature of the survey area, it is not possible to ascertain an archaeological origin with any degree of certainty, and this anomaly could equally be of a natural origin.

11 Conclusions

11.1.1 In conclusion, it can be stated that the magnetic survey detected 15 anomalies, 11 of which relate to ridge and furrow ploughing. The remainder of the anomalies were either natural or of probable recent origin.

11.1.2 The resistivity survey was also successful in detecting the ridge and furrow, as well as in identifying the southern side of a building (see Figure 12).

Figure 12 HVCP volunteers excavating the structure

11.1.3 It is not often that confirmation of geophysical interpretations can be demonstrated so promptly, but shortly after the initial geophysical surveys which are the subject of this report, the HVCP began a small-scale excavation across the southern corner of the potential structure. Very quickly it became clear that there were indeed a number of stones present, and by the time of the author's visit (23/06/2021), the corner of a substantial structure had been revealed. Although at this early stage we cannot with any certainty say that we have found the "lost" chapel, the discovery of this building is certainly significant, and is a credit to the work of the volunteers of the Hidden Valleys Community Project.

12 Bibliography

David, A. et al, (2008) Geophysical Survey in Archaeological Field Evaluation (2nd edition). English Heritage Publishing.

Schmidt, A. (2013). Geophysical Data in Archaeology: A Guide to Good Practice (2nd edition).

13 Appendix One - A3 magnetic geophysical survey plot

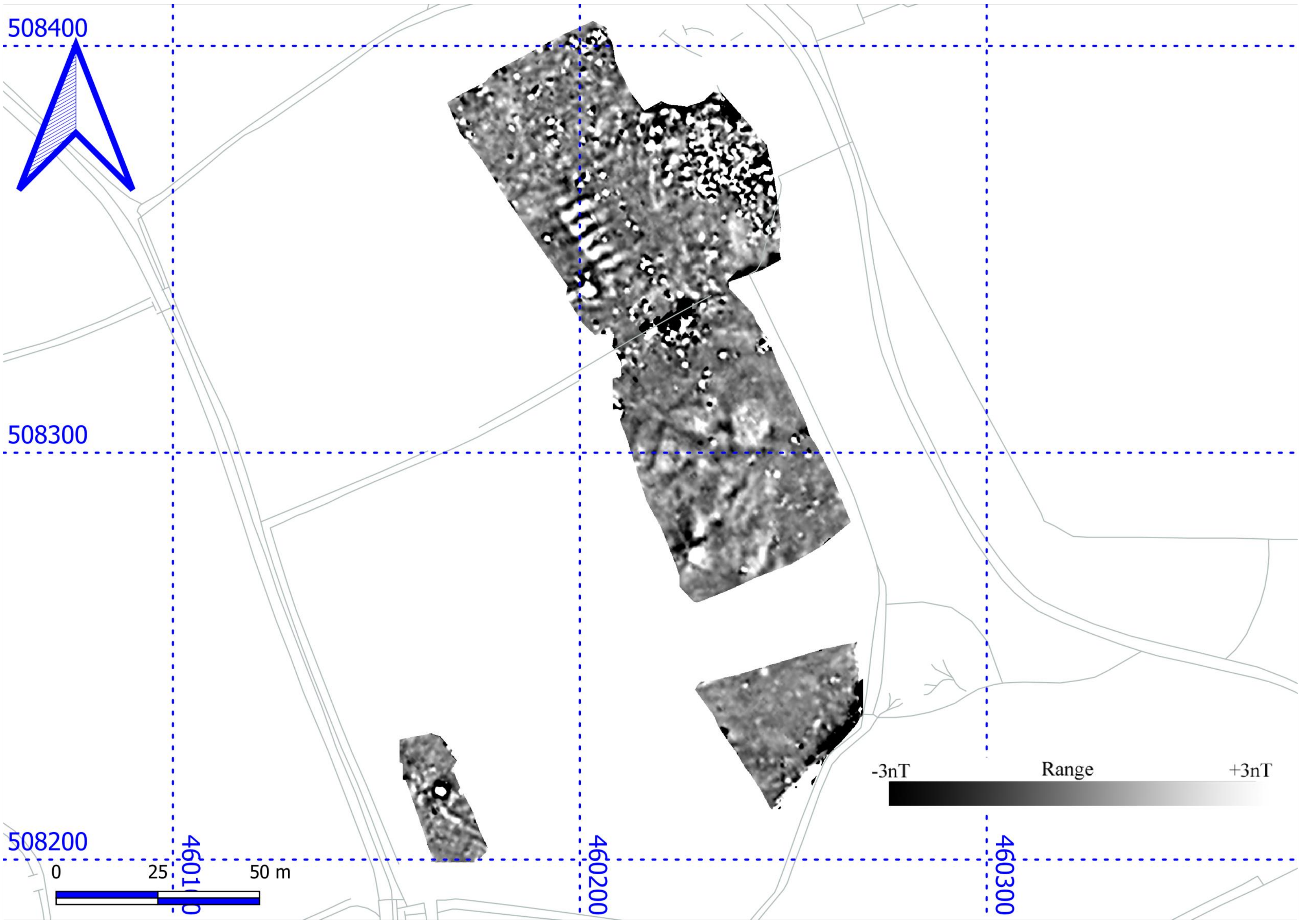

Figure 13 Magnetic survey data on the Ordnance survey grid

14 Appendix One - A3 resistivity geophysical survey plot

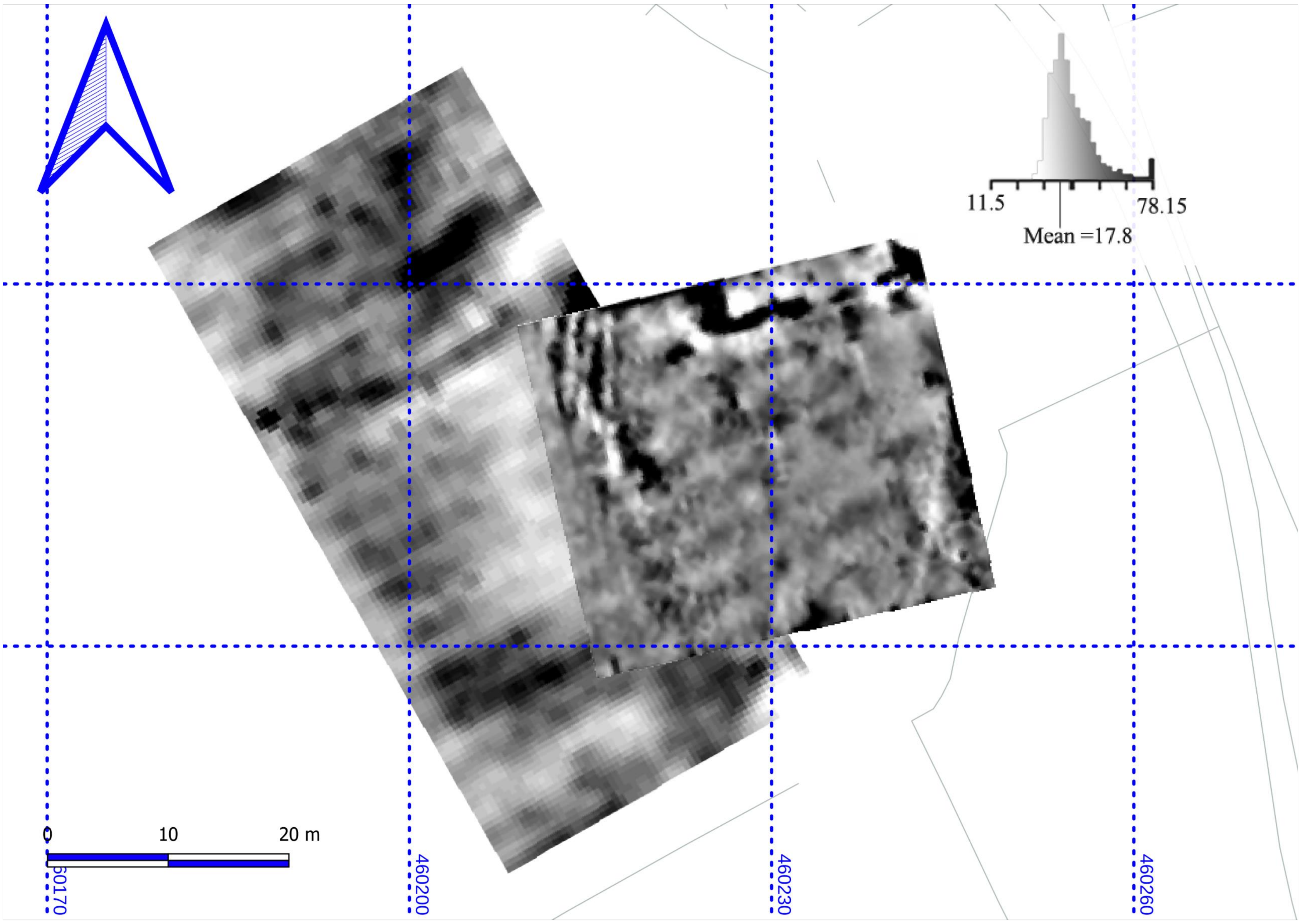

Figure 14 Resistivity survey data with histogram showing the range in ohms