Lowick
Heritage
Group

BERNICIAN STUDIES GROUP

Geophysics at Hunting Hall 2018

BERNICIAN STUDIES GROUP AND THE LOWICK HERITAGE GROUP

REPORT OF THE GEOPHYSICAL SURVEY AT HUNTING HALL, LOWICK, NORTHUMBERLAND

By Jack Pennie, with contributions from Geoff Taylor and Ray Shepherd of the Bernician Studies Group and members of the Lowick Heritage Group

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SUMMARY

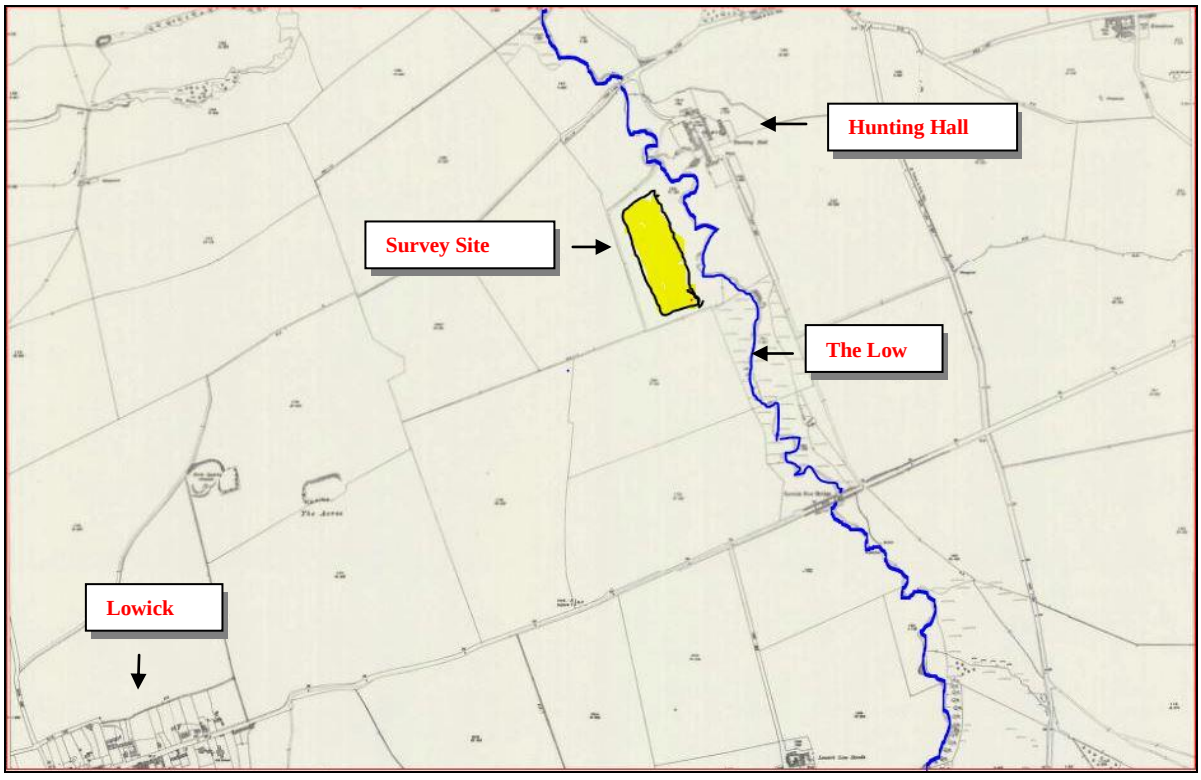
- This Report is produced by the **Bernician Studies Group (BSG)** in conjunction with the **Lowick Heritage Group (LHG).** Ownership of the results rests with the BSG.
- Hunting Hall Farm lies on the Northumberland coastal plain, some twelve kilometres south of Berwick-upon-Tweed and five kilometres from the coast at the Holy Island causeway.
- At Hunting Hall, the LHG identified a ditched and embanked enclosure for further archaeological investigation. With the full support of the landowner and approval from **Natural England (NE)**, two trenches were excavated at points where the outermost rampart and ditches were projected to reach the edge of the river terrace. Due to inclement weather conditions and the heavy clay soil the identification of cultural deposits and other features proved extremely difficult.
- Following the awarding of a grant by the **Northumberland Coast Area of Outstanding Natural Beauty Partnership (AONB)** to the LHG, the BSG were contracted to provide initial training for its members to conduct a geophysical survey of the site as well as providing on-going advice and to analyse the results.
- The grid pattern was largely prepared in advance by members of the LHG with some additional partial grids being added on the advice of the BSG in order to ensure the survey covered the surface features to the maximum extent.
- Commencing on 23 July 2018 and using a Geoplot FM256 Fluxgate Gradiometer the survey covered an area of 2.1ha. LHG members downloaded the data twice daily to ensure that any errors could promptly be identified and corrected. Initial analysis of the data was undertaken by the BSG.
- Inside the enclosure ditch, where no features were identifiable on the surface, the survey identified sub-surface features. It is possible that there is a complex entrance-way from west. More particularly inside the ditch, there is another inner circular feature, a potential palisade that cannot be seen on the ground.
- Inside this palisade, there are a number of distinct features aligned north to south that require further exploration to reveal their purpose. They are potentially ancient and could represent either habitation or burial structures. Also inside the palisade is a path or roadway with an entrance to the south, which runs through the palisade compound exiting through a smaller gap in the north.

PART 1: BACKGROUND

1 INTRODUCTION

1.1 The origin of this survey was in a series of lectures given to the Lowick Heritage Group (LHG) by Dr Kristian Pedersen of the University of Edinburgh who subsequently led practical archaeological exercises for some members of the LHG. One of these was to attempt to identify the location of the original village of Lowick and possibly find some evidence of continuity of settlement. The name 'Lowick' derives from Old English and means 'the farm [*vicus*] on the Low'. This implies that the original village was situated along the river Low (The Low) which flows in a northerly direction, approximately one and a half kilometres to the east of the present village. The Low was originally called Aber LLeu (in Brittonic) at whose mouth the legendary British warlord Urien Rheged was supposedly assassinated after a failed attack on Lindisfarne, according to the poem Canu Urien.

Figure 1: Hunting Hall and its Environs



Northumberland (New Series) VII.15 (Kyloe; Lowick) Published 1924: Reproduced with the permission of the National Library of Scotland

1.2 To the north-east of the village and on the The Low, lies Hunting Hall Farm (Figure 1 above). Hunting Hall lies on the Northumberland coastal plain, some twelve kilometres south of Berwick-upon-Tweed and five kilometres from the coast at the Holy Island causeway. Immediately to the west of Hunting Hall, on

the left bank of the The Low, lies a promontory enclosure. This is defined by semi-circular ditches and ramparts on the landward side, whereas the steep face of the river terrace now drops away to the east. These features are clearly visible both on the ground and from the air. This feature has not been scheduled by Historic England and was considered to be suitable for further archaeological investigation. It is possible that the ditches and ramparts originally created a complete circle but that the eastern parts have been eroded by the river.

1.3 The enclosure lies amongst several Iron Age enclosures in the area, of different sizes and aspect. These include Kentstone Hill (Historic England Monument No. 1581564), overlooking Hunting Hall, just one kilometre to the east, a multivallate hillfort of Iron Age date visible as a crop mark. The Kentstone enclosure is visible in great detail on satellite imagery (eg Google Earth imagery of 2006). The interior diameter is circa 85m, the outer circuit circa 150m across the three broad ditches.

1.4 With the enthusiastic support of the owners, Mr & Mrs Burn, and receipt of derogation from Natural England (NE)[1], an initial two 20m x 2m trenches were excavated at points where the outermost rampart and ditches are projected to reach the edge of the river terrace. Here the ditches and ramparts were least salient and therefore it was suspected that more erosion has occurred than elsewhere. The aim was to cause as little damage as possible to archaeological deposits and the floral community. The unusual weather conditions prevailing in 2018 - a cold and wet winter and spring followed by an unusually dry summer severely hampered the archaeological work, making it particularly difficult to identify soil colour contrasts which are indicative of cultural deposits and other features. A number of small finds were retrieved which require further analysis. A 3" 19th century field drain system was also exposed

1.5 Whilst this work was in progress, enquiries were made as to the possibility of undertaking a non-invasive geophysical survey (magnetometry) designed to detect features which survive below the surface. Magnetometry relies on the linked phenomena that all soils contain minute particles of iron; that these align themselves with the earth's magnetic field at the time of deposition; and that human disturbance of soils changes the alignment of the iron particles. The survey instrument records numerical values reflecting the intensity of the magnetic field. Any variations above or below a background norm across the survey area indicate places where the ground has been disturbed. Patterns are revealed and the raw data are then processed by a computer programme which transforms the numbers into areas of tone in a graphic display.

1.6 The LHG, having approached various organisations, invited the Bernician Studies Group (BSG) to provide a training package with equipment to allow the LHG to carry out a geophysics survey using their own members**.** Building upon their close relationship with Hunting Hall, the Northumberland Coast Area of Outstanding Natural Beauty Partnership (AONB) awarded a grant to the LHG that financed the initial training and subsequent use of magnetometry survey equipment provided by the BSG. The survey took place over a ten day period at the end of July 2018.

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[1] *The field surveyed is classified as semi-rich grassland. NE reference NU02407693.*

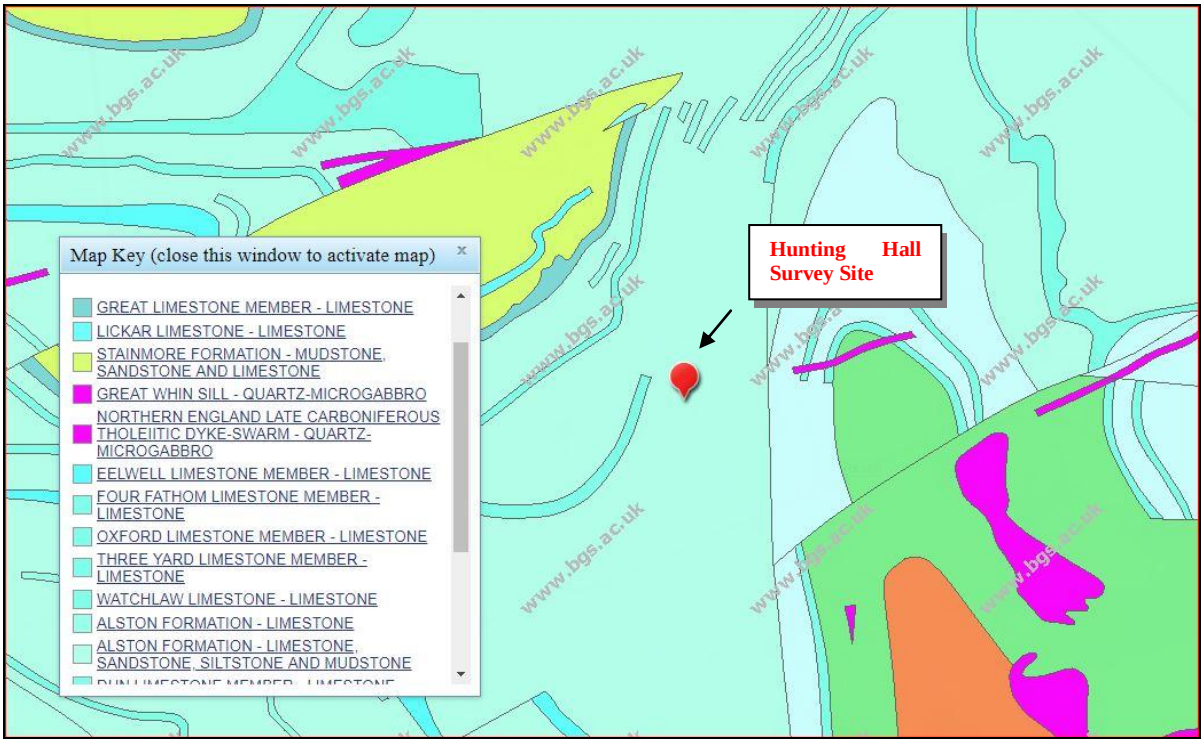
2 SCOPE OF THE PROJECT

2.1 Prior to carrying out the magnetometry survey, scans of the site were undertaken using both a metal detector and divining rods, revealing some unexplained patterns. Other than the ditches and ramparts no surface features were evident except for some plant growth that did not conform with the usual grass / wild flower population. In discussions between the LHG, Dr Kristian Pedersen and the BSG, an assessment was made of the area to be surveyed, taking into account both time constraints and the limited experience of LHG members.

3 SITE GEOLOGY

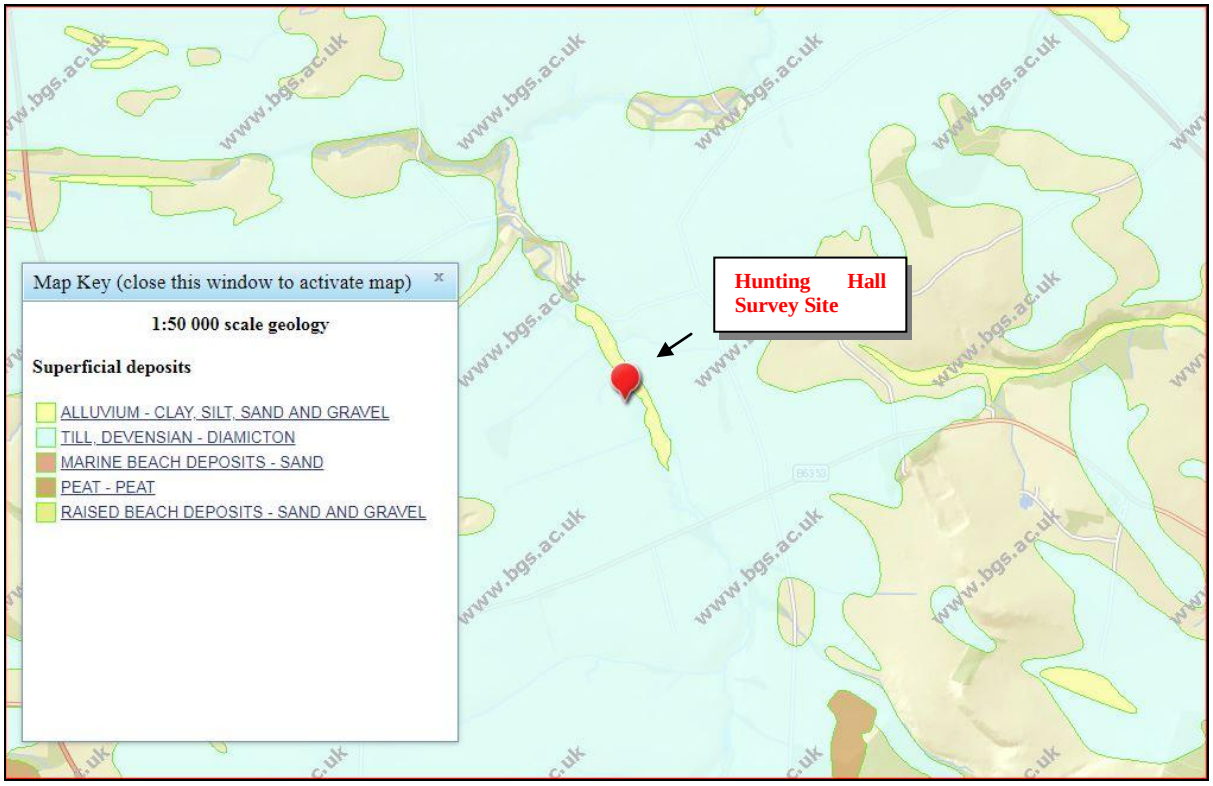
3.1 The geology consists of Alston Formation of limestone, sandstone, siltstone and mudstone (Figure 2 below). The sedimentary bedrock was formed approximately 328 to 337 million years ago in the Carboniferous period. There is no evidence of limestone quarrying at Hunting Hall but within two kilometres are numerous historic kilns where limestone was burnt to create quicklime (calcium oxide) which can be used to improve land fertility and for other uses. In our excavations on the site evidence of sandstone in varying states of decomposition was found.

Figure 2: Hunting Hall Bedrock Geology



3.2 The bedrock has been covered by deposits of Till, Devensian - Diamicton, a group of sediments formed up to 3 million years ago in the Quaternary Period by glacial ice of variable lithology (Figure 3 below). Above and to the west of The Low with its alluvium deposits, the area surveyed, from the evidence of the two trenches previously dug, was dominated by clay deposits which may account for the current land use of permanent pasture.

Figure 3: Hunting Hall Surface Geology



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4 LANDSCAPE CHARACTERISTICS

4.1 Hunting Hall is a mixed farm of 113ha of which 17.12ha is grass with the remainder in arable cropping or stewardship arable options. The whole farm is subject to environmental management. All grassland, including the area surveyed of 2.1ha, is farmed organically under environmental management schemes administered by NE. The aerial photograph below of the area surveyed (Figure 4) demonstrates the present land use of low intensity sheep grazing. No cultivation has taken place on this site since at least 1951 and probably for many years before that. However there is evidence of rig and furrow ploughing in the past, possibly medieval, running both north to south and west to east.

Figure 4: The Surveyed Site – Bottom Dene field (looking North) – July 2018

4.2 The surveyed site lies approximately 50m above sea level and 10m above The Low. It is generally flat, though dipping to a track at the northern end after which the land rises again. At its northern end the surveyed area ended some 40 metres south of the track. To the eastern side the land falls steeply to The Low with evidence of significant slumping. These features, together with field boundaries on the western and southern margins broadly defined the area to be surveyed.

4.3 Other than the existence of the ditches, which caused the LHG some difficulties when creating an accurate grid pattern and the slumping of the land to the east which necessitated partial grids, the site offered no potential issues that might have impacted on the survey results. The underlying bedrock and surface geology was favourable to good survey results. Additionally, weather conditions were generally very favourable.

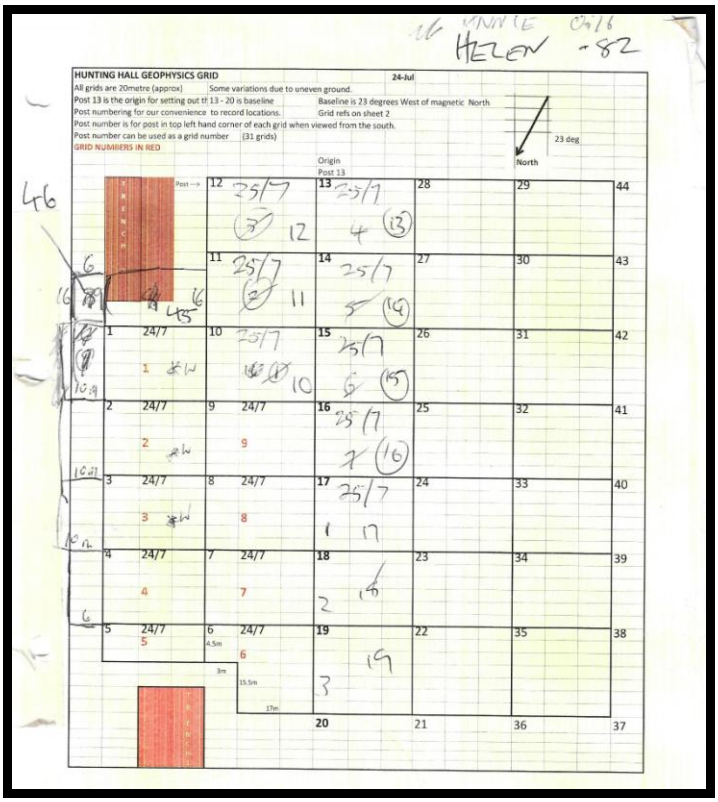
PART 2: BSG REPORT OF THE GEOPHYSICS SURVEY

5 ESTABLISHING THE GRID

5.1 Generic guidelines for setting out grids are given in **Appendix 1**. It is normal practice to undertake a survey beginning at a base line along one of the ordinal compass points and then gradually progressing across the site. There was a problem at the Hunting Hall site because of the size of the site and the lack of obvious fixed points to which to refer. In this instance the LHG had already laid out a grid which was aligned to two footpath way-markers that were approximately 23 degrees west of magnetic north. The initial grid included 31 squares (44 peg points) and had been set out using surveying poles and tapes and using basic geometry. A dumpy level had been used to check angles on uneven ground where accurate measurements were more difficult to achieve. The quality of this work was of such a standard that although it did not conform to the normal BSG system it was more than adequate for the task at hand.

5.2 An Excel sheet showing the initial grid with marked out squares had been prepared in advance by the LHG and was used in the field, with data being written in as work progressed. The Excel sheet was updated each evening with surveyed grid numbers and dates and to reflect additional grids being pegged out and/or surveyed. The example below (Figure 5) is the sheet as prepared on the evening of the second survey day and updated in the field on the third day. Note that south is at the top on these working sheets. The final version of these sheets is attached **as Appendix 2**.

Figure 5: Hunting Hall on-site grid plan with South at the top.



5.3 Although the working grid plans had south at the top the final grid plan and all the images included below have north at the top. An overlay map of the Grid with Table of OS Grid References, measured using GPS, of all the peg positions and of the trenches is at **Appendix 3**.

5.4 To fix the grid in the landscape, a BSG team member assisted by LHG team members took measurements and bearings with tapes and a prismatic compass following the procedure described in **Appendix 1**.The measurements and bearings taken were from five of the numbered peg points and the measurements are shown on the map at **Appendix 4**.This can be used to recreate the same grid in future.

6 SCANNING METHODOLOGY

6.1 Geophysical surveying using a Geoplot FM256 Fluxgate Gradiometer began in the south east edge of the field. The initial plan was to survey consecutive squares up and down the grid to cover the site broadly centered on the area encompassed by the ditch. On examining the results of the first 4 20x20m squares the plan was revised to cover a small strip of land overlooking The Low to the west of the initial start line, then continuing as outlined above.

6.2 Using the FM256 set at 0.01Nt and surveying at 0.5m intervals in E-W aligned passes with a 50cm separation and at a sample rate of 8 readings per metre, giving 6,400 (8x2x20x20) readings per 20m square. The same methodology was used for all of the surveyed areas.

6.3 The survey commenced with squares 1 - 4 running approximately S-N. Encountering archeological features, the survey was later extended with partial squares 5 to the north, 45 to the south and 51 to 54 to the east. (see red numbers in Appendix 2). It was the intention then to follow the plan to survey in turn squares 6 to 33. Given fine weather and a willing personnel it was possible to extend further to the south with squares 59 to 74. Squares 12, 13, 26 and 27 were resurveyed. Squares 12 and 13 were retained, but squares 26 and 27 were replaced by 57 and 58. Subsequently squares 62 to 65 were also re-surveyed and replaced by 75 to 78. New partial squares 80 to 83 were surveyed although only data from square 82 was included, in the south east, to align with the original squares 1 to 4.

6.4 As this project was a teaching exercise, the quality or results to be expected was uncertain at the outset. In the event, it was satisfactory, even in the more difficult partial squares; just a few squares needed a repeat scan and the results from the repeats are included in the data set.

6.5 In total the LHG surveyed 55 full 20m x 20m squares (47 plus 8 repeats) and 15 partial squares (11 plus 4 repeats) of which 47 full and 8 partials have been included for analysis. The total area surveyed was 20,980 square metres, (this figure does not including repeated work). Squares were surveyed in contiguous rows with each LHG member surveying a number of squares to ensure consistency in the quality of data.

6.6 During the survey period, the weather altered from hot and dry to cool and windy. This, together with the change in personnel, despite the mitigation provided by each LHG member surveying number of contiguous squares, meant that there was some variability in the quality of the data.

6.7 All of the final survey data has been included in the images in section 7 below. All plots have been processed in one batch clipped to +- 20nT and then a zero mean traverse with no threshold applied. This process smoothes the edge match and creates a more cohesive image. (Only raw data and batch processed data images are included below). As the background has a low base reading with little variation so any modern metallic object within range of the survey such as fencing has a higher than normal interference and obliterates any small differences from non-metallic archeology. It was therefore necessary to edit data from 3 partial squares to eliminate these spikes before processing. In addition, all squares were initially processed individually to ensure no features were missed by applying a universal setting. Each individual square had a zero mean traverse applied was de-staggered up to a maximum of 4 points (0.5m) and clipped when necessary normally within –12 to +24 range and occasionally –6 to +12. However, only original data was used in the batch processing, with the exception of the 3 partial squares that were edited all other squares had no pre-processing applied.

7 SUMMARY OF RESULTS

7.1 The outline of the visible ditches can be traced with banks on either side. It is possible that there is a complex entranceway from the west (the right of the image in Figure 6 below). More particularly inside the ditch, there is another inner circular feature, a potential palisade that cannot be seen on the ground. Inside this putative palisade a number of distinct features aligned south to north require further exploration to reveal their purpose. They are potentially ancient and could represent either habitation or burial structures. Inside the palisaded enclosure is a path or roadway with a substantial entrance to the south (top), which runs through the palisade compound exiting through a smaller gap in the north.

Figure 6: Hunting Hall Ditch Enclosure (unprocessed data)

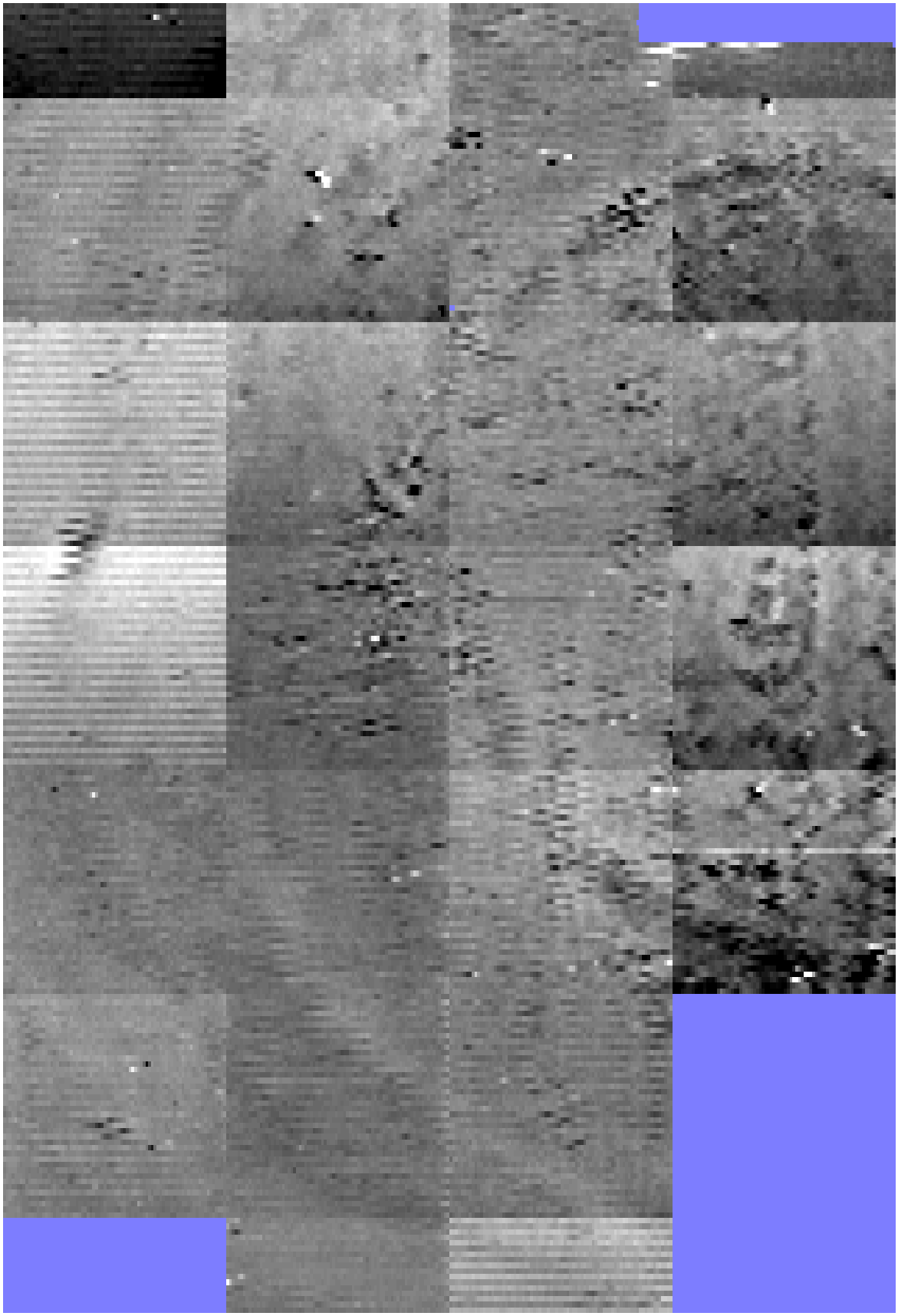
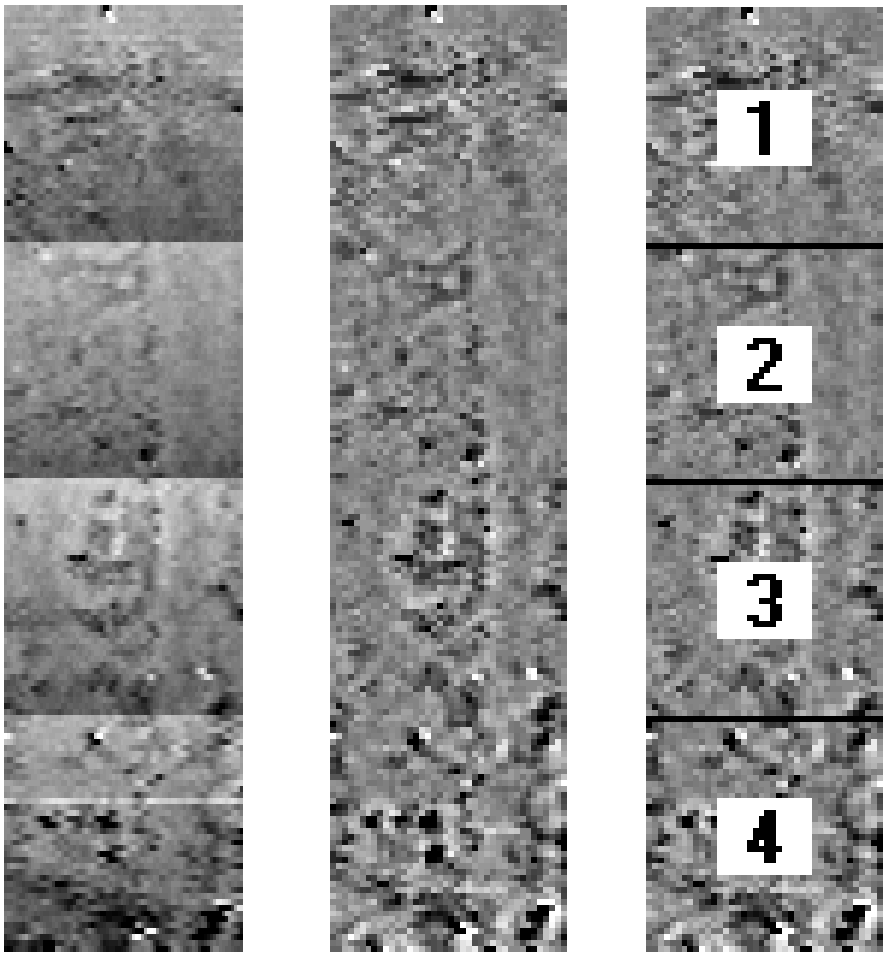


Figure 7: The initial 4 squares

(Please note that all references to the square numbers below are entirely arbitrary and for ease of reference only)

The first image is raw data, the second is processed (as per 6.7 above) and the third contains reference the numbers.

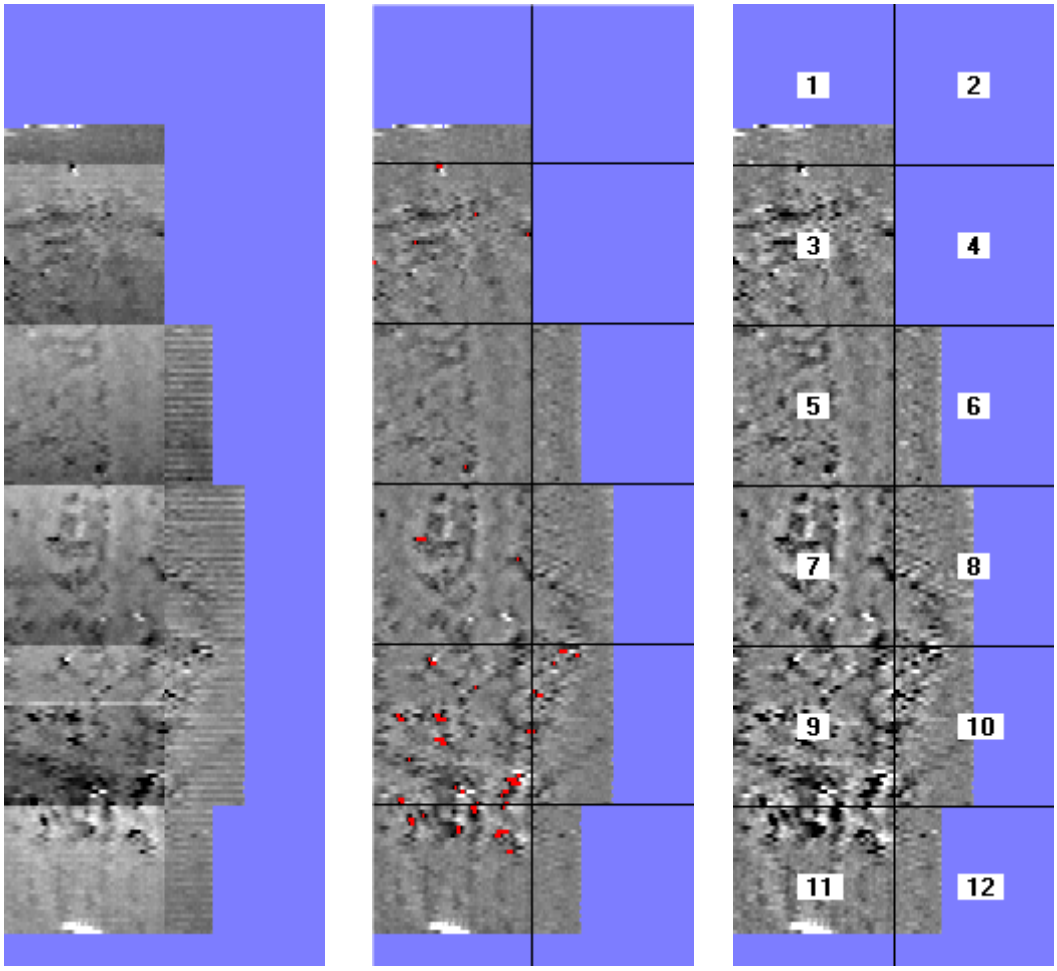


7.2 It can be seen that the top square (1) is complex but there is a distinct ditch running along the left of centre with possible banks either side. Square 1 also has a number of circular features to the left. Square 2 has a distinctive north - south line just to the right of centre, which extends to square 3, possibly 1 and 4 as well. Squares 2 and 3 also include circular or semicircular features to the left of the vertical intersect. The bottom square (4) there is a number of rectangular structures to the left. To the right of square 4 a possible bank which could indicate that the north - south feature is a track way.

Figure 8: The initial 4 surveyed squares with the additional partial squares attached.

(Please note that all square numbers below are entirely arbitrary and for ease of reference only)

The first image is raw data, the second is processed (as per 6.7 above) and the third contains reference the reference numbers.

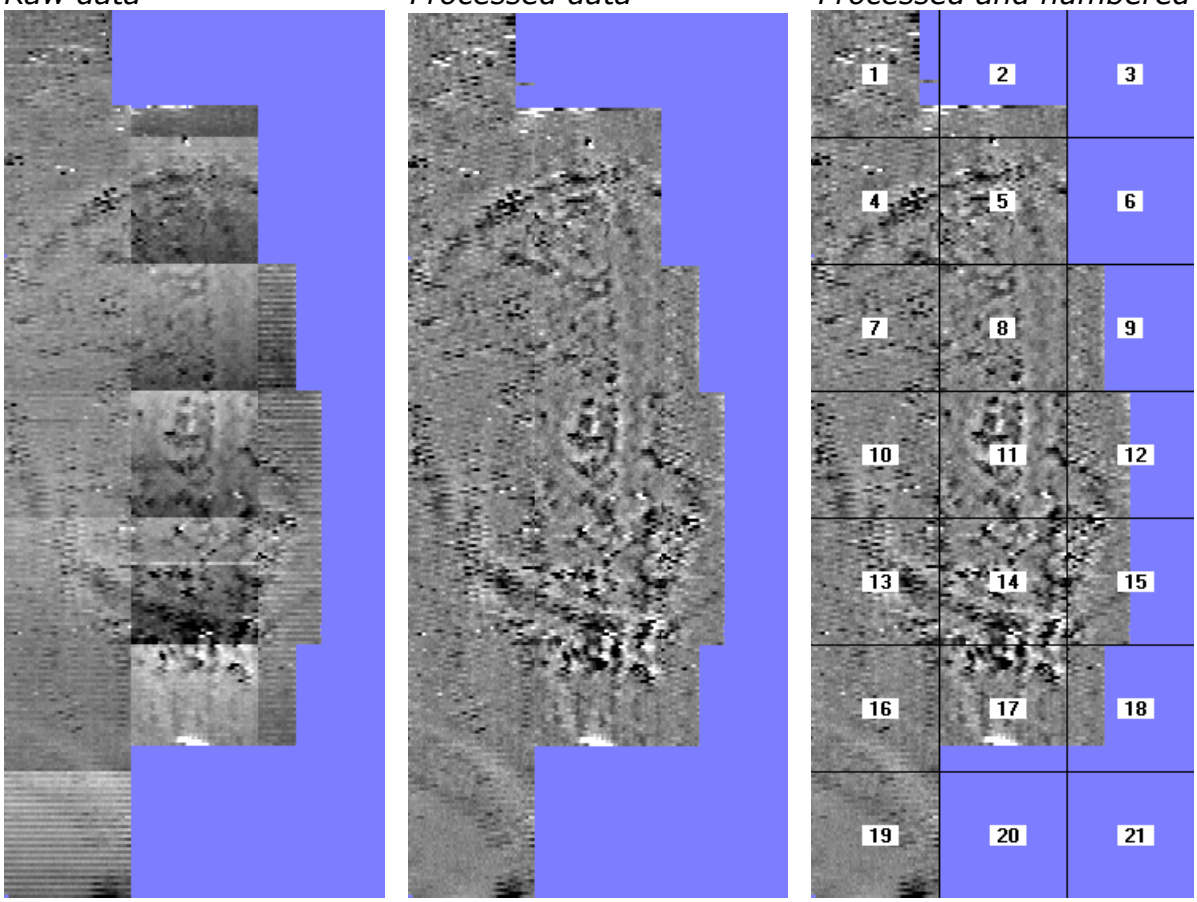


7.3 In Figure 8 squares 3, 5, 7 & 9 are the original squares as shown in figure 8 above. Squares 6, 8, 10 & 12 are partial squares that overlook the steep edge of The Low. Squares 1 & 11 are restricted by the in-situ ditches and could not be extended. The interference from the fence surrounding the dig can be seen on the edge of the image. The benefit of extending to partial squares can be seen within the image above as we can now clearly see the track way, its junction and the entranceway between squares 9 & 11. Also, the bank and ditch at both squares 3 and 9 is more visible. The red highlights indicate individual points of relatively high magnetism often associated with ferrous metal but at this level probably indicate organic material or burning.

Figure 9: Extending the survey west

(Please note that all square numbers below are entirely arbitrary and for ease of reference only)

Raw data *Processed data* *Processed and numbered*

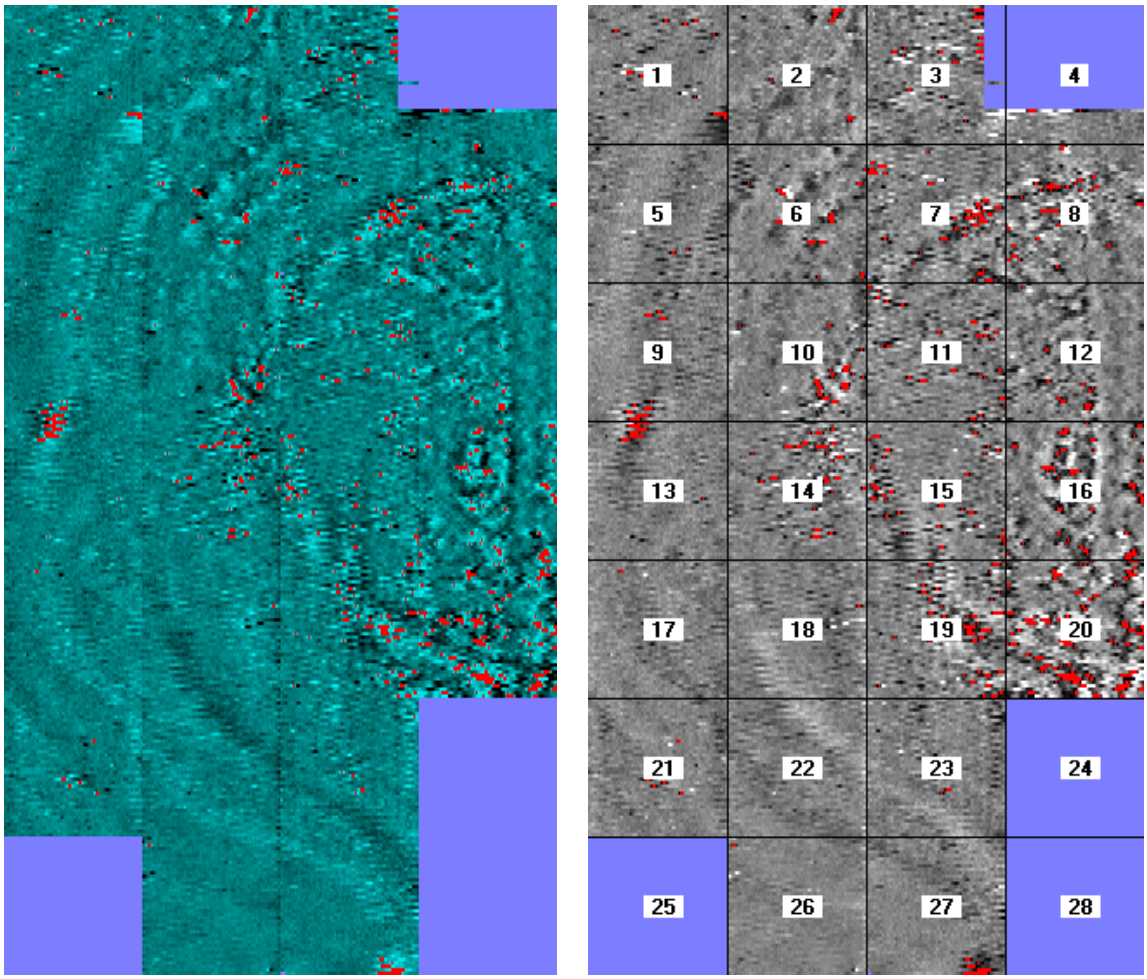


7.4 In Figure 9 the extent of the circular feature, which is not visible on the ground, can be seen running from square 4 through 3, 5, 7, 9 to 10. This feature has a diameter of approximately 60 meters. It is possible that this may be a palisade and it seems likely that there is a bank/ditch associated with it, which can be seen internally in squares 3 - 4 and possibly externally in squares 9 & 10. The palisade feature fades in square 5. it could represent a larger entrance or just later wear and tear. In squares 11 and 13 we see the first signs of the visible ditch. In square 13 it runs more south than expected as the rest of the visible ditch follows the circular line of the palisade.

Figure 10: Further extension to cover visible ditch

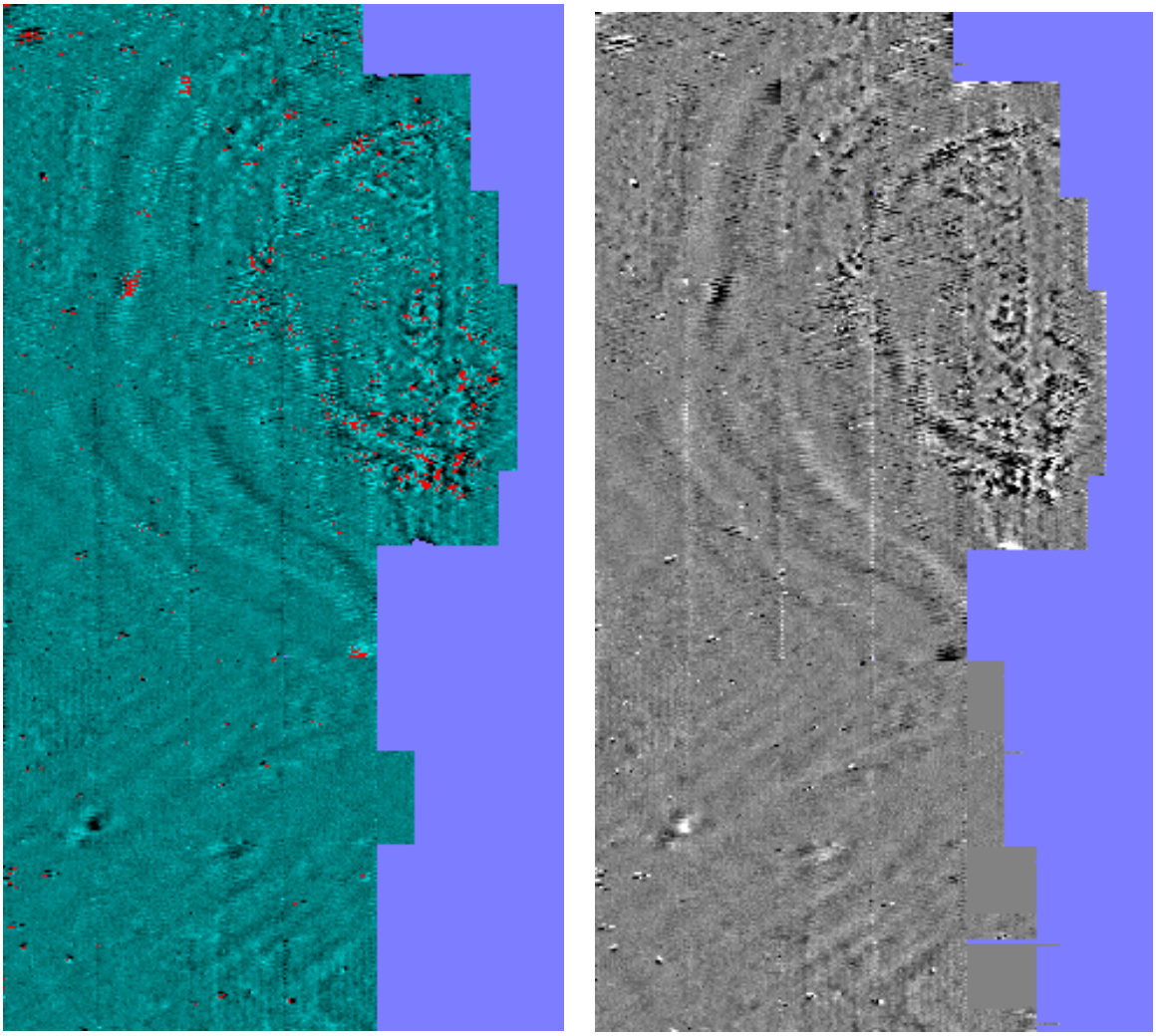
(Please note that all square numbers below are entirely arbitrary and for ease of reference only)

Both images are processed. The green image is simply a colour shift to enhance the detail there is no difference in the data displayed.



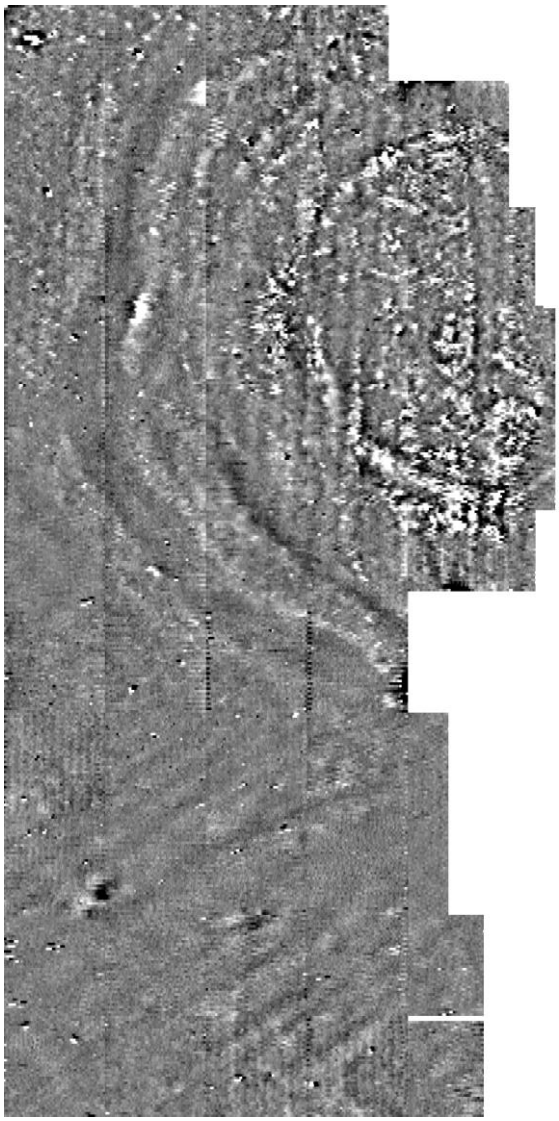
7.5 In Figure 10 above it is now possible to see how the visible ditch snakes around the site and is more complex than it looks from ground level. Starting at square 2 through 5, 6, 9 & 10 with a possible staggered entrance at 13 &14. Picking up again at 17, 18, 22, 23, and 27. The entrance through the palisade at between squares 11 & 15 now looks more convincing. The ditch has possibly 2 or even 3 phases seen in squares 5,6 and 21-23, which may have remnants of an older ditch features.

Figure 11: Full site as surveyed by the LHG (processed as per 6.7 above) in green with colour highlights and in greyscale



7.6 The complexity of the ditch is even more visible on this image (Figure 11). Also lines running diagonally (NE-SW) are visible at the bottom of the image. Similar lines are also visible on the LIDAR image for this area (see **Appendix 5**) but do not correspond to ridge and furrow lines which run W-E and are visible on the ground, in aerial photos and on LIDAR.

Figure 12 . Full site with processing (Zero Median Traverse and Stagger filter)



7.7 The image in Figure 12 above has been produced by the LHG using independently produced plotting software and (with permission) ArchaeoFusion, written at the Center for Advanced Spatial Technologies, University of Arkansas, Fayetteville, USA.

8 LHG CONCLUSION

8.1 The LHG are extremely pleased with the outcome of the survey. The training and support provided by the BSG allowed a far greater area of the Bottom Dene field to be surveyed than originally expected and the amount of necessary repeat work was less than anticipated. The results obtained exceeded all expectations. Small areas of other fields close to the farmhouse were also surveyed but without any significant results being obtained.

8.2 Although the outer banks and ditches are visible on the ground, the geophysics scan has revealed more detail about possible entrances. More importantly it has identified a number of possible features within the enclosure which are worthy of further investigation. These include a putative palisade, a path or roadway, circular and rectangular features which may be habitation or burial structures and banks and ditches. The imagery within the enclosure is in stark contrast to the area outside the enclosure (to the south) where there is a marked lack of features. These results should prove invaluable in guiding further investigations on the site.

8.3 As well as the actual results, the Lowick Heritage Group has gained valuable knowledge and experience about the practical application of Geophysics.

8.4 The Flodden Young Archaeologists Club also had the opportunity to visit the site, to learn about the activities and practice using the survey equipment.

9 NEXT STEPS FOR THE LHG

9.1 The LHG has completed the recording of the two existing trenches and these will be backfilled. Subject to availability of additional funding, it is proposed to undertake a further geophysics survey of the areas adjacent to the trench sites.

9.2 Further analysis and visualisation of the Geophysics data on a square by square basis is ongoing, using the ArchaeoFusion software. The results of this analysis and the methodology will be the subject of a separate report from the LHG.

9.3 Permission is currently being sought to open further trenches within the enclosure area in 2019. The precise location of these further trenches will be determined by review of all available data and the need to avoid impinging upon existing visible features.

9.4 Again, subject to availability of funding, further geophysics surveys could be carried out to the north of the existing grid site where the edge of the archaeology cannot be determined. It is also possible that some similar features will be seen further to the north, across the small burn that joins The Low at this point.

BSG/LHG OCT 2018

ANNEX 1

BERNICIAN STUDIES GROUP

The BSG is a Registered Charity no 1170897 a seminar and research group, which originated within a University Lifelong Learning setting and which is now constituted as in the UK as a charity.

The Group's studies, scholarly activities, and its fieldwork standards and practices are conducted under the guidance of its Research Directors, Max Adams and Colm O'Brien.

The Group has initiated a project in the Republic of Ireland, *The Inishowen Early Christian Landscapes Project*, within which it has conducted seven fieldwork seasons (2012 - 2018). Within this project, the Group has conducted full magnetometry survey at the early ecclesiastical centres of Carrowmore, Clonca and Cooley Co. Donegal. In all cases under licence from the Department of Arts, Heritage and the Gaeltacht of the Irish Republic.

Publications arising from the Inishowen Project:

O'Brien, C. and Adams, M. 2016a 'Early Ecclesiastical Precincts and Landscapes of Inishowen, Co. Donegal' 160-174 in T. Ó Carragáin and S. Turner (eds) Making Christian Landscapes in Atlantic Europe. University of Cork Press.

O'Brien, C., Adams, M., Haycock, D., O'Meara, D. and Pennie, E. 2014 'The Early Ecclesiastical Complexes of Carrowmore and Clonca and their Landscape Context in Inishowen, Co. Donegal.' Ulster Archaeological Journal, 72, 142-160.

Early Christian Landscape of Inishowen: Results of Fieldwork 2012 and 2013. Web publication at

http://www.bernicianstudies.eu/wp-content/uploads/2014/03/Inishowen-Fieldwork-Report.pdf

APPENDIX 1: METHODS OF GEOPHYSICAL SURVEY (Page 1 of 3)

1. BSG follows the English Heritage Guidelines on Geophysical Survey in Archaeological Field Evaluation 2008. This has now been superseded by EAC Guidelines 2016 but they incorporate the earlier EH guidelines. BSG has also created its own guidelines which are a practical application of those principles.

2. The EH guidelines have this to say on the subject of grids:

"This is the network of control points used to locate the geophysical survey measurements relative to base mapping and/or absolute position on the Earth's surface, (see Part IV, 1.1). Whether physically marked on the ground or measured while surveying using a global positioning system (GPS), these must be located to survey-grade accuracy (±0.1m). The survey grid must be independently re-locatable on the ground by a third party, by measurement to local permanent features, and/or by the use of GPS coordinates. All vocational information must be geo-referenced. In certain cases (e.g. where permanent features are absent), and with appropriate permission, it may be acceptable to emplace permanent survey markers."

3. The BSG guidelines expand on this:

"It is important that when you have once set up a grid for a survey, you can set out the same grid again. This is so you know exactly where on your site the new features are, and can tell people where they should be excavating. The best way to do this is to set a baseline. If you can find two points that can be found again by referencing them to fixed points in the landscape, you can draw a line between them and offset your grids from this line. The fixed points can be anything that is fixed in the landscape and is unlikely to be moved. You need two of these features for each point. If you measure from the point on the end of your baseline to each of the fixed points, you will be able to triangulate back from the two fixed points back to the baseline point using the measurements you have recorded. Whilst it is desirable to have the length of the baseline equal to the length of the survey area, it is not always possible, so you must record how far along the baseline the survey area begins. The baseline itself can be positioned anywhere you wish, but there are certain constraints, such as the availability of fixed points to reference from. Also as it is easier to orientate your survey NS-EW a base line that is aligned to true north would be more practical as you may need to refer back to this throughout your survey.

It is therefore useful to mark out your compass points at this stage, perhaps by using large canes with coloured flags. The baseline may not readily align with the compass. However, if you can align N-S or E-W, imagine how beneficial such an alignment will be as your grid pattern will be more logical and easier to manage. You may end up with more dummy readings but you will be surer that each grid is aligned properly and in the correct position."

APPENDIX 1: METHODS OF GEOPHYSICAL SURVEY (Page 2 of 3)

4. Phase 1 Geophysical Survey

If the Initial Evaluation indicates a need for a comprehensive Geophysical Survey then it is undertaken using the following BSG standard.

A base line is set up across the whole site at the widest point for a N-S or an E-W alignment. From this base line a grid of 20m by 20m squares aligned N–S and E-W is set up over the area. If this survey indicates that there may be archaeology between the edges of the squares and the site boundary then these partial grids may be included within the overall survey area up to 1m from the boundary edge. The FM256 Fluxgate Gradiometer set at 0.1(nT), the highest sensitivity. The FM256 is balanced, aligned and zeroed against drift as per English Heritage *Standards for Geophysical Survey*. A zig-zig survey is undertaken, with readings every 0.125m on a traverse of 0.5m.

5. Phase 2 Post Survey Processing

Survey data are processed using Geoplot 3 software.

It is the group's aim to limit data processing to the barest minimum necessary. Therefore, as well as adhering to Historic England Standards, processing has been restricted to the following procedures:

6. Zero Mean Traverse are applied. Graphics are limited to Greyscale and 1 other appropriate colour representation.

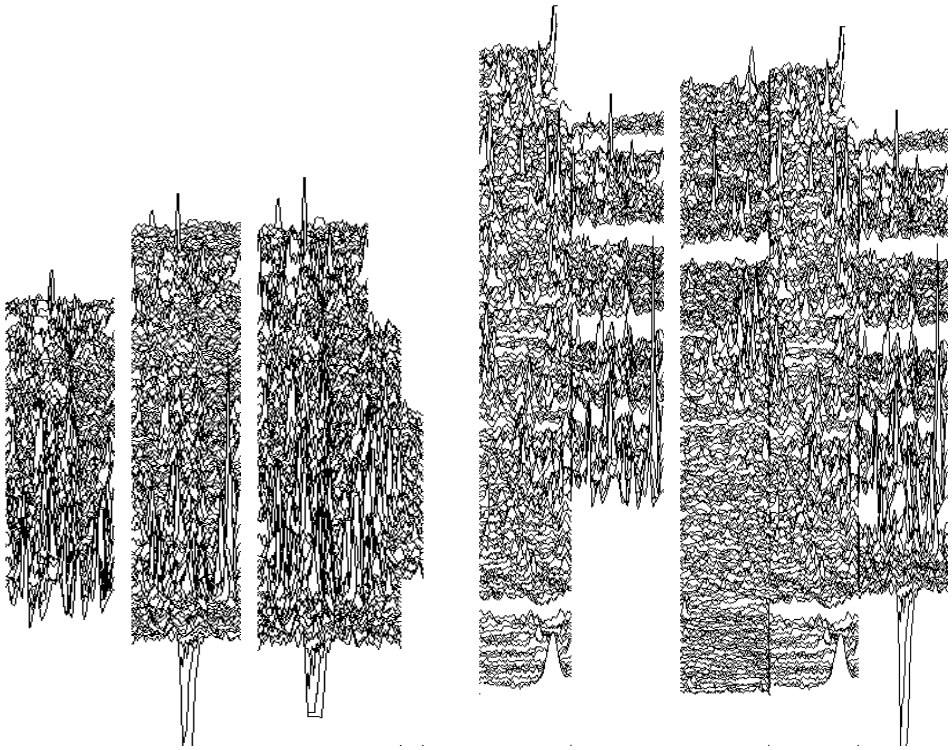
Raw data, pre-processing, are retained in archive for reference.

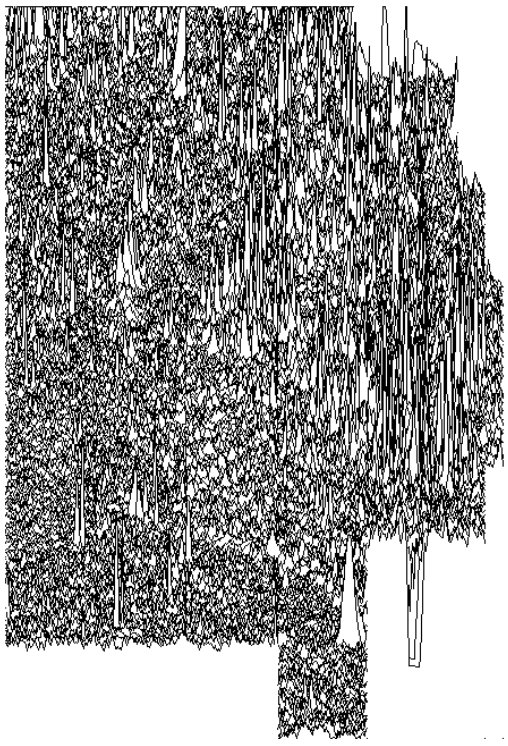
APPENDIX 1: METHODS OF GEOPHYSICAL SURVEY (Page 3 of 3)

Trace images

grids 1-4, extended north - south with partials, extended east with partials Raw data version, Extended west raw data, Full site processed data trace image.

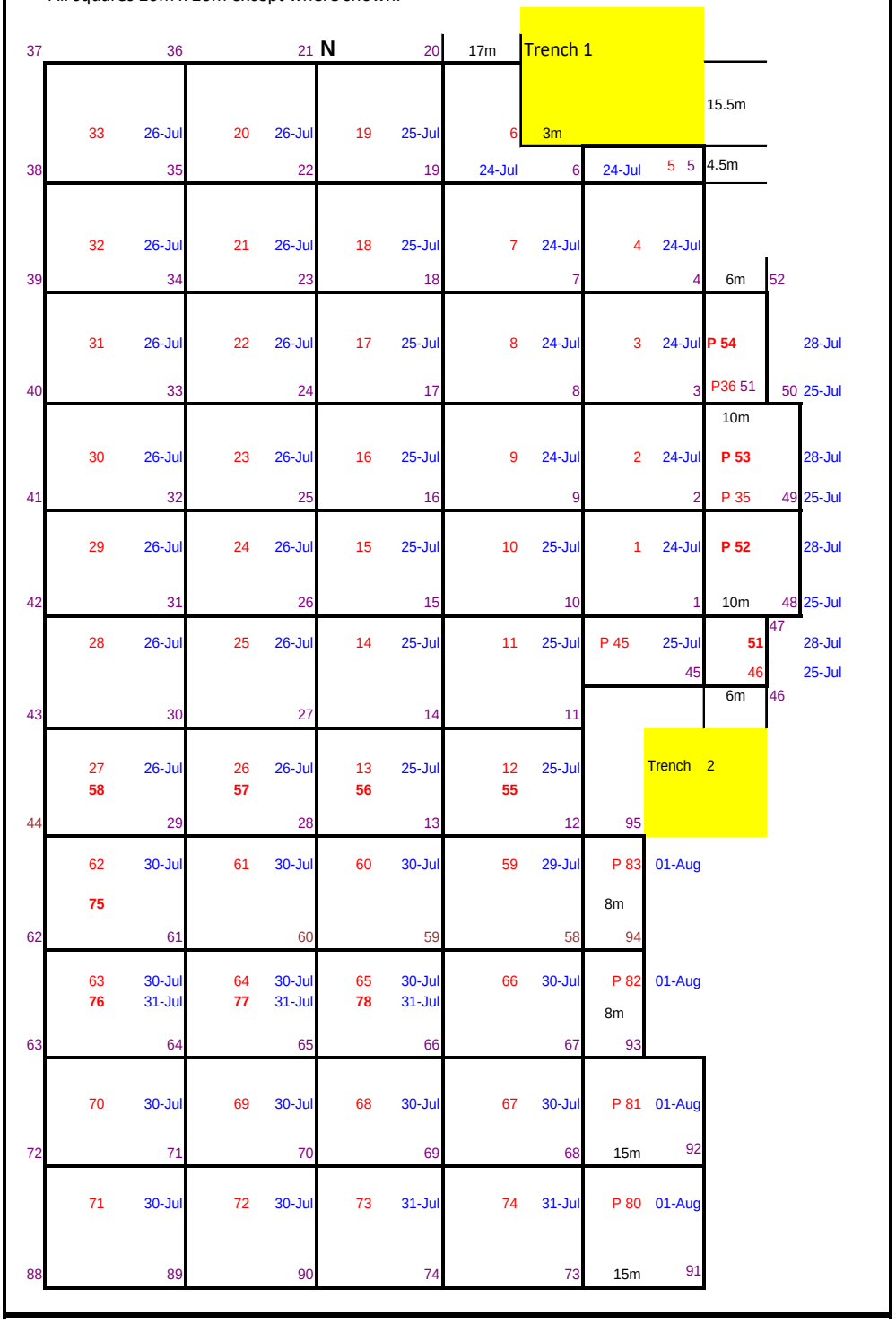
Raw data is available on request from the Bernician Studies Group.



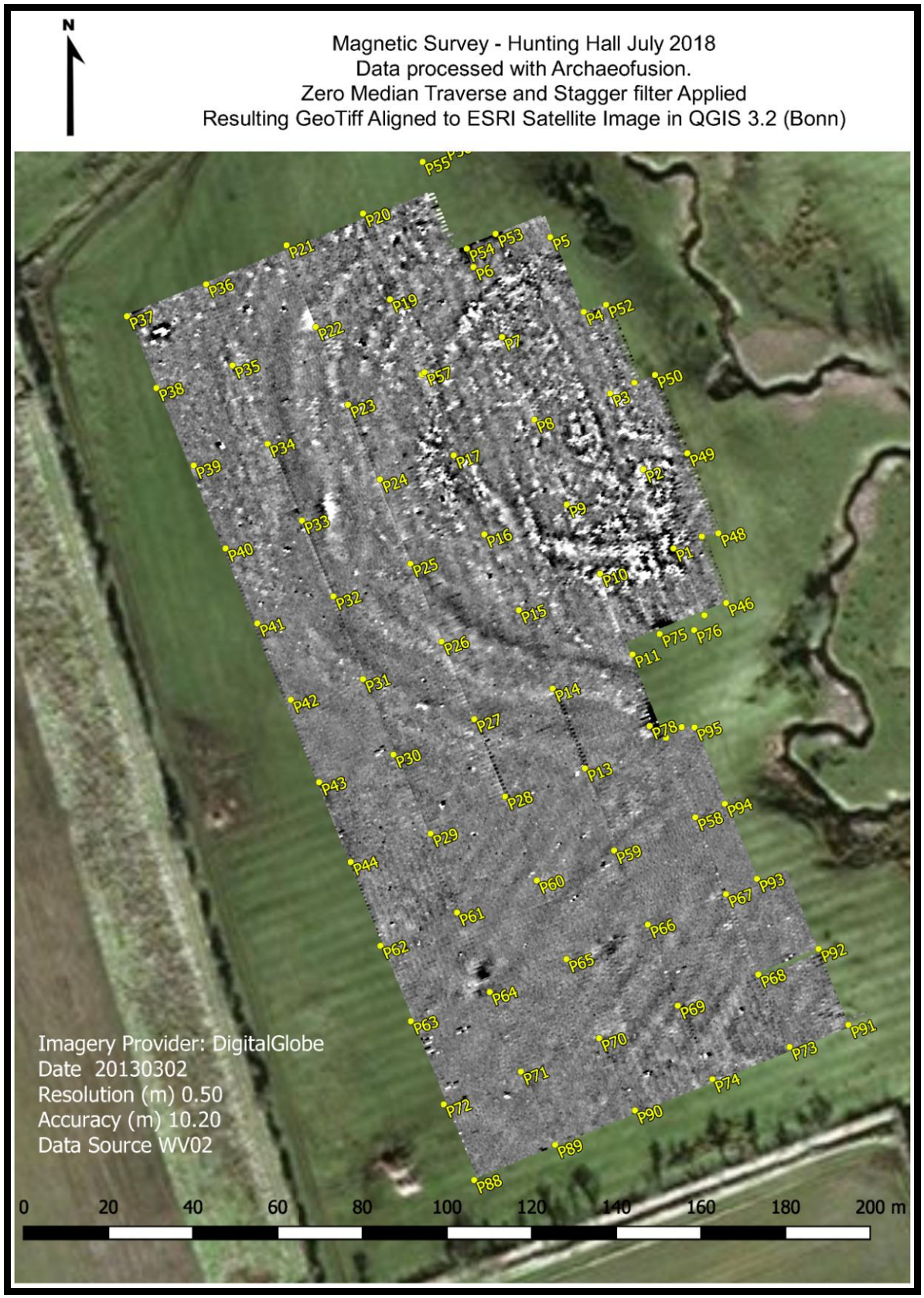


APPENDIX 2: FINAL GRID

Square numbers in red. Bold for repeated data used in analysis.
P indicates partial square
Purple for peg numbers
Blue for date of survey
Existing trenches in yellow
All squares 20m x 20m except where shown.



APPENDIX 3: OVERLAY MAP OF THE GRID WITH TABLE OF OS GRID REFERENCES (Page 1 of 3)



APPENDIX 3: OVERLAY MAP OF THE GRID WITH TABLE OF OS GRID REFERENCES (Page 2 of 3)

Position of Pegs as shown in Appendix 2

Co-ordinate System ESPG:4326 - WGS 84

Positioning : U Blox - Neo 6 Chipset

Peg Name	latitude	longitude	HDOP	Grid Reference (OSGB36)	X	Y
P1	55.660882	-1.9569072	1.85	NU0281040819	402810	640819
P2	55.6610497	-1.9570207	0.79	NU0280240838	402802	640838
P3	55.6612104	-1.9571447	0.79	NU0279540855	402795	640855
P4	55.6613834	-1.9572442	0.79	NU0278840875	402788	640875
P5	55.661542	-1.95737	0.79	NU0278040892	402780	640892
P6	55.6614786	-1.9576581	0.84	NU0276240885	402762	640885
P7	55.6613301	-1.9575509	0.8	NU0276940869	402769	640869
P8	55.6611551	-1.9574296	0.82	NU0277740849	402777	640849
P9	55.6609751	-1.9573083	0.75	NU0278440829	402784	640829
P10	55.6608282	-1.9571827	0.79	NU0279240813	402792	640813
P11	55.660657	-1.9570609	0.78	NU0280040794	402800	640794
P12	55.6604805	-1.9569352	0.78	NU0280840774	402808	640774
P13 (Origin)	55.6604156	-1.9572394	0.78	NU0278940767	402789	640767
P14	55.6605845	-1.9573611	0.78	NU0278140786	402781	640786
P15	55.6607509	-1.9574878	0.78	NU0277340804	402773	640804
P16	55.6609117	-1.9576173	0.78	NU0276540822	402765	640822
P17	55.6610792	-1.9577321	0.78	NU0275840841	402758	640841
P18	55.6612507	-1.9578524	0.78	NU0275040860	402750	640860
P19	55.66141	-1.9579714	0.78	NU0274340878	402743	640878
P20	55.6615921	-1.9580727	0.78	NU0273640898	402736	640898
P21	55.6615248	-1.9583599	0.78	NU0271840890	402718	640890
P22	55.6613516	-1.9582503	0.89	NU0272540871	402725	640871
P23	55.6611866	-1.9581291	0.92	NU0273340853	402733	640853
P24	55.6610284	-1.9580091	0.9	NU0274040835	402740	640835
P25	55.6608493	-1.9578949	0.91	NU0274740815	402747	640815
P26	55.6606841	-1.957778	0.91	NU0275540797	402755	640797
P27	55.6605198	-1.9576552	0.92	NU0276240779	402762	640779
P28	55.6603557	-1.9575396	0.93	NU0277040760	402770	640760
P29	55.660277	-1.9578191	0.95	NU0275240752	402752	640752
P30	55.6604446	-1.9579587	0.93	NU0274340770	402743	640770
P31	55.6606046	-1.9580729	0.94	NU0273640788	402736	640788
P32	55.66078	-1.958184	0.94	NU0272940807	402729	640807
P33	55.6609409	-1.958302	0.94	NU0272240825	402722	640825
P34	55.6611035	-1.9584309	0.94	NU0271440843	402714	640843
P35	55.66127	-1.9585629	0.94	NU0270540862	402705	640862
P36	55.661442	-1.9586616	0.99	NU0269940881	402699	640881
P37	55.6613743	-1.9589589	0.94	NU0268040874	402680	640874
P38	55.6612222	-1.9588486	0.97	NU0268740857	402687	640857
P39	55.6610578	-1.9587083	0.96	NU0269640838	402696	640838
P40	55.6608819	-1.9585889	0.96	NU0270440819	402704	640819
P41	55.660723	-1.9584699	0.95	NU0271140801	402711	640801
P42	55.6605609	-1.9583439	0.94	NU0271940783	402719	640783
P43	55.660386	-1.9582376	0.94	NU0272640764	402726	640764
P44	55.6602168	-1.9581191	0.93	NU0273340745	402733	640745
P45	55.6607402	-1.9567913	0.97	NU0281740803	402817	640803
P46	55.6607662	-1.9567095	0.97	NU0282240806	402822	640806
P47	55.6609074	-1.9568009	0.97	NU0281640822	402816	640822
P48	55.6609139	-1.9567387	0.97	NU0282040822	402820	640822
P49	55.6610837	-1.9568553	0.97	NU0281340841	402813	640841
P50	55.6612498	-1.9569766	0.98	NU0280540860	402805	640860
P51	55.6612334	-1.9570541	0.98	NU0280040858	402800	640858
P52	55.6613987	-1.9571604	0.98	NU0279440876	402794	640876
P53 Trench 1	55.661549	-1.9575751	0.94	NU0276740893	402767	640893
P54 Trench 1	55.6615176	-1.957683	0.94	NU0276140890	402761	640890
P55 Trench 1	55.6617017	-1.957849	0.94	NU0275040910	402750	640910
P56 Trench 1	55.6617332	-1.9577685	0.94	NU0275540914	402755	640914

All Data using EGNOS (European Geostationary Navigation Overlay Service) 2.0m CEP (Circular Error Probability)

APPENDIX 3: OVERLAY MAP OF THE GRID WITH TABLE OF OS GRID REFERENCES (Page 3 of 3)

Position of Pegs as shown in Appendix 2

Co-ordinate System ESPG:4326 - WGS 84

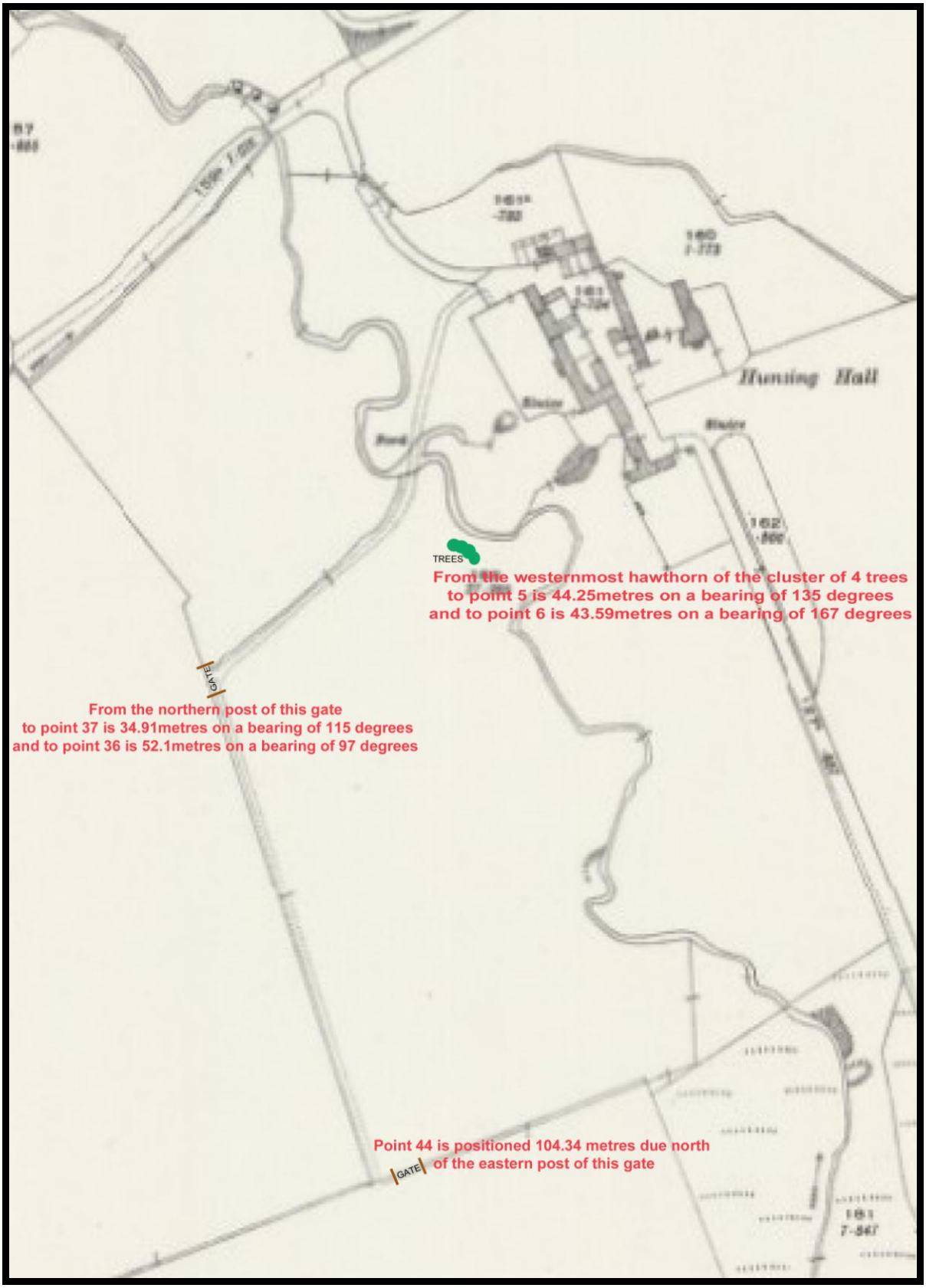
Positioning : U Blox - Neo 6 Chipset

Peg Name	latitude	longitude	HDOP	Grid Reference (OSGB36)	X	Y
P57 Way Mark	55.6612553	-1.9578418	0.94	NU0275140860	402751	640860
P58	55.6603116	-1.9568254	0.72	NU0281540755	402815	640755
P59	55.6602412	-1.9571303	0.77	NU0279640748	402796	640748
P60	55.6601777	-1.9574202	0.72	NU0277740740	402777	640740
P61	55.6601097	-1.95772	0.83	NU0275840733	402758	640733
P62	55.6600391	-1.9580072	0.77	NU0274040725	402740	640725
P63	55.6598791	-1.957893	0.72	NU0274840707	402748	640707
P64	55.6599411	-1.9575969	0.72	NU0276640714	402766	640714
P65	55.6600109	-1.9573093	0.72	NU0278440722	402784	640722
P66	55.6600839	-1.9570037	0.72	NU0280340730	402803	640730
P67	55.6601486	-1.9567101	0.72	NU0282240737	402822	640737
P68	55.6599783	-1.9565887	0.72	NU0283040718	402830	640718
P69	55.6599122	-1.956891	0.8	NU0281140711	402811	640711
P70	55.659843	-1.9571864	0.81	NU0279240703	402792	640703
P71	55.6597721	-1.95748	0.72	NU0277440695	402774	640695
P72	55.6597027	-1.9577697	0.8	NU0275540688	402755	640688
P73	55.6598246	-1.9564713	1.26	NU0283740701	402837	640701
P74	55.6597561	-1.956761	1.22	NU0281940694	402819	640694
P75 Trench 2	55.6607004	-1.9569591	0.94	NU0280640799	402806	640799
P76 Trench 2	55.6607087	-1.9568298	0.86	NU0281440800	402814	640800
P77 Trench 2	55.660503	-1.9568766	0.68	NU0281140777	402811	640777
P78 Trench 2	55.6605052	-1.9569968	0.71	NU0280440777	402804	640777
P88	55.6595423	-1.9576556	0.7	NU0276340670	402763	640670
P89	55.659617	-1.9573515	0.7	NU0278240678	402782	640678
P90	55.6596899	-1.9570518	0.7	NU0280040686	402800	640686
P91	55.6598714	-1.9562507	0.85	NU0285140706	402851	640706
P92	55.6600325	-1.9563624	0.7	NU0284440724	402844	640724
P93	55.660181	-1.9565939	0.7	NU0282940741	402829	640741
P94	55.6603403	-1.9567146	0.7	NU0282240759	402822	640759
P95	55.6605022	-1.9568283	0.77	NU0281440777	402814	640777

All Data using EGNOS (European Geostationary Navigation Overlay Service)

2.0m CEP (Circular Error Probability)

APPENDIX 4: REFERENCE DATA TO RE-ESTABLISH PEG POINTS



APPENDIX 5: LIGHT DETECTION AND RANGING (LIDAR) IMAGE OF THE SITE

(SOURCE: ENVIRONMENT AGENCY)