Bernician Studies Group Geophysics

Beamish, Pockerley, Sunny Banks Geophysical Survey

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The Bernician Studies Group
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FIGURES

1: SUMMARY

This report presents the results of geophysical surveys conducted as part of a joint project between Beamish Open Air Museum in County Durham (Beamish) and the Bernician Studies Group (BSG). The aims of the project were two-fold. Firstly, to assess an area of fields within the greater museums area for potential future development by identifying any sites that may contain archaeology. Secondly, as an open access resource for development and training of members of the BSG in site preparation and field survey work using Magnetometry equipment

The work consisted of detailed geomagnetic survey of 4 fields in the Sunny Banks area of Pockerley.

1.1 The Environment

Generally, there are areas which show potential archaeological features. The field shapes and rights of way, although unchanged since the 19th century, do not seem to be consistent with the surrounding area. In particular, the rights of way do not seem to link logically with known structures or routes. One path that crosses the Red Burn is particularly difficult to negotiate on foot but seemed to be associated with cart tracks, which could relate to industrial usage, as there is a history of both mining and milling in the area. Another leading into the top of field 4, a deep cart track, peters out within a yard of the entrance.

The fields are used for livestock and hay production. The soil is of poor quality and there is no indication of previous ploughing or rig and furrow. We do not believe that this area has been used intensively in the recent past and therefore any archaeology should have had a good potential for being undisturbed.

The underlying bedrock geology is mainly Pennine Middle Coal Measures Formation with - mudstone, siltstone, sandstone, ironstone and ferricrete, all Sedimentary Bedrock formed approximately 309 to 312 million years ago in the Carboniferous Period.

The surface geology consists of deposits of alluvium - clay, silt, sand and gravel. These deposits formed up to 2 million years ago in the Quaternary Period. The local environment was previously dominated by rivers depositing mainly sand and gravel detrital material in channels to form river terrace deposits, with fine silt and clay from over-bank floods forming floodplain alluvium, and some bogs depositing peat.

There had been significant erosion particularly along the Beamish Burn cutting into the bank side to a depth of 10m on the southern end of field 4 and into the paddock (field 3) on the south side of the site as you approach. It seems likely that the southern end of field 4 has gained in size from deposits whilst the paddock has lost considerably to this scouring by the Burn. This may account for the particular shape of these 2 fields.

In addition, the general terrain of field 4 indicates that drainage has been an issue. The sandy silt would normally lead to a well-drained environment and yet there are areas

of deep bog with a raised bog of sphagnum in one area and a substantial dewpond in another. However, the greatest areas of interest are a series of raised platforms that form the contours of field 4.

Figure 1: The site from the air. Featuring field 4 in the foreground and the entrance to Beamish in the top right. From this image, you may be able to distinguish the boggy areas mentioned above and the series of 3 platforms that run down the field from North (the bottom of the image) to South.

Figure 2 Google Image showing the position of the fields

1.2 The Results

1. In field 1 there was no archaeology found.

2. In field 2 in the narrow section at the north of the field close by the crossing of the Red Burn, there was a partial structure possibly a barn or part of a mill.

3. In field 3 there are numerous indications of track ways, some paved and some unpaved as well as a strange semicircular feature that may require further investigation.

4. In field 4 most of the topography is a result of geology, although there is a track way that links the corner of field 2 across the Red Burn around in a semicircle towards the boggy area where it is joined by another and thence goes North and South where it runs out. This feature can be seen in both of the images above.

2: PROJECT BACKGROUND

Location (Fig 1)

The survey areas comprised 4 fields of nearly 24 hectares under pasture to the East of the Beamish Burn and dissected by the Red Burn within the area of Beamish Open air Museum.

Survey Aims

The principal aim of the surveys was to assess the nature and extent of any subsurface features of potential archaeological significance within the survey areas in anticipation of any future development in that area.

Methods statement

The surveys have been undertaken in accordance with instructions from Max Adams and Colm O'Brien our Project Directors and in accordance with national standards and guidance.

Geophysical survey standards

The surveys and reporting were conducted in accordance with English Heritage Guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for Archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of Geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology.

In this instance it was considered likely that cut features such as ditches and pits would be present on the site, and that other types of feature such as track ways, wall foundations and fired structures such as hearths might also be present.

Given the anticipated shallowness of targets and the geological environment of the study area a geomagnetic technique, Fluxgate Gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of a hand-held magnetometer to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

Given the size of the area to be investigated, it was decided that an initial evaluation would take place in each field under the supervision of the Project Directors to identify areas of potential archaeology.

After this initial evaluation of each field a North – South baseline was created across the main area of interest. From this a 20m*20m grid pattern was established across each survey area. With 3 exceptions as this survey was also part of an ongoing training program 3 anomalous grids were created. In field 1, a 30m*30m partial grid was added to the existing pattern. In field 4 1 20*20m grid was offset by 10m and another 10m*20m was added. The ends of each base line and each corner of each grid logged using a ten place Ordinance Survey Reference on a Garmin GPSmap 62sc Satellite navigation system to an accuracy of +-1m. In addition, each end of the base line was mapped to 2 known fixed points to an accuracy of +- 10cm, so that any subsequent team could replicate the grid pattern.

Once this initial phase of the survey was completed and the data analysed an expansion of the survey area would be undertaken if the site merited further investigation.

Measurements of vertical geomagnetic field gradient were determined using a Geoplot FM256 fluxgate gradiometer. A zigzag traverse scheme was employed and data were logged in 20m sq grid units. The instrument sensitivity was set at 0.01nT, the sample interval was 0.125m and the traverse interval was 0.5m, thus providing 6,400 sample measurements per 20m sq grid. This intensity of survey 16 readings per sq meter has been found to be useful in locating postholes and hearths associated with pre-roman and Anglo-Saxon buildings. Although this requires a slower survey pace, this pace can be sustained more readily over uneven ground and sloped terrain.

Dates

Fieldwork was undertaken in 11 visits between March and August 2014. This report was prepared in August 2014 and edited in November 2014.

Personnel

Fieldwork was conducted by Jack Pennie, Ray Shepherd and Geoff Taylor. The geophysical data were processed by Jack Pennie. This report was prepared by Jack Pennie under the supervision of Max Adams and Colm O'Brien.

Data processing

All data are downloaded on to a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Geoplot v.3 software was used to process the geophysical data and to produce continuous tone greyscale images of the raw (minimally processed) data. The various greyscale images and interpretations are presented in Figures 4, 6, 8 & 10. We have used different palettes to bring out the individual features in each field. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nano Tesla.

For fields 1-3 no processing was applied. Field 4's dataset had the following basic processing functions applied:

Zero Mean Traverse sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities.

Zero Mean Grid sets the background mean of each grid to zero; As the survey was undertaken over a long period the weather conditions effect the moisture content of the soil and this in turn can effect the magnetic drift. Zero Mean Grid can remove some the effects of this drift.

In addition, the dataset from the 10*20m additional grid on the eastern edge of the field was substantially edited as part of the training exercise. The traverse direction was input erroneously and therefore nearly every piece of data had to translated.

Interpretation: anomaly types

Colour-coded geophysical interpretation plans are provided. Three types of geomagnetic anomaly have been distinguished in the data:

Positive magnetic regions, which may be associated with higher magnetic susceptibility such as soil-filled structures e.g. pits and ditches whose magnetic susceptibility has been enhanced by decomposed organic matter or by burning.

Negative magnetic regions, conversely, can be associated with features of lower magnetic susceptibility such as limestone wall footings.

Dipolar magnetic paired positive/negative magnetic anomalies typically reflect ferrous objects (including ironstone) or fired materials such as hearths or drainage pipes.

Archive

The survey raw data, processed data, images and report will be supplied on CD to Beamish Museum for their archive and for future use by researchers after these findings have been formally presented.

Acknowledgements

We are grateful for the assistance of Beamish Museum and the Farmers whose livestock shared the site with us over the months of the survey.

3: PREVIOUS ARCHAEOLOGICAL WORKS

To the best of our knowledge there has been no previous in depth study of this area. There are however, two references to a possible roman road crossing the site from the same source: Raymond Selkirk

1 *Chester-le-Street and its place in history* by R Selkirk Pub Cascade ISBN1-900456-05-02

Page223 paragraph 3 -suspected roman road at grid ref NZ223548

2 Durham County Council Website -Keys to the past - Beamish - Roman Road. Ref D7968 Map shows the road crossing the Beamish Burn at bottom of field 4.

There is a further reference in the County Durham Historic Environment Record. HER 118658 indicates that there is an item in the site but no details could be found.

4: INTERPRETATION - FEATURES

General comments

There are very few areas with strong magnetic anomalies either positive or negative. Therefore, most of the findings reflect a subtle variation, which on other sites may not be considered important but on this site are often supported, but not always, by surface evidence.

Except where stated otherwise in the text below, relatively positive magnetic anomalies are taken to reflect typically sediments in cut archaeological features (such as ditches or sunken track ways)

Small, discrete dipolar magnetic anomalies have been detected in all of the survey areas. These almost certainly reflect items of ferrous ironstone and have little or no archaeological significance.

Dipolar magnetic anomalies have been detected along the edges of many of the survey areas; these anomalies reflect adjacent metal barbed wire fences.

Some linear dipolar magnetic anomalies away from the edges and close to boggy areas are associated with drainage pipes.

Finally, larger dipolar anomalies in field 3 relate to tracks that have been paved.

5: FIELD BY FIELD GEOPHYSICAL SURVEY

Field 1

Figure 3 aerial view of field 1 with rough lay-out of surveyed area

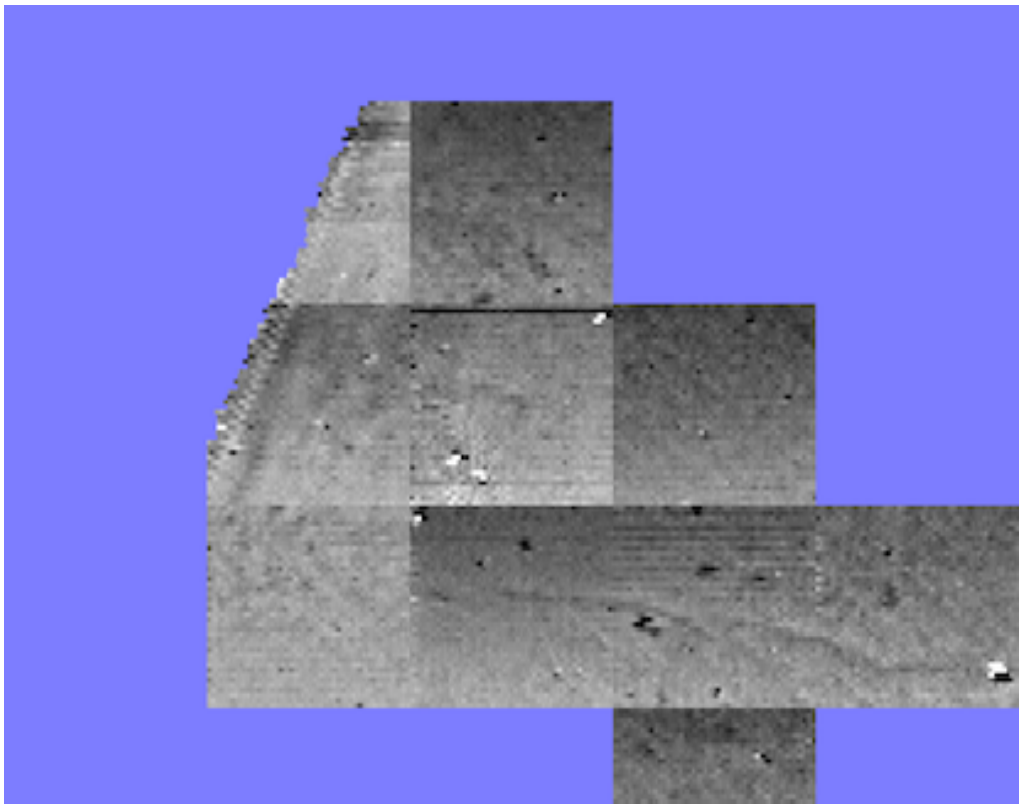

Figure 4 geophysics plot of field 1

The top left hand side (north-west) of this field shows faint signs of a track way running parallel to the fence line. The faint line running roughly west – east near the bottom of the image is probably the result of land slippage as it is running across the slope of the field. This ends with a small dipolar anomaly, which may be associated with a metal watering trough close by. There is again a very faint circular image centred at the join of the two top grids and the two sitting directly below. This is likely to be the result of a cattle-feeding station.

Field 2

Figure 5 Aerial view of field 2 with rough lay out of surveyed area.

Figure 6 Geophysics plot of Field 2.

After an initial evaluation survey, it was decided that a strip 20m by 80m at the northern end of field 2 showed the best potential for archaeology. This end of the field has access to a ford across the Red Burn and as such was an historical crossing point. In the northwest corner there is a strong bi-polar anomaly measuring over 7m in length. This is likely to be a wall of a building with access very close to its southern end. A gap is just discernible with two parallel curved features running through. It is very possibly a barn or byre now demolished as the Red Burn has eroded the bank side to the west of the structure. The blue strip along the left edge near the bottom of the image is caused by the encroachment of the bank and fence by the Red Burn that prevented survey in that area. The other dark and red spots on the image are erratic

high magnetic readings possibly from farm machinery or bits of ironstone, which is common on parts of the site.

Field 3

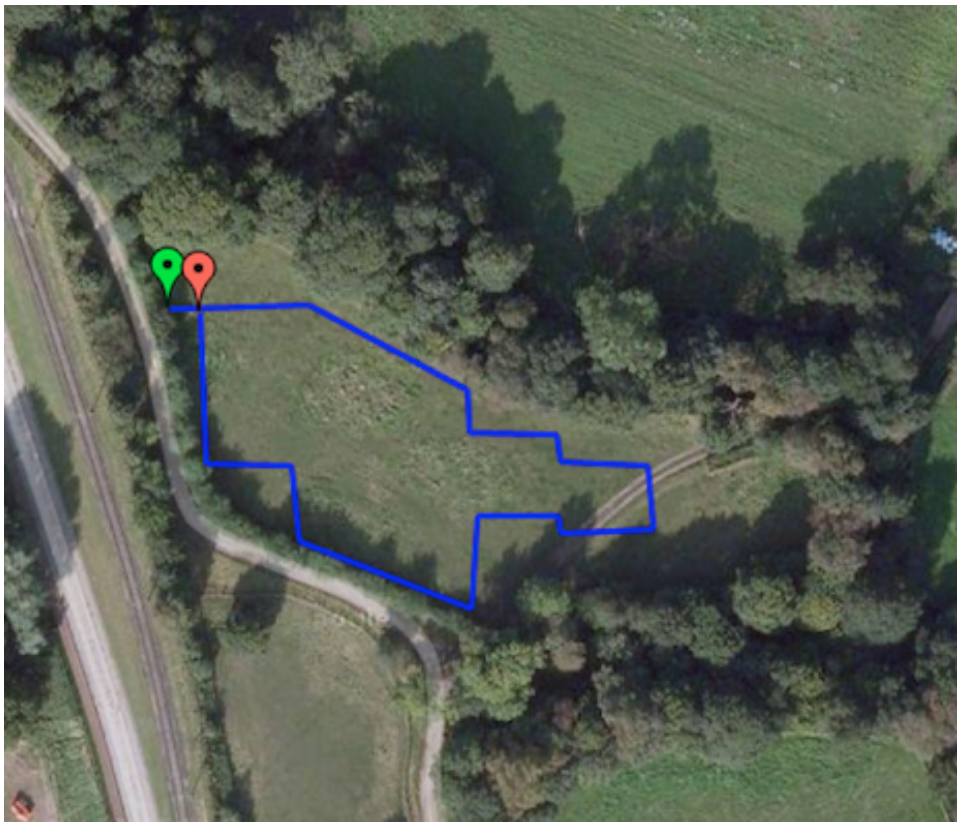

Figure 7 Aerial view of field 3 with rough lay out of surveyed area

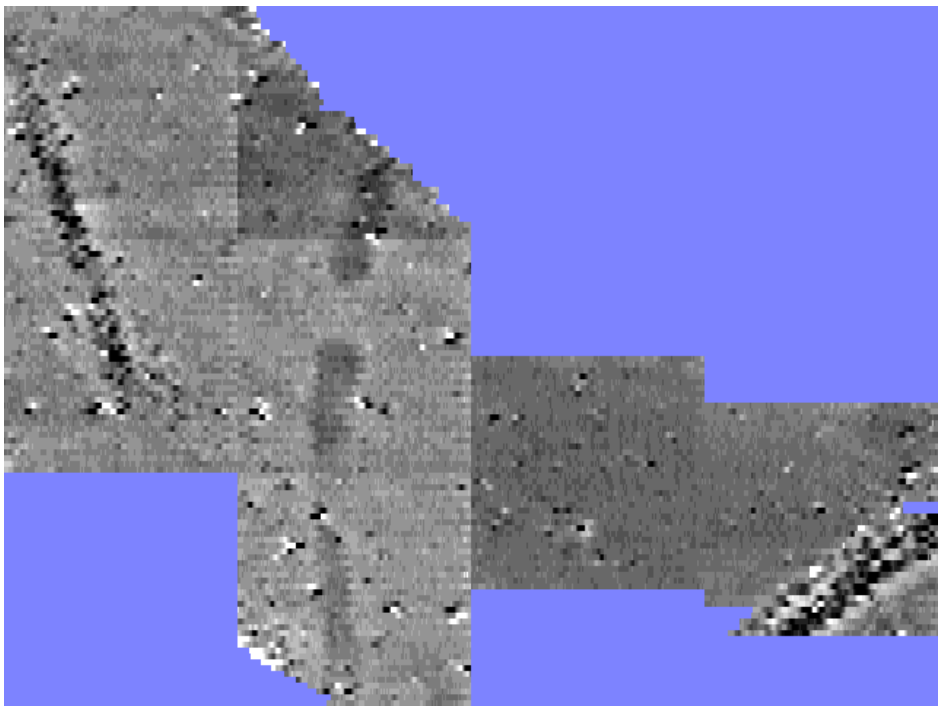

Figure 8 Geophysics plot of field 3

Field 3 was originally surveyed as an afterthought as there seemed to be a number of visible features that should be investigated. One such circular feature can be seen almost central in the aerial photograph. This is likely to have been either a large animal feeding trough or a horse tether point, as there is no evidence in the geophysics of any similar below-surface feature. Notwithstanding that, the feature that stands out in the southeast corner is the metalled track way leading to the Beamish Burn Crossing. This was deliberately included in this survey to give a sharp image. What we can see in the northwest of the field is a similar feature. This is probably the line of the original track, which can now be seen snaking to the west and south of the field. Although all of these fields have the same shape as in the 1860's Ordinance Survey Maps, it seems likely that they have altered considerably over time. As demonstrated by the central feature this ditch is 2.5m wide and over 45m long with a 6m gap in the middle. To the north of this ditch is the Beamish Burn with an almost vertical drop of 20m. To the south, it could run into the now culverted Letch Burn, but seems to broad and too short for this purpose, the field is currently too high for possibility of water to run in the other direction. Leaving a large feature with a mysterious purpose.

Field 4

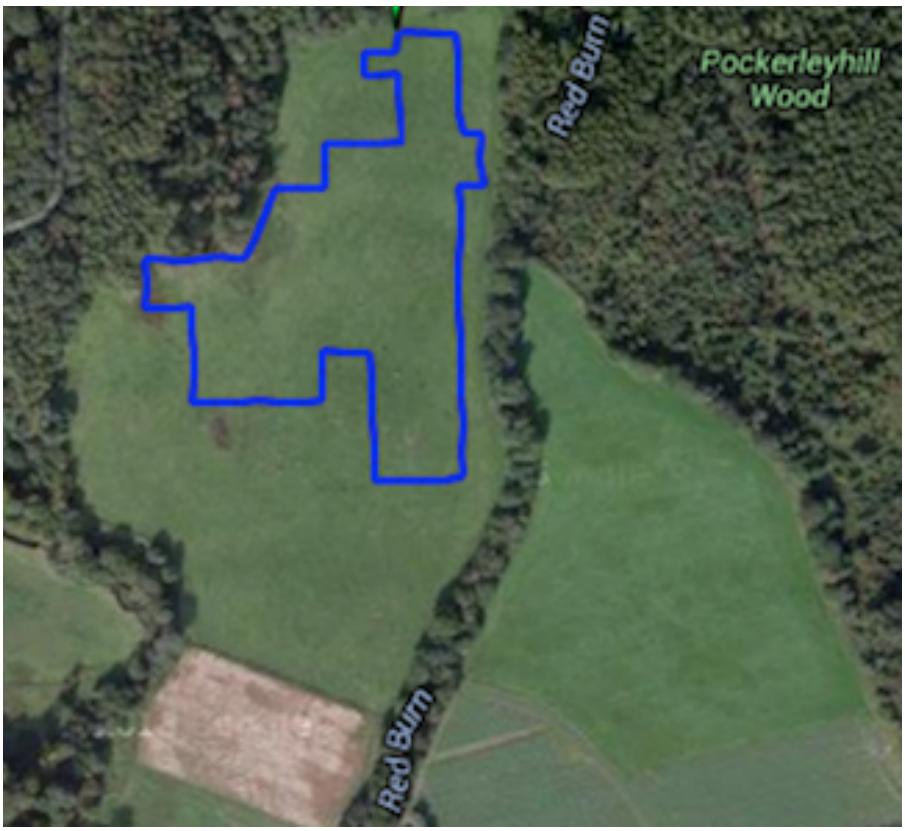

Figure 9 Aerial view of field 4 with rough lay out of surveyed area

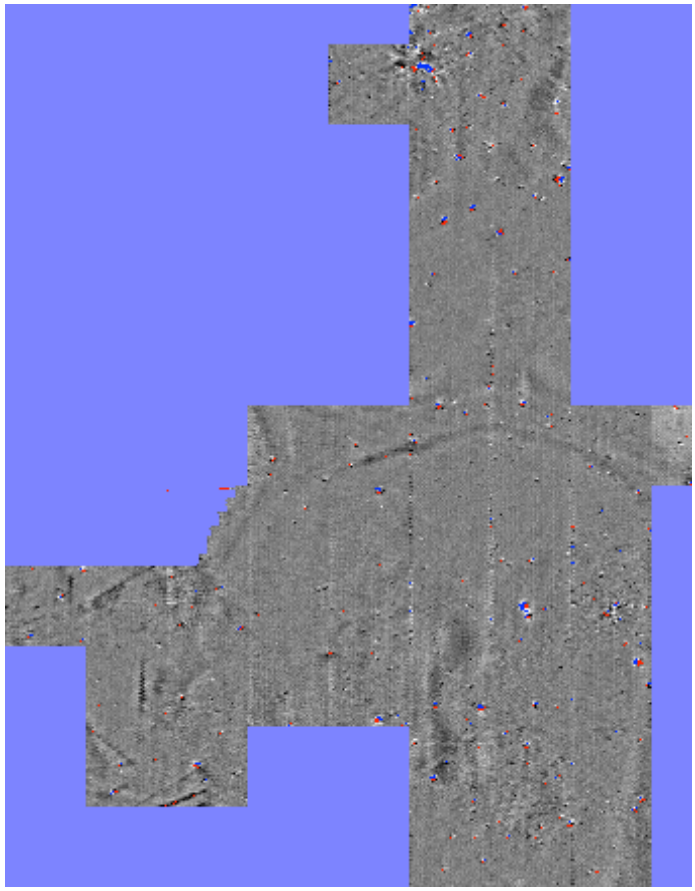

Figure 10 Geophysics plot of field 4

Most of the features in field 4 seem to be natural, probably as result of a series of landslips. The main feature of the field, which can be seen on the ground and in the aerial photographs, is the semicircular sunken track way in the centre of the image. This links with another sunken track way at its western end. At its eastern end it leads down sharply to the crossing of the Red Burn; this is not a suitable crossing point for tracked vehicles. This second track way was not visible when we first arrived on site, but as the surveyed progressed over several weeks of the dry summer, this emerged as the soil dried out. In the western section of the image, a number of sharply defined linear features are likely to be drainage ditches and pipes as this area is boggy and leads down to a small pond or dew pool. Random high magnetic points can be seen throughout the image with a larger cluster towards the top (north) of the field. Initially we could detect a small-banked surface feature running south from the entrance of the field for perhaps 40m. We thought that this small cluster may have been spoil tipped in this area as the path through the trees leading from the pond/ lake to the north is very sunken and yet there is no sign of a sunken track once you enter the field. The very feint dumb bell feature to the south of the semicircular sunken track way could be of interest but it does not relate well to the topography of the ground. Again, this is something that may have been covered by landslip age in the past.

Finally, we undertook a rough survey of the profile of the field, as this was one of the main reasons that led us here in the first place. The graph below indicates height above sea level in feet taken every 20m along the length of the field from south to north (left to right on the graph). Our survey was taken along the main south – north base line of the survey for nearly 1/3 of a mile. Rising over 80ft or 25m in a series of

3 steps. To the north of each platform is an area that is either sunken or flat land, which is out of site from anyone further down the field. We ourselves used these areas to hide our equipment from public view whilst working on the site. Midway along at approximately 656 ft is the site of the sunken track way hidden well out of site by the platform to the south.

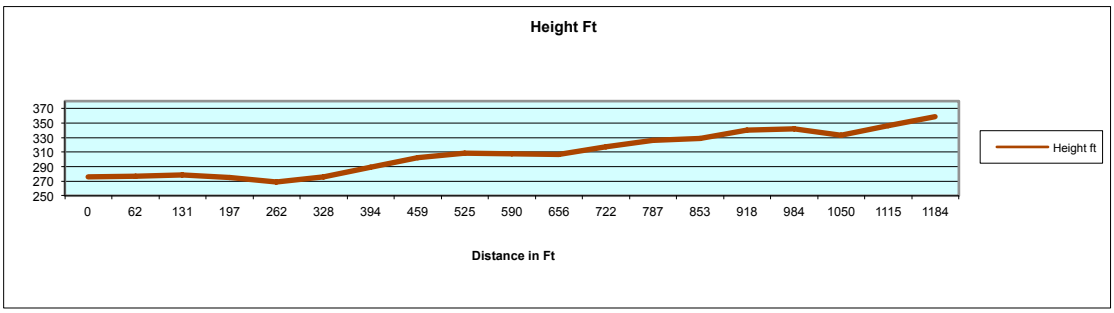

Figure 11 south – north base line profile in feet.

5: CONCLUSIONS AND RECOMMENDATIONS

5.1 In the main, the site was devoid of any significant archaeology. a number of features are worth checking both to check the quality of the geophysics, as the ground was not as conducive to magnetometry as first thought with many readings being very marginal also simply to answer the questions what are they and why are they there in particular.

5.2 The remains of only 1 structure could be identified in field 2. It is assumed this is a barn or byre but it may be associated with the Red Burn and could be part of a Mill and should therefore be investigated in the future.

5.3 Possible structural remains and anomalies, which could relate to industrial practices, have been detected at the top of field 4.

5.4 Probable sunken track way in field 4 needs investigation. This clearly defined feature crosses the site but seems to lead from nowhere to nowhere.

5.5 The possible ditch in field 3 will need investigation. It could be possible to see if the profile extends beyond the edge of the field to the bank of the Beamish Burn. It would also be useful to extend the survey of this feature to the south and see if it can be tracked further.

The Bernician Studies Group

The Bernician Studies Group is a community-based seminar and research group based on Tyneside and which arises out of university lifelong learning. It is constituted as a small charity.	
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