NAA

GEOPHYSICAL SURVEY REPORT

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PERCY WOOD GOLF COURSE

SWARLAND

NORTHUMBERLAND

prepared for
Nathaniel Lichfield and Partners
on behalf of
Percy Wood Leisure Ltd

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PERCY WOOD GOLF COURSE

SWARLAND, NORTHUMBERLAND

GEOPHYSICAL SURVEY REPORT

Summary

Northern Archaeological Associates Ltd was commissioned by Nathaniel Lichfield and Partners on behalf of Percy Wood Leisure Ltd to undertake a geophysical survey of the northern section of Percy Wood Golf Course (NGR: NU 15824 03612). The survey was required to evaluate the archaeological potential of the site in support of a planning application for holiday static caravan and lodge development. The survey was carried out between 20th March and 21st March 2017 and covered an area of approximately 7.5 hectares of greenland that comprised the northern part of the golf course.

The results of the geophysical survey have mapped numerous modern features relating to the current layout of the golf course such as the bunkers, tee boxes, putting greens, and metalled tracks and paths connecting the various fairways. Further modern disturbances have been caused by debris within the topsoil and above ground features external to the areas surveyed.

Regularly spaced linear anomalies appear clearly throughout the areas surveyed and are indicative of agricultural features such as ridge and furrow and land drains.

Although it is plausible that responses caused by modern and agricultural activity have in part masked or truncated archaeological features buried deeper in the stratigraphy, the strong responses caused by ridge and furrow are possibly suggestive that if further in-filled features were present in the site they would be detected through the geophysical survey. There are several trends composed of both positive and negative magnetic responses running across the site that possibly relate to in-filled features, but are of uncertain origin. It is likely that these are either caused by agricultural or modern activity. However, given the weak and diffuse nature of these anomalies, a tentative interpretation applies and it is possible that they could signify archaeological features.

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Report copy (PDF)

Scaled figures:

- Gradiometer survey grid location
- Unprocessed data
- Processed data
- XY-trace data
- Interpreted data

Site photographs and catalogue

Disclaimer

The results of geophysical survey may not reveal all potential archaeology and do not provide a comprehensive map of the sub-surface, but only responses relative to the environment. Geological, agricultural and modern responses may mask archaeological features. Short-lived features may not give strong responses. Only clear features have been interpreted and discussed in this report.

1.0 INTRODUCTION

1.1 Northern Archaeological Associates Ltd was commissioned by Nathaniel Lichfield and Partners on behalf of Percy Wood Leisure Ltd to undertake a geophysical survey of land at Percy Wood Golf Course (NGR: NU 15824 03612). The survey was required to evaluate the archaeological potential of the site in support of a planning application for holiday static caravan and lodge development. The survey was carried out between 20th March and 21st March 2017 and covered an area of approximately 7.5 hectares of land that comprised the northern part of the golf course.

Location

1.2 The proposed development site encompassed the northern extent of Percy Wood Golf Course, which is located to the west of Swarland, Northumberland (**Figure 1**). The survey area was bordered on all sides by Swarland Wood, as well as the southern extent of the golf course to the south, Percy Wood Country Park to the north and west, and the golf course driving range to the east.

1.3 The natural topography was generally level across the site, with a slight depression in the centre. The north and south of the survey area is recorded at lying approximately 170m above Ordnance Datum (aOD), and the centre lies at approximately at 160m aOD.

Geology

1.4 The solid geology of the survey area consists of mudstone, siltstone and sandstone of the Stainmore Formation, with superficial deposits of diamicton of Devensian Till to the south, and no recorded superficial deposits to the north (British Geological Survey 2017). The soils to the north of the site are mapped as Brickfield 3 Association (Soil Survey of England and Wales 1983) consisting of loamy and clayey surface-water gley soils (Jarvis et al. 1984, 123). To the south, the soils are recorded as Dunkeswick Association (Soil Survey of England and Wales 1983), comprising stagnogley soils in greyish brown drift (Jarvis et al. 1984, 165).

Archaeological background

1.5 The following section summarises a Desk-Based Assessment completed by NAA (2017):

1.6 There is no recorded evidence of prehistoric or Roman activity within the proposed development area and known activity relating to the early and mid medieval periods comprises ridge and furrow earthworks.

1.7 In the local environs of the proposed development site there is evidence of prehistoric activity. Several cairns are recorded on the 1807 Swarland Estate Plan in various fields that are located to the south of the proposed development area, recorded as Cairn Field, Wood Field and Spring Field on the 1807 Swarland Estate Plan. It is unclear as to whether these cairns are indicative of Bronze Age burial monuments, or are later in origin and associated with field clearance, or some form of waymarker or land mark. Known Iron Age activity within the vicinity of the site includes a sub-circular cropmark located approximately 1km to the west of the proposed development site, and a defended settlement comprising defensive ditches and an embankment constructed from earth and stone at Chesterhill, approximately 0.5km to the north of the site.

1.8 Between the 14th and 18th centuries, the Manor of Swarland was owned by the Haselrigg Family of Swarland Old Hall. Swarland Old Hall survives as a Grade II listed building and is located approximately 1.6km to the south of the survey area. The Manor of Swarland included the northern parts of Swarland Moor, previously called Felton North Common.

1.9 In 1741 Richard Grieve of Alnwick bought the Swarland Estate for £10,180 (Vaggs 1994:3). The estate was enlarged towards the end to the 18th century when Felton North Common was enclosed by Parliament in 1754.

1.10 Several years after succeeding his father in 1765, Davidson Richard Grieve built Swarland Hall, which was located directly to the south-east of the survey area, and an associated parkland including land that comprises the proposed development area.

1.11 After the death of David Richard Grieve, Swarland Hall was sold to Alexander Davidson, who improved and enlarged the estate (Vaggs 1994:3). Davidson was a close friend of Horatio Nelson, and after Nelson's victory over the French fleet at the Battle of the Nile (also known as the Battle of Aboukir Bay) in 1798, Davidson redesigned Swarland Park to mirror the shape of the Battle, making it one of two Battle Parks associated with this Battle. The Hall remained in the Davidson family until 1874, when it passed to Hugh Andrews, who made several extensions to the Hall and alterations to the parkland. The Estate was briefly owned by James E. Woods between 1902 and 1922, before being bought by the Forster family, who converted the Hall into accommodation for miners. During this period the estate fell into disrepair and by 1928 timber on the estate was being felled (Vaggs 1994:4).

1.12 In 1934 the estate was bought by Mr Clare Vyner of the Fountains Abbey Settlers' Society as part of a land settlement scheme to provide home and employment for Tyneside tradesmen, who were out of work as a consequence of the Great Depression in the 1930s (Vaggs 1994:3). As part of this, the main hall was demolished and replaced by seventy smallholdings. In 1947 the land settlement scheme finished and the free holdings were sold into private ownership. The village Hall, as well as a number of dwellings on Park Road and The Avenue were constructed as part of this scheme and are Grade II listed buildings.

1.13 Cartographic evidence suggests landscaping associated with the golf course has generally not been destructive to features present on 19th century historic maps. Field boundaries present on the 1807 Swarland Plan are still extant in the modern landscape, and a former Stock Well corresponds with the location of a pond located in the north of the survey area.

2.0 AIMS

2.1 The aims of the survey were:

- To attempt to characterise the nature of any sub-surface remains within the survey boundary and to identify possible concentrations of past activity in order to inform the requirement for any archaeological mitigation work at the site; and

- To produce a report including XY-trace plots, raw and processed greyscale images of the survey areas and interpretations of these results.

3.0 METHODOLOGY

3.1 All survey work was completed to appropriate standards as outlined by existing guidelines (English Heritage 2008; CIfA 2014). The geophysical survey was undertaken as gradiometer survey using the Bartington Grad601-2 dual magnetic gradiometer system with data logger. The readings were recorded at a resolution of 0.1nT and data was collected with a traverse interval of 1m and a sample interval of

0.25m. All recorded survey data was collected with reference to a site survey grid comprised of individual 30m x 30m squares. The grid was established using Real Time Kinematic (RTK) differential GPS equipment and marked out using non-metallic survey markers. All grid nodes were set out with a positional accuracy of at least 0.1m and could be re-located on the ground by a third party. The base lines used to create the survey grids are shown on Figure 2 and further details are available in **Appendix A**.

3.2 In this report, the word anomaly is used to refer to any outstanding high or low readings forming a particular shape or covering a specific area.

3.3 The processing was undertaken using Geoplot 3.0 software and consisted of standard processing procedures, details of processing steps applied to collected data are given in **Appendix B**.

3.4 On the greyscale plots (Figs. 3 and 4), positive readings are shown as increasingly darker areas and negative readings are shown as increasingly lighter areas. The interpretation uses colour coding to highlight specific readings in the survey area (Figure 5) and details of theses characterisations used are presented in **Appendix C**.

Surface conditions and other mitigating factors

3.5 The survey area boundaries were fairly informal comprising hedgerow, trees, 'roughs', sand bunkers, buildings, trackways and streams. Within the survey area there were several metallic features associated with the golf course, including bridges and signs. It was necessary to avoid all metal objects to ensure that magnetic responses did not impinge on the survey results and mask potential buried features. Several trees and areas of high vegetation were located within the survey area and dummy values were used where trees prevented the passage of survey. Areas containing modern debris, dense vegetation and woodland were unsuitable for survey.

4.0 RESULTS

4.1 Isolated anomalies with an amorphous form that possibly relate to archaeological features have been denoted as a positive response (archaeology – lesser). Given the lack of anomalies conclusively identified as being of an archaeological nature, a very tentative interpretation applies and, it is equally possible that these are of a modern or geological origin.

4.2 There are several weak and diffuse linear trends composed of either negative or positive responses. These fail to produce the necessary patterning or increases in magnetic response in order to be interpreted fully. It is possible that the trends are indicative of former agricultural or archaeological activity, but given the lack of patterning of these anomalies and the modern disturbance within the survey area, it is equally plausible that they are of a modern origin.

4.3 Across the survey area there are regular, broadly spaced positive linear anomalies that relate to ridge and furrow. The ridge and furrow has provided fairly strong responses across areas surveyed and corresponds with earthworks visible within the proposed development site.

4.4 In the south of the site there are several regularly spaced linear anomalies composed of strong increases in magnetic response that are on the same alignment as anomalies identified as ridge and furrow. The strong magnetic responses of these linear anomalies is indicative of land drains, and given the similarity in alignment, it is likely that the land drains have been built into the ridge and furrow. There are further linear anomalies across the site that are composed of similar increases in magnetic response, but comprising fairly irregularly forms and distribution. These are also considered to be indicative of land drains.

4.5 There are several weakly enhanced linear magnetic responses that are likely to relate to agricultural activity, but lack the patterning to be fully interpreted. Subsequently their exact origin is unknown.

4.6 A linear bipolar anomaly has been identified running along the eastern edge of Areas 7, 8 and 9. It is likely that this anomaly is of a modern nature and possibly indicative of a buried utility.

4.7 Areas of increased magnetic response have been used to encapsulate concentrations of dipolar anomalies. These are likely to be caused by modern magnetic debris in the topsoil or near the surface.

4.8 Several bipolar anomalies and areas of disturbance correspond with above ground features associated with the present golf course layout, including, sand bunkers, putting greens, teeing ground and marker signs.

4.9 Several broad areas of increased magnetic response have been identified that are likely to relate to above ground modern features (external interference), both internal and peripheral to the area surveyed.

5.0 CONCLUSIONS

5.1 Generally results appear to be fairly archaeologically 'quiet'. It could be noted that that the coherent responses of the ridge and furrow may suggest that the soil has the necessary magnetic susceptibility for in-filled features, if present, to be detected. It is possible that modern features and areas of disturbance, along with agricultural features have masked or truncated buried features of an archaeological nature. Furthermore, the small and irregular shape of the various survey areas targeted with survey may mean that potential archaeological features have only in-part been covered by the geophysical survey.

5.2 Survey results have identified several positive and negative trends that may be indicative of buried archaeological features. However, the weak and diffuse nature of these trends has meant their interpretation is very tentative, and it is possible that they are instead related to material of a modern, agricultural or geological nature.

5.3 The gradiometer survey has successfully mapped a variety of different agricultural features including ridge and furrow and land drains.

5.4 Also appearing clearly within the survey results are responses caused by features relating to the golf course visible above the ground, as well as modern disturbances both internal and peripheral to the survey area, and a bipolar linear anomaly that is possibly indicative of a buried pipe.

6.0 STORAGE AND CURATION

6.1 The records of the geophysical survey are currently held by NAA. All material will be appropriately packaged for long-term storage in accordance with national guidelines (English Heritage 2008; CIfA 2014).

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APPENDIX A

TECHNICAL INFORMATION

Gradiometer Survey Instrumentation

The data was collected using Hand Held Bartington Grad 601-2 fluxgate gradiometers. The Bartington 601-2 is a single axis, vertical component fluxgate gradiometer comprising a data logger battery cassette and two sensors. The sensors are Grad-01-1000L cylindrical gradiometer sensors mounted on a rigid carrying frame, each sensor contains two fluxgate magnetometers with 1m vertical separation.

The gradiometer records two lines of data on each traverse, the grids are walked in a zig-zag pattern amounting to 15 traverses. The gradiometers are calibrated at the start of every day and recalibrated whenever necessary.

The difference in the magnetic field between the two fluxgates in each sensor is measured in nanoTesla (nT) and for this investigation the readings are measured at 0.1nT. The units' sensors can measure down to 1m from the ground level depending on the ground conditions.

Readings reach between +/-100nT and lower readings are created by upstanding or harder remains such as walls or areas of stone, higher readings are created by softer or cut features, such as ditches and pits (see below).

Limitations

Poor results can be due to several factors including short lived archaeological occupation/use or sites with minimal cut or built features. Results can also be limited in areas with soils naturally deficient in iron compounds or in areas with soils overlying naturally magnetic geology, which will produce strong responses masking archaeological features.

Overlying layers such as demolition rubble or layers of made ground can hide any earlier archaeological features. The presence of above ground structures and underground services containing ferrous material can distort or mask nearby features.

Particularly uneven or steep ground can distort results beyond the capabilities of processing to even out. Over processing of data can also obscure features.

Table 1: Survey summary

	Survey
Grid size	30mx30m
Traverse interval	1m
Reading interval	0.25m
Direction of 1st traverse	North
Number of Grids	211

Table 2: Grid co-ordinates (The base line is shown on Figure 2)

Grid point (gp) A	**Grid point (gp) B**
NGR: 415633.4523 603603.3241	NGR: 415649.4526 603596.2333

APPENDIX B

DATA PROCESSING INFORMATION

The processing is undertaken using Geoplot 3.0 software, and the following processing techniques:

- Zero Mean Traverse - to remove directional effects inherent in the survey,
- Destagger - to shift the traverses back or forward to correct for user error,
- Clip - to enhance the weaker features, by reducing the readings above a set value,
- Despike - removing data points that are above an appropriate mean to reduce the appearance of dominant readings, created by modern ferrous objects distorting the results,
- Low pass filter - Decreases the correlation between neighbouring cells effectively smoothing the data
- Interpolation – reduces the blocky effect of the survey smoothing the appearance of the data.

Table 3: Processing steps

Minimal Processing	Increased Processing
• Zero Mean Traverse +5/-5 • Destagger: Area 1 - Grid 2, 9, 16, 19 and 26: 1 Area 2 - All: 2 Area 3 - Grid 12: 1 - Grid 15: 2 - Grids 14, 25, 26 and 29: 3 - 23: 9 Area 4 - Grids 6, 7 and 9: 2 - Grid 8: 4 - Grid10: 5 - Grid 11: 6 - Grids 13 and 14: 7	• Low Pass Filter • Interpolate Y, Expand - Linear ,x2

Area 5 - All: 4 Area 6 - All: 2 - Grids 2, 6, 7, 10, 11, 14: 4 - Grid 15: -2 Area 7 - All: 2 - Grids 6, 12 and 18: 4 - Grid 15: 6 - Grid 9: 8 Area 8 - All: 6 Area 9 - Grids 1, 4, 6, 8 and 10: 2 - Grids 7 and 9: 4 - Grid 3: 8 Area 10 - All: 2 Area 12 - All: 2 - Grids 5, 6, 9, 10 and 18:2 - Grids 13 and 14: 4 Area 13 - All: 2 - Grids 8 and 9: 2 - Grid 5: 6	

APPENDIX C

DATA VISUALISATION INFORMATION

Figures

The data is used to produce a series of images to demonstrate the results of surveys these are detailed below:

- Greyscale/Colourscale Plot – This demonstrates the results as a shaded drawing with highest readings showing as black, running through different shades to lowest showing as white. This can also be created using a colour pallet to demonstrate the different values.

- XY-trace Plot – This creates a line drawing showing the peaks and troughs of the readings as vertical offset from a centreline.

- Interpreted data – This is created to show features and particular high or low readings to re enforce and clarify the written interpretation of the data. This is based on the Greyscale plot but with different colours representing the various readings.

Magnetic anomalies and terminology

The different magnetic anomalies can represent different features created by soil and geology, human activity, modern or agricultural activity. Anomalies interpreted with a 'greater' categorisation are considered more likely to be of an archaeological nature; a more tentative interpretation is applied to those with a 'lesser' categorisation as a consequence of weaker increases in magnetic response or the anomalies incomplete patterning or irregular form.

In areas where mining activity has been recorded, it is possible that dipolar anomalies (often appearing as a broad sub-circular positive response with a negative halo) and amorphous areas containing bipolar responses are caused by mine shafts, pits and historic mineral extraction.

Positive linear anomalies have an increased magnetic response and are often caused by archaeological features, such as ditches and field boundaries but can also be natural.

Isolated anomalies or anomalies with a more amorphous form possibly represent infilled or thermomagnetic features that can be of an archaeological or natural origin. Areas of heating/burning or heated objects produce thermoremanent responses as this creates a magnetic field. These can appear as bipolar responses or as magnetic debris depending on whether it is in situ, or moved into place.

Negative linear anomalies represent earthworks, walls and other upstanding or compacted remains with a lower magnetic response compared to background readings. Isolated negative anomalies can represent archaeological or natural features.

Weak and diffuse anomalies with an uncertain origin are denoted by trends. It is possible that these belong to archaeological features, but given their weak signatures it is equally plausible that they relate to natural soil formations.

Regularly spaced linear anomalies are often caused by agricultural practices. Depending on their form and magnetic responses they either denote ridge and furrow, modern ploughing or land drains.

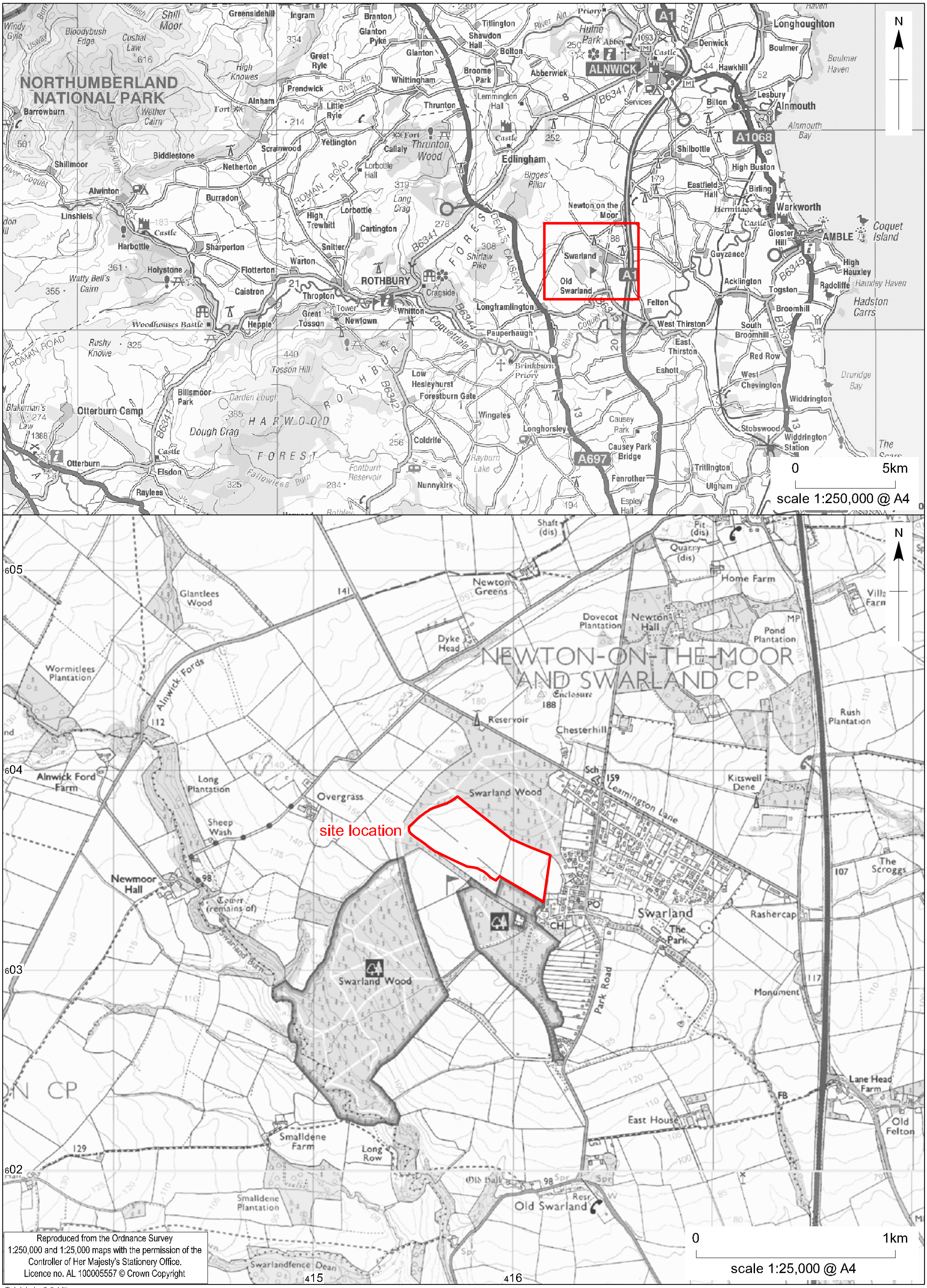
Dipolar readings are single positive responses with a surrounding negative response. Strong responses tend to be caused by ferrous objects. These responses have only been shown when located near to archaeological features. Given the former land uses of the survey area it is possible that identified dipolar anomalies relate to mining activity and are indicative of further pits and mine shafts.

Positive anomalies with associated negative responses (bipolar) denote features with a strong magnetic response, likely to be of a modern origin. Linear bipolar anomalies are often modern services such as cables; however weaker responses can be archaeological features such as earthworks.

Increased magnetic response is caused by magnetic debris and is noticeable as areas of positive and negative responses, which can relate to general ground disturbance, spreads of ferrous debris or areas of rubble.

Areas of magnetic disturbance, often along the edges of survey areas are caused by standing metal structures such as fencing and buildings. This can cause interference extending out from the structure, across the area.

Variable weak magnetic responses can demonstrate natural features or changes in geology or soil type.



Percy Wood Golf Course: site location *Figure 1*

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Percy Wood Golf Course: gradiometer survey grid location

Figure 2

Percy Wood Golf Course: unprocessed greyscale plots of gradiometer survey results

Figure 3

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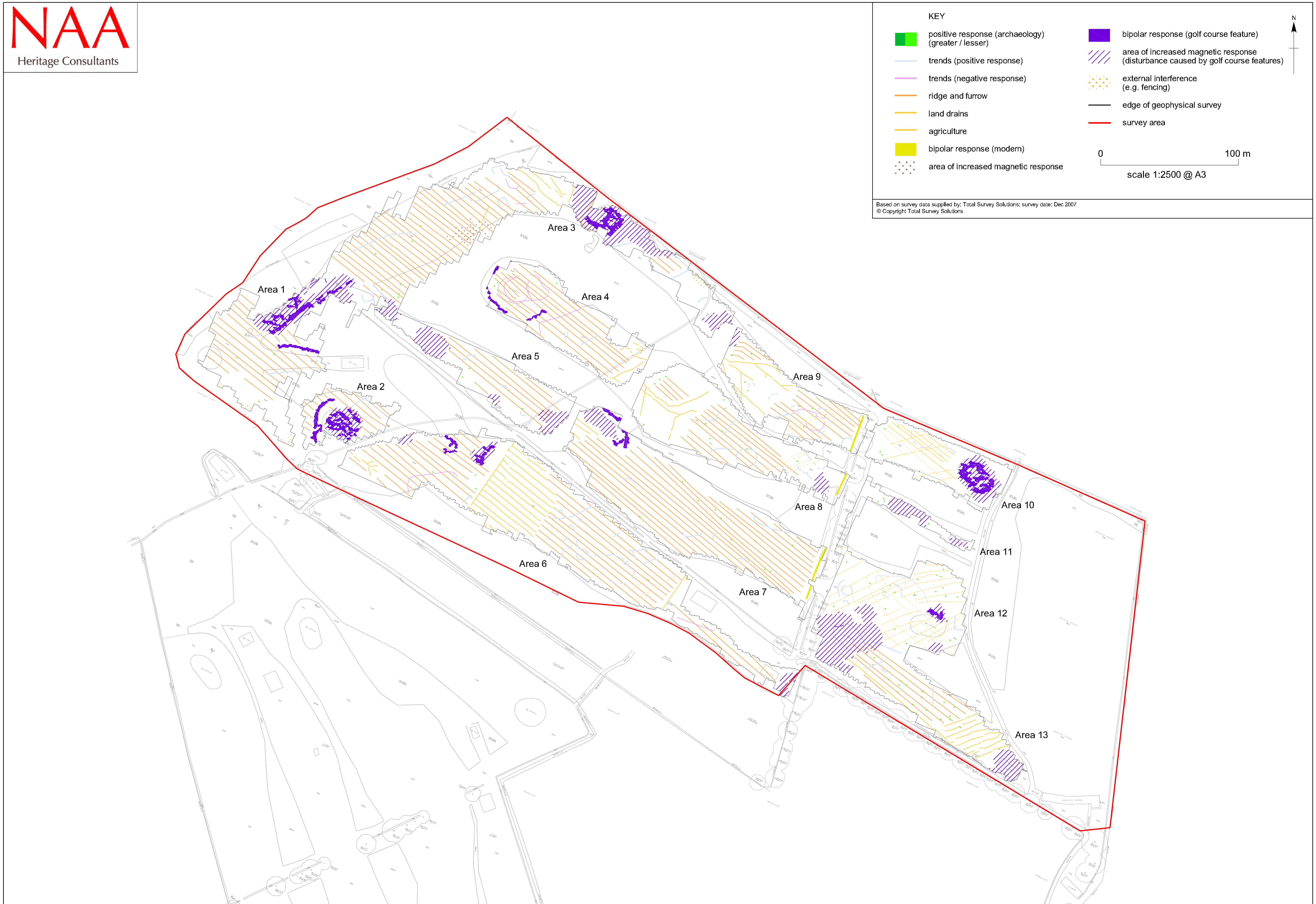
KEY
proposed development boundary
0 100 m
scale 1:2500 @ A3
N

Based on survey data supplied by: Total Survey Solutions: survey date: Dec 2007
© Copyright Total Survey Solutions

2nT
-2nT
Pallette:grey55.ptt

Percy Wood Golf Course: processed greyscale plots of gradiometer survey results

Figure 4



Percy Wood Golf Course: interpretation of gradiometer survey results

Figure 5