HARRYS FARM, TWYFORD, STENSON

Report on geophysical survey conducted in May 2014

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SUMMARY

- Trent & Peak Archaeology as part of York Archaeological Trust was commissioned by John Bowler Farms to conduct a geophysical survey at the site of a proposed photo-voltaic array at Harrys Farm on the outskirts of Stenson, Derbyshire, centered on NGR SK 32488 29457 (Fig 1). The site is level and lies at a height of c.40m OD.

- The work was carried out between the 30th May and 3rd June 2014 following the methodology detailed in the WSI (May 2014), in accordance with standard, accepted practices for archaeological geophysical surveys (EH 2008).

- The site is situated on deposits of Gunthorpe Member Bedrock, with overlying superficial Holme Pierrepont Member deposits.

- The site was composed of a single c. 2 hectare area surveyed as a contiguous entity. The site was bounded by fencing which contained metal elements, its presence resulted in the reduction of the survey area in order to minimize interference in the dataset. To the south of the proposed survey area, a number of large piles and spreads of crushed brick on the ground-surface were present which prevented geo-magnetic survey in these areas.

- Geophysical survey demonstrated the presence of potential buried archaeological features, these comprised:

    - A possible 35m by 23m enclosure in the southwest of the area surveyed.

    - A possible 39m by 30m enclosure in the northeast of the area surveyed.

    - A possible 74m-long linear feature which may be a result of ancient agricultural practices.

Report on the geophysical survey of land at Harrys Farm, Twyford, Stenson, Derbyshire. NGR SK 32488 29457

CONTENTS

SUMMARY..... 3

CONTENTS..... 4

List of Figures..... 5

List of Plates..... 5

ACKNOWLEDGEMENTS

1. **INTRODUCTION**..... 6
2. **PROJECT BACKGROUND**..... 7
3. **OBJECTIVES** 7
4. **METHODOLOGY**..... 8
5. **RESULTS** 9
6. **DISCUSSION**..... 12
7. **CONCLUSION**..... 13
8. **Bibliography**..... 14

Appendix A Details of Survey Strategy

Appendix B Geophysical Prospection Methods

LIST OF FIGURES

Figure 1: Site location within South Derbyshire.
Figure 2: Greyscale plot of geomagnetic survey results.
Figure 3: Vectorised plan of geomagnetic survey results.
Figure 4: Archaeological interpretation plan of geomagnetic survey results.
Figure 5: Unprocessed greyscale plot of geomagnetic survey results.
Figure 6: Location of the proposed photovoltaic array in relation to possible archaeological features.

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The Project Manager for the work undertaken was Paul Johnson. The Project advisor was Lee Elliott. The Project Team comprised Tom Hooley, and Povilas Cepauskas. Curatorial monitoring was undertaken by Steve Baker (Derby and Derbyshire Development Control Archaeologist).

1. INTRODUCTION

1.1. Trent & Peak Archaeology as part of York Archaeological Trust was commissioned by John Bowler Farms to conduct a geophysical survey at the site of a proposed photo-voltaic array at Harrys Farm on the outskirts of Stenson, Derbyshire, centered on NGR SK 32488 29457 (Fig 1).

1.2. The fieldwork was conducted in May and June of 2014 on an approximately 2 hectare area of land at Harrys Farm, Twyford, Stenson, Derbyshire.

1.3. The site is situated on deposits of Gunthorpe Member; Sedimentary Bedrock formed c.229–246 million years ago (Triassic Period). The bedrock is overlain by superficial deposits of Holme Pierrepont Sand and Gravel Member. Superficial Deposits formed up to 3 million years ago in the Quuaternary Period. (British Geological Survey).

1.4. Topographically the site is level with no significant topographical variation across the area of the survey, which lies at a height of c. 40m OD.

1.5. A pre-existing geo-magnetic survey (Morris and Lewis 2008), and archaeological watching brief (Binns 2012) revealed that no significant archaeological features were present along the southern boundary of the field investigated. This area was not available for re-survey as part of the investigation reported here.

1.6. A Written Scheme of Investigation was prepared for conducting the geophysical survey in line with the National Planning Policy Framework.

2. PROJECT BACKGROUND

2.1. Potential Remains

2.1.1. The archaeological watching brief revealed very little material culture or features of archaeological significance within the field. The site is however, in close proximity to a known complex of cropmarks (HER 27406) in the field to the west.

- ***Mediaeval***
  One sherd of highly abraded pottery (dating to the 13th/14th century) was recovered from the topsoil/subsoil interface during the archaeological watching brief.

- ***Post-Mediaeval and modern***
  A small collection of modern pottery was recovered from within the topsoil during the archaeological watching brief.

2.2. Proposed Development

2.2.1. The proposed development on the site consists of the installation of 648 ground-mounted photovoltaic panels over a total area of c. 915m^2. In addition to the three arrays of PV panels associated cabling will be run to a substation located to the southwest of the field in question. (see: South Derbyshire Planning Application 9/2014/0350)

2.3. Proposed Fieldwork

2.3.1. In order to evaluate the archaeological potential of the land at Harrys Farm, the following fieldwork investigation was proposed:

- Geophysics – Magnetic-gradiometer survey across an area totalling c. 2 ha. This area was constrained to the south by an area of already disturbed ground which had previously been the subject of a prior geophysical survey (Morris & Lewis 2008) and an archaeological watching brief (Binns 2012). As such, this area was omitted from the present survey.

3. OBJECTIVES

3.1. The aim of the present work is to enhance the understanding of existing archaeological evidence by determining whether the fields to be surveyed contain any as-yet unknown evidence of past human activity.

3.2. The survey results will be used to inform future archaeological mitigation strategy for the site.

4. METHODOLOGY

4.1. Geophysical Survey: Geomagnetic

4.1.1. The decision to use magnetic gradiometry to survey the site was based on its efficiency as a survey technique suitable for detecting the buried remains of a range of materials based on differences in their magnetic characteristics as compared to the geological background of the area (Gaffney et al. 1991, 6; 2003).

4.1.2. The results of this method are, however, severely restricted in areas of modern disturbance and by the presence of ferrous material (Scollar et al. 1990, 362ff). Because of the presence of metal fencing within the field boundaries, these features were given a wide-berth with an average distance of 3m being allowed to limit their effect on the archaeological data. Although a number of alternative geophysical survey techniques could be applied to the site (Appendix B), magnetometry represented the best compromise between speed and quality of data retrieval for an initial investigation.

4.1.3. The magnetometer survey was undertaken, within the guidelines advocated by English Heritage (David et al. 2008), by a two-person team using a Bartington Instruments Grad 601-2 fluxgate gradiometer. This equipment allowed the survey to be conducted rapidly as the area was relatively free of obstructions. Readings were taken at 0.25m intervals along traverses of 1m spacing walking south. This enabled a sufficiently high density of data for the purposes of archaeological assessment to be collected across the site in the relatively short time allotted for the survey to be completed.

4.1.4. The geophysical survey grids of 30m by 30m were set out using a Leica GS15 GPS with SmartNet, in the Ordnance Survey National Grid coordinate system. The use of a north-south orientation for the survey grids was employed in the expectation that any surviving remains would be intersected by the survey traverses at an angle of approximately 30º.

4.1.5. The geophysical survey data were processed in Geoplot 3.0 software to remove any environmental disturbances or variations produced in the course of the survey. Firstly data were manipulated to remove any distorting ‘spikes’ from the survey results. A high-pass filter was then also used to reduce the effect of geological anomalies in the data-set. Low-pass filtering was then used to improve the resolution of larger archaeologically derived anomalies. Finally the data were interpolated to produce uniform data-densities equivalent to 0.25m x 0.25m.

4.1.6. The results were exported as greyscale, raster images and inserted into the AutoCAD plan of the site, generated from Ordnance Survey data, for georeferencing and production of a descriptive, vector overlay. The anomalies presented here were identified visually and manually digitised to produce the vectorised plans which are discussed in the results section of this report. The final print-versions of these plans were elaborated and prepared for printing in Adobe Illustrator CS4.

Ground Conditions

4.1.7. Ground conditions for the survey were generally good, the presence of large quantities of crushed brick material on the surface of the southeastern part of the site was noted. This corresponds to the area previously subjected to an archaeological watching brief as noted above.

5. RESULTS
(Figures 2-7)

5.1. Geomagnetic Survey
5.1.1. Within the area surveyed, the site exhibited a generally good response to the geomagnetic survey and whilst buried features can be discerned against the geological background there is a high degree of noise in the dataset. As the overall background magnetic response is expected to be low, a result of the nature of the superficial geology, any cut features are likely to show as areas of positive magnetism. In contrast, structural remains are likely to present either positive or negative signals, depending upon the particular materials used and their contrast against the relatively non-magnetic background.

5.1.2. The geomagnetic survey suffered a high degree of disturbance from the presence of modern ferrous/metallic features and the presence of highly magnetic material on or near the surface of the fields. The most notable of these areas of disturbance are discussed in the following text. The overall effect of these strongly magnetic disturbances is to suppress the response of any archaeological features within the dataset.

5.1.3. The results are presented below as a greyscale image of the processed data (Figure 2), and complementary numbered interpretative plan to which the following description relates (Figure 3). This description is organised from west to east, and is restricted to discussion of features which have a likely impact on the archaeological understanding of the area.

5.1.4. The southwestern extent of the survey area exhibited a number of clear responses to the geomagnetic survey. A group of 4 positive maculae [1], describing a linear alignment of c. 14.5m in length runs northwest–southeast from the southern edge of the area surveyed. Approximately 3m from the northern end of this alignment is a group of 3 positive anomalies [2] which appear to show a return of the alignment described by [1] to the northeast. Approximately 10m to the northeast of this feature are a pair of positively magnetic maculae [3] which appear to continue the alignment of this return. To the southeast of [3] are two linear, positive anomalies [4] which describe a 14m long parallel alignment to that of [1], 22m to the northeast of it. Adjacent to the southeastern terminus of these anomalies is an irregular, positive anomaly [5], which despite its proximity does not appear to definitively relate to the previously discussed anomalies.

5.1.5. Approximately 20m to the north of [3] is a 12.5m-long linear, positive anomaly [6] which intersects the eastern edge of the survey area. The alignment of this feature may be continued by a pair of positive maculae [7], located approximately 20m to the west of it.

5.1.6. The largest single anomaly discerned in the results of the survey is a weak positive linear anomaly [8] which runs for approximately 74m in a broadly northeast–southwest direction across the area surveyed. Approximately 38m to the north of the western end of this long, linear anomaly is a small, c. 5m-long, positive, linear anomaly [9] which runs in a north–south direction. Approximately 28m to the east of this feature is a cluster of mostly positive maculae [10] which although grouped in close proximity to each other, do not appear to describe any recognisable form. To the north of this cluster and approximately 7.5m from the northern edge of the survey is a 14m-long linear alignment of positively magnetic maculae [11]. A further cluster of positive maculae [12], is located to the north of the central portion of [8]. Approximately 13m to the north of the eastern end of [8] are a group of irregular positive anomalies and maculae [13] which appear to describe an alignment running northwest–southeast for approximately 28m. Further to the southeast of these anomalies another group of positive maculae [14], may present a continuation of this alignment to the southern edge of the area surveyed.

5.1.7. Approximately 30m to the east of [14], is a 31m-long linear alignment of 8 positive maculae [15], running broadly north–south. This alignment appears to turn through 90°, running 15m to the east as demonstrated by the presence of a series of 3 further maculae [16]. Approximately 30m to the east of [15] is an irregular, linear anomaly [17] which runs for 13.5m in a broadly north–south direction, parallel to [15]. Approximately 3.5m to the north of this feature is a similar, c. 6m-long linear, positive anomaly [16], running on the same

alignment. Approximately 8m further to the north is a group of 4 positive anomalies [19], which may represent the return of the alignment described by [17] & [18] to match that of [16].

5.1.8. The eastern extent of the area surveyed displays a much lower density of recognisable anomalies. A dispersed cluster of positive anomalies [20] are located approximately 45m from the eastern edge of the survey area. Immediately adjacent to the eastern edge of the survey is a large, irregular positive anomaly [21] which appears to correlate with the location of the current access route along the southern edge of the field.

6. DISCUSSION

6.1. Geomagnetic Survey

6.1.1. In general the geomagnetic survey was considered to be successful in recovering evidence of sub-surface archaeological features. The overall response of the area to the survey was affected by the presence of a great deal of noise in the data, presumably a result of the presence of magnetic material on, or near, the ground surface.

6.1.2. The group of features [1] – [4] appear suggestive of an enclosure measuring approximately 35m by 23m. The positive magnetism and morphological characteristics of these features would argue for their representing stratigraphically negative features such as ditches.

6.1.3. The features [15] – [19] are strongly suggestive of a second, larger, enclosure measuring c. 39m by 30m. Again, the positive magnetic signature and morphology of these features argue for their representing stratigraphically negative features such as ditches.

6.1.4. The large feature [8], may represent an anthropogenic landscape feature. However, the weakness of the response would suggest that there is a lesser quantity of material present in the sub-surface or that the feature is more deeply buried than those previously identified as enclosures.

7. CONCLUSION

7.1. Geophysical survey demonstrated the presence of potential buried archaeological features.

These comprised:

- A possible 35m by 23m enclosure in the southwest of the area surveyed.
- A possible 39m by 30m enclosure in the northeast of the area surveyed.
- A possible 74m-long linear feature which may be a result of ancient agricultural practices.

7.2. The distribution of geophysical anomalies across the area surveyed should probably be seen as representing the continuation of features seen through aerial-photographic evidence in the fields to the west of the site. These anomalies are however apparently concentrated in the areas where enclosures have been identified and a sensitive approach to the location of the photovoltaic array and its cabling should be able to minimise the impact of development on the likely archaeological resource.

8. BIBLIOGRAPHY

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Morris, A. & Lewis, B. 2008. Geophysical survey on land near Stenson, Derbyshire.

Scollar et al. 1990. *Archaeological Prospecting and Remote Sensing*. Cambridge: Cambridge University Press

Cartographic references

BGS British Geological Survey: England and Wales (online) Solid and Drift Geology: 1: 50,000

OS Ordnance Survey 1: 50,000 Landranger Map

Ordnance Survey Maps: All editions 1859-1992

Appendix A: Details of Survey Strategy
Date of Survey: 30th May–3rd June 2014
Site: HTS – Harrys Farm, Twyford, Stenson (Derbyshire)
Region: Twyford, (South Derbyshire)
Grid Reference: NGR SK 32488 29457
Surveyor: Trent and Peak Archaeology
Personnel: Tom Hooley, Povilas Cepauskas
Geology: Gunthorpe Member
Survey Type 1: Magnetic Gradiometry
Approximate area: 2 hectares
Grid size: 30m
Traverse Interval: 1m
Reading Interval: 0.25m
Instrument: Bartington Instruments Grad 601-2
Resolution: 0.1nT
Traverse mode: Zig-zag

Appendix B: Geophysical Prospection Methods

Magnetic Survey

Magnetic prospection of soils is based on the measurement of differences in magnitudes of the earth's magnetic field at points over a specific area. The iron content of a soil provides the principal basis for its magnetic properties. Presence of magnetite, maghaematite and haematite iron oxides all affect the magnetic properties of soils.

Although variations in the earth's magnetic field which are associated with archaeological features are weak, especially considering the overall strength of the magnetic field of around 48,000 nano-Tesla (nT), they can be detected using specific instruments (Gaffney et al. 1991).

Three basic types of magnetometer are available to the archaeologist; proton magnetometers, fluxgate gradiometers, and alkali vapour magnetometers (also known as caesium magnetometers, or optically pumped magnetometers).

Fluxgate Gradiometer

Fluxgate instruments are based around a highly permeable nickel iron alloy core (Scollar et al. 1990, 456), which is magnetised by the earth's magnetic field, together with an alternating field applied via a primary winding. Due to the fluxgate's directional method of functioning, a single fluxgate cannot be utilised on its own, as it cannot be held at a constant angle to the earth's magnetic field. Gradiometers therefore have two fluxgates positioned vertically to one another on a rigid staff. This reduces the effects of instrument orientation on readings.

Fluxgate gradiometers are sensitive to 0.5nT or below depending on the instrument. However, they can rarely detect features which are located deeper than 1m below the surface of the ground.

Archaeological features such as brick walls, hearths, kilns and disturbed building material will be represented in the results, as well as more ephemeral changes in soil, allowing location of foundation trenches, pits and ditches. The results are however extremely dependent on the geology of the particular area, and whether the archaeological remains are derived from the same materials.

FIGURES