STRATASCAN

Geophysical Survey Report

Back Field, Norton Priory
Cheshire



For
Donald Insall Associates Ltd

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REGISTERED IFA ORGANISATION

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Client:	**Donald Insall Associates Ltd**
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Techniques:	**Detailed magnetic survey (gradiometry)** **Detailed resistance survey**
National Grid Ref:	**SJ 549 830**

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1 SUMMARY OF RESULTS

A detailed magnetic survey and a resistance survey were carried out on land adjacent to Norton Priory, Cheshire. Both surveys identified features of archaeological origin. The magnetometer survey highlighted a number of cut features of possible archaeological origin, potentially relating to pits or ditches. A large linear structural remain is observed in the resistance data running east west across the survey area, whilst a number of smaller anomalies can been seen in both the northwest and the southwest of the area, indicating further structural remains.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned by Donald Insall Associates Ltd to undertake a geophysical survey to assist with the preparation of a Conservation Plan for Norton Priory.

2.2 Site location

The site is located at Norton Priory, Cheshire at OS ref. SJ 549 830.

2.3 Description of site

The survey area is approximately 3.4 hectares of flat pasture. The area is located on the eastern side of the Priory and is known as Back Field. The underlying geology is Permian and Triassic sandstones (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are of the Clifton soil association which are typical stagnogley soils. These consist of slowly permeable seasonally waterlogged reddish fine and coarse loamy soils with some deep coarse loamy soils (Soil Survey of England and Wales, Sheet 3 Midland and Western England).

2.4 Site history and archaeological potential

The site is located adjacent to the Augustinian Abbey Norton Priory which is Scheduled Ancient Monument number 27608. Back Field is encompassed by the scheduled area although its archaeology is unknown.

2.5 Survey objectives

The objective of the survey was to locate any anomalies that may be of archaeological origin to inform the production of a Conservation Plan by Donald Insall Associates Ltd.

2.6 Survey methods

Detailed magnetometry and resistivity surveys were carried out across the site in order to assess the area with complementary techniques. More information regarding these techniques is included in the Methodology section below.

3 METHODOLOGY

3.1 Date of fieldwork

The fieldwork was carried out over 5 days from 10th October 2006 when the weather was fine.

3.2 Grid locations

The location of the survey grids has been plotted in Figure 2 together with the referencing information.

3.3 Description of techniques and equipment configurations

3.3.1 Magnetometer

Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTesla (nT) in an overall field strength of 48,000nT, can be accurately detected using an appropriate instrument.

The mapping of the anomaly in a systematic manner will allow an estimate of the type of material present beneath the surface. Strong magnetic anomalies will be generated by buried iron-based objects or by kilns or hearths. More subtle anomalies such as pits and ditches can be seen if they contain more humic material which is normally rich in magnetic iron oxides when compared with the subsoil.

To illustrate this point, the cutting and subsequent silting or backfilling of a ditch may result in a larger volume of weakly magnetic material being accumulated in the trench compared to the undisturbed subsoil. A weak magnetic anomaly should therefore appear in plan along the line of the ditch.

3.3.2 Resistance Meter

This method relies on the relative inability of soils (and objects within the soil) to conduct an electrical current, which is passed through them. As resistivity is linked to moisture content, and therefore porosity, hard dense features such as rock will give a relatively high resistivity response, while features such as a ditch which retains moisture give a relatively low response.

The resistance meter used was an RM15 incorporating an MPX15 multiplexer manufactured by Geoscan Research using a mobile Twin Probe Array. The Twin Probes are separated by 0.5m and the associated remote probes were positioned approximately 15m outside the grid. The instrument uses an automatic data logger, which permits the data to be recorded as the survey progresses for later downloading to a computer for processing and presentation.

Though the values being logged are actually resistances in ohms they are directly proportional to resistivity (ohm-metres) as the same probe configuration was used through-out.

3.4 Sampling interval, depth of scan, resolution and data capture

3.4.1 Sampling interval

Magnetometer
Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid.

Resistivity
Readings were taken at 1.0m centres along traverses 1.0m apart. This equates to 900 sampling points in a full 30m x 30m grid. All traverses were surveyed in a "zigzag" mode.

3.4.2 Depth of scan and resolution

Magnetometer
The Grad 601 has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects have been buried in the site. The collection of data at 0.5m centres provides an appropriate methodology balancing cost and time with resolution.

Resistivity
The 0.5m probe spacing of a twin probe array has a typical depth of penetration of 0.5m to 1.0m The collection of data at 1m centres with a 0.5m probe spacing provides an appropriate methodology balancing cost and time with resolution.

3.4.3 Data capture

Magnetometer
The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each job, data is transferred to the office for processing and presentation.

Resistivity
The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each job, data is transferred to the office for processing and presentation.

3.5 Processing, presentation of results and interpretation

3.5.1 Processing

Magnetometer
Processing is performed using specialist software known as *Geoplot 3.* This can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves 'flattening' the background levels with respect to adjacent traverses and adjacent grids. 'Despiking' is also performed to remove the anomalies resulting from small iron objects often found

on agricultural land. Once the basic processing has flattened the background it is then possible to carry out further processing which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following schedule shows the basic processing carried out on all processed magnetometer data used in this report:

Zero mean traverse	*Last mean square fit = off*
Despike	*X radius = 1 Y radius = 1*
	Threshold = 3 std. dev.
	Spike replacement = mean

Resistivity
The processing was carried out using specialist software known as *Geoplot 3* and involved the 'despiking' of high contact resistance readings and the passing of the data though a high pass filter. This has the effect of removing the larger variations in the data often associated with geological features. The nett effect is aimed at enhancing the archaeological or man-made anomalies contained in the data.

The following schedule shows the processing carried out on the processed resistance plots.

Despike	*X radius = 1*
	Y radius = 1
	Spike replacement

3.5.2 Presentation of results and interpretation

Magnetometer
The presentation of the data for the survey involves a print-out of the raw data both as grey scale (Figure 3) and trace plots (Figure 4 and 5), together with a grey scale plot of the processed data (Figure 6). Magnetic anomalies have been identified and plotted onto the 'Abstraction and Interpretation of Anomalies' drawing for the site (Figure 7).

Resistivity
The presentation of the data for the site involves a print-out of the raw data as a grey scale plot (Figure 8), together with a grey scale plot of the processed data (Figure 9). Anomalies have been identified and plotted onto the ‘Abstraction and Interpretation of Anomalies’ drawing (Figure 10).

4 RESULTS

4.1 Magnetometer

The magnetometer survey identified a number of geophysical anomalies across the site, some of which may relate to archaeological activity. These anomalies have been divided into the following categories:

- Linear anomaly – possible agricultural mark
- Positive linear anomaly – cut feature of possible archaeological origin
- Negative linear anomaly – possible bank feature of archaeological origin
- Positive linear anomaly with associated negative response – uncertain origin
- Area of positive response – possible cut feature / pit of archaeological origin
- Discrete positive response – possible pit
- Weak discrete positive response with associated negative response – unknown origin
- Magnetic debris – evidence of ground disturbance
- Magnetic disturbance – possibly caused by modern magnetic interference
- Area of positive response with associated negative anomaly – uncertain origin

Linear anomalies – possible agricultural marks
Two areas of parallel linear anomalies have been identified in the northwest and the southeast of the survey area. This pattern of linear anomalies is typically caused by ploughing action.

Positive linear anomalies – cut features of possible archaeological origin
Several positive linear anomalies have been identified, three in the northeast, three just north of the centre, one towards the southwest and one towards the southeast of the survey area. These may represent infilled cut features, possibly ditches, of archaeological origin.

Negative linear anomaly – possible bank feature of archaeological origin
One negative linear anomaly has been identified in the north of the site. This may be representative of a bank feature of possible archaeological origin.

Area of positive response – possible cut feature / pit of archaeological origin
Numerous small areas of positive response are isolated in the southwest of the area. These indicate the presence of infilled cut features, which may be of archaeological origin.

Discrete positive response – possible pit
Areas of discrete positive response have been identified throughout the survey area. These anomalies may indicate cut features, perhaps pits, of possible archaeological origin.

Weak discrete positive response with associated negative response – unknown origin
Numerous weak discrete positive responses with associated negative responses are observed across the central section of the survey area. These are of unknown origin but may be representative of weakly magnetic material.

Magnetic debris - evidence of ground disturbance
Large areas of magnetic debris are evident across the site. These anomalies indicate areas of ground disturbance of uncertain origin, although they may be caused by something as simple as dug or mixed earth. An archaeological origin for these responses cannot be ruled out.

Magnetic disturbance – probably caused by modern magnetic interference

A large area of strong magnetic disturbance is observed running along the north western perimeter of the survey area, with another along the south western edge. These anomalies are most probably associated with modern field boundaries. The smaller isolated areas of magnetic disturbance where positive anomalies with associated negative returns can be seen are typical of near surface ferrous objects.

4.2 Resistance Survey

The resistance survey identified features comparable to those observed within the magnetometer survey, with additional features that may be of archaeological origin. The anomalies have been divided into the following categories:

- High resistance linear anomaly – possible structural remains of archaeological origin
- Low resistance linear anomaly – cut feature of possible archaeological origin
- Linear anomaly – probably agricultural in origin
- High resistance area anomaly – possible structural remains of archaeological origin
- Moderate resistance anomaly – possible compacted or dry earth
- Low resistance area anomaly – possible cut feature or area of wet ground

Low resistance linear anomaly – cut feature of possible archaeological origin

Two low resistance area anomalies are identified towards the south east of the survey area. These are representative of cut features of possible archaeological origin, possibly relating to ditches or previous field boundaries. The longer of the two anomalies corresponds with a positive magnetic anomaly adding further evidence that this anomaly relates to a ditch or cut feature.

High resistance linear anomalies – possible structural remains of archaeological origin

A high resistance linear anomaly can be seen running east to west across the survey area. This correlates in position with a positive anomaly with an associated negative response observed in the magnetic survey data. It is possible that this anomaly may be caused by structural remains of archaeological origin possibly relating to a former field

boundary or wall. Further linear anomalies of high resistance are seen in the north and in the south west of the survey area. While it seems likely that these are anthropogenic in origin they do not take on recognisable patterns, although there does seem to be a north west to south east trend in the anomalies. They are probably associated with some form of structural features although further investigation would be required to clarify their precise cause.

Linear anomaly – probably agricultural in origin

A number of linear anomalies can be seen throughout the site, these are in the same orientation as those observed within the magnetometer data, and are indicative of ploughing action.

High resistance area anomaly – possible structural remains of archaeological activity

High resistance area anomalies exist mainly in the north and in the south of the survey area. Again these anomalies are likely to relate to structural remains and are therefore likely to be anthropogenic in origin but further investigation would be required to clarify their precise cause.

Moderate resistance anomaly – possible compacted ground or dry earth
Three areas of moderate resistance have been identified in the north of the survey area. These area anomalies may represent structural debris or areas of compacted ground or dry earth.

5 CONCLUSION

Both the magnetometer and resistance surveys have identified features of possible archaeological origin. The magnetometer survey has identified distinct positive anomalies throughout the site. These cut features suggest the presence of archaeological features across the site possibly relating to pits or ditches. The areas of low resistance highlighted in the resistance data suggest possible cut features, some of which correspond to those shown in the magnetometer data.

Additionally, the resistance data shows areas of high resistance throughout the site. These anomalies may represent structural remains, possibly stonework, although few corresponding anomalies are seen within the magnetometer data perhaps suggesting the use of a non magnetic building stone.

The gradiometer survey highlighted areas of magnetic disturbance which are probably related to ferrous objects of modern origin, although it is possible some of these may be caused by metal objects associated with previous occupation. The series of parallel linear anomalies located across the northwest and east of the survey area probably represent agricultural ploughing marks and could derive from archaeological activity.

6 REFERENCES

British Geological Survey, 2001. *Geological Survey Ten Mile Map, South Sheet, Fourth Edition (Solid)*. British Geological Society.

Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 3 Midland and Western England*.