GEOPHYSICAL SURVEY REPORT

STRATASCAN™

SUMO Survey Services
SUMO Group Member

Project name:
Gedling, Nottinghamshire

Client:
WYG

Job ref:
J9987

June 2016

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Project name: **Gedling, Nottinghamshire** Client: **WYG**	Job ref: **J9987**
Survey date: **31st May - 2nd June 2016**	Report date: **June 2016**
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1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 17 hectares of arable farmland and rough pasture. No features of probable or possible archaeological origin, have been identified. A small area of ridge and furrow, combined with evidence of more modern ploughing and former field boundaries indicates that the site has a largely agricultural past. Areas of made ground and a strongly magnetic linear anomaly are likely to be related to the former Gedling Colliery, with the areas of made ground related to landfilling activity. The remaining features are modern and include services, magnetic disturbance from nearby ferrous objects, such as fencing, and magnetic spikes which are likely to be modern rubbish.

2 INTRODUCTION

2.1 Background synopsis

Stratascan were commissioned to undertake a geophysical survey of an area outlined for residential development. This survey forms part of an archaeological investigation being undertaken by WYG.

2.2 Site Details

NGR / Postcode	SK 608 437 / NG4 4GY
Location	The site is located to the north of Gedling, Nottinghamshire. Arnold Lane forms the south-western boundary of the site, Gedling Country Park lies to the north and north-east and Lambley Lane Recreation Ground lies to the south-east.
HER/SMR	Nottinghamshire
District	Gedling
Parish	Gedling
Topography	Undulating
Current Land Use	Arable and rough pasture
Weather Conditions	Overcast
Soils	The overlying soils are unsurveyed – mainly urban and industrial areas (Soil Survey of England and Wales, Sheet 3 Midland and Western England).
Geology	The underlying geology across the majority of the site comprises siltstone of Tarporley Siltstone Formation. An area of Radcliffe Member – mudstone and siltstone is recorded in the south-west of the site. No drift geology is recorded (British Geological Survey website).

Archaeology	Extract from "Keepmoat, Land at Chase Farm – Written Scheme of Investigation for Geophysical Survey" (WYG, 2016): *The prehistoric period is poorly represented within the study area and there are no records of prehistoric date. However, within the wider area a possible Iron Age promontory fort has been identified to the east of the site. Also within the wider area there are a large number of heritage assets of unknown date, including enclosures and ditches, which may be of prehistoric date.* *The Roman period also includes few recorded heritage assets within the study area. It appears that the majority of Roman activity was concentrated to the east and south east of the study area, running along the Trent Valley. Roman activity has also been recorded at the possible Iron Age fort identified to the east of the site.* *Both Gedling and neighbouring Stoke Bardolph, to the south east, were mentioned in the Domesday Book indicating that they were established settlements during the early medieval period. These two villages were listed together and a large number of smallholders and ploughs are mentioned associated with them. A church, fishery and two mills were also recorded in the Domesday Book, indicating that the surrounding agricultural land was producing enough material to licence the construction of the two mills. Although there is documentary evidence relating to the medieval activity in Gedling, there are limited assets of medieval date recorded within the study area. The exception is a small area of ridge and furrow (10382).* *Gedling Colliery (1923) as constructed during the late Industrial and early modern period but is now disused. No significant features associated with it remain although a large spoil heap has been restored as Gedling Country Park. The colliery included an associated tramway (1924) which is now dismantled although the alignment of it is still visible.* *There are significant areas of truncation across the proposed site which primarily relate to the activities associated with Gedling Colliery. An area in the south east of the site was used for colliery soil tipping and lagoons, which will also have removed any archaeological deposits. In addition to this, parts of the site, including the line of former tramway (1924) have been subject to landfill activities. Depths of made ground across the area of truncation vary from 1.5m to 7m.*
Survey Methods	Detailed magnetic survey (gradiometry)
Study Area	c.20 hectares – an area of 1.4 hectares could not be surveyed in the south-east of the site (Field 9) due to horses, and c. 1.6 hectares could not be surveyed in the north due to overgrown vegetation. The total area surveyed was reduced to c.17 hectares.

2.3 Aims and objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (2008) and the Chartered Institute for Archaeologists (2002 & 2014).

Stratascan Ltd are a Registered Organisation with the CIfA and are committed to upholding its policies and standards.

3.2 Survey methods

Detailed magnetic survey was used as an efficient and effective method of locating archaeological anomalies.

More information regarding this technique is included in Appendix A.

3.3 Processing

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

1. *Destripe*
2. *Destagger*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a plot of the minimally processed data as a greyscale plot and a colour plot showing extreme magnetic values. Magnetic anomalies have been identified and plotted onto the 'Interpretation of Anomalies' drawing.

When interpreting the results several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to very specific known features documented in other sources, this is done (for example: Abbey Wall, Roman Road). For the generic categories levels of confidence are indicated, for example: probable, or possible archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification "possible".

4 RESULTS

The detailed magnetic gradiometer survey conducted at Gedling has not identified any anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin. The following refers to numerical labels on the interpretation plots.

4.1 ***Probable Archaeology***

No probable archaeology has been identified within the survey area.

4.2 ***Possible Archaeology***

No possible archaeology has been identified within the survey area.

4.3 ***Medieval/Post-Medieval Agriculture***

Weak positive linear anomalies **[1-2]** in the centre of the area. These are related to former field boundaries, visible on available historic OS mapping. Anomaly 1 is visible from 1884 to 1920, and Anomaly 2 is visible from 1884 to 1938. Further positive linear anomalies **[3]** in the centre and west of the site are likely to be related to former field boundaries but are not visible on historic mapping. A small area of ridge and furrow cultivation **[4]** is visible in the east of the site in the form of widely spaced, slightly curved, parallel linear anomalies. Evidence of modern ploughing **[5]** is visible across the site in the form of magnetically weak, closely spaced, parallel linear anomalies.

4.4 ***Other Anomalies***

A high magnitude linear anomaly **[6]** in the north-east of the area is likely to be related to the former colliery in this area, perhaps related to a pipe or cable, with areas of strong magnetic debris **[8]** related to likely landfilling activity. Two bipolar linear anomalies **[7-7a]** in the south of the area are likely to relate to modern services. Anomaly 7 is aligned with overhead power cables, though the response is consistent with that of an underground service, such as a pipe. Areas of magnetic disturbance **[9]** are the result of substantial nearby ferrous objects, such as fencing. The effects of these features has the potential to mask weaker archaeological anomalies, but have not affected a significant proportion of the area on this site. Smaller magnetic anomalies, or 'magnetic spikes' **[10]** indicate ferrous metal objects and are likely to be modern rubbish.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Siltstone geologies, such as those present across the site, can provide variable results for gradiometer survey. The data from the site has revealed large areas of agricultural cultivation, along with former field boundaries, suggesting that the underlying geology is conducive to gradiometer survey. The areas of made ground, likely related to landfilling activity from the colliery, have the potential to mask weaker archaeological anomalies should any have survived the industrial activity.

6 CONCLUSION

The survey at Gedling has not identified any features of probable or possible archaeological origin, supporting information from the written scheme of investigation (WSI) of the site having a generally low potential for archaeological remains of all periods. A small area of ridge and furrow has been detected, further supporting information from the WSI. The evidence of ridge and furrow, combined with evidence of more modern ploughing and former field boundaries indicates that the site has a largely agricultural past. Areas of made ground and a strongly magnetic linear anomaly are likely to be related to the former Gedling Colliery, with the areas of made ground related to landfilling activity. The remaining features are modern and include services, magnetic disturbance from nearby ferrous objects, such as fencing, and magnetic spikes which are likely to be modern rubbish.

7 REFERENCES

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Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad*601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m.

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 site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (Destagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology/Probable Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal- working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains will often lead and empty into larger diameter pipes and which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
Service	Magnetically strong anomalies usually forming linear features indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) cause weaker magnetic responses and can be identified from their uniform linearity crossing large expanses.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* and *Possible Natural* or (in the case of linear responses) *Possible Archaeology* and *Possible Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.2 nanoTeslas (nT) in an overall field strength of 48,000nT, can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns and material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried field. The difference between the two sensors will relate to the strength of a magnetic field created by a buried feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity, disturbance from modern services etc.

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