

GEOPHYSICAL SURVEY REPORT

# STRATASCAN™



Project name:  
**North Bexhill Access Road, East Sussex**

Client:  
**Chris Butler Archaeological Services**

**March 2016**

Job ref:  
**J8771**

Report author:  
**Thomas Richardson MSc ACIfA**

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Project name:

**North Bexhill Access Road, East Sussex**

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**J8771**

Techniques:

**Detailed magnetic survey –  
Gradiometry**

Survey date:

**27th-30th July, 10th-11th August  
2015, 19th-20th January &  
2nd-4th March 2016**

Site centred at:

**TQ 727 101**

Post code:

**TN39 5JE**

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## 1 SUMMARY OF RESULTS

A detailed gradiometry survey was conducted over approximately 23.2 hectares of grassland along a 2.2km planned road route. The survey has identified a ring ditch with associated pits, and a possibly associated ditch feature. However the ring ditch itself lies outside of the buffer zone for the planned road. Prehistoric or Roman enclosures have also been detected. A number of possible archaeological anomalies have also been identified, however these could equally relate to modern agricultural activity or be natural in origin. The detection of former field boundaries and agricultural activity suggests that the area has a recent agricultural past. The remaining anomalies are natural or modern in origin, relating to land drains, ferrous objects, and fencing.

## 2 INTRODUCTION

### 2.1 *Background synopsis*

Stratascan were commissioned to undertake a geophysical survey of an area outlined for the route of a new road. This survey forms part of an archaeological investigation being undertaken by Chris Butler Archaeological Services.

### 2.2 *Site location*

The site is located to the south of Freezeland Lane, Bexhill-on-Sea, East Sussex at OS ref. TQ 727 101.

### 2.3 *Description of site*

The survey area is approximately 23.2 hectares of grassland along a 2.2km proposed road route. The majority of the survey area lies on the northern slope of a valley, with the eastern end of the route lying on the southern slope. A small copse of trees at the eastern end of the route is the only obstruction on the site.

### 2.4 *Geology and soils*

The underlying geology for the majority of the site is Tunbridge Wells Sand Formation – Siltstone, Mudstone and Sandstone, with an area of Wadhurst Clay Formation – Mudstone in the centre of the site. (British Geological Survey website). There is no recorded drift geology (British Geological Survey website).

The overlying soils at each end of the survey area are known as Curtisden, which are typical stagnogleyic argillic brown earths. These consist of silty soils over siltstone. The centre of the site is covered by soils known as Wickham 5, which are typical stagnogley soils. These consist of fine loamy over clayey, fine silty over clayey, and clayey soils (Soil Survey of England and Wales, Sheet 6 South East England).

## 2.5 **Site history and archaeological potential**

Extract from 'A Desk-Based Assessment for North Bexhill Access Road, East Sussex' (Chris Butler Archaeological Services 2015):

*A desk-based assessment can generally only consider the potential of a site in principle. Its conclusions usually require testing by fieldwork in order to confirm whether remains are actually present and, if this is the case, to establish their character, condition and extent and thus indicate the weight that ought to be attached to their preservation. It must always be acknowledged that remains of a type for which there is no prior evidence may be found on a site by fieldwork.*

*The proposed development Site itself has not undergone any major recent development activity that would highlight the presence (or absence) of unrecorded archaeology, as such, the presence of unrecorded below ground features cannot be discounted.*

*The proposed development site has remained principally as open land since the mid-19<sup>th</sup> century as arable and/or pasture land.*

*A review of the evaluation work done by Oxford Archaeology (2007 & 2012) indicates the presence of human activity in this area illustrated as such by nearby temporary hunting camps, flint working and Iron Age and Roman period iron working.*

*Based on the designation of sites as outlined in the methodology (Appendix 2), the cultural value of these potential features is generally likely to be 'Undesignated/Local to Regional', if present. However, it must be noted that the cultural value of each archaeological component can only be predicted at this stage and it is always a possibility that finds or features of higher (National) significance may be located within the proposed development site boundary.*

*The potential for discovery of new sites has been revealed by a review of known archaeological sites in the immediate vicinity. The estimated potential for sites and/or findspots being located within the appraisal area can be summarised thus:*

*Prehistoric – **Unknown / Low - High**  
Romano-British – **Medium - High**  
Anglo-Saxon – **Low**  
Medieval – **Low - Medium**  
Post-medieval – **Low***

## 2.6 **Survey objectives**

The objective of the survey was to locate any features of possible archaeological origin in order that they may be assessed prior to development.

## 2.7 **Survey methods**

This report and all fieldwork have been conducted in accordance with both the English Heritage guidelines outlined in the document: *Geophysical Survey in Archaeological Field Evaluation, 2008* and with the Chartered Institute for Archaeologists document *Standard and Guidance for Archaeological Geophysical Survey*.

Given the potential for prehistoric and Romano-British activity, detailed magnetic survey (gradiometry) was used as an efficient and effective method of locating archaeological anomalies. More information regarding this technique is included in Appendix A.

## 2.8 **Processing, presentation and interpretation of results**

### 2.8.1 *Processing*

Processing is performed using specialist software. 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. 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 minimally processed gradiometer data used in this report:

1. *Destripe* (Removes striping effects caused by zero-point discrepancies between different sensors and walking directions)
2. *Destagger* (Removes zigzag effects caused by inconsistent walking speeds on sloping, uneven or overgrown terrain)

### 2.8.2 *Presentation of results and interpretation*

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

## 3 **RESULTS**

The detailed magnetic gradiometer survey conducted at North Bexhill has identified a number of anomalies that have been characterised as being either of a *probable* or *possible* archaeological origin.

The difference between *probable* and *possible* archaeological origin is a confidence rating. Features identified within the dataset that form recognisable archaeological patterns or seem to be related to a deliberate historical act have been interpreted as being of a probable archaeological origin.

Features of possible archaeological origin tend to be more amorphous anomalies which may have similar magnetic attributes in terms of strength or polarity but are difficult to classify as being archaeological or natural.

The following list of numbered anomalies refers to numerical labels on the interpretation plots.

### 3.1 *Probable Archaeology*

- 1-2 A circular positive anomaly (Anomaly 1) in the centre of the site with two small discrete positive anomalies at the centre (Anomaly 2). This likely related to a ring ditch with two internal pits. The ring ditch is between 15m and 18m in diameter with an opening in the western side. These features lie outside of the buffer zone for the planned road.
- 3 A positive linear anomaly in the centre of the site. This is indicative of a former cut feature, and is likely to be archaeological origin, relating to Anomalies 1 and 2.
- 4 A sub-circular positive anomaly in the east of the site with a linear extending from its southern side. The sub-circular element is approximately 10.5m wide with an open northern side. This is likely to be a former enclosure related to the prehistoric or Roman activity seen in the surrounding area.
- 5 A positive curvilinear anomaly in the east of the site. This is indicative of a former cut feature, and likely relates to a former boundary or enclosure ditch. This is probably associated with the prehistoric or Roman activity seen in Anomaly 4.

### 3.2 *Possible Archaeology*

- 6 Positive linear anomalies in the east of the site. These are indicative of former cut features, and may relate to a former field system. However, they could also relate to land drains or other modern agricultural activity.
- 7 Parallel, positive, linear anomalies in the east of the site. These are indicative of former cut features, and may be of archaeological origin. These anomalies form possible evidence of a medieval lynchet field system.
- 8-9 A number of positive linear anomalies, mostly across the east of the site. These are indicative of former cut features, and may be of archaeological, agricultural, or natural origin. It is possible that Anomaly 9 is an extension of the activity seen in Anomalies 4 and 5.
- 10 A number of small discrete positive anomalies, mostly across the east of the site. These are indicative of small former cut features, such as backfilled pits, and may be of archaeological or natural origin.



### 3.3 *Medieval/Post-Medieval Agriculture*

- 11 A positive linear anomaly in the west of the site. This is likely to relate to a former field boundary not present on available mapping.
- 12 Areas of closely spaced, parallel, linear anomalies across the site. These are indicative of modern agricultural activity, such as ploughing.

### 3.4 *Other Anomalies*

- 13 Weak, bipolar linear anomalies at the eastern end of the survey area. These are indicative of land drains.
- 14 A number of short, closely spaced, parallel linear anomalies in the centre of the site. These are of unknown origin, but are likely to be modern, possibly relating to a drainage system.
- 15 A positive linear anomaly with associated negative response at the eastern end of the survey area. This is of unknown origin, but is likely to be modern, possibly relating to drainage or a trackway.
- 16 Areas of magnetic variation across the site. These anomalies are likely to be geological or pedological in origin.
- 17 Areas of magnetic disturbance are the result of substantial nearby ferrous metal objects such as fences and underground services. These effects can mask weaker archaeological anomalies, but on this site have not affected a significant proportion of the area.
- 18 A number of magnetic 'spikes' (strong focussed values with associated antipolar response) indicate ferrous metal objects. These are likely to be modern rubbish.

## 4 DATA APPRAISAL & CONFIDENCE ASSESSMENT

Mudstone geologies can give variable responses to magnetic survey. The presence of a ring ditch, settlement activity, and former field boundaries across the site corresponds with the desk-based assessment of the area. This suggests that the geology is conducive to magnetic survey, and that the survey has been effective in identifying any archaeology on the site.

## 5 CONCLUSION

The survey at North Bexhill has identified a number of anomalies of probable and possible archaeological origin. A ring ditch with associated pits, and a possibly associated ditch feature, gives evidence for prehistoric settlement activity in the area, as alluded in the desk-based assessment. However the ring ditch itself lies outside of the buffer zone for the planned road. Prehistoric or Roman activity is seen at the eastern end of the survey area in the form of enclosure ditches. A number of possible archaeological anomalies have also been identified, however these could equally relate to modern agricultural activity or be natural in origin. The detection of former field boundaries and agricultural activity suggests that the area has a recent agricultural past. The remaining anomalies are modern or natural in origin. The modern anomalies relate to land drains, ferrous objects, and fencing.

## 6 REFERENCES

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## APPENDIX A – METHODOLOGY & SURVEY EQUIPMENT

### ***Grid locations***

The location of the survey grids has been plotted together with the referencing information. Grids were set out using a Leica 705auto Total Station and referenced to suitable topographic features around the perimeter of the site or a Leica Smart Rover RTK GPS.

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. A SmartNet RTK GPS uses Ordnance Survey's network of over 100 fixed base stations to give an accuracy of around 0.01m.

### ***Survey equipment and gradiometer configuration***

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 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.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. The instrument consists of two fluxgates very accurately aligned to nullify the effects of the Earth's magnetic field. Readings relate to the difference in localised magnetic anomalies compared with the general magnetic background. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame. Each gradiometer has a 1m separation between the sensing elements so enhancing the response to weak anomalies.

### ***Sampling interval***

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

### ***Depth of scan and resolution***

The Grad 601-2 has a typical depth of penetration of 0.5m to 1.0m, though strongly magnetic objects may be visible at greater depths. The collection of data at 0.25m centres provides an optimum methodology for the task balancing cost and time with resolution.

### ***Data capture***

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.

## APPENDIX B – BASIC PRINCIPLES OF MAGNETIC SURVEY

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.

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.

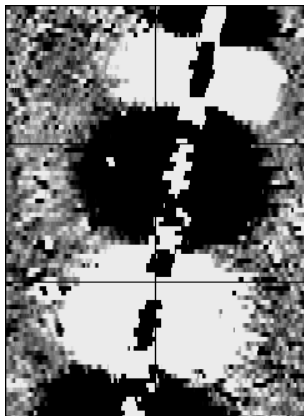
Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement 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.

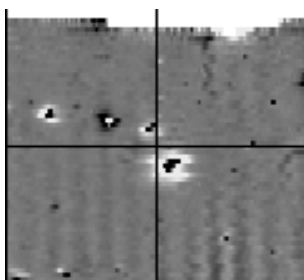
## APPENDIX C – GLOSSARY OF MAGNETIC ANOMALIES

### Bipolar



A bipolar anomaly is one that is composed of both a positive response and a negative response. It can be made up of any number of positive responses and negative responses. For example a pipeline consisting of alternating positive and negative anomalies is said to be bipolar. See also dipolar which has only one area of each polarity. The interpretation of the anomaly will depend on the magnitude of the magnetic field strength. A weak response may be caused by a clay field drain while a strong response will probably be caused by a metallic service.

### Dipolar

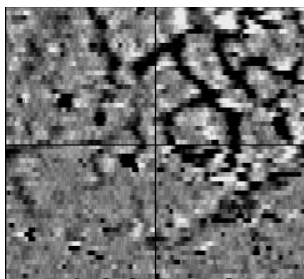


This consists of a single positive anomaly with an associated negative response. There should be no separation between the two polarities of response. These responses will be created by a single feature. The interpretation of the anomaly will depend on the magnitude of the magnetic measurements. A very strong anomaly is likely to be caused by a ferrous object.

### Positive anomaly with associated negative response

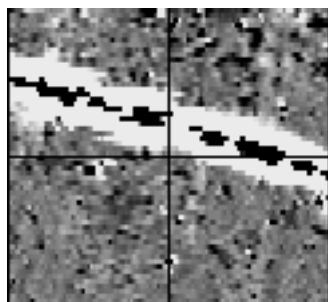
See bipolar and dipolar.

### Positive linear



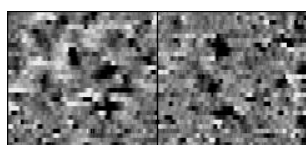
A linear response which is entirely positive in polarity. These are usually related to in-filled cut features where the fill material is magnetically enhanced compared to the surrounding matrix. They can be caused by ditches of an archaeological origin, but also former field boundaries, ploughing activity and some may even have a natural origin.

### Positive linear anomaly with associated negative response



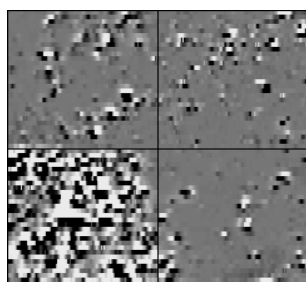
A positive linear anomaly which has a negative anomaly located adjacently. This will be caused by a single feature. In the example shown this is likely to be a single length of wire/cable probably relating to a modern service. Magnetically weaker responses may relate to earthwork style features and field boundaries.

### Positive point/area



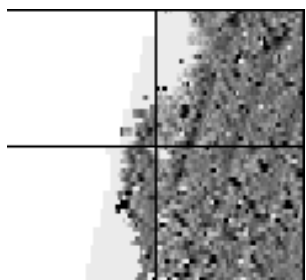
These are generally spatially small responses, perhaps covering just 3 or 4 reading nodes. They are entirely positive in polarity. Similar to positive linear anomalies they are generally caused by in-filled cut features. These include pits of an archaeological origin, possible tree bowls or other naturally occurring depressions in the ground.

### Magnetic debris



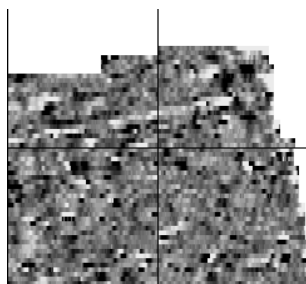
Magnetic debris consists of numerous dipolar responses spread over an area. If the amplitude of response is low ( $\pm 3nT$ ) then the origin is likely to represent general ground disturbance with no clear cause, it may be related to something as simple as an area of dug or mixed earth. A stronger anomaly ( $\pm 250nT$ ) is more indicative of a spread of ferrous debris. Moderately strong anomalies may be the result of a spread of thermoremanent material such as bricks or ash.

### Magnetic disturbance



Magnetic disturbance is high amplitude and can be composed of either a bipolar anomaly, or a single polarity response. It is essentially associated with magnetic interference from modern ferrous structures such as fencing, vehicles or buildings, and as a result is commonly found around the perimeter of a site near to boundary fences.

### Negative linear

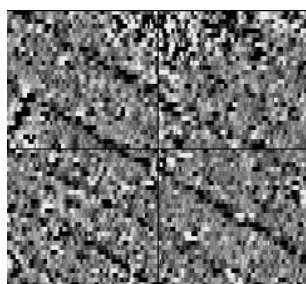


A linear response which is entirely negative in polarity. These are generally caused by earthen banks where material with a lower magnetic magnitude relative to the background top soil is built up. See also ploughing activity.

### Negative point/area

Opposite to positive point anomalies these responses may be caused by raised areas or earthen banks. These could be of an archaeological origin or may have a natural origin.

### Ploughing activity



Ploughing activity can often be visualised by a series of parallel linear anomalies. These can be of either positive polarity or negative polarity depending on site specifics. It can be difficult to distinguish between ancient ploughing and more modern ploughing. Clues such as the separation of each linear, straightness, strength of response and cross cutting relationships can be used to aid this, although none of these can be guaranteed to differentiate between different phases of activity.

### Polarity

Term used to describe the measurement of the magnetic response. An anomaly can have a positive polarity (values above 0nT) and/or a negative polarity (values below 0nT).

### Strength of response

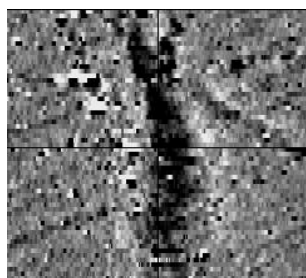
The amplitude of a magnetic response is an important factor in assigning an interpretation to a particular anomaly. For example a positive anomaly covering a 10m<sup>2</sup> area may have values up to around 3000nT, in which case it is likely to be caused by modern magnetic interference. However, the same size and shaped anomaly but with values up to only 4nT may have a natural origin. Colour plots are used to show the amplitude of response.



### Thermoremanent response

A feature which has been subject to heat may result in it acquiring a magnetic field. This can be anything up to approximately +/-100 nT in value. These features include clay fired drains, brick, bonfires, kilns, hearths and even pottery. If the heat application has occurred in situ (e.g. a kiln) then the response is likely to be bipolar compared to if the heated objects have been disturbed and moved relative to each other, in which case they are more likely to take an irregular form and may display a debris style response (e.g. ash).

### Weak background variations



Weakly magnetic wide scale variations within the data can sometimes be seen within sites. These usually have no specific structure but can often appear curvy and sinuous in form. They are likely to be the result of natural features, such as soil creep, dried up (or seasonal) streams. They can also be caused by changes in the underlying geology or soil type which may contain unpredictable distributions of magnetic minerals, and are usually apparent in several locations across a site.

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