GEOPHYSICAL SURVEY REPORT G1572

Geophysical Survey at The Laurels, Church Fenton North Yorkshire

Client:

YORK ARCHAEOLOGICAL TRUST

On Behalf Of:

DC Architecture

GSB PROSPECTION Ltd

Celebrating over 25 years at the forefront of Archaeological Geophysics

sumo Survey Services

GEOPHYSICAL SURVEY REPORT

Project name:	Geophysical survey at The Laurels, Church Fenton
Job ref:	G1572
Client:	York Archaeological Trust
Survey dates:	18 April 2016
Report date:	25 April 2016
Field Co-ordinator:	Leanne Swinbank BA
Field team:	Jennifer Peacock BA MA PhD
Report written by:	Leanne Swinbank BA
CAD illustrations by:	Jennifer Peacock BA MA PhD
Report approved by:	Jon Tanner BSc MSc PCIfA
Project Director:	Dr John Gater MCIfA FSA
Version number and issue date:	V1 25 April 2016
Amendments:	

GSB Prospection Ltd
Cowburn Farm 21 Market Street Thornton Bradford
West Yorkshire BD13 3HW

T: 01274 835016 F: 01274 830212
info@gsbsumo.com www.gsbprospection.com

SUMO Survey Services
SUMO Group Member

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

DIGITAL CONTENT (CD)

- Minimally Processed Greyscale Images and XY Trace Plots in DWG format
- DWG Viewer
- Digital Copies of Report Text and Figures (both PDF and native formats)

1 SUMMARY OF RESULTS

The survey did not detect any responses which can be confidently classified as having an archaeological provenance, but did identify some ditch-like anomalies and trends of *Uncertain Origin* as well as a spread of magnetic disturbance. These could be related to a medieval hall but the small survey area prevents the opportunity to place the responses in context; relatively modern origins for the anomalies are also possible. Modern ferrous anomalies were also detected.

2 INTRODUCTION

2.1 Background synopsis

GSB Prospection Ltd. were commissioned to undertake a geophysical survey of an area proposed for development. This survey forms part of an archaeological investigation being undertaken by **York Archaeological Trust** on behalf of **DC Architecture**.

2.2 Site Details

NGR / Postcode	SE514370/ LS24 9WD
Location	The site is located 7 miles northwest of Selby in the village of Church Fenton. It is accessed off the Main Street just after Kirk Fenton School through a gateway between two houses.
HER/SMR	North Yorkshire County Council HER
District	Selby
Parish	Church Fenton CP
Topography	Flat
Current Land Use	Wasteland
Weather Conditions	Weather was dry but windy.
Soils	Foggathorpe 2 (712i) association soils - slowly permeable seasonally waterlogged stoneless clayey and fine loamy over clayey soils. Some similar coarse loamy over clayey soils (SSEW 1983).
Geology	The bedrock geology consists of: Roxby Formation - mudstone, calcareous. The superficial deposits are Hemingbrough Glaciolacustrine Formation - clay, silty (BGS 2016).
Archaeology	The northern site boundary follows the course of a moat that surrounded an area containing a medieval hall, mentioned in a Subsidy Roll of 1379. No building remains are visible on the grounds, but there is potential for structural remains relating to the manor to be present (YAT 2014).
Survey Methods	Detailed magnetometer survey (fluxgate gradiometer)
Study Area	0.8ha

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 (EH 2008) (then English Heritage) and the Chartered Institute for Archaeologists (IfA 2002 & CIfA 2014).

3.2 Survey methods

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

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

This project was carried out in accordance with a WSI submitted to the Local Planning Authority (LPA).

More information regarding this technique is included in Appendix A.

3.3 Data Processing

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

1. *De-stripe*
2. *De-stagger Magnetic Data*

3.4 Presentation of results and interpretation

The presentation of the data for each site involves a greyscale plot of processed data. Magnetic anomalies have been identified, interpreted and plotted onto the 'Interpretation' drawings. The minimally processed data is provided as a greyscale image on the CD together with an XY trace plot in CAD format. A CAD viewer is also provided.

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

4.1 Three ditch-like anomalies, in part visible only as trends in the data, were detected. It is possible that they are related to the medieval hall mentioned in Site Details above, but the small survey area prevents the responses being viewed in their wider context and thus prohibits a confident interpretation; the ditches could be of relatively modern origin, perhaps plot or field divisions. Accordingly they have been placed in the category *Uncertain Origin*.

4.2 A band of magnetic disturbance aligned approximately north-south through the dataset could represent partial remains of the medieval hall; however, for the reason described above, a confident interpretation is not possible. Responses of this nature are typically associated with relatively recent deposits, such as consolidation material or modern debris perhaps from the two derelict sheds on site, or surrounding buildings.

4.3 The large ferrous anomaly to the north is caused by a collapsed shed. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data; these have been assigned a modern origin and are best illustrated on the XY trace plots. The most prominent of these are highlighted on the interpretation diagram.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

5.1 The site is relatively magnetically "noisy" due to the proximity of built-up areas, and the presence of two derelict sheds in the survey area. It is possible that magnetically weak anomalies, if present, may have been masked.

5.2 Site conditions were generally acceptable for survey, the area being flat and foliage cut short. However, the presence of an extant but derelict shed has led to a small gap in the data. Survey fully up to the boundary of the site was not possible in some places due to overgrown vegetation.

6 CONCLUSION

6.1 No anomalies were identified which could be considered probable archaeology with a high degree of confidence, due to the limited extent of the survey. Linear anomalies and trends, and an area of magnetic disturbance, may be associated with the medieval hall, but this interpretation is highly tentative; the anomalies could be relatively recent origin.

6.2 Numerous strong responses derived from items of ferrous material were also recorded across the survey area.

7 REFERENCES

BGS 2016 British Geological Survey., *website*: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps) Geology of Britain viewer. [Accessed 19/04/2016]

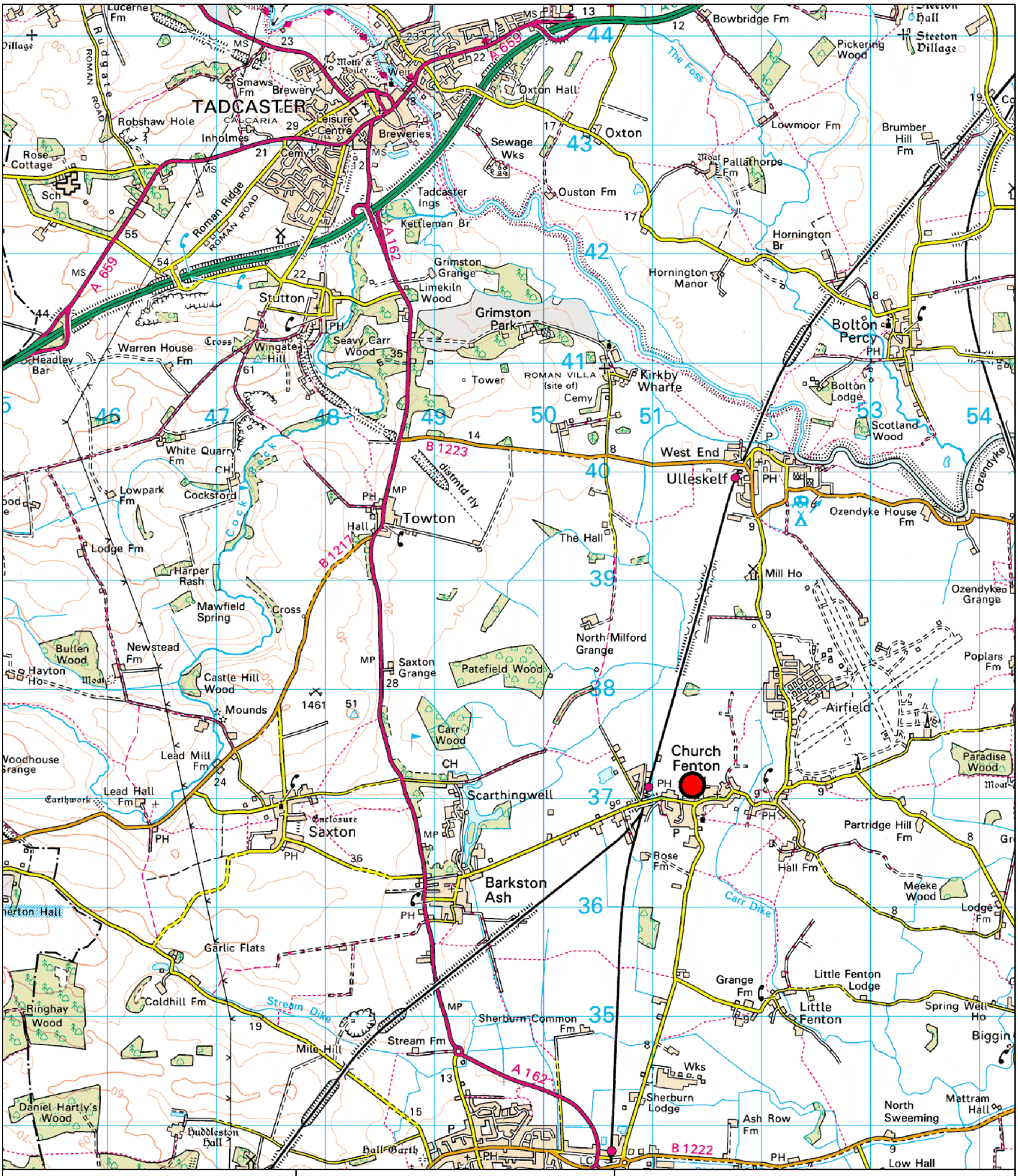
CIfA *Standard and Guidance for Archaeological Geophysical Survey.* CIfA Guidance note. Chartered Institute for Archaeologists, Reading http://www.archaeologists.net/sites/default/files/node-files/CIfAS&GGeophysics_1.pdf

EH 2008 *Standard and Guidance for Archaeological Geophysical Survey.* CIfA Guidance note. Chartered Institute for Archaeologists, Reading http://www.archaeologists.net/sites/default/files/node-files/CIfAS&GGeophysics_1.pdf

IfA 2002 *The Use of Geophysical Techniques in Archaeological Evaluations*, IFA Paper No 6, C. Gaffney, J. Gater and S. Ovenden. Institute for Archaeology, Reading

SSEW 1983 *Soils of England and Wales. Sheet 1, Northern England*. Soil Survey of England and Wales, Harpenden.

YAT 2014 *Written Scheme of Investigation for Archaeological Investigations at The Laurels, Church Fenton.* Unpublished Draft WSI, York Archaeological Trust. York



N

Site Location

Title:

Site Location Diagram

Client:

York Archaeological Trust

Project:

G1572 Church Fenton

GSB PROSPECTION Ltd

GSB Prospection Ltd

COWBURN FARM
21 MARKET STREET
THORNTON
BRADFORD
BD13 3HW

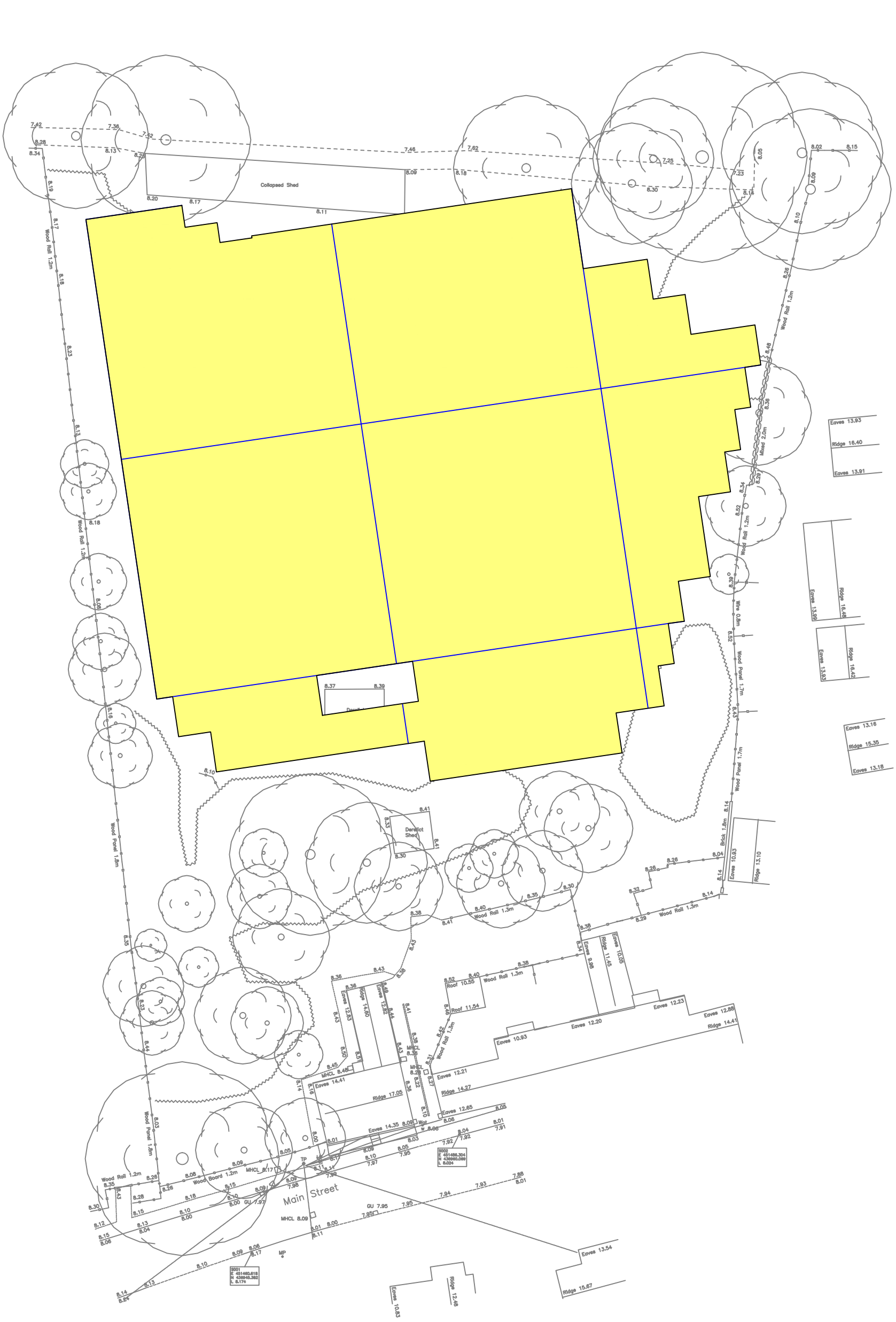
TEL: 01274 835 016
FAX: 01274 830 212

www.gsbprospection.com

Scale: 0 metres 2000

1:5000 @ A4

Fig No: 1



Area of Magnetometer Survey
Showing 30m Grids

GSB PROSPECTION Ltd

GSB Prospection Ltd
COWBURN FARM
21 MARKET STREET
THORNTON
BRADFORD
BD13 3HW
TEL: 01274 835 016
FAX: 01274 830 212
www.gsbprospection.com

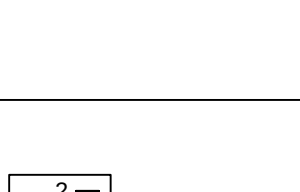
Title: Location of Survey Area

Client: York Archaeological Trust

Project: G1572 Church Fenton

Scale: 0 metres 20
1:500 @ A3

Fig No: 2



GSB PROSPECTION Ltd

GSB Prospection Ltd
COWBURN FARM
21 MARKET STREET
THORNTON
BRADFORD
BD13 3HW
TEL: 01274 835 016
FAX: 01274 830 212
www.gsbprospection.com

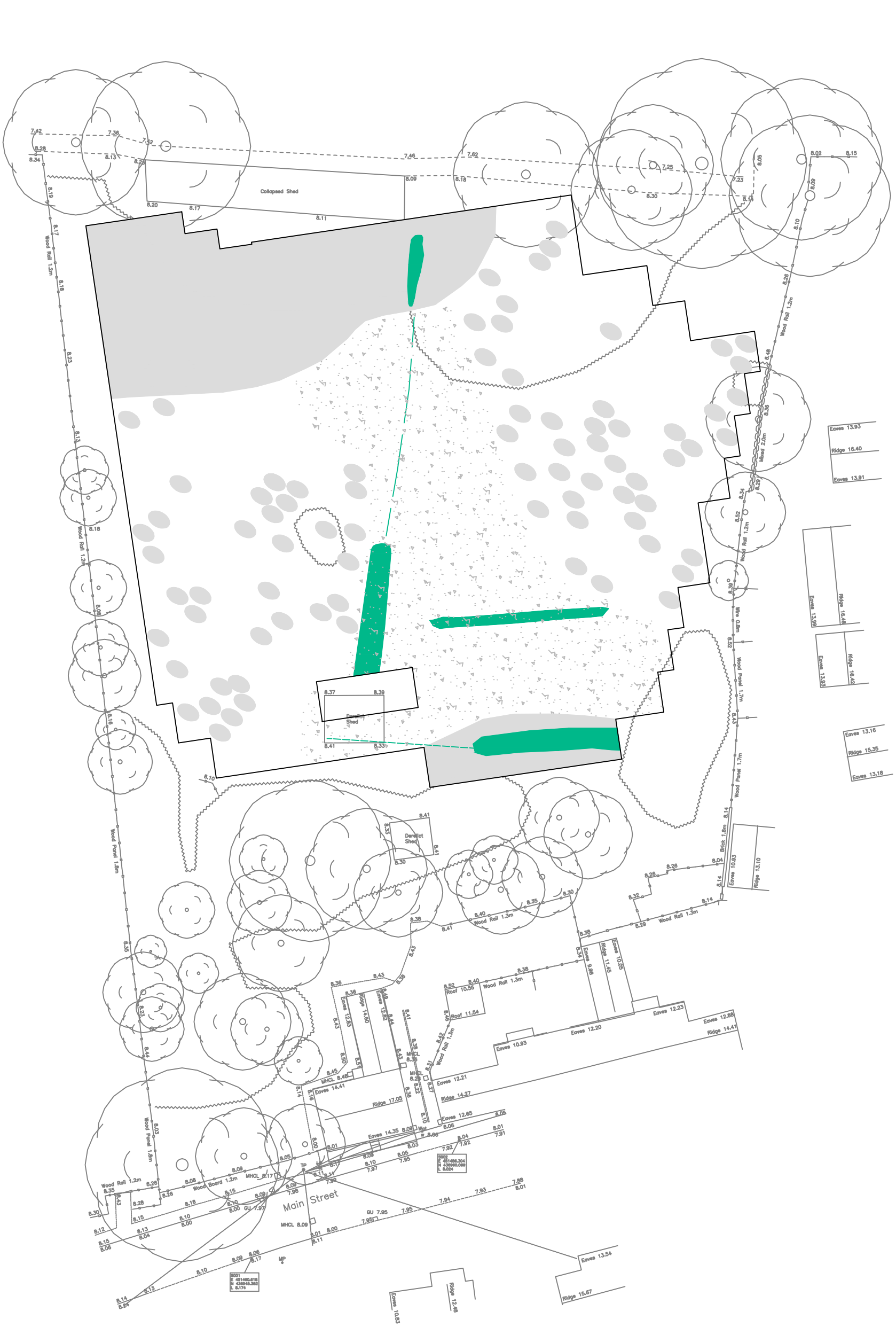
Title: Magnetometer Survey
Greyscale Plot

Client: York Archaeological Trust

Project: G1572 Church Fenton

Scale: 0 metres 20
1:500 @ A3

Fig No: 3



Uncertain Origin
(discrete anomaly / trend)

Area of Magnetic
Disturbance

Ferrous

GSB PROSPECTION Ltd

GSB Prospection Ltd
COWBURN FARM
21 MARKET STREET
THORNTON
BRADFORD
BD13 3HW
TEL: 01274 835 016
FAX: 01274 830 212
www.gsbprospection.com

Title: Magnetometer Survey Interpretation

Client: York Archaeological Trust

Project: G1572 Church Fenton

Scale: 0 metres 20
1:500 @ A3

Fig No: 4

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.

For CARTEASY^{N} collected data each data point had its position recorded using a Trimble R10 Real Time Kinematic (RTK) VRS Now GNSS GPS system. The geophysical survey area is georeferenced relative to the Ordnance Survey National Grid.

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
Magnetometer	CartEasy^{N} cart system (Bartington Grad 601 sensors)	0.75m	0.125m

Instrumentation: Bartington *Grad*601-2 / GSB CARTEASY^{N} Cart system
Both the Bartington and CARTEASY^{N} 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 CARTEASY^{N} system has four gradiometer units mounted at 0.75m intervals across its frame – rather than working in grids, the cart uses an on-board survey grade GNSS for positioning. The cart system allows for the collection of topographic data in addition to the magnetic field measurements.

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.
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points along a traverse (the x axis) and/or between traverses (the y axis) and results in a smoother greyscale image.

Display

XY Trace Plot	This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane.
Greyscale 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.

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.

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.

GSB PROSPECTION Ltd

SUMO Group Member
STRATASCAN
GEOPHYSICS FOR ARCHAEOLOGY AND ENGINEERING

TEAM surveys

Survey services you can rely on

sumo Survey Services

Your Survey Partner

For a complete and complementary range of survey services.

Survey services you can rely on

- Archaeological
- As Built Records
- Boundary Disputes
- CCTV
- Geophysical
- Laser Scanning
- Measured Building
- Pipeline Routes
- Railway
- Retrofit
- Setting Out
- Statutory Plan Collation
- Topographic
- Utility Mapping
- UXO Detection
- Void Detection

GSB PROSPECTION Ltd

Celebrating over 25 years at the
forefront of archaeological geophysics

sumo Survey Services

Tel: +44 (0)1274 835016
Fax: +44 (0)1274 830212
Email: info@gsbsumo.com
Web: www.gsbprospection.com

GSB Prospection Ltd. Registered in England, Registration Number: 4783292. VAT Registration Number: 516177841
Registered Office: Unit 8 Hayward Business Centre, New Lane, Havant, Hampshire, PO9 2NL