AB HERITAGE
ARCHAEOLOGICAL CONSULTANCY

Land at Buckland Brewer, Devon

Geophysical Survey Report

Client: SAVILLS UK

AB Heritage Project No:10733

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Land at Buckland Brewer, Devon

Geophysical Survey Report

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Project Number	**10733**
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CONTENTS

1. INTRODUCTION 4
1.1 Project Background 4
1.2 Site Location 4
1.3 Geology and Topography 4
2. AIMS & METHODOLOGY 5
2.1 Aims of Survey Works 5
2.2 Methodology of Survey Works Summary 5
2.3 Known Constraints 6
3. RESULTS 7
4. INTERPRETATIONS AND DISCUSSION 8
5. CONCLUSION 10
6. ARCHIVE 11
7. REFERENCES 12

FIGURES

Figure 1: Site Location
Figure 2: Raw Geophysical Data
Figure 3: Processed Geophysical Data
Figure 4: Interpretation of Geophysical Data

TABLES

Table 1: Setting Parameters of Magnetometer 5
Table 2: Features Identified through interpretation of Geophysical Survey Data 7
Table 3: Interpretation of Geophysical Anomalies 8
Table 4: Site Archive Data 11

1. INTRODUCTION

1.1 Project Background

1.1.1 AB Heritage Limited (hereinafter AB Heritage) have been commissioned by Savills to conduct a Geophysical Survey (Magnetometer Survey) covering a site of proposed development on land at Buckland Brewer, Devon (see Figure 1). The survey took place on the 3rd of June.

1.1.2 The purpose of the survey is to identify and map any potential surviving archaeological remains along the proposed route, and identify their form and significance.

1.2 Site Location

1.2.1 The proposed development site comprises a single field of c. 1.5ha, on the north-eastern edge of the village of Buckland Brewer, in northern Devon. An approximate centre point is located at NGR SS 42068 20904.

1.2.2 The field is bound on all sides by hedgerow boundaries, and lies between farm buildings to the north-east of the site, and modern residential development to the east.

1.2.3 A dirt-track provides access to the proposed development site through the northern site boundary, which also provides access to a footpath through the yard of the Parish Church of St Mary and St Benedict.

1.3 Geology and Topography

1.3.1 The proposed development site is situated upon Bude Formation sandstone (BGS 2016). Most sandstone geologies are considered to give a variable response in magnetometer survey.

1.3.2 Soils covering the proposed development site consist of ‘freely draining slightly acid loamy soils’ (LandIS 2016).

1.3.3 The gradient at the proposed development site increases from c.140m above Ordnance Datum (AOD), at the south-eastern boundary of the proposed development site, to c. 150m AOD at the north-western edge of the proposed development site.

2. AIMS & METHODOLOGY

2.1 Aims of Survey Works

2.1.1 Geophysical survey is a programme of non-intrusive archaeological work. The aims of this geophysical survey were to:

- Identify any geophysical anomalies of possible archaeological origin within the specified survey area;
- Accurately locate these anomalies and present the findings in map form;
- And identify the significance from the form, and extent of any identified features.

2.2 Methodology of Survey Works Summary

Site Specific Information

2.2.1 A geophysical survey was undertaken covering c. 1.5ha across pasture at Buckland Brewer, Devon on the 3rd of June 2016.

2.2.2 The AB Heritage staff members who undertook the site work were Glenn Rose (Project Officer) and Peter Bonvoisin (Archaeological Technician).

2.2.3 The weather conditions were dry throughout the survey; these conditions had no material impact upon the survey.

Equipment

2.2.4 The magnetic survey equipment used was two Bartington Grad-601 (fluxgate magnetometers). Please see Appendix A, which contains a detailed methodology for the works undertaken; however, briefly, Table 1, below, shows site specific information on how the magnetometer was set up:

Table 1: Setting Parameters of Magnetometer

Grid Size	30x30 metres
Data Capture Distances	1m x 0.25m
Sensors	2
Sensitivity	0.1nT

2.2.5 A Trimble Geo XR GPS was used to setup the geophysical survey. This has sub-centimetre accuracy suitable for this survey.

2.3 Known Constraints

2.3.1 At the entrance to the field the metallic gate and a few small spoil heaps; this caused c. 2 - 3m of magnetic disturbance in the survey data from the point they were located (Figure 4).

2.3.2 The boundaries within the survey area were hedgebanks on the north, east, and south sides. The west boundary was made up of modern fencing, which could create magnetic disturbance within c. 1 - 2m from that boundary.

3. RESULTS

3.1.1 For the purposes of this detailed magnetic survey, results for the geophysics data have been shown within Figures 2 and 3, with the interpretation shown in Figure 4.

3.1.2 Below is a table that shows the results of survey data. GP numbers have been used to place interpretations into categories. These results are interpreted in Section 4.

Table 2: Features Identified through interpretation of Geophysical Survey Data

GP No.	Feature identifier (Location)	Appearance	Shape / form	Orientation	Approx. Length of linear (m) / Area (m^2)	Approx. Range of readings (nT)
1	A	Positive Features	Linear	NE-SW	13.8m	0.89 to 4.48
	B		Area	N/A	3m^2 1.5 m^2	1.44 to 10.83
	C		Parallel Linears	NE-SW	13.4m 4.1m 30.1m 46.5m	1.46 to 12.46
	D		Area	NE-SW	4.5 m^2	2.35 to c.18
	E		Linear	NW-SE	5.5m	3.45 to c.6
	F		Area	N/A	4.2 m^2	4.01 to 11.68
	G		Area	N/A	3.9 m^2	1.48 to 7.74
2	H	Strong Positive Features	Area	N/A	1.5 m^2	8.01 to 26.32
	I		Area	N/A	c.6 m^2	1.79 to c.58
3	N/A	Magnetic Disturbance	N/A	N/A	N/A	N/A
4		Di-Polar anomaly	N/A	N/A	N/A	N/A

4. INTERPRETATIONS AND DISCUSSION

4.1.1 Interpretation of the results of geophysical survey is based on professional judgement as to the likely/probable cause of an anomaly or reading.

4.1.2 Below is a discussion of the results, a confidence rating has been applied to the features identified (See Appendix 1). A summary of the features interpretation is included in Table 3 (below).

Table 3: Interpretation of Geophysical Anomalies

AB No	Appearance	Potential Cause
GP 1A & E	Positive linear	Possible archaeology
GP 1B, D, F & G	Positive features / areas	
GP 1C	Parallel positive linears	
GP 2 H & I	Strong positive features/ areas	
GP 3	Di-Polar anomaly	Magnetic debris
GP 4	Areas of strong positive/negative	Magnetic debris/modern disturbance

4.1.3 Several positive linear features and areas [**GP 1 & 2**] of possible archaeological origin have been identified within the site. These consist of positive linears [**GP 1A, C & E**], which may represent possible ditches or banks, and positive areas / features [**GP 1B, D, F & G**], which are more likely to represent possible pits.

4.1.4 There is a medium to high confidence rating that parallel positive linear features [**GP 1C**] identified within the north western corner of the site, are likely parallel ditches. While this could represent a feature such as a ditch or trackway, when taken in combination with features identified during a Desk Based Assessment (DBA) of the site (AB Heritage, 2016), this may represent something of more complexity such as a sub-rectangular enclosure (Devon Historic Environment Record, MDV113884).

4.1.5 Other linear features [**GP 1A & E**] identified within the site could be also be possible ditches; however, there is overall a low confidence rating with this interpretation, as features could relate to modern ground disturbance. This is based on location of features [**GP 1A & E**] next to the sites boundaries.

4.1.6 Strong positive features [**GP 2**] identified within the site are likely to represent possible pits based on their form, and could have a relationship with features [**GP 1A & C**], identified within the north west corner of the site There is a low to medium confidence rating for these features [**GP 2**] contain archaeological potential.

4.1.7 Other features [**GP 1B, D, F & G**] that may also represent possible pits have a low confidence rating to contain archaeological potential, based on their weaker readings and sporadic placement through the site.

4.1.8 Di-Polar anomalies [**GP 3**] and Magnetic disturbance [**GP 4**] are located across the site. The spread of Di-Polar anomalies [**GP 3**] is concentrated towards the boundaries, though are otherwise in a largely amorphous pattern across the site; there is a high confidence rating that these readings are likely due to magnetic and/or agricultural debris.

4.1.9 There is also a high confidence rating that areas of magnetic disturbance [**GP 4**], identified throughout the site, mainly relate to the western boundary and the entrance of the site.

4.1.10 Overall there has been identified the potential for archaeological remains within the site, with the majority of the large features [**GP 1A & C**] likely to contain archaeological potential located within the north western corner of the site.

4.2 Summary

4.2.1 A number of features were found within the site, associated with some of these features there is potential for the recovery of archaeological remains. Possible ditch [**GP 1A & E**] and pit features [**GP 1B, F, G & GP 2**] are present within the site as well as a group of parallel linears [**GP 1C**] which when taken in combination with the Devon Historic Environment Record (MDV113884) and DBA for this site represent a possible enclosure of archaeological significance.

5. CONCLUSION

5.1.1 A geophysical survey was undertaken by AB Heritage from the 3rd of June on behalf of Savills, covering c. 1.5ha of fields immediately to the east of the village of Buckland Brewer, Devon.

5.1.2 The purpose of the survey is to identify and map any potential surviving archaeological remains along the proposed route, and identify their form and significance.

5.1.3 Overall it has been concluded that there is a potential for the recovery of archaeological remains within the site, with the most complex feature shown within the north western corner of the site. The site contains a possible enclosure [**GP 1C**], ditches [**GP 1A & E**] and pits [**GP 1B, F, G & GP 2**] that could be of archaeological origin.

5.1.4 Of particular note is the possible identification of sub-rectangular enclosure [**GP 1C**], when taken in combination with the Devon Historic Environment Record (MDV113884) and DBA for this site, which extends from the north western corner of the site.

6. ARCHIVE

6.1.1 The Site Archive will contain the following, as a minimum:

Table 4: Site Archive Data

Archive	Format
Raw Geophysical Data files	XYZ and Text
Processed geophysical data files	JPEG, BMAP
Archaeological Interpretation	Shape Files ARC GIS
Final Report	PDF
Final Images	PDF

6.1.2 A physical and digital archive will be stored in a suitable format at AB Heritage Limited offices in Taunton, Somerset, as well as being uploaded to the Archaeological Data Service as stipulated in the Written Scheme of Investigation by Devon County Council.

7. REFERENCES

AB Heritage 2016. *Land at Buckland Brewer, Devon: Written Scheme of Investigation for Geophysical Survey*

AB Heritage 2016. *Land at Buckland Brewer, Devon: Desk Based Assessment*

BGS (British Geological Society) 2016.*Geology of Britain viewer.* http://mapapps.bgs.ac.uk/geologyofbritain/home.html.

CIFA, 2014. *Standard and Guidance for archaeological geophysical survey.*

Cranfield Soil and Agrifood Industry, 2016. *Soilscapes viewer*, http://www.landis.org.uk/soilscapes/

Elevation Finder, 2016. https://www.freemaptools.com/elevation-finder.htm.May 2016

Jones, D.M. (ED) 2008. *Geophysical Survey in Archaeological Field Evaluation.English Heritage.*

Schmidt, A. 2002. *Geophysical Data in Archaeology: a Guide to Good Practice.* Oxford. Oxbow.

Appendix 1 Technical Information on Geophysical Survey

FLUXAGTE MAGNETOMETRY SURVEY

The 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.

Survey equipment

The Bartington Grad 601-2 dual magnetic gradiometer is capable of surveying to an accuracy of 0.1 nanotesla (nT).

Sample interval and depth of scan

The magnetometer data is collected in 30mx30m grids at a resolution of 1m x 0.25m. This sample density is recommended for site evaluation (English Heritage, 2008). This equates to 3600 points per 30mx30m grid. The magnetometer has a typical depth of penetration of 0.5m to 1.0m. This would be increased if strongly magnetic objects are buried within the site.

Data capture

The readings are logged continually by the data logger during the survey, which is then downloaded on site to a site laptop. At the end of each job, data is transferred to the office PC's for processing and presentation.

This 'regular xy' data is then downloaded into specialist data processing software, at user defined sample intervals (in this case 1 m by 0.25 m). This is processed as standard magnetometer data.

Processing

Standard Raw Magnetometer data processing consists of:

Zero mean Traverse- This process sets the background mean of each traverse within each grid to zero, the operation allows for the removal of striping effects.

Destagger- The collection of geophysical data can lead to errors with time due to a slight variation in speed of traverses or time lag within the collection of data. The process corrects the errors of stagger within the data.

Non-Standard Magnetometer processing:

Interpolation- The results of greyscale geophysical data can sometimes appear blocky in nature. Interpolation is a process which calculates and inserts values between existing data to give a smoother grey scale image.

Clipping – The clipping process will clip extreme values from the data set and increase the contrast in the data values closer to the mean. As most data within a data set is concentrated around the

mean clipping can produce a better visualisation of standard data sets, particularly very weak signals that tend to be lost in a myriad of grey shades.

Some degree of heading error is inevitable when using a fluxgate gradiometer with such an acute sensitivity to the direction of travel in bi directional manner i.e. zigzag traverses. The error displays as a series of alternating lighter and darker stripes in the traverse direction and the function asses and corrects the mean for each line of data to bring them in to the same mean range and remove any visible artefacts.

Display of data

Greyscale-This is display takes a range of reading and divides into a set number of classes. Each class is represented by a specific shade of grey and the higher the positive reading the darker the grey.

Colour- Colour can be applied to Greyscale plots to show high and low data collection points in a more direct way.

XY Trace Plot- Data is represented by a line, which is incremented along the Y axis. This produces a stepped effect, thus the data can be viewed to show a possible shaping of a feature. Typically features are clipped to limit odd readings.

Assigned ranges can be adjusted to give the best display of the data.

Some degree of heading error is inevitable when using a fluxgate gradiometer with such an acute sensitivity to the direction of travel in bi directional manner i.e. zigzag traverses. The error displays as a series of alternating lighter and darker stripes in the traverse direction and the function asses and corrects the mean for each line of data to bring them in to the same mean range and remove any visible artefacts.

GPS METHODOLOGY

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to sub-cm accuracy, a far greater accuracy than a standard GPS unit. An RTK system uses a base station receiver and a number of mobile units (rovers). The base station takes measurements from satellites in view and then broadcasts them along with its known position to the rover receivers. The rover receiver also collects measurements from the satellites in view and processes them with the base station data. The rover then computes its location relative to the base.

During such a survey a Trimble GeoXR Differential Global Positioning System (dGPS), capable of Real Time Kinematic (RTK) is used to set out a nominal grid prior to the survey. This increases the accuracy and efficiency of the survey. The data is then downloaded from the unit on the day, using a USB stick.

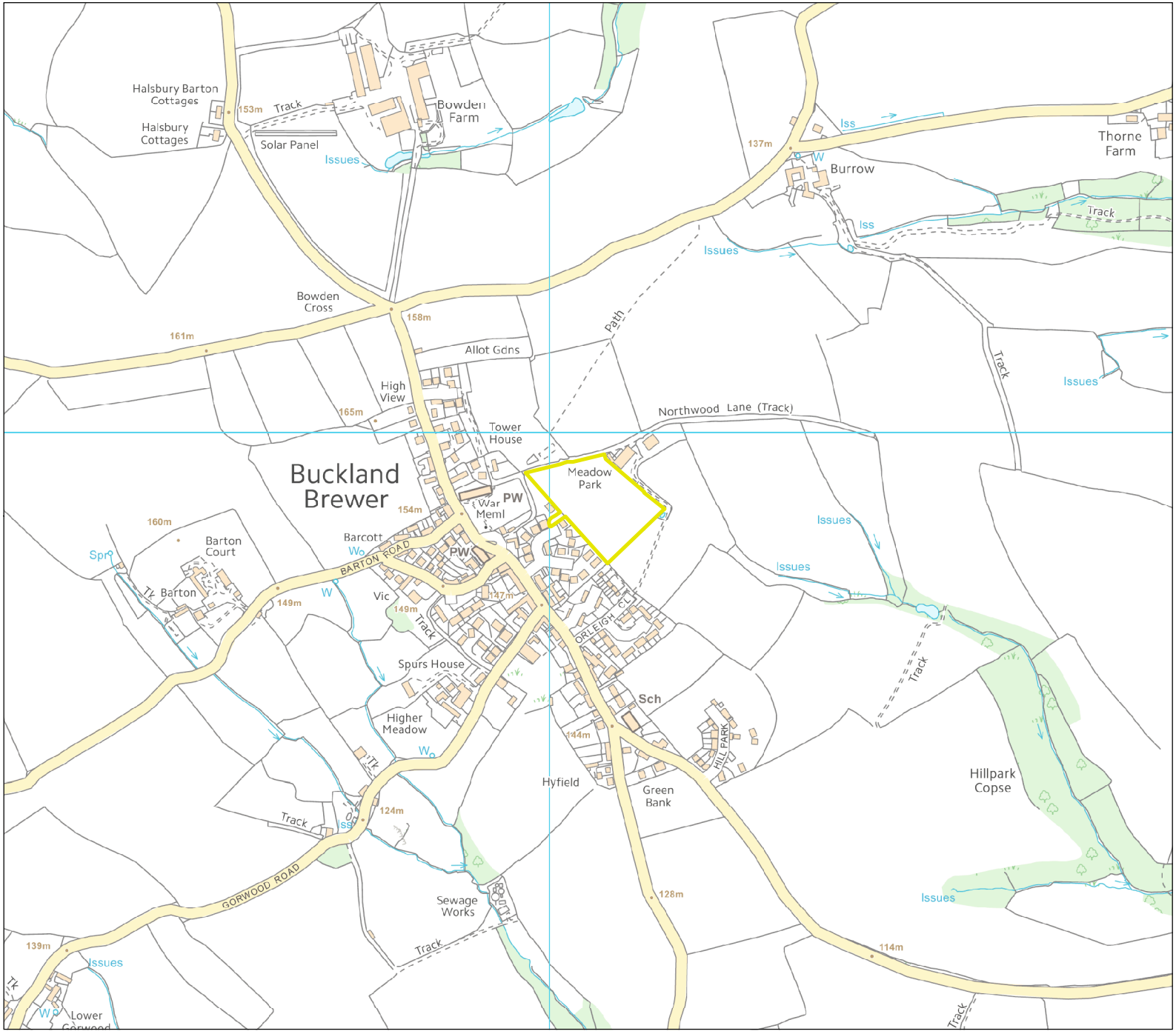
CONFIDENCE RATING OF INTERPRETATION

As with English Heritage 2008 guidelines for geophysical survey for archaeological field evaluation, this is an acceptable additional option only on the clear understanding that such ratings are subjective and potentially fallible assessments, which can only really be tested through excavation.

Categories for interpretations when there is corroborative evidence from mapping/desk based or excavation data can be assigned to magnetic anomalies (for example, Utility, Road, Wall, etc.) and where appropriate, such interpretations will be applied.

Table A1: Table of Confidence with interpretation

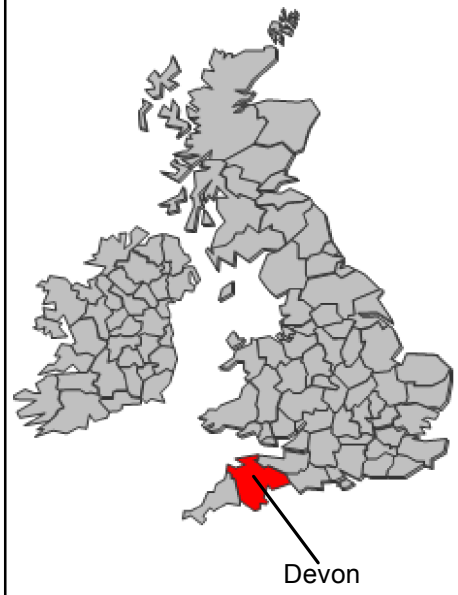
Interpretation Confidence	Evidence
High	Backed by mapping / desk based work / excavation. A clear feature with a clear form.
Medium	A feature which has an unclear structure though has grouped potential or associated potential.
Low	Unknown provenance entirely based on form.



N

Legend

Site Boundary



0 175 350 700 m

Figure 1: Site Location

Project: Buckland Brewer, Devon

Date: 02/12/15	Job Number: 10733
Drawn by: ZE	Approved by: GR

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Figure 2: Raw Geophysical Data

Project: Buckland Brewer

Date: 06/06/16	Job Number: 10733
Drawn by: PB	Approved by: GR

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N

Legend

Site Boundary

+10

Plotting Perameters

-10

0 25 50 100 m

Figure 3: Processed Geophysical Data

Project: Buckland Brewer

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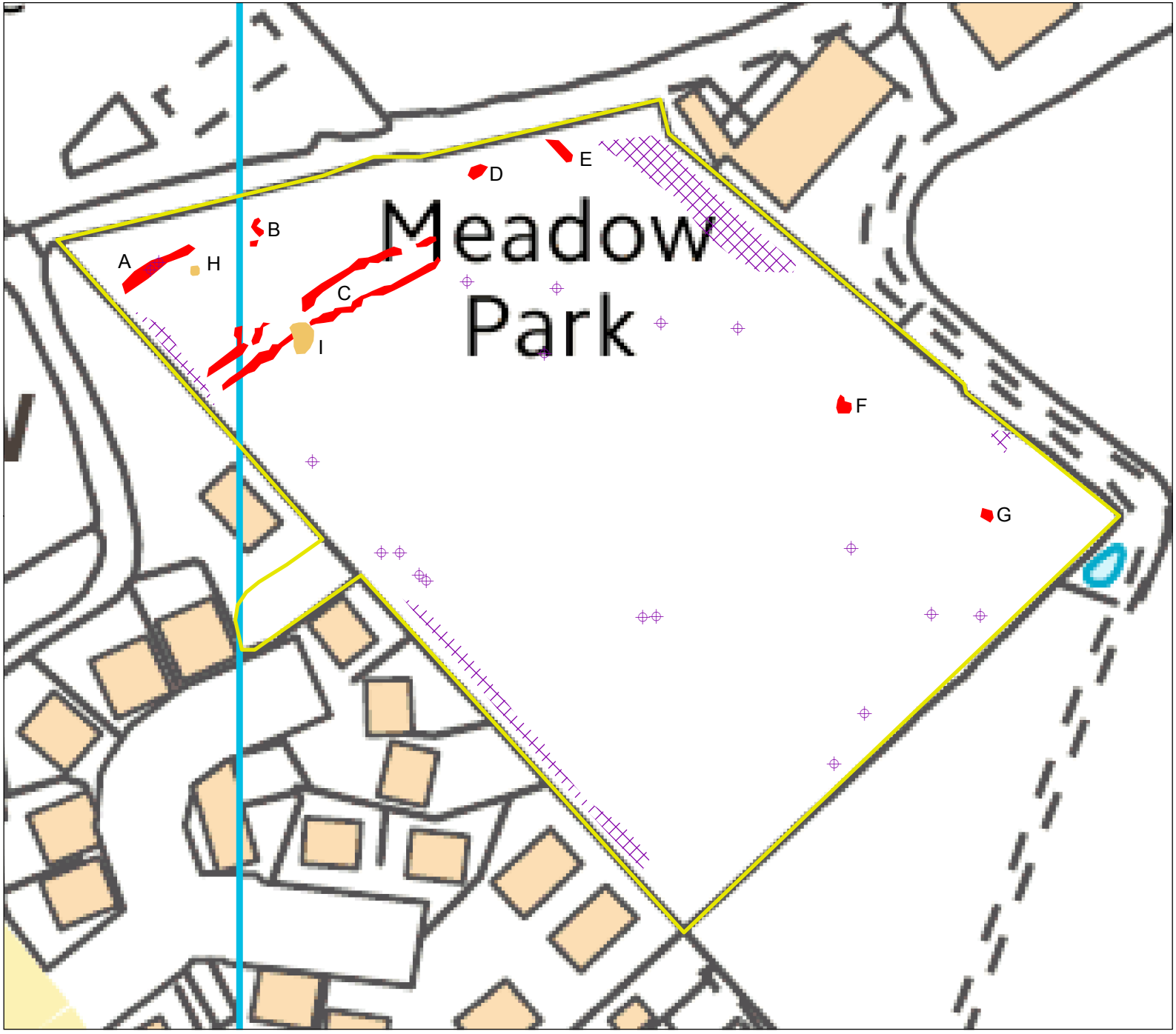

Legend

- GP1 - Positive Features
- GP2 - Strong Positive Feature
- GP3 - Magnetic Disturbance
- GP4 - Di-Polar Anomalies
- Site Boundary

Figure 4: Geophysical Data Results Interpretation

Project: Buckland Brewer

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