Land at Ashchurch, Gloucestershire

Geophysical Survey Report

Client: MR BARRY CONNELLY

AB Heritage Project No:10820

Date: 26/04/2016

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1. NON TECHNICAL SUMMARY

1.1.1 AB Heritage Limited (herein AB Heritage) were commissioned by Mr Barry Connelly to undertake a programme of geophysical survey covering c. 4.8 ha of land at Ashchurch, Gloucestershire, ahead of a proposed development.

1.1.2 Based on the results of the geophysical survey there is limited potential for the recovery of archaeological remains.

2. INTRODUCTION

2.1 Project Background

2.1.1 AB Heritage Limited (hereinafter AB Heritage) have been commissioned by Mr Barry Connelly to conduct a Geophysical Survey (Magnetometer Survey) covering the proposed development on land at Ashchurch, Gloucestershire, (see Figure 1) prior to development of the site.

2.1.2 The purpose of the survey is to identify any potential surviving archaeological remains along the proposed route.

2.2 Site Location & Description

2.2.1 The proposed development at Ashchurch, in Gloucestershire (hereafter referred to as the site), covers approximately 4.8 hectares (ha) and is centred at the National Grid Reference (NGR) SO 93111 33141. It is situated immediately to the south of Ashchurch, and is approximately c. 1.5km east of junction 9 of the M5, c. 3km west of Tewkesbury, and c.11.5km north of Cheltenham.

2.2.2 To the south and east of the site is farmland (mostly pasture), to the west of the site are the grounds of Ashchurch Primary School, and to the north is Ashchurch (see Figure 1). The site boundary is made up of hedgerows on the east and west sides, a river and hedgerows to the south and fences along the northern boundary. The site itself is pasture with the west half named as Fitzhamon Park.

2.3 Geology & Topography

2.3.1 The underlying bedrock geology comprises of Charmouth Mudstone Formation, over the majority of the site this has no superficial deposits. Along the southern edge of the site around the river the bedrock geology is overlain by superficial deposits of Alluvium, made up of clay, silt, sand, and gravel (BGS 2016).

2.3.2 The soils on site are mostly lime-rich loamy and clayey soils with impeded drainage; however, in the south-west corner of the site the soils are loamy and clayey floodplain soils with naturally high groundwater (Soilscape 2016).

2.3.3 The response over Mudstone should be average with a variable response within the geophysical data (English Heritage, 2008).

2.3.4 Topographically the site is relatively flat with an average height of about 19m Above Ordnance Datum (AOD), the site rises slightly from c. 18m AOD in the west to c. 21m AOD in the east. Along the southern edge of the site a bank slopes downwards towards the river going down to c. 15m OAD.

3. AIMS & METHODOLOGY

3.1 Aims of Survey Works

3.1.1 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

3.2 Methodology of Survey Works Summary

Site Specific Information

3.2.1 A geophysical survey was undertaken covering c. 4.8 ha of land at Ashchurch, Gloucestershire on the 21st and the 22nd of April 2016.

3.2.2 The AB Heritage staff members who undertook the works were Glenn Rose (Project Officer), and Joe Critchley (Archaeological Technician).

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

Equipment

3.2.4 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

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

3.3 Known Constraints

3.3.1 A river bounds the south face of the site, this impacts upon the western area of the site, there is a steep bank running along the south of the western area down to the river (Plate 1). This was too steep to effectively survey.

Plate 1: View of bank by the river, facing west

3.3.2 The northern boundary of the site is made up of modern fencing (Plate 2); this has metallic components and created a small local area of magnetic disturbance c.1-3m. The south west corner of the eastern area of the site was fenced off and partially scrubland surrounding a firing range (Plate 3), as a result this was not able to be surveyed.

Plate 2: View of northern boundary, facing north

Plate 3: View of scrubland and firing range, facing south

3.3.3 In the north-west corner of the eastern side of the site there is a drinking trough for livestock (Plate 4), this created a small local area of magnetic disturbance c.2-4m.

Plate 4: View of metallic livestock trough, facing south

3.3.4 A large proportion of the site appears to be made ground which causes magnetic disturbance (Figure 4). This means that there is a high level of magnetic disturbance across the site. Since the survey equipment measures to c.2m below ground level it may be the case that archaeological features are present underneath the made ground.

4. RESULTS

4.1.1 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.

4.2 Geophysical Survey Results

4.2.1 Whilst Di-Polar anomalies are likely present on the site, due to the high levels of magnetic disturbance, along with the consistently high readings of this disturbance, it was not possible to differentiate Di-Polar anomalies from the magnetic disturbance.

4.2.2 Magnetic disturbance [**GP 1**] broadly covers the site, this exceeds the range that the data was recorded at, in the western area of the site the range is c. -100 to c. 96.7 nT. In the eastern area of the site the range is over c. -100 to c. 100 nT.

5. INTERPRETATIONS AND DISCUSSION

5.1.1 Interpretation of the results of geophysical survey is based on professional judgement as to the likely/probable cause of an anomaly or reading. For example, strong dipolar discrete anomalies of small size are often associated with ferrous debris or similarly magnetic debris. In addition, where a positive linear anomaly is recorded, which has a negative anomaly associated alongside either side of it, is often likely to relate to the line of a modern utility.

5.1.2 GP numbers have been used to place interpretations into categories. Below is a discussion of the results, there has also been applied a confidence rating to the features identified (See Appendix 1). 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.

Table 2: Interpretation of Geophysical Anomalies

AB No	Appearance	Potential Cause
GP 1	Negative and positive readings	Modern ground disturbance

5.1.3 Within the site, magnetic disturbance [**GP 1**] covers the majority of the site; this is visible in the interpretation data (Figure 4).

5.1.4 The Ordinance Survey Six-inch map (published in 1924) shows a field boundary running on a rough east to west axis; this is not visible in the geophysical survey data. The 1952 1:25,000 Ordinance Survey map also shows the same field boundary. This map also shows a sewage works in the eastern half of the western area of the site; this is also not visible in the geophysical survey data.

5.1.5 There is a high confidence that this disturbance is caused by re-landscaped ground based on previous mapping and the site visit.

6. CONCLUSION

6.1.1 A geophysical survey was undertaken by AB Heritage at the proposed development site at Ashchurch, Gloucestershire.

6.1.2 The purpose of this work was to understand the potential for any archaeological remains to survive within the site, and, where possible, identify the form, function and extent of any potential remains.

6.1.3 Overall the geophysical survey has identified no archaeological features and limited potential for archaeological remains. However, heavy magnetic disturbance [**GP 1**] covered much of the site and could have obscured any archaeological features.

7. ARCHIVE

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

Table 3: 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

7.1.2 A physical and digital archive will be stored in a suitable format at AB Heritage Limited offices in Taunton, Somerset.

8. REFERENCES

BGS (British Geological Society) 2015.*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, 2015.*Soilscapes viewer*, http://www.landis.org.uk/soilscapes/

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.

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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

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 2: 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.

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Legend

Site Boundary

Figure 1: Site Location and Field Identification

Project: Ashchurch, Gloucestershire	
Date: 27/04/16	Job Number: 10820
Drawn by: PB	Approved by: AB

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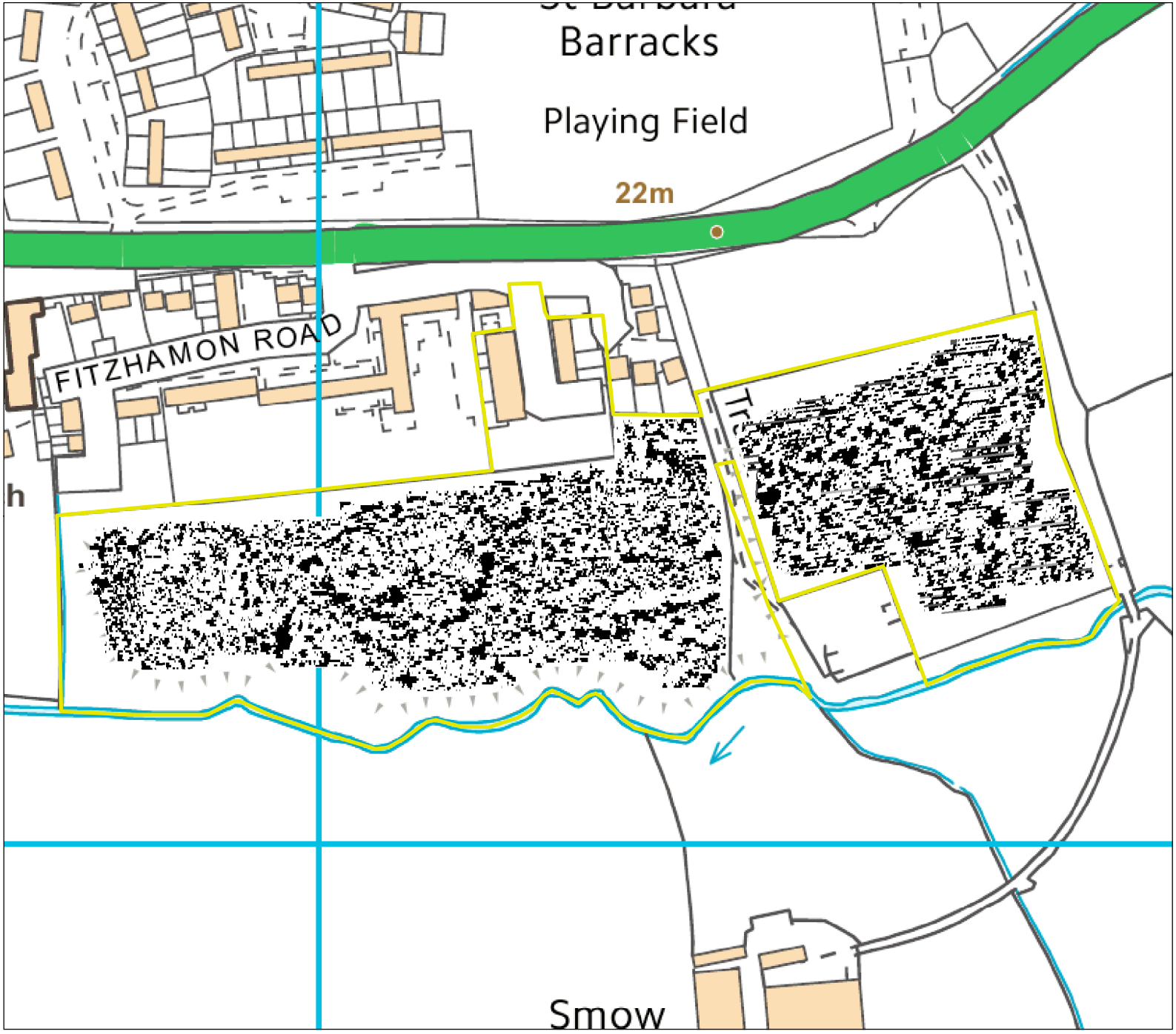

N

Legend

Site Boundary

+2

Plotting Perameters

-2

0 62.5 125 250 m

Figure 2: Raw Geophysical Data

Project: Ashchurch, Gloucestershire

Date: 27/04/16	Job Number: 10820
Drawn by: PB	Approved by: AB

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Legend

Site Boundary

+100

Plotting Perameters

-100

Figure 3: Processed Geophysical Data

Project: Ashchurch, Gloucestershire

Date: 27/04/16	Job Number: 10820
Drawn by: PB	Approved by: AB

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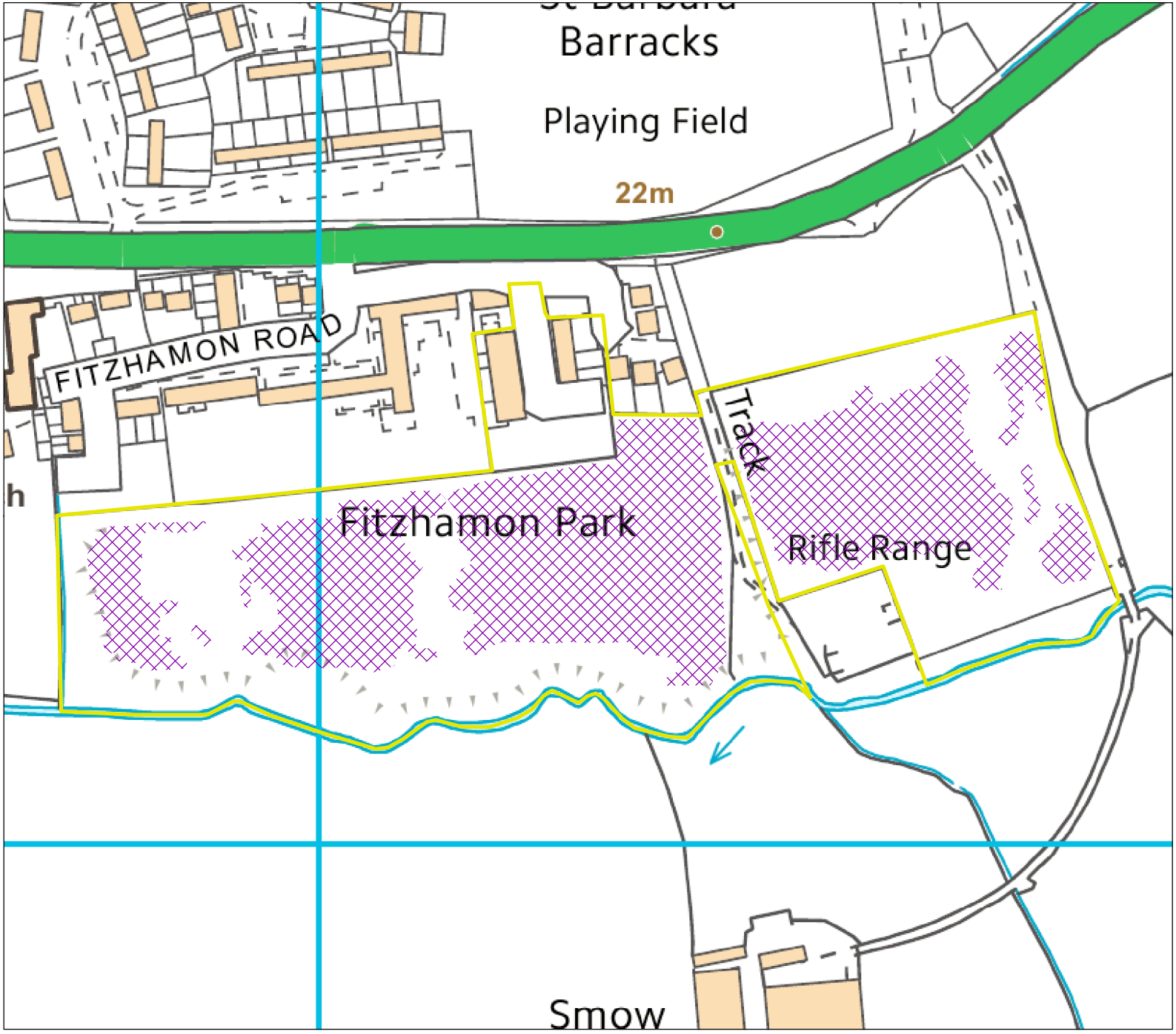

Legend

[GP1] Magnetic Disturbance

Site Boundary

Figure 4: Geophysical Data Results Interpretation

Project: Ashchurch, Gloucestershire

Date: 27/04/16	Job Number: 10820
Drawn by: PB	Approved by: AB

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