AB HERITAGE
ARCHAEOLOGICAL CONSULTANCY

The House, Brassington Lane, Old Tupton

Geophysical Survey Report

Client: TAYLOR HOLMWOOD

AB Heritage Project No: 10766

Date: 09/02/2016

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Geophysical Survey Report

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Project Number	**10766**
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1. NON TECHNICAL SUMMARY

1.1.1 AB Heritage Limited (herein AB Heritage) were commissioned to undertake a programme of geophysical survey over c. 0.7 ha of land at The House, Brassington Lane, Old Tupton. The survey took place on the 25th of January 2016, ahead of a proposed development.

1.1.2 Based on the geophysical survey there is low potential for the recovery of significant archaeological remains within the surveyed area.

2. INTRODUCTION

2.1 Project Background

2.1.1 AB Heritage have been commissioned by Taylor Holmwood to undertake a geophysical survey over c. 0.7 hectares (ha) of land at The House, Brassington Lane, Old Tupton, S42 6LB (Figure 1) ahead of a proposed development.

2.1.2 The purpose of this work is to identify any potential surviving archaeological remains.

2.2 Site Location & Description

2.2.1 The proposed development site is approximately centred on the National Grid Reference (NGR) SK 39160 65094 and is located c.5.5km south of Chesterfield and c. 1.75km to the west of North Wingfield.

2.2.2 To the west of the site lies Brassington Lane, beyond that Pear Tree Farm and pasture land. To the south and south-west, are modern and historical buildings (including Egstow Hall), and pasture. The north of the site is bordered by scrubland, and the east is bordered by woodland with a nearby fishpond (AB Heritage 2016).

2.2.3 At the time of survey the proposed development site was mostly grassland, though dump material, trees (both standing and felled), and fences were all present within the site boundary, making a large area of the site unable to be surveyed.

2.3 Geology & Topography

2.3.1 The majority of the proposed development site lies within a thin band of Parkgate Rock sandstone formed during the Carboniferous Period, when rivers in the area deposited sand and gravel detritus to form river terrace deposits.

2.3.2 The eastern edge of the site is beyond the band of Parkgate Rock, where the geology consists of the mudstone, siltstone, and sandstone of the Pennine Lower Coal Measures Formation. This bedrock was also formed in the Carboniferous Period, but in a setting of swamps and estuaries in coastal plains.

2.3.3 No superficial deposits have been recorded in the area of the site boundary (BGS 2016).

2.3.4 The proposed development site lies on a north and north-west facing slope, with a high point of c. 140m Above Ordnance Datum (AOD). The lowest area of the site is at the southern boundary at 130m AOD. The incline is gradual and has not affected the survey.

2.3.5 The overlying soils are restored soils with a loamy texture (Cranfield Soil and Agrifood Industry 2016).

2.3.6 These forms of geology and soils are not likely to have an effect on the results of the geophysical survey, with the response being good to average (Jones, 2008).

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
- Provide recommendations for any further archaeological work(s) necessary to contribute to the mitigation of the impacts of proposed development on these potential features.

3.2 Methodology of Survey Works Summary

Site Specific Information

3.2.1 A geophysical survey was undertaken covering an area of c. 0.7 ha on Monday the 25th of January 2016.

3.2.2 The AB Heritage staff members who undertook the works were Tom Cloherty (Archaeological Technician), and Peter Bonvoisin (Archaeological Technician).

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

Equipment

3.2.4 The magnetic survey equipment used was a 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 The GPS used to setup and reference the geophysical survey was a Trimble GeoXR, this has a sub-centimetre accuracy, suitable for this survey.

3.3 Known Constraints

3.3.1 Within the site boundary there were multiple factors that affected surveying. Some small areas of the site were inaccessible, due to trees, fencing, artificial bodies of standing water, and greenhouses. Plates 1 to 6 show examples of the conditions on site.

3.3.2 Plates 1 and 2 both show artificial bodies of water that remain on site.

Plate 1: Modern brick feature near the centre of the site, looking west.

Plate 2: Modern concrete feature in the south-east corner of the site facing south.

3.3.3 The eastern half of the site was covered by trees, fences, a pile of tree stumps, and dumped material. These unsurveyable areas have created some gaps in the results.

3.3.4 Plate 3 shows an area of surface disturbance and concrete slab. This cuts on a rough north-south axis through the site. Whilst this area was surveyable the results are expected to be disturbed.

Plate 3: A view of central concrete 'track' [GP 1], looking south.

Plate 4: Greenhouses and concrete shed in the south-east of the site, looking south.

Plate 5: Orchard on the east side of the site, looking south-west.

Plate 6: Part of one of the fences and part of the orchard on the east side of the site, looking east.

3.3.5 Plates 4, 5 and 6 show the obstructions that were found on the eastern side of the site. The area seen in Plate 4 was unsurveyable. The orchard seen in Plates 5 and 6 meant that some

gaps were left the survey results where trees were located. Plate 6 also shows metallic and wooden fencing which enclosed various areas across the site.

4. RESULTS

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

4.1.2 Below is a factual account of the results

4.2 Geophysical Survey Results

4.2.1 Following an approximate north south orientation, there is a large linear feature measuring approximately 60m long and 6m wide, with a variation of readings [**GP 1**] from -50 nanoteslas (nT) up to 100 nanoteslas (nT) .

4.2.2 The positive areas [**GP 2**], which are identified in Figure 4, have mostly high positive readings. The area in the south-west corner is c. 30 to 90 nt (c. 28m2). The northern most area has a reading of c. 9 nt (c.10m2) and the two remaining areas range from c. 20 to 30 nt (c. 15m2 for the north area and c. 8m2 for the southern area).

4.2.3 Di-polar anomalies [**GP 3**] are present on site; two are located in the north-west of the site.

4.2.4 There is magnetic disturbance [**GP 4**] that extends along the north and western side of the site and ranges from c. -5 to -60 nt.

5. INTERPRETATION 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 service.

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	Positive/negative features	Area of ground disturbance and concrete slab
GP 2	Positive areas	Ground disturbance
GP3	Di-Polar Anomalies	Magnetic debris
GP 4	Magnetic Disturbance	Magnetic debris or fencing

5.1.3 Orientated along a roughly north-south axis through the centre of the site is a large linear feature [**GP 1**], there is a high confidence that this identified feature has been caused by the location of a large concrete slab, with surrounding ground disturbance. (Plate 4)

5.1.4 There is a medium confidence that positive features in the western side of the site [**GP 2**] are caused by ground disturbance.

5.1.5 Two Di-Polar anomalies [**GP 3**] are present in the north-west area of the site likely caused by magnetic debris.

5.1.6 Within the site, magnetic disturbance [**GP 4**] borders the north and west edges of the site, there is a high confidence that these areas are caused by metallic fencing that borders the site.

6. CONCLUSION

6.1.1 A geophysical survey was undertaken by AB Heritage at the proposed development site at The House, Busk Lane. This took place on the 25th of January 2016.

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 Based on the geophysical survey it is likely that there is low potential for the recovery of significant archaeological remains with the surveyed area.

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

AB Heritage 2016. The House, Brassington Lane, Old Tupton: *Heritage Impact 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/

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.

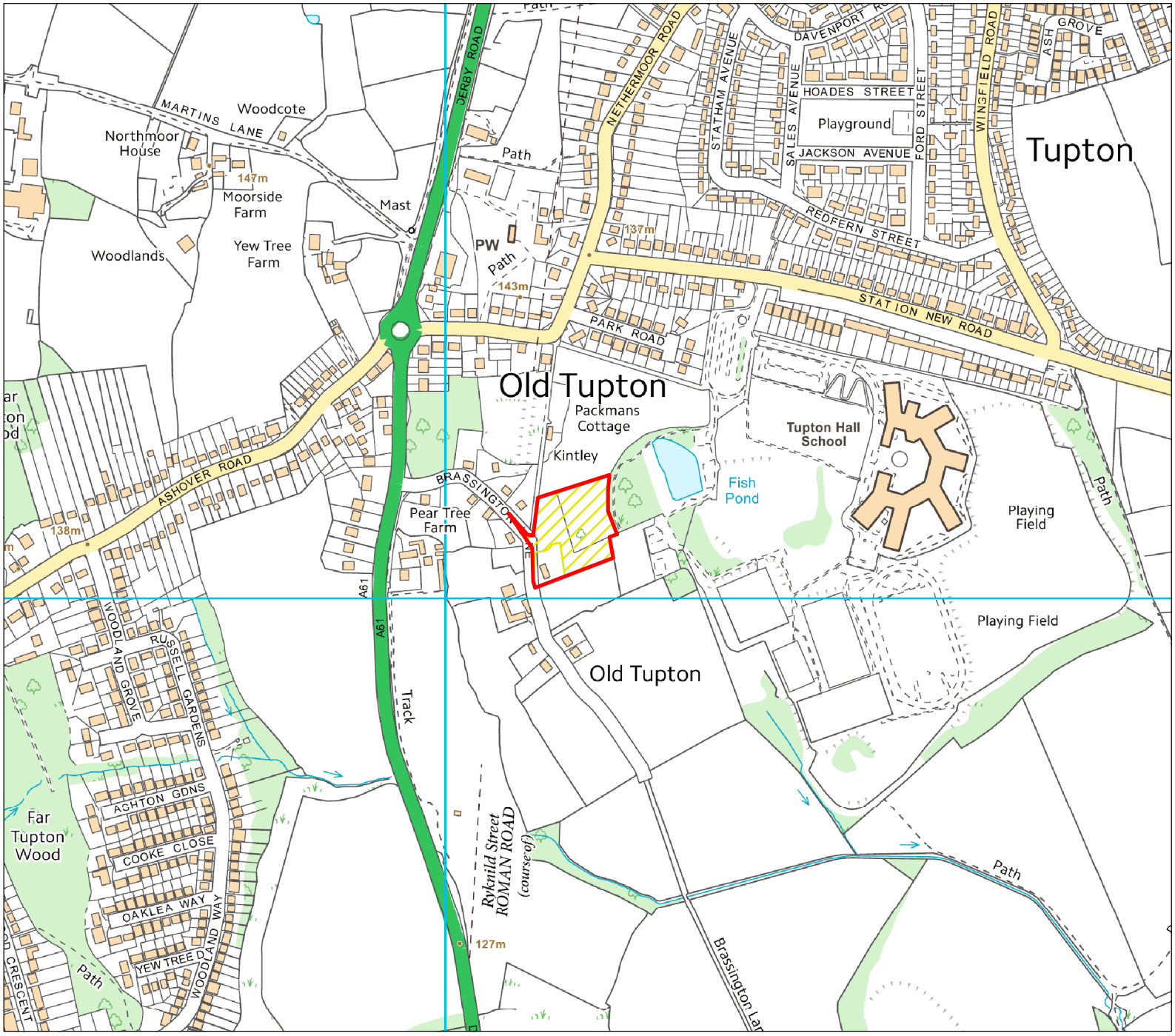

Figure 1: Site Location

Project: The House, Old Tupton

Date: 21/01/16	Job Number: 10766
Drawn by: ZE	Approved by: HS

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N

Legend

Survey Area

+2

Plotting Perameters

-2

0 12.5 25 50 m

Figure 2: Raw Geophysical Data

Project: The House, Old Tupon

Date: 01/02/16	Job Number: 10766
Drawn by: ZE	Approved by: GR

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N

Legend

Survey Area

+8

Plotting Perameters

-8

0 12.5 25 50 m

Figure 3: Processed Geophysical Data

Project: The House, Old Tupon

Date: 01/02/16	Job Number: 10766
Drawn by: ZE	Approved by: GR

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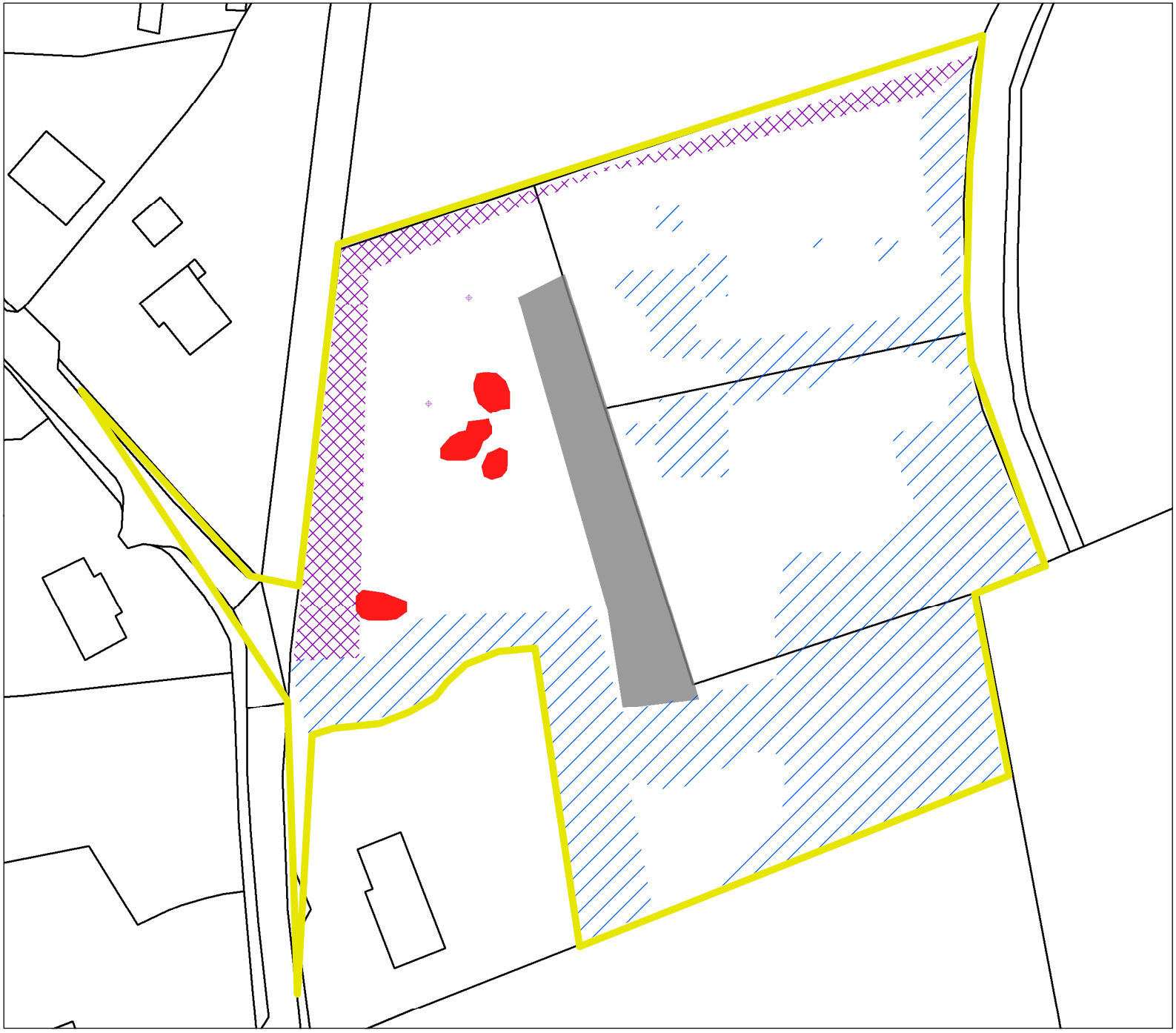

Legend

- Area of Surface Disturbance and Concrete Slab [GP1]
- Positive Area [GP2]
- Di-Polar Anomalies [GP3]
- Magnetic Disturbance [GP4]
- Unsurveyable Areas
- Survey Area

Figure 4: Interpretation of Geophysical Data

Project: The House, Old Tupon

Date: 01/02/16	Job Number: 10766
Drawn by: ZE	Approved by: GR

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