magnitude surveys

Geophysical Survey Report

of

Hill Farm Road,

Halesworth, Suffolk

For

CgMs Consulting

On Behalf Of

Hopkins Homes

Magnitude Surveys Ref: MSTM102

HER Parish Code: HWT 051

HER Event Number: ESF25449

March 2017

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a *c.* 6.7 ha area of land at Hill Farm Road, Halesworth, Suffolk. A fluxgate gradiometer survey was successfully completed and no anomalies of probable or possible archaeological origin have been identified. The geophysical results primarily reflect agricultural and modern activity, as well as natural variations in the soils and geology. A former field boundary/modern track has been detected in the eastern half of site, as well as several different ploughing regimes. Responses at the western end of the site may relate to former field boundaries.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by CgMs Consulting on behalf of Hopkins Homes to undertake a geophysical survey on a c. 6.7ha area of land off Hill Farm Road, Halesworth, Suffolk (TM 3954 7763).

1.2. The geophysical survey comprised quad-towed, cart-mounted fluxgate gradiometer survey.

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David *et al*., 2008), the Charted Institute of Field Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt *et al*., 2015).

1.4. The survey was conducted in-line with an archaeological evaluation brief by Suffolk County Council Archaeology Service (2015).

1.5. The survey commenced on 2nd March and took 1 day to complete.

2. Quality Assurance

2.1. Project management, survey work, data processing and report production have been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CIfA, 2014; David *et al*., 2008, Schmidt *et al*., 2015).

2.2. Magnitude Surveys is a corporate member of ISAP (International Society of Archaeological Prospection).

2.3. Director Graeme Attwood is a Member of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, as well as the Secretary of GeoSIG, the CIfA Geophysics Special Interest Group. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Director Chrys Harris is a doctoral candidate in archaeological geophysics at the University of Bradford.

2.4. All MS managers have postgraduate qualifications in archaeological geophysics. All MS field staff have relevant archaeology or geophysics degrees and supervisors have at least three years' field experience.

3. Objectives

3.1. The geophysical survey aimed to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

3.2. The site is located on the eastern fringe of Halesworth, Suffolk (Figure 1). The site is bounded to the south by housing, to the west by Halesworth Cemetery and to the north and east by hedgerows with agricultural land beyond. Survey was undertaken across two adjacent fields (Figure 2), which were not under cultivation or pasture usage at time of survey. Both fields slope gently down towards the south.

3.3. The underlying geology comprises Crag Group Gravel. In the northern part of the site, this is overlain by Lowestoft Formation Diamicton, and in the southern portion by Sand and Gravel of the same formation (British Geological Survey, 2017).

3.4. The soils consist of lime-rich loamy and clayey soils with impeded drainage (Soilscapes, 2017).

3.5. Survey considerations:

Survey Area	Ground Conditions	Further notes:
1	Under c. 30cm height grass. The ground sloped gently down towards the south.	This area is bisected by a track running east-west across the centre of the field. The western/southern periphery is formed by the gardens and properties of Hill Farm Road and Holton Road.
2	The ground cover was variable and consisted of low vegetation, areas of disturbed and waterlogged ground, and overgrown thickets. The ground sloped gently down towards the south.	The overgrown thickets and areas of badly disturbed ground, primarily located towards the northern and southern edges of this area, precluded survey in some areas.

5. Archaeological Background

5.1. The following section summarise the archaeological background of the site and its wider landscape from an Archaeology Desk-Based Assessment produced by CgMs Consulting (Flitcroft, 2016).

5.2. There are no recorded heritage assets within the site boundary and no recorded archaeological investigations have been undertaken within the site itself. A number of non-designated heritage assets have been recorded within a 1km radius of the site; although they primarily relate to features within the historic town centre of Halesworth.

5.3. No Prehistoric activity has been recorded on the site. Within the wider landscape, evidence for Prehistoric activity is primarily limited to artefactual remains, with a Bronze Age socketed axe recorded *c.* 100m south of site and flint tools recorded within the Halesworth town centre. Undated cropmarks c. 650m south of site may possible be Prehistoric in date.

5.4. There is no recorded evidence for Roman activity within the site boundary or the immediate vicinity of the site, although Roman pottery has been recovered from Halesworth itself. In the

wider landscape, a Roman road follows the line of the modern A144, which lies just over 1km away from the site.

5.5. Evidence for Saxon and Medieval occupation in the area is concentrated within Halesworth. The Medieval centre of Halesworth lies around 500m to the east of site, where Saxon finds have also been recovered. The site is also situated c. 375m east of the Medieval core of Hulton. The relative location of the site in relation to these villages indicates the site likely was part of the agricultural hinterland.

5.6. Map regression in the DBA tracks the changes in the configuration of the site's land usage. The site has remained in agricultural usage throughout the Post-Medieval and Modern periods. The 1884 Ordnance Survey map records the division between the adjacent eastern and western fields in its current location. In addition, a field boundary is recorded running east-west across the centre of Area 2, corresponding with the track noted during survey. Towards the northwestern end of the site, a boundary that is no longer extant is also indicated, orientated on a northeast-southwest alignment. A further shorter boundary associated with Hill Farm, located to the southwest of the site, is shown running parallel to this feature. The 1995 Ordnance Survey map records the construction of properties adjacent to the site on Hill Farm Road, Halton Road and The Paddocks.

6. Methodology

6.1. Data Collection

6.1.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1 m	200 Hz reprojected to 0.125 m

6.1.3. The magnetic data were collected using MS' bespoke quad-towed cart system.

6.1.3.1. MS' cart system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a Hemisphere S321 GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The Hemisphere S321 GNSS Smart Antenna is accurate to 0.008 m + 1 ppm in the horizontal and 0.015 m + 1 ppm in the vertical.

6.1.3.2. Magnetic and GPS data will be stored on an SD card within MS' bespoke datalogger. The datalogger is continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allows data collection, processing and visualisation to be monitored in real-time as fieldwork is ongoing.

6.1.3.3. Data were collected by traversing the survey area along the longest possible lines, to ensure that the data was efficiently collected and processed.

6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David *et al*., 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen *et al*. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3. Data Visualisation and Interpretation

6.3.2. This report presents the gradient of the sensors' total field data as greyscale images. Multiple greyscales images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 7). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.3. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street mapping, satellite imagery, historic mapping and LiDAR data. Google Earth (2017) was consulted as well, to track recent changes in the land usage.

7. Results

7.1. Qualification

7.1.1. Geophysical techniques are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

7.2. Discussion

7.2.1. The geophysical results are presented in consideration with satellite imagery (Figure 5) and historic mapping (Figure 6).

7.2.2. The fluxgate gradiometer survey has been successful in detecting a range of different categories of anomalies across the site. The results reveal a relatively quiet magnetic background, against which responses generated by natural, modern and agricultural processes are apparent. Modern intrusions are generally limited to the edges of the survey areas, reflecting adjacent structures and fencing. Natural responses have been identified across the site and reflect changes within the soil and superficial geology. Ploughing responses occur on several alignments in the eastern field, reflecting a combination of different cultivation regimes. These responses generally correlate well with features visible in recent satellite imagery. Responses associated with the location of former field boundaries have also been detected in Areas 1 and 2. Further anomalies have been classified as Undetermined, reflecting uncertainty surrounding their origins. These are considered more likely to reflect agricultural, natural or modern processes; a potential archaeological origin is considered less likely, but cannot be ruled out entirely.

7.3. Interpretation

7.3.1. General Statements

7.2.2.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.2.2.2. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes--although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.

7.2.2.1. **Ferrous (Discrete/Spread)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of modern metallic disturbance on or near the ground surface. A ferrous spread refers to a concentrated scattering of these discrete, dipolar anomalies. Broad dipolar ferrous responses from modern metallic features, such as fences, gates, neighbouring buildings and services, may mask any weaker underlying archaeological anomalies should they be present.

7.3.2. Magnetic Results - Specific Anomalies

7.2.2.1. **Ferrous –** A linear band of magnetic disturbance [**1a**] has been detected running approximately east-west across the centre of Area 1. [**1a**] corresponds with the current track (see 3.5) and a field boundary denoted on historic mapping (Figure 6). The nature of this response indicates the boundary has been filled with mixed metallic debris.

At the western end of Area 2, an area of ferrous material and weak linear response [**2a**] on a SW-NE alignment correlate with a change in vegetation visible in the satellite imagery (Figure 5), which appears to reflect the remnants of a former field boundary (Figure 6).

7.2.2.2. **Agricultural –** A series of parallel linear anomalies has been detected across Area 1 and are characteristic of ploughing activity. The nature of these closely spaced, weakly magnetically enhanced responses is typical of relatively modern agricultural activity, as opposed to ridge and furrow practices. The alignment of the responses correlates with ploughing trends visible in recent satellite imagery of the site (Figure 5; Google Earth, 2017). The ploughing responses exhibit stronger magnetic contrast in the southern half of Area 1; the regime on an east-west alignment runs parallel with the former field boundary that crosses Area 1. Weaker, more ephemeral ploughing trends have been identified on sub north-south alignments. Satellite imagery (Google Earth, 2017) shows that recent ploughing respects this boundary, with trends running east-south in the southern half and sub north-south in the northern half. However, a 1945 aerial photograph shows ploughing orientated sub north-south in both halves (Google Earth, 2017).

7.2.2.3. **Ferrous –** The perimeter of Area 1 is dominated by broad dipolar ferrous responses, generated by adjacent metal fencing and garden/residential structures.

The southeastern extent of Area 2 also contains extensive dipolar ferrous responses, associated with the dumping of material around the field entrance. At the western end of the field, an area of “Ferrous (Dipolar)”

Small, discrete responses across the site are attributed to ferrous debris on or near the ground surface.

7.2.2.4. **Natural –** Magnetic anomalies caused by natural variations in the soils and superficial geology have been detected across the site. Small, discrete responses scattered across the site are characteristic of superficial deposits (see 3.3). Concentrations of these deposits, visible in the data as amorphous accumulations,

have been categorised as 'Natural (Spread)'. It is conceivable that some of these discrete responses may have an anthropogenic origin; however, these would appear indistinguishable in the magnetic results from those responses produced by natural geology.

7.2.2.5 **Undetermined**—A strongly magnetic linear anomaly [**2b**] has been detected running northeast-southwest across the centre of Area 2. [**2b**] appears to occur on the same alignment as, and runs towards, a boundary marked on the 2nd edition Ordnance Survey map and may represent a continuation of this feature (Figure 6). To the east of this, several discrete anomalies and trends demonstrating increased magnetic response relative to the surrounding soil may be the result of modern and/or agricultural processes, or potentially reflect variations in the superficial geology.

An amorphous spread of increased magnetic response [**1b**], covering an area approximately 500m^2, was detected in the southeastern quadrant of Area 1. The XY traces (Figure 7) suggest that this is not generated by a purely ferrous source, and could reflect a combination of processes, potentially relating to sand and gravel extraction; such activity is denoted adjacent to the site in historic mapping (Figure 6).

8. Conclusions

8.1. A fluxgate gradiometer survey has been successfully undertaken on the site. A relatively quiet magnetic background has allowed a range of anomalies to be detected. Agricultural and modern activity has been detected across the site, as well as minor variations in the soils and geology. The detection of anomalies natural and anthropogenic in origin, weak and strong in magnitude, demonstrates the method has been effective at this site.

8.2. Agricultural activity is primarily evident through ploughing regimes across the eastern field. The former field boundary/modern track across the eastern field has also been detected, as well as responses potentially reflecting remnants of former field boundaries in the western field.

8.3. Anomalies of natural origin have been detected across the site. These responses most likely reflect variations in the recorded superficial deposits and localised changes in the susceptibility of the soil.

8.4. Modern activity is evidenced by ferrous responses, which are primarily limited to the perimeter of the site. Broad ferrous responses at the edges of the fields reflect adjacent fencing and structures, while scattered metallic debris has been detected across the fields.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes all reports to the ADS Grey Literature Library subject to any time embargo dictated by the client.

10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

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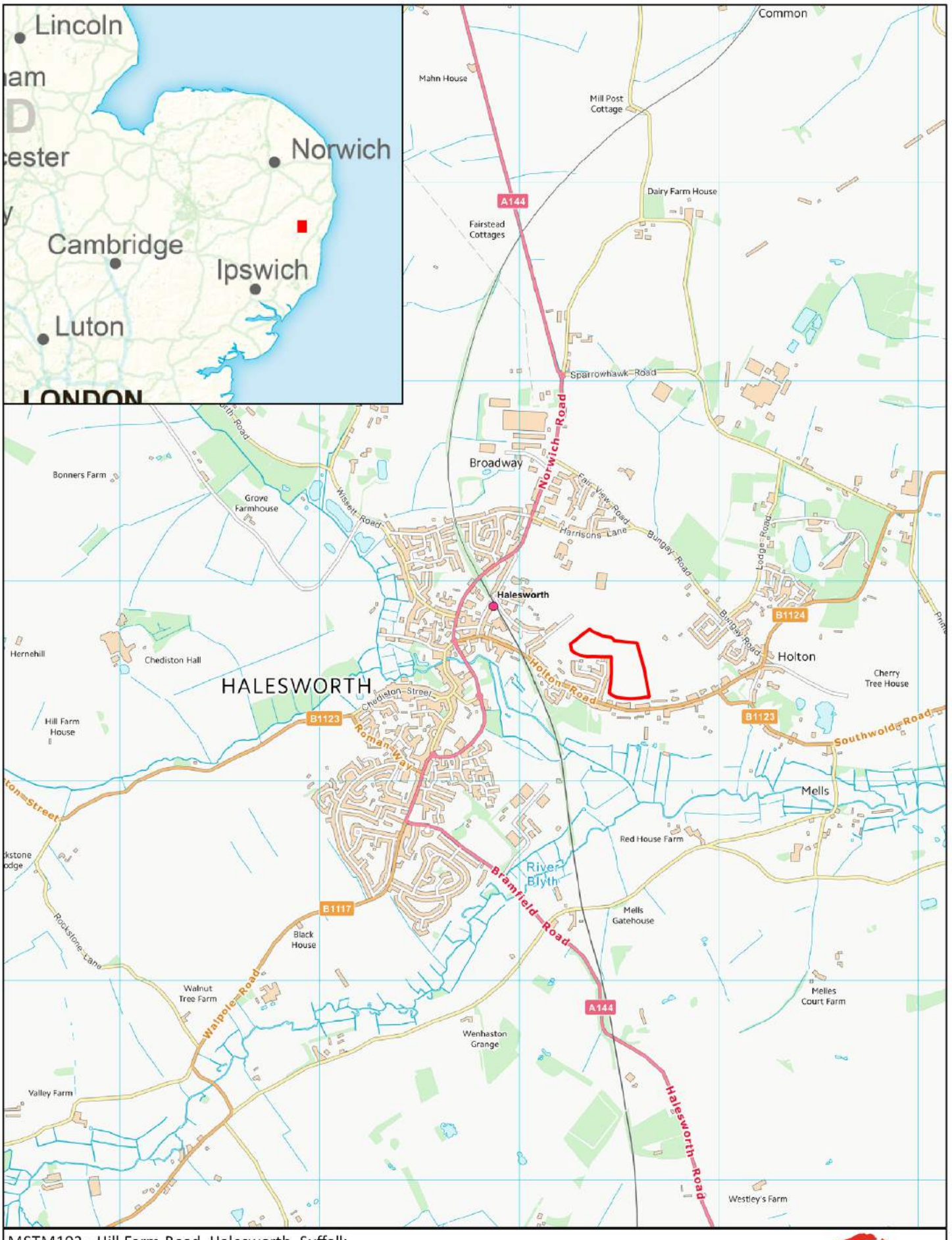

MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 1 - Site Location
1 : 25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

639000
640000
278000
277000
Halesworth
Holton Road
Bungay Road
Bungay Road
Lodge
B1124
B1123
Holton
Area 2
Area 1

MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 2 - Location of Survey Areas
1:5,000 @ A3

Surveyable Extent
Site Boundary

N
0 100 200 300 m

magnitude surveys

639200
639300
639400
639500
639600
639700
277700
277600
277500
277400
Area 2
Area 1
Road
MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 3 - Magnetic Greyscale
1:1500 @ A3

-1
nT
2
N
0
40
80
120 m
magnitude surveys

639200
639300
639400
639500
639600
639700
277700
277600
277500
277400

Area 2

2a
2a
2b

Area 1

1a
1b

Road

MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 4 - Magnetic Interpretation
1:1500 @ A3

Agricultural (Trend)
Undetermined (Trend)
Agricultural (Weak)
Ferrous (Dipolar)
Ferrous (Spread)
Natural (Strong)
Natural (Spread)
Natural (Weak)
Undetermined (Strong)
Undetermined (Weak)
Undetermined (Spread)

N

0 40 80 120 m

magnitude surveys

639200 639300 639400 639500 639600 639700

277700 277600 277500 277400

Area 2

2a

2a

2b

Area 1

1a

1b

MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 5 - Magnetic Interpretation - Satellite
1:1500 @ A3

- Agricultural (Trend)
- Undetermined (Trend)
- Agricultural (Weak)
- Ferrous (Dipolar)
- Ferrous (Spread)
- Natural (Strong)
- Natural (Spread)
- Natural (Weak)
- Undetermined (Strong)
- Undetermined (Weak)
- Undetermined (Spread)

N

0 40 80 120 m

magnitude surveys

639100 639200 639300 639400 639500 639600 639700 639800 639900 640000

277800 277700 277600 277500 277400 277300

Area 2

Area 1

2a

2a

2b

1a

1b

CEMETERY

CEMETERY

Chap.

Sch.

Mort. Chaps

Hill Farm

Post

B.M. 72·3

Castle House

U.D. By.

Old Gravel Pit

Gravel Pits

B P 48

B.P

B.M. 57·9

100

50

MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 6 - Magnetic Interpretation - Historic
1:2500 @ A3

Historic mapping Ordnance Survey, 6" 2nd edition c. 1882-1913 © National Library of Scotland

Agricultural (Trend)
Undetermined (Trend)
Agricultural (Weak)
Ferrous (Dipolar)
Ferrous (Spread)
Natural (Strong)
Natural (Spread)
Natural (Weak)
Undetermined (Strong)
Undetermined (Weak)
Undetermined (Spread)

N

0 60 120 180 m

magnitude surveys

639200
639300
639400
639500
639600
639700
277700
277600
277500
277400
Area 2
Area 1
Road
MSTM102 - Hill Farm Road, Halesworth, Suffolk
Figure 7 - XY Trace Plot
30nT/cm at 1:1500 @ A3

N
0
40
80
120 m
magnitude surveys

Appendix 1: Photos of Area 2 Ground Conditions