magnitude surveys

Geophysical Survey Report

of

Land off Butt Lane, Snaith

For

York Archaeological Trust

On Behalf Of

Midlands Construction ltd

Magnitude Surveys Ref: MSSE392

October 2018

magnitude surveys

Unit 17, Commerce Court

Challenge Way

Bradford

BD4 8NW

01274 926020

info@magnitudesurveys.co.uk

Version	Purpose/Revision	Author	Interpretation/Figures	Approved By	Date Issued
Draft 1.0	Initial draft	Hugo Kesterton Bsc Chris Nelson MA MPhil	Chris Nelson MA MPhil	Marta Fortuny BA MA	17 October 2018
Draft 1.1	Draft to client	n/a	Marta Fortuny MA BA	Finnegan Pope-Carter BSc MSc FGS	19 October 2018

Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c.1.7ha area of arable land off Butt Lane, Snaith, East Riding of Yorkshire. A fluxgate magnetometer survey was successfully completed and anomalies of probable or possible archaeological origin have been identified. The geophysical results primarily reflect linear anomalies that have been interpreted as a series of Iron Age/Roman enclosures, possibly a field system. A single ploughing regime has been detected across the survey area, with a spread of material collocating with a former field boundary and footpath (still in use), shown on historic mapping. Modern activity is limited to ferrous 'halo' anomalies associated with material along field boundaries.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by York Archaeological Trust on behalf of Midlands Construction ltd to undertake a geophysical survey on a c.1.7ha area of land off Butt Lane, Snaith, East Riding of Yorkshire (SE 6434 2173).

1.2. The geophysical survey comprised hand-carried GNSS-positioned fluxgate magnetometer survey.

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

1.4. The survey commenced on 09/10/2018 and took 1 day to complete.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

2.2. Director Graeme Attwood is a Member of CIfA, 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 has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of the International Society for Archaeological Prospection.

2.3. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

3. Objectives

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

4. Geographic Background

4.1. The site is located off Butt Lane on the southern fringe of Snaith, East Riding of Yorkshire (Figure 1). Survey was undertaken across a single arable field, bounded by housing off South Parkway to the north, Butt Lane to the east, and housing off Oakdale Close and Walnut Crescent to the west; the field extended beyond the survey area to the south, beyond which were additional agricultural fields and then the M62. Ground conditions were flat, though there was a sugar beet crop in the east part of the survey area (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	Flat arable field. Two thirds of the field to the west was ploughed and the eastern third contained a sugar beet crop.	Telegraph pole towards the northern edge of the field, on the boundary between the ploughed ground and sugar beets, with telegraph wires running in a southeast direction. Manhole cover towards the northeast corner of the survey area. Bounded by Hedgerow and wooden fence on the northern edge, hedgerow on the southern edge, and wooden fence on the western edge; the field continued beyond the survey area to the south.

4.3. The underlying geology comprises sandstone of the Sherwood Sandstone Group, with superficial deposits of sand and gravel of Lacustrine Brach Deposits (British Geological Survey, 2018).

4.4. The soils consist of freely draining slightly acid sandy soils (Soilscapes, 2018).

5. Archaeological Background

5.1. The following section provides a brief overview of the archaeological background of the site, summarising a search on Heritage Gateway (2018), within 1km from NGR: SE 6434 2173.

5.2. There are no heritage assets recorded on site.

5.3. Iron Age or Roman ditched enclosures and trackways or boundary ditches (MHU22483) were identified from cropmarks c.250m south from the site. Further Roman activity within the site's environs has been recorded from an inhumation with tile and coins (HER No. 1323) located c.520m north-northwest from the site, and a Roman coin (HER No. 1324) recovered c.680m northwest from the site.

5.4. The vast majority of heritage assets are recorded within the Medieval Settlement of Snaith (HER No. 9679), located c.300m north from the site. It comprises numerous designated and non-designated buildings, pits and ditches, pottery finds and kilns, all of Medieval to Post-Medieval in date.

5.5. The site is denoted in historic maps to stretch across three different enclosed fields until the 1964-1971 OS Plan, when the boundaries are removed and only a footpath remains running north-south across the eastern portion of the site.

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	1m	200Hz reprojected to 0.125m

6.1.3. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

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

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

6.1.3.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

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

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the upper and/or lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 8). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historic maps, LiDAR data, and soil and geology maps. Google Earth (2018) was consulted as well, to compare the results with recent land usages.

7. Results

7.1. Qualification

7.1.1. Geophysical results 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 maps (Figure 6).

7.2.2. The fluxgate magnetometer survey has responded well to the survey area's environment. Anomalies of a probable and possible archaeological origin have been detected, as well as features related to agricultural practices.

7.2.3. Several linear magnetic anomalies have been detected across the site, which may relate to an Iron Age or Romano-British field system. The overall orientation of the archaeological features (NW-SE) isn't respected by the ploughing trends or current field boundaries (N-S), supporting an earlier origin for the anomalies of archaeological origin.

7.2.4. A clear regime of former ploughing has been detected across the site in the form of consistent linear responses. A former field boundary and footpath has been detected as a spread of magnetic material, which is shown on historic mapping. The footpath is still in use.

7.2.5. Modern activity is limited to ferrous 'halo' anomalies along the field boundaries and small near surface metal objects scattered across the survey area.

7.3. Interpretation

7.3.1. General Statements

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

7.3.1.2. **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.

7.3.1.3. **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 deposition 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

7.3.2.1. **Archaeology Probable (Enclosures) -** A series of linear positive magnetic anomalies. These features are morphologically similar to those recorded as cropmarks of possible Iron Age/Roman ditched enclosures and trackways or boundary ditches, located c.250m south of the survey area (5. Archaeological Background). The linear anomaly to the east (**A**) may be a trackway; it is recorded running northeast-southwest. Very faint cropmarks are visible on recent satellite imagery which match the orientation of the geophysical anomalies, suggesting the features extend further to the south.

7.3.2.2. **Archaeology Possible –** Several weak negative anomalies forming a possible sub-circular ditched enclosure (**B**), c.28m in diameter. This may represent an earlier phase of land enclosure; however, due to the ephemeral nature of the anomalies and truncation by stronger archaeological anomalies and later ploughing, makes it difficult to clearly distinguish potential phasing of features.

7.3.2.3. **Agriculture –** A single phase of ploughing has been detected across the survey area as consistent linear anomalies. A trackway and field boundary mapped on early editions of the OS map has been detected as a spread of highly magnetic material. The footpath continues to serve as an unenclosed field boundary, between two different crops, with the field boundary being removed sometime between 1956 and 1964.

8. Conclusions

8.1. A fluxgate magnetometer survey was successfully undertaken across the site, with anomalies of a probable and possible archaeological, agricultural and modern origin being identified.

8.2. Archaeological activity in the form of a series of linear anomalies has been interpreted possible Iron Age/Roman enclosures and a trackway, possibly related to a more extensive field system and settlement pattern recorded to the south of the site.

8.3. Agricultural activity was detected in the form of ploughing across the survey area and a footpath and former field boundary.

8.4. Modern activity is evidenced by ferrous 'halo' along field boundaries and a scatter of small ferrous responses probably related to small near-surface metal objects.

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 reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

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.

11. References

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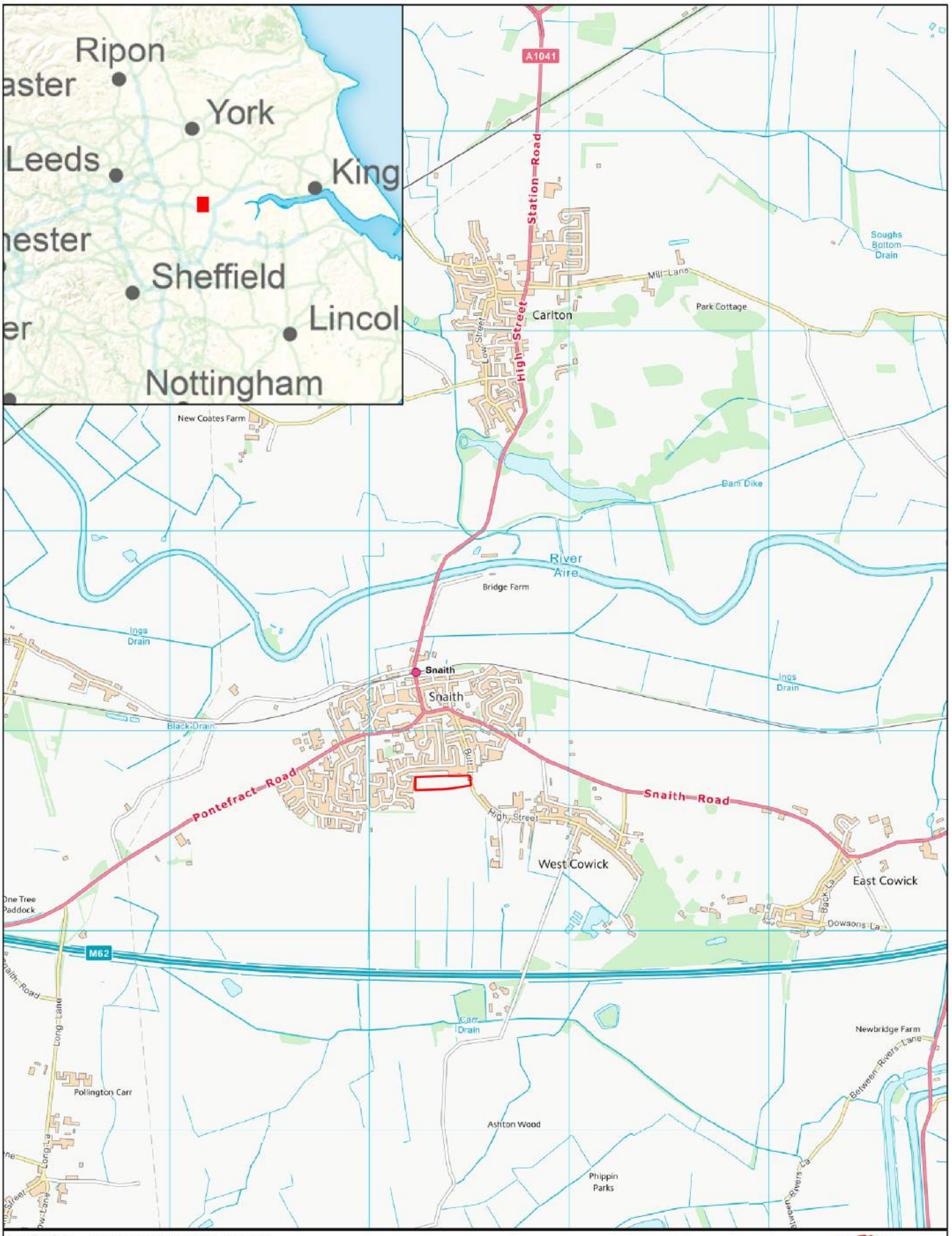

MSSE392 - Land off Butt Lane, Snaith
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

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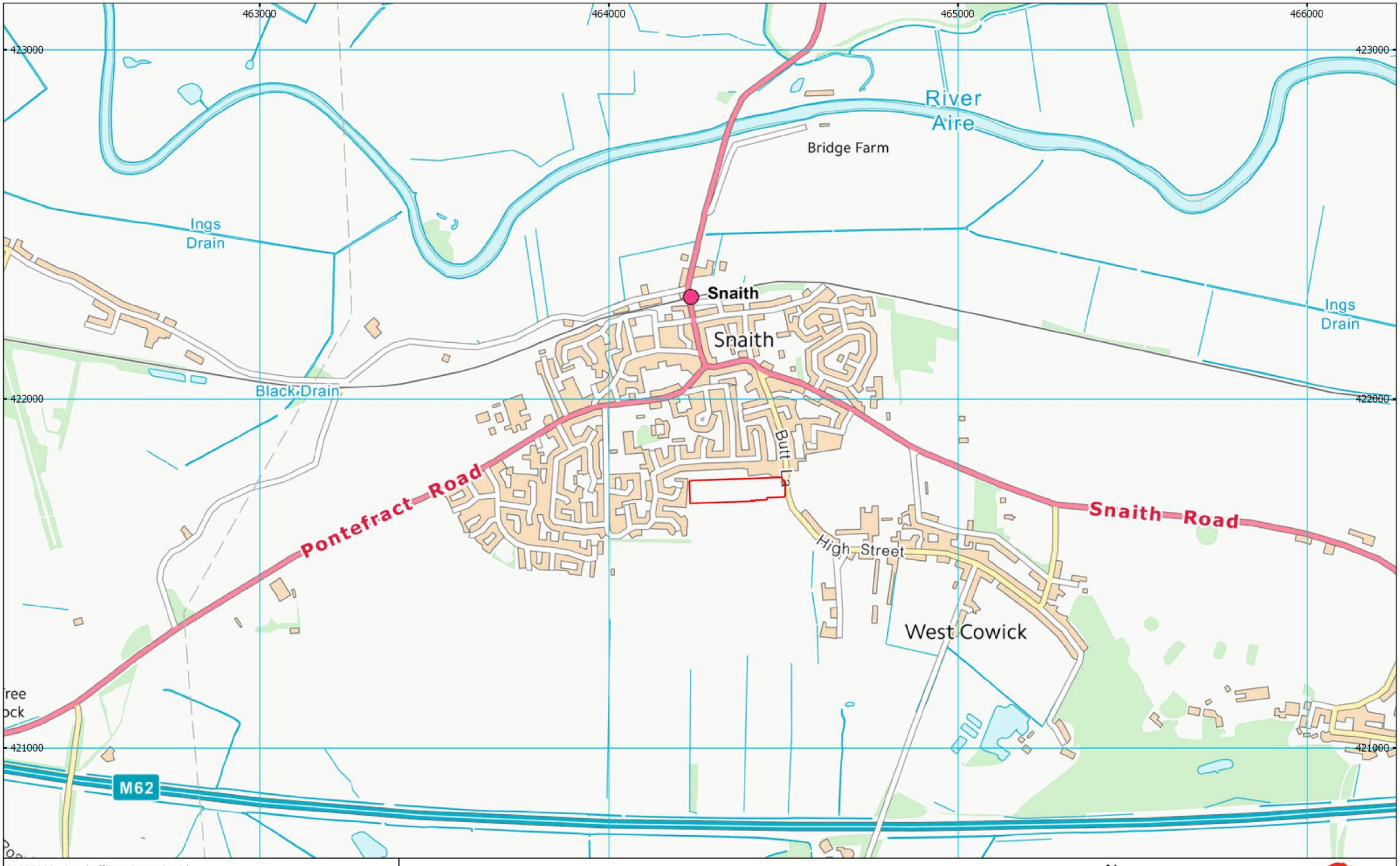

MSSE392 - Land off Butt Lane, Snaith
Figure 2 - Location of Survey Area
1:10,000 @ A3

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464200
464300
464400
464500
421800
421800
421700
421700

MSSE392 - Land off Butt Lane, Snaith
Figure 3 - Magnetic Total Field
1:1,000 @ A3

48,998 nT 49,003

N

0 20 40 60 m

magnitude surveys

464200
464300
464400
464500
421800
421800
421700
421700

MSSE392 - Land off Butt Lane, Snaith
Figure 4 - Magnetic Gradient
1:1,000 @ A3

-1 nT 2

N

0 20 40 60 m

magnitude surveys

464200
464300
464400
464500
421800
421700
A
B

MSSE392 - Land off Butt Lane, Snaith
Figure 5 - Magnetic Interpretation
1:1,000 @ A3

Archaeology Probable (Strong)
Archaeology Probable (Weak)
Archaeology Probable (Trend)
Archaeology Possible (Strong)
Archaeology Possible (Weak)
Archaeology Possible (Trend)
Agricultural (Spread)
Agricultural (Trend)
Ferrous (Dipolar)
Ferrous (Spread)

N
0 20 40 60 m

magnitude surveys

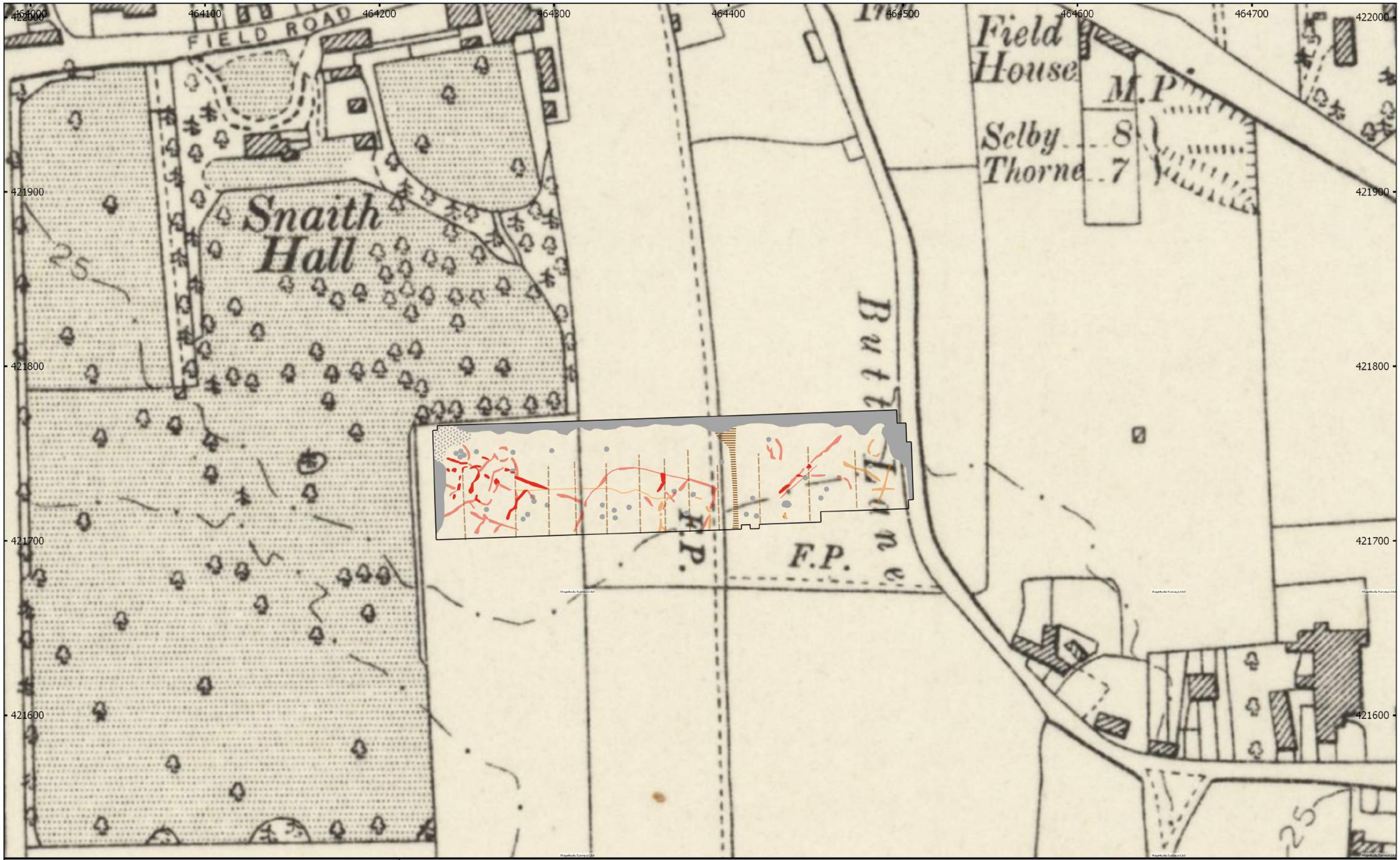
MSSE392 - Land off Butt Lane, Snaith
Figure 6 - Magnetic Interpretation Over Satellite Imagery
1:2,000 @ A3

- Archaeology Probable (Strong)
- Archaeology Probable (Weak)
- Archaeology Probable (Trend)
- Archaeology Possible (Strong)
- Archaeology Possible (Weak)
- Archaeology Possible (Trend)
- Agricultural (Spread)
- Agricultural (Trend)
- Ferrous (Dipolar)
- Ferrous (Spread)

N

0 50 100 150 m

magnitude surveys



MSSE392 - Land off Butt Lane, Snaith
Figure 7 - Magnetic Interpretation Over Historic Maps
1:2,000 @ A3

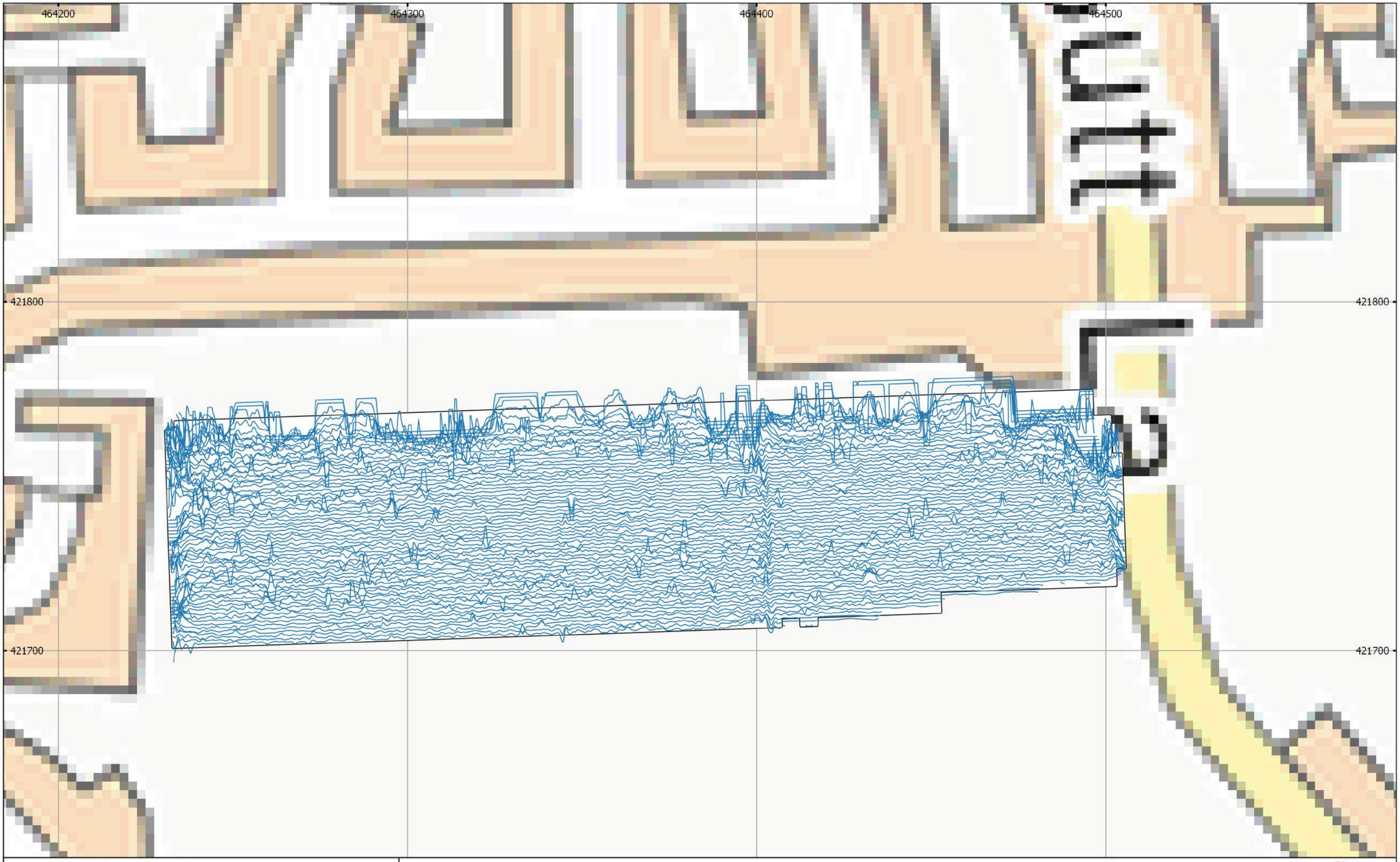
Contains historic maps: Ordnance Survey, 6" 2nd edition c. 1882-1913 © National Library of Scotland

- Archaeology Probable (Strong)
- Archaeology Probable (Weak)
- Archaeology Probable (Trend)
- Archaeology Possible (Strong)
- Archaeology Possible (Weak)
- Archaeology Possible (Trend)
- Agricultural (Spread)
- Agricultural (Trend)
- Ferrous (Dipolar)
- Ferrous (Spread)

N

0 50 100 150 m

magnitude surveys



MSSE392 - Land off Butt Lane, Snaith
Figure 8 - XY Trace Plot
20nT/cm at 1:1,000 @ A3

N

0 20 40 60 m

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