Land at Red Lodge,

Suffolk

Geophysical Survey Report MSTL16

For

Pre-Construct Archaeology

On Behalf Of

CgMs Consulting

Magnitude Surveys Ref: MSTL16

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magnitude surveys

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Abstract

Magnitude Surveys was commissioned to assess the archaeological landscape of *c.* 25 ha of land at Red Lodge, Suffolk through geophysical survey. A cart-based magnetometer survey was successfully completed and no anomalies of an archaeological or probable archaeological origin have been identified. The geophysical results primarily reflect agricultural and modern activity. Anomalies pertaining to modern agricultural processes have been identified, as well as areas of ferrous noise. The ferrous noise has been caused by modern development in the areas surrounding the site. A number of anomalies have been detected that cannot be attributed to specific origins and likely reflect natural, agricultural and modern processes.

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Detailed figures at 1:1000 are available on the archive disk.

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by Pre-Construct Archaeology (PCA) on behalf of CgMs Consulting (CGMS) to undertake a geophysical survey on land at Red Lodge, Suffolk (TL 706 713). The geophysical survey comprised:

1.1.1. Hand pulled, cart-mounted fluxgate gradiometer survey.

1.2. 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).

1.3. The survey commenced on 21 March 2016 and took four days 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. Graeme Attwood is a Member of the Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group.

2.4. 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.

3. Objectives

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

3.2. The survey forms part of the archaeological mitigation required by the planning archaeologist and shall be used to inform the location of any trenches, should they be required.

4. Geographic Background

4.1. The underlying geology comprises Holywell Nodular Chalk formation and New Pit Chalk formation; no superficial deposits have been recorded (BGS, 2016). Historic England guidelines state the magnetometer response to survey over chalk is good (David et al., 2008).

4.2. The soils consist of freely draining slightly acid and sandy soils to the south and freely draining lime-rich soils to the north (Soilscapes, 2016).

4.3. The largest field, at the site's northern end, comprises approximately half of the survey area. This field was under stubble and sloped gently down from north to south. The fields at the site's southern end were smaller, many of which contained detritus from previous development schemes (see Section 7 for further detail).

5. Archaeological Background

5.1. The following forms a brief summary of the known archaeological assets within 1 km of the site, as compiled by Heritage Gateway.

5.2. A Palaeolithic hand axe (Pastscape ID 380148) was discovered from Bay Farm, Worlington approximately 1 km west of the site. Further to the west lies the Swales Tumulus (NMR 1875251 & Suffolk HER MSF 8016). The Tumulus is approximately 28 m in diameter and is mostly ploughed out in its present state. Numerous sherds of Neolithic pottery and burnt bone were discovered during excavation (MSF 8015).

5.3. A pair of round barrows of unknown date are recorded northeast of the site (MSF 223 and 224). An additional group of four barrows, only one of which remains extant, are recorded to the north of site (Pastscape ID 380101).

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 1000L fluxgate gradiometer	0.75 m	10 Hz projected to 0.125 m

6.1.3. The magnetic data were collected using MS' bespoke hand-pulled cart system.

6.1.3.1. The cart system supports the magnetic and GPS instruments with a bespoke datalogger. The magnetic instruments comprise two Bartington Instruments 1000L fluxgate gradiometers operating in NMEA mode. Positional referencing is through a Hemisphere S320 RTK GPS outputting in NMEA mode. Corrections were made through Topcon TopNet. Data from both instruments were logged in a bespoke datalogger. Data were transferred to a laptop computer for processing.

6.1.3.2. A series of temporary sight markers were established in each survey area to guide the surveyor and ensure full coverage with the cart. 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 using bespoke software produced by MS. Processing steps were limited to:

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

6.3.1. Magnetic greyscales should be viewed alongside the accompanying XY trace plots. XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

7. Survey Considerations

Refer to Figure 2 for survey area locations. F

Survey Area	No. Survey Blocks	Surveyed Y/N	Ground Conditions	Further Notes:
1	1	Y	Stubble	The field was bounded to south by a large wire fence and to the west by the embankment of the A11. Directly south of the field was a large industrial unit.
2	1	Y	Young cereal crop	The field was bounded by the west by a wire fence.
3	3	Y	Stubble	Large mounds of earth and rubble from previous development precluded survey in some areas. Further detritus was encountered throughout the survey block. A compound was located at the western end of the survey area.
4	4	Y	Stubble	Large mounds of earth and rubble from previous developments precluded survey in some areas.

8. Results

8.1. Qualification

8.1.1. *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.*

8.2. Discussion

8.2.1. The geophysical results, both greyscale images and XY traces, were interpreted in consideration with satellite imagery (Google Earth, 2016; Figure 5) and historic mapping (Ordnance Survey, 6" 2nd edition *c.*1882-1913; Figure 6).

8.2.2. The geophysical results primarily reflect modern and agricultural activity. A major gas service crosses through Area 1, which produces an overwhelming magnetic halo that at some points is 60 m in diameter. Within Areas 3 and 4, much of the results are dominated by spreads of strong, discrete signals. These anomalies will almost certainly have been caused by the large-scale modern development of the surrounding site.

8.3. Interpretation

8.3.1. General Statements

8.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually. Specific anomalies discussed within the text have been assigned numbers, which are emboldened within square parenthesis e.g. [**1**].

8.3.1.2. **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.

8.3.1.3. **Ferrous** – A number of discrete ferrous-like anomalies have been mapped throughout all survey areas. These responses are likely to be the result of modern metallic disturbance on or near the ground surface. Broad 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. A gas main crosses Area 1 on a southwest-northeast alignment. Large

portions of Areas 3 and 4 are dominated by ferrous noise that has been produced through the surrounding modern activity. This includes the nearby building works, which have impacted the land during construction and through the subsequent dumping of material within the survey areas. This activity can be seen in the satellite imagery (Figure 5) and the resulting noise is best visualised in the XY trace plots.

8.3.2. Magnetic Results - Specific Anomalies

8.3.2.1. **Natural** – Natural subtle variations in the magnetic properties of the topsoil have been detected. This natural variation creates the patterned effect across most of Area 2 and is also visible from the southwestern corner of Area 1 to the northeastern corner of Area 4.

8.3.2.2. **Agricultural** – Soil compaction caused by the wheels of agricultural machinery has been detected as slight, linear negative responses. These lines are visible throughout Area 1, while only some ruts are visible in Area 2. A similar effect has been caused by construction traffic in Areas 3 and 4.

8.3.2.3. **Undetermined** – The majority of Undetermined anomalies exhibit only very subtle magnetic changes and are likely agricultural or natural in origin. A group of weak, linear anomalies are detected towards the centre of Area 4 (Figure 25-27). Due to their alignments and nature of geophysical response, these anomalies are likely agricultural in origin, potentially reflecting a former ploughing regime. However, an archaeological origin cannot be entirely ruled out.

8.3.2.4. **Undetermined** – A stronger group of Undetermined anomalies form a sub rectangular shape within the eastern half of Area 3. However, the shaping of these anomalies is likely more coincidental than an archaeological patterning. These anomalies are more likely resultant of some disturbance caused by the modern activity on site.

9. Conclusions

9.1. No anomalies of an archaeological or probable archaeological origin have been identified in the survey results. Large areas of the data are dominated by ferrous noise, which is resultant from the modern activity in the areas surrounding the site. A gas pipe has been detected in Area 1, which has produced overwhelming magnetic signals that may mask any weaker archaeological signals, should they be present. The wheel ruts created by agricultural machinery have been detected as weak, parallel linear anomalies. A number of anomalies have been detected that cannot be attributed to specific origins and likely reflect natural, agricultural and modern processes.

10. Archiving

10.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013).

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

10.3. Whenever possible, MS has a policy of making data available to view in easy to use forms on its website. This can benefit the client by making all of their reports available in a single repository, while also being a useful resource for research. Should a client wish to impose a time embargo on the availability of data this can be achieved in discussion with MS.

11. Copyright

11.1. 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.

12. References

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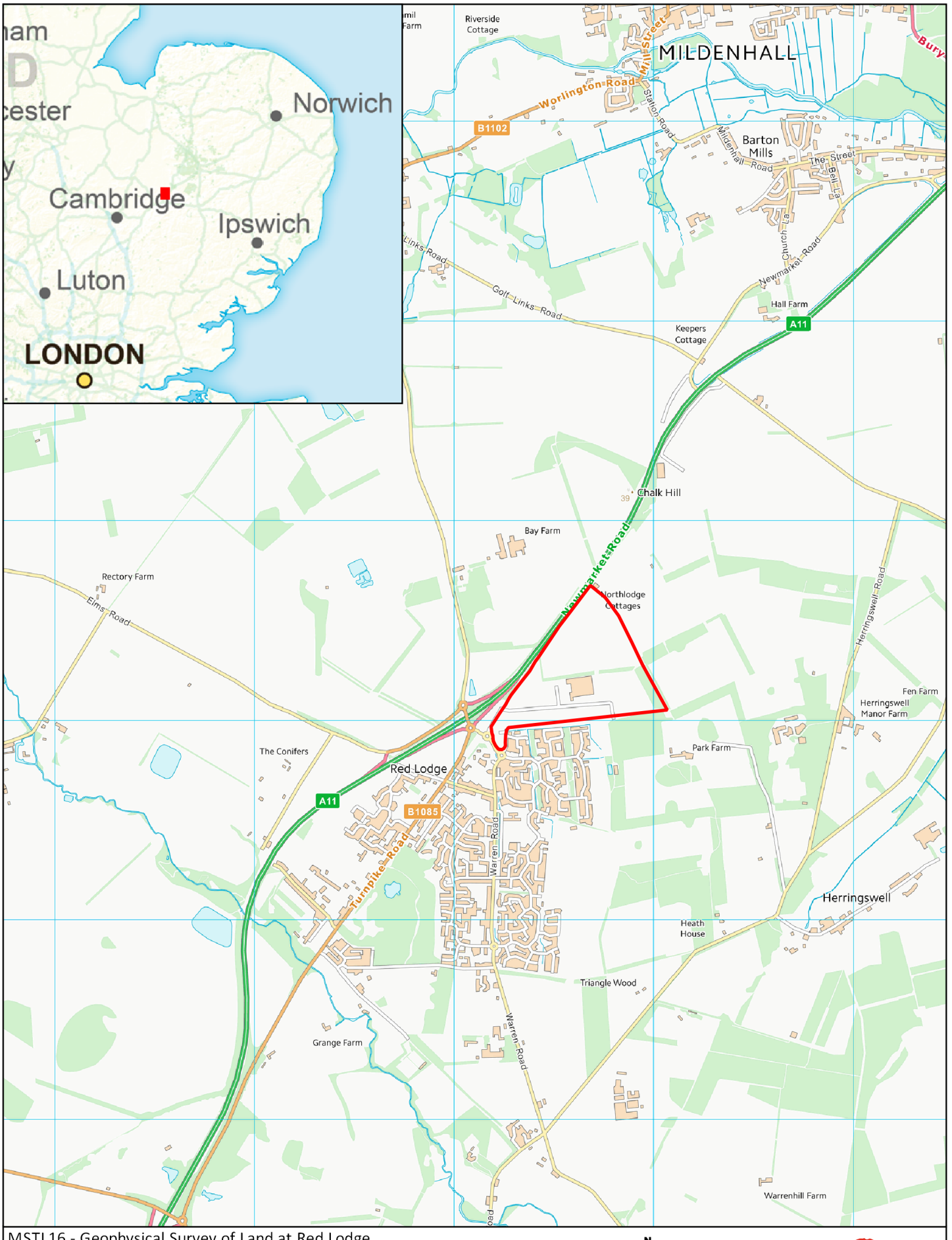

MSTL16 - Geophysical Survey of Land at Red Lodge
Figure 1 - Site Location
1 : 25,000 @ A4

Survey Area

N
W
E
S

0 0.5 1 km

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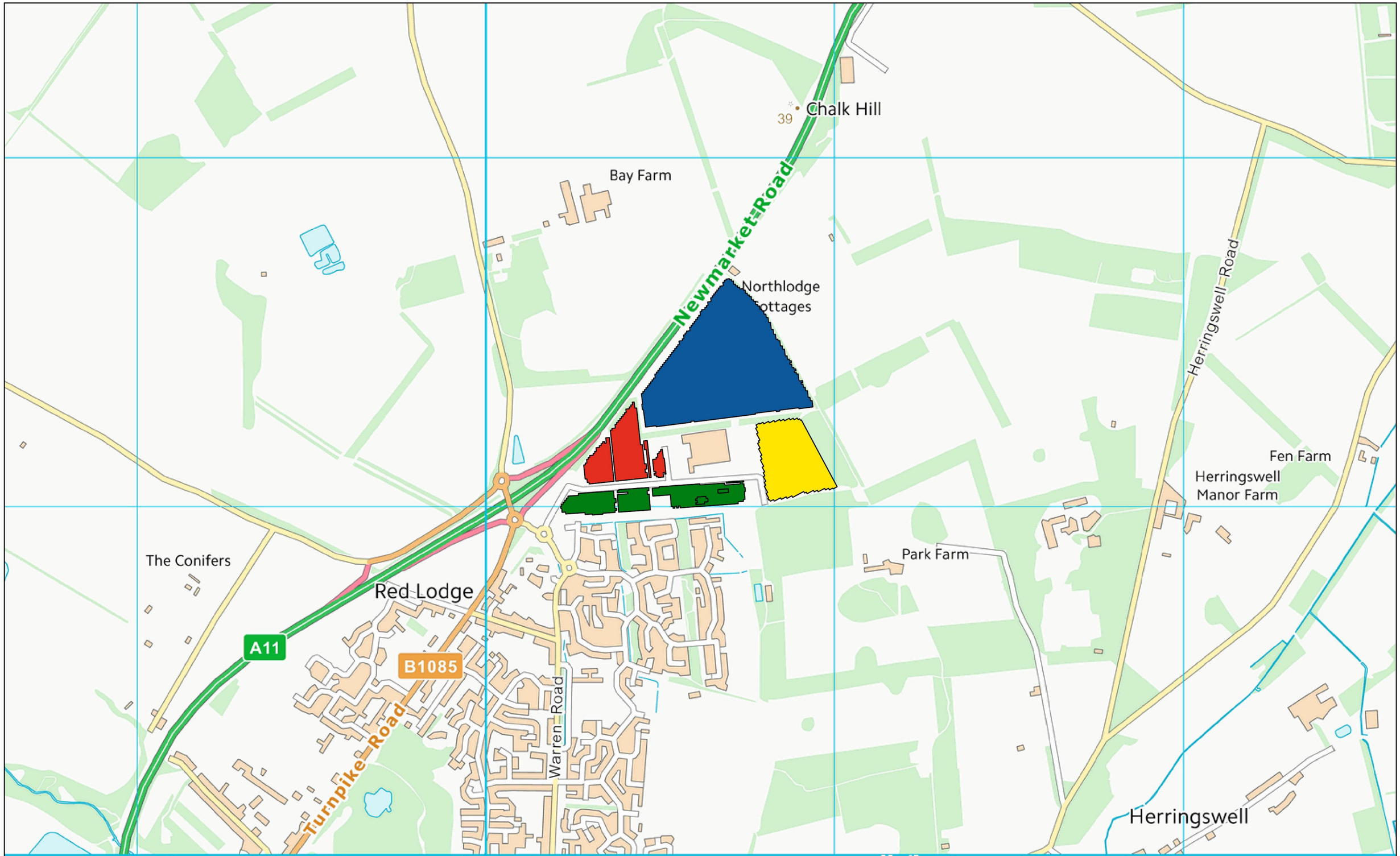

MSTL16 - Geophysical Survey of Land at Red Lodge
Figure 2 - Location of Survey Areas
1 : 10,000 @ A3

Area 1 Area 3
Area 2 Area 4

N W E S

0 200 400 600 m

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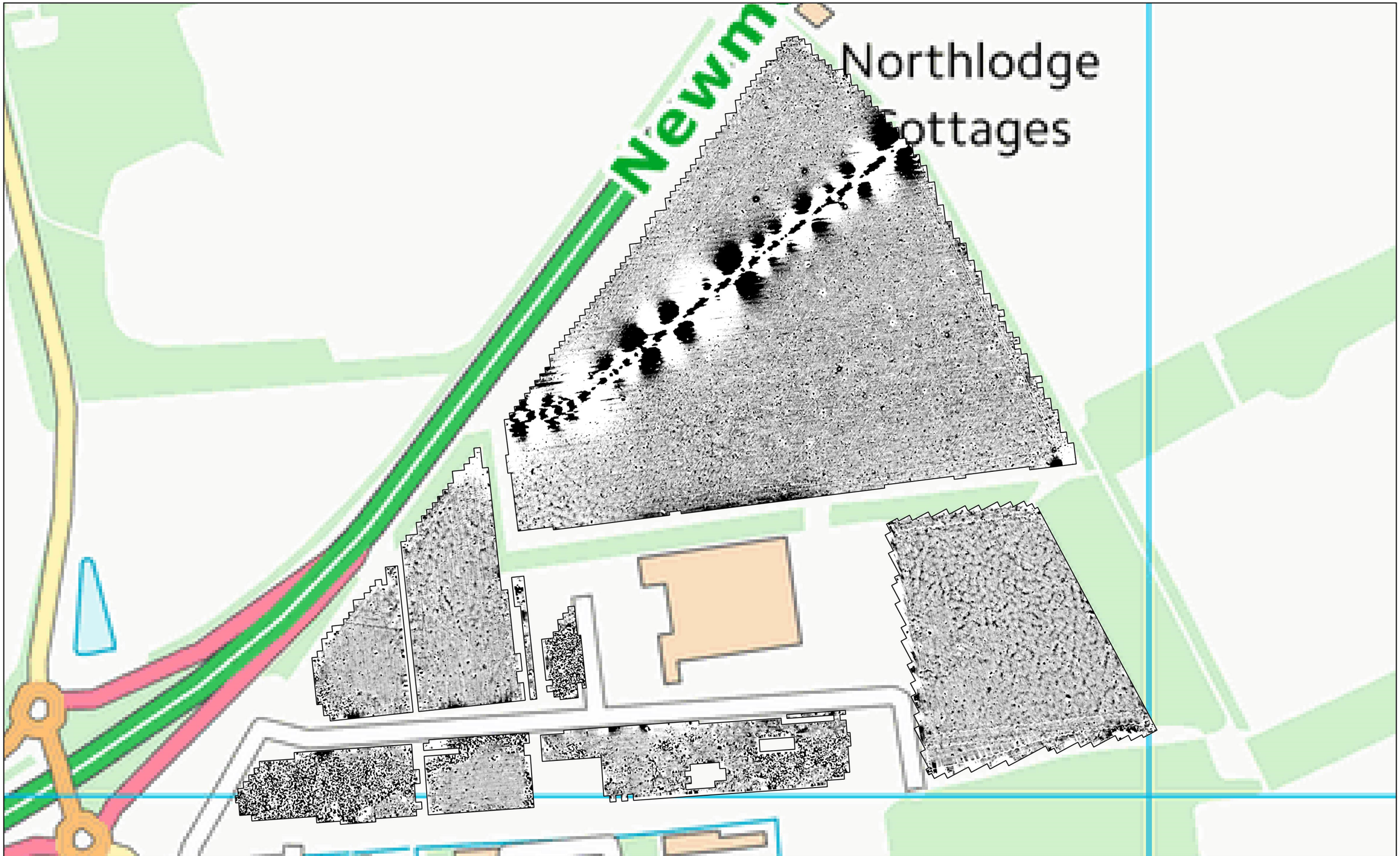

MSTL16 - Geophysical Survey of Land at Red Lodge
Figure 3 - Magnetic Greyscale - Overview
1 : 3000 @ A3

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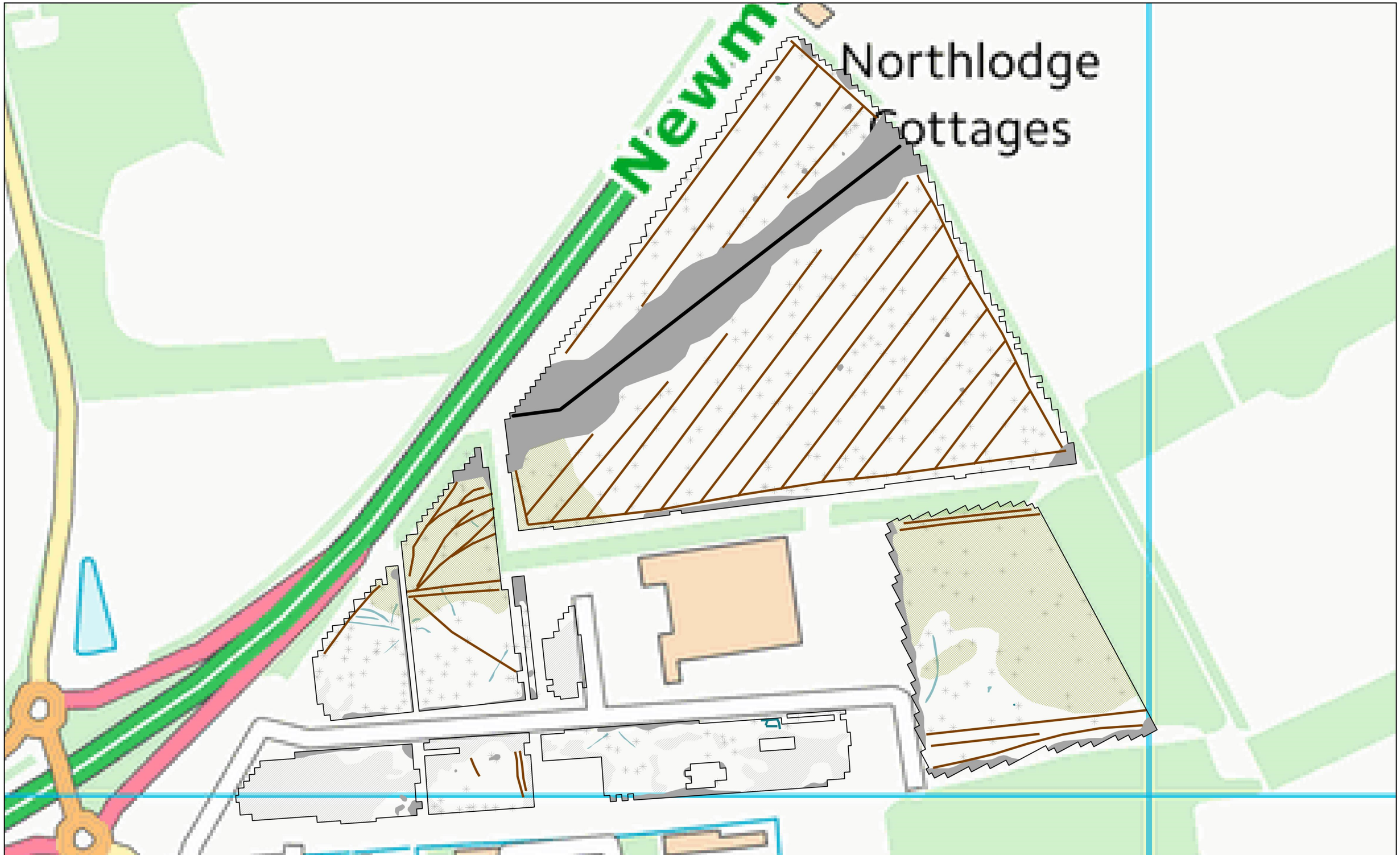


MSTL16 - Geophysical Survey of Land at Red Lodge
Figure 4 - Magnetic Interpretation - Overview
1 : 3000 @ A3

Undetermined (Strong)
Undetermined (Weak)
Natural (Spread)
Ferrous (Spread)
Ferrous (Dipolar)
Undetermined
Agricultural
Service
Magnetic - Points

N
W
E
S

0 60 120 180 m

magnitude surveys

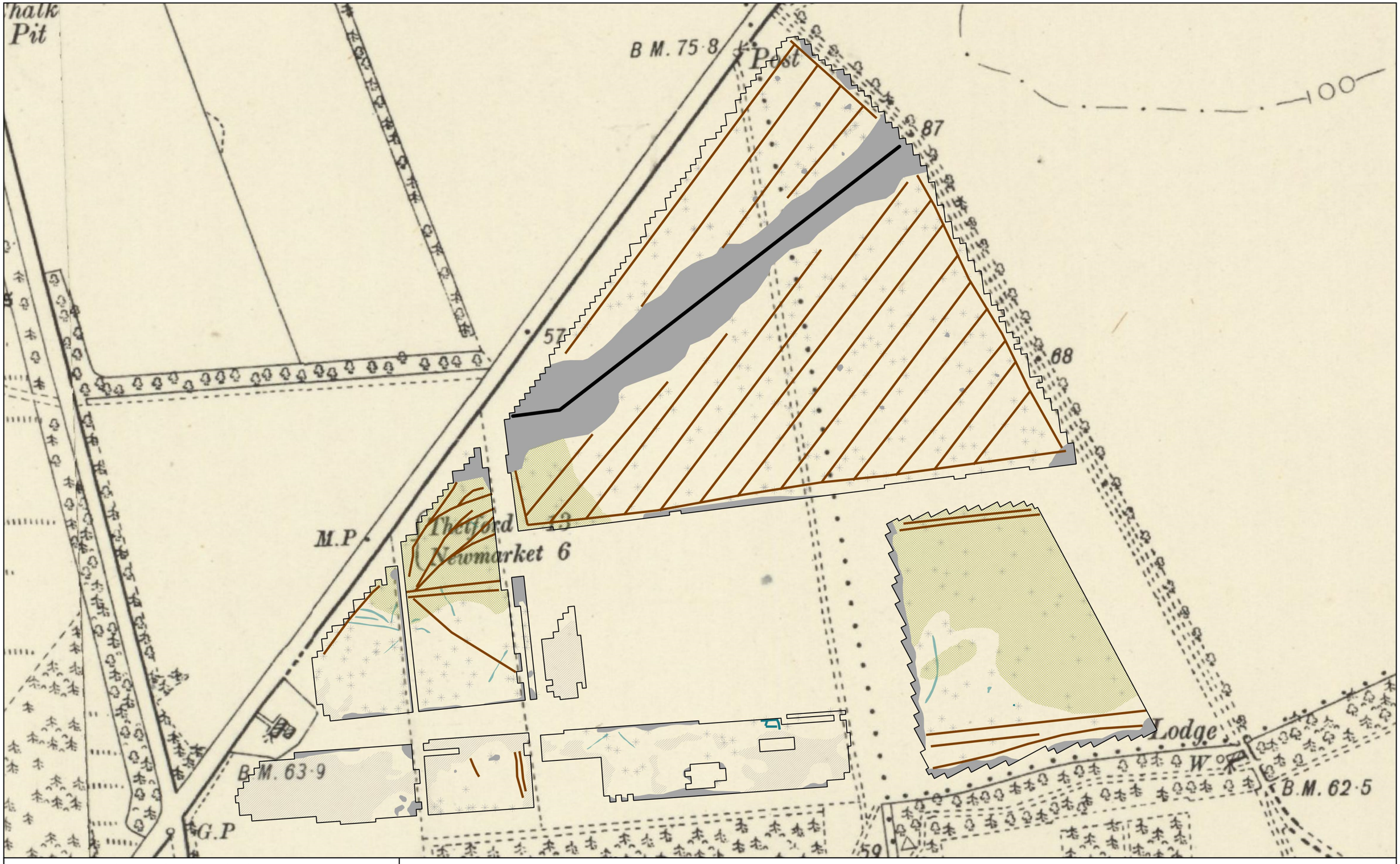
MSTL16 - Geophysical Survey of Land at Red Lodge
Figure 5 - Magnetic Interpretation - Satellite Imagery - Overview
1 : 3000 @ A3

Undetermined (Strong)
Undetermined (Weak)
Natural (Spread)
Ferrous (Spread)
Ferrous (Dipolar)
Undetermined
Agricultural
Service
Magnetic - Points

N
W
E
S

0 60 120 180 m

magnitude surveys



MSTL16 - Geophysical Survey of Land at Red Lodge
Figure 6 - Magnetic Interpretation - Historic mapping - Overview
1 : 3000 @ A3

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

Undetermined (Strong)
Undetermined (Weak)
Natural (Spread)
Ferrous (Spread)
Ferrous (Dipolar)
Undetermined
Agricultural
Service
Magnetic - Points

N
W
E
S

0 60 120 180 m

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