



LAND TO THE REAR OF HIGH STREET, NEWMARKET, SUFFOLK

DETAILED MAGNETOMETER SURVEY





**LAND TO THE REAR OF HIGH STREET,
NEWMARKET, SUFFOLK**

Detailed Magnetometer Survey

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Site Code	XSF NEW 11	NGR	NGR 563781 263180
Report Number	1005	OASIS	TBC
Approved By	Matthew Adams	DATE	
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ABSTRACT

Detailed fluxgate gradiometer survey on land to the rear of High Street, Newmarket, Suffolk, recorded anomalies relating to the sites previous land use as agricultural land and more recently as a stables and paddocks.

Weak positive linear anomalies indicative of agricultural furrows were recorded aligned on different orientations to the modern field boundaries and roads. A broad curvilinear anomaly present over the position of an extant earthwork and cropmark demarcates the location of a modern horse track. Twelve discrete pit type anomalies of possible archaeological, or equally natural or modern origin were recorded within the dataset. Three broad linear anomalies record the location of modern pathways.

Areas of magnetic disturbance were present where the demolition of a barn and swimming pool had taken place in the recent past. These strong readings may be masking weaker archaeological anomalies that could survive beneath. Predominant in the dataset were a plethora of isolated dipolar ('iron spike') responses probably introduced through manuring or perhaps equestrian paraphernalia lost within the topsoil. One strong dipolar linear response orientated approximately east to west records the position of a ferrous service run.

1.0 INTRODUCTION

On the 19th of July 2012, Britannia Archaeology Ltd (BA) undertook detailed magnetometer survey on land to the rear of High Street, Newmarket, Suffolk (NGR 563781 263180) in advance of the construction of a supermarket. The survey was undertaken on behalf of Aileen Connor of Oxford Archaeology East, in response to a brief (dated 29th May 2012) prepared by Dr Jess Tipper of Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT) on 3.5 hectares of land previously used as paddocks. The weather was overcast with occasional sunny periods and showers.

2.0 SITE DESCRIPTION

The site is located in the historic core of Newmarket to the north of High Street. It is bounded by Rowley Drive to the north, Black Bear Lane to the east, Fitzroy Stables to the south-east and by private properties to the south and west. The area totals 3.5 hectares on land formerly used as paddocks, bisected by a tarmac drive which is unsuitable for magnetometer survey.

The bedrock comprises Holywell Nodular Chalk and New Pit Chalk Formation a sedimentary bedrock formed approximately 89 to 99 million years ago in the Cretaceous Period, when the environment was dominated by warm chalk seas. There are no records describing the superficial deposits however archaeological monitoring nearby at Church Lane describes the soil as sandy silt.



3.0 PLANNING POLICIES

The archaeological investigation is to be carried out on the recommendation of the local planning authority, following guidance laid down by the National Planning and Policy Framework (NPPF, DCLD 2012) which replaces Planning Policy Statement 5: Planning for the Historic Environment (PPS5, DCLG 2010). The relevant local planning policies also include the Forest Heath *Local Plan* (Policy 8.20, 1995).

3.1 *National Planning Policy Framework (NPPF, DCLG March 2012)*

The NPPF recognises that 'heritage assets' are an irreplaceable resource and planning authorities should conserve them in a manner appropriate to their significance when considering development. It requires developers to record and advance understanding of the significance of any heritage assets to be lost (wholly or in part) in a manner proportionate to their importance and the impact, and to make this evidence (and any archive generated) publicly accessible. The key areas for consideration are:

- The significance of the heritage asset and its setting in relation to the proposed development;
- The level of detail should be proportionate to the assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance;
- Significance (of the heritage asset) can be harmed or lost through alteration or destruction, or development within its setting. As heritage assets are irreplaceable, any harm or loss should require clear and convincing justification;
- Local planning authorities should not permit loss of the whole or part of a heritage asset without taking all reasonable steps to ensure the new development will proceed after the loss has occurred;
- Non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets.

3.2 *Forest Heath Local Plan, (Policy 8.20, 1995)*

Forest Heath's local plan development plan was adopted in 1995 and has undergone some revision since. A Core Strategy was released in 2010 and an updated assessment of their Heritage Policy is pending. The Council's position on heritage assets is summarised as follows:

- The District Council will seek provision to be made for the evaluation of archaeological sites of unknown importance and areas of high potential prior to the determination of development proposals. Where nationally or locally important sites, whether scheduled or not, and their settings, are effected by proposed development, there will be a presumption in favour of their preservation. On sites where there is no overriding case for preservation, development will not normally be permitted unless agreement has been reached to provide either for their preservation or for their recording and, where desirable, their excavation prior to development.



4.0 ARCHAEOLOGICAL BACKGROUND

There is a general dearth of finds and features recorded in the area with no records present within the bounds of the site. It appears that the plot has been used as fields since the medieval period and archaeology of a medieval or earlier date is therefore likely to be preserved.

5.0 PROJECT AIMS

This specific aim of the geophysical survey and subsequent targeted trial trench evaluation is to enable the archaeological resource, both in quality and extent, to be accurately quantified.

6.0 METHODOLOGY

6.1 Instrument Type Justification

Britannia Archaeology Ltd employed a Bartington Dual Grad 601-2 fluxgate gradiometer to undertake the survey, because of its high sensitivity and rapid ground coverage. The soils and underlying geology were relatively receptive to magnetometer survey, with adequate contrast between the anomalies and the relatively low magnetic susceptibility of the sandy silt natural drift geology.

6.2 Instrument Calibration

The Magnetometer was left on for a minimum of 20 minutes in the morning for the sensors to settle before the start of the first grid. The instrument was zeroed after every three grids to minimise the effect of sensor drift. A set-up station with low magnetic susceptibility was easy to locate, this same station was used exclusively throughout the survey to align the sensors providing a common zero point. The geophysical surveyors noted that instrument drift was relatively minor throughout the survey.

6.3 Sampling Interval and Grid Size

The sampling interval was 0.125m along 1m traverse intervals providing 8 readings a metre, the magnetometer survey was undertaken on 20 x 20m grids.

6.4 Survey Grid Location

The survey grid was set out to the Ordnance Survey OSGB36 datum to an accuracy of $\pm 0.1\text{m}$ employing a Leica Viva Glonass Smart Rover differential global positioning system (DGPS). Data were then converted to the National Grid Transformation OSTN02 and the instrument was regularly tested using stations with known ETRS89 coordinates. The grid was positioned parallel to the long axis of the field for ease of survey progression.



6.5 Data Capture

Instrument readings were recorded on an internal data logger which were downloaded to a laptop at midday and at the end of the survey. The grid order was recorded on a BA pro-forma to aid in the creation of the composites. Data were filed in job specific folders and broken up into individual field composite datasets. These data composites were checked for quality on site by BA, allowing grids to be re-surveyed if necessary. The data were backed up onto an external storage device in the office and finally a remote server at the end of the day. A five metre exclusion zone was left between the boundaries and the survey area to reduce the amount of disturbance caused by metal boundary fences *etc.* Large areas of dumped material and metal objects also had a five metre exclusion zone to the nearest survey point. Ferrous objects, spoil heaps, hardcore-rubble and tarmac surfaces were accurately recorded using a DGPS to help with the dataset interpretation. The extant horse race track earthwork was also accurately surveyed and plotted (see Figures 1-7).

6.6 Data Presentation and Processing

Only minimal processing of the data set was undertaken:

De-spike: X diameter = 3, Y diameter = 3, Threshold = 1, centre value=mean, replace with = mean;
Data Clipping: -3/+3 nT;
De-stripe: Traverse, Mean, X (Horizontal), Threshold = 2 SD's (Maintain Survey Mean);
Data Display: Clip to -3/+3.

Raw and processed greyscale/XY trace plots were produced for comparison, ensuring that no anomalies were processed out of the original dataset. An interpretation plan characterising the anomalies was produced drawing together the evidence collated from the greyscale and XY trace plots. All figures were tied into the National Grid and printed to an appropriate scale.

6.7 Software

Raw data was downloaded using Bartington software Grad601 and will be stored in this format as raw data. The software used to process the data and produce the composites was DW Consulting's Archeosurveyor v2.0. Datasets were then exported into AutoCAD and placed onto the local survey grid. An interpretation plot was then produced using AutoCAD.

7.0 RESULTS

The results reveal that there were 12 discrete positive anomalies, one strong positive broad curvilinear anomaly, two weakly positive broad linear anomalies, 19 weak positive linear anomalies, one broad weakly negative linear anomaly, one strong dipolar linear



anomaly, large areas of magnetic disturbance and a plethora of dipolar isolated responses (Figure 7).

Twelve discrete positive anomalies were present across the site that may prove to be of archaeological origin and are possible rubbish pits. However a modern, natural or fire heated origin cannot be ruled out. One of these anomalies (coloured green) is present over the remains of a cut down tree.

The most striking anomaly present within the dataset is the broad strong positive curvilinear anomaly that is the remains of a probable modern oval horse track, located to the south of the tarmac drive. It is still clearly extant and its position was recorded by BA using a DGPS. This anomaly is characterised by strong positive responses present along its entire course, the track's surface being the likely cause of the readings. It can also be clearly witnessed on aerial photographs and is probably of modern origin, falling out of use some time before 1999 (earliest available photograph available on Google Earth).

Two broad linear weakly positive anomalies are also present. The first located in the centre of the horse track aligned parallel to the long-edge of the horse track (south-west to north-east). The second is just outside the track to the west and aligned almost north-south. Both probably originate from around the time that the horse track was in use meaning they are modern in date, however an archaeological origin cannot be ruled out.

One broad weakly negative linear anomaly aligned north-east to south-west is located over the position of a former pathway, its surface make-up causing the negative readings. This pathway appears to go out of use by the time the 2007 Google Earth air photograph was taken.

Weak positive linear anomalies aligned north-east to south-west are present on either side of the central tarmac driveway. Testament to the former agricultural practices undertaken on site before it became a stable and paddocks. They could possibly relate to remnant ridge and furrow or other agricultural regimes and are perhaps of medieval or post-medieval origin.

The most numerous anomalies (perhaps not surprisingly) are the dipolar isolated responses ('iron-spike') that are present throughout the dataset. This ferrous material is likely to have been introduced into the topsoil during manuring, or perhaps it is caused by equestrian paraphernalia lost within the field.

There are also large areas of magnetic disturbance particularly present within the south-eastern corner of the site. Demolition of a swimming pool and a barn had left remnant ceramic building material, metal joists and other associated building materials strewn across most of this area causing the readings in places to register off the scale. The other areas are either close to boundaries which commonly have a higher magnetic susceptibility or nearby spoil heaps that were numerous within the survey area.

One dipolar linear response present just off the south-eastern boundary aligned almost east-west records the location of a ferrous service pipe.



8.0 DISCUSSION & CONCLUSION

The Bartington DualGrad 601-2 fluxgate gradiometer performed relatively well on the Newmarket soils. There was good contrast between the stronger anomaly readings and the relatively low background magnetic susceptibility readings recorded over the natural drift geology.

The discrete pit type anomalies may be of archaeological origin, however a more modern origin cannot be ruled out. As hypothesised in the Archaeological Background above (Section 4.0) the sites primary land use appears to have been of an agricultural nature before the stables and paddocks were constructed. Weak positive linear anomalies indicative of agricultural furrows (aligned north-east to south-west) are on a different orientation to those of the modern field boundaries and roads which implies that the field boundaries have been redesigned over time.

There are many anomalies that relate to the current land use of stables and paddocks, the horse track being the most striking. Three other broad linear anomalies may prove also to be paths constructed for the movement of horses. The areas of magnetic disturbance appear to relate to modern demolition and activity, this is particularly prevalent in the south-eastern corner, it is possible that weaker archaeological anomalies have been masked here and survive beneath.

The site does have archaeological potential, the discrete and linear anomalies warrant further investigation to help understand the sites taphonomy. Areas of low magnetic susceptibility and those within the magnetic disturbance should also be further investigated to test whether the fluxgate gradiometer has failed to locate anomalies of an archaeological origin.

9.0 ACKNOWLEDGEMENTS

Britannia Archaeology would like to thank Stephen Macaulay and Aileen Connor of Oxford Archaeology East for funding the project and for their help and support throughout.

We are also grateful for the advice of Dr Jess Tipper of SCCAS/CT.

10.0 PROJECT ARCHIVE AND DEPOSITION

A full archive will be prepared for all work undertaken in accordance with guidance from the *Selection, Retention and Dispersion of Archaeological Collections*, Archaeological Society for Museum Archaeologists, 1993. Arrangements will be made for the archive to be deposited with the relevant museum/HER Office.



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APPENDIX 1 – TECHNICAL DETAILS

Magnetometer Survey

The magnetometer differs from the 'active' magnetic susceptibility meter by being a 'passive' instrument. Rather than injecting a signal into the ground it detects slight variations in the Earth's magnetic field caused by cultural and natural disturbance (Clark).

Thermoremanent magnetism is produced when a material containing iron oxides is strongly heated. Clay for example has a high iron oxide content that in a natural state is weakly magnetic, when heated these weakly magnetic compounds become highly magnetic oxides that a magnetometer can detect.

The demagnetisation of iron oxides occurs above a temperature known as the Curie point; for example haematite has a Curie point of 675 Celsius and magnetite 565C. At the time of cooling the iron oxides become permanently re-magnetised with their magnetic properties re-aligned in the direction of the Earth's magnetic field (Gaffney and Gater). Kilns, hearths, baked clay and ovens can reach temperatures of the Curie point, and are the strongest responses apart from large iron objects that can be detected. Cultural anomalies that can be detected by the magnetometers include occupation areas, pits, ditches, furnaces, sunken feature buildings, ridge and furrow field systems and ritual sites (David, 2011). Modern ferrous service pipes, field drainage pipes, removed field boundaries, perimeter fences and field boundaries can also be recorded.

Fluxgate Gradiometers

Fluxgate gradiometers are sensitive instruments that utilise two sensors placed in a vertical plane, spaced 1 metre apart. The sensor above reads the Earth's magnetic (background) response while the sensor below reads the local magnetic field. Both of the sensors are carefully adjusted to read zero before survey commences at a 'zeroing' point, selected for its relatively 'quiet' magnetic background reading. When differences in the magnetic field strength occur between the two sensors a positive or negative reading is logged. Positive anomalies have a positive magnetic value and negative anomalies have a negative magnetic value relative to the site's magnetic background. Examples of positive magnetic anomalies include hearths, kilns, baked clay, areas of burning, ferrous material, ditches, sunken feature buildings, furrows, ferrous service pipes, perimeter fences and field boundaries. Negative magnetic anomalies include earthwork embankments, plastic water pipes and geological features.

The instruments are usually held approximately 0.30m to 0.50m above the ground surface and can detect to a depth of between 1-2metres. Best practice dictates that the direction of traverse should be east to west, optimising the instruments data quality.



Magnetic Anomalies

Linear trends

Linear trends can be both positive and negative magnetic responses. If they are broad, relatively weak or negative in nature they may be of agricultural or geological origin, for example periglacial channels, land drains or ploughing furrows. If the responses are strong positive magnetic linear trends they are more likely to be of archaeological origin. Archaeological settlement ditches tend to be rich in highly magnetic iron oxides that accumulate in them via anthropogenic activity and humic backfills. Curvilinear trends can also be recorded and are indicative of archaeological structures such as drip-gullies.

Discrete anomalies

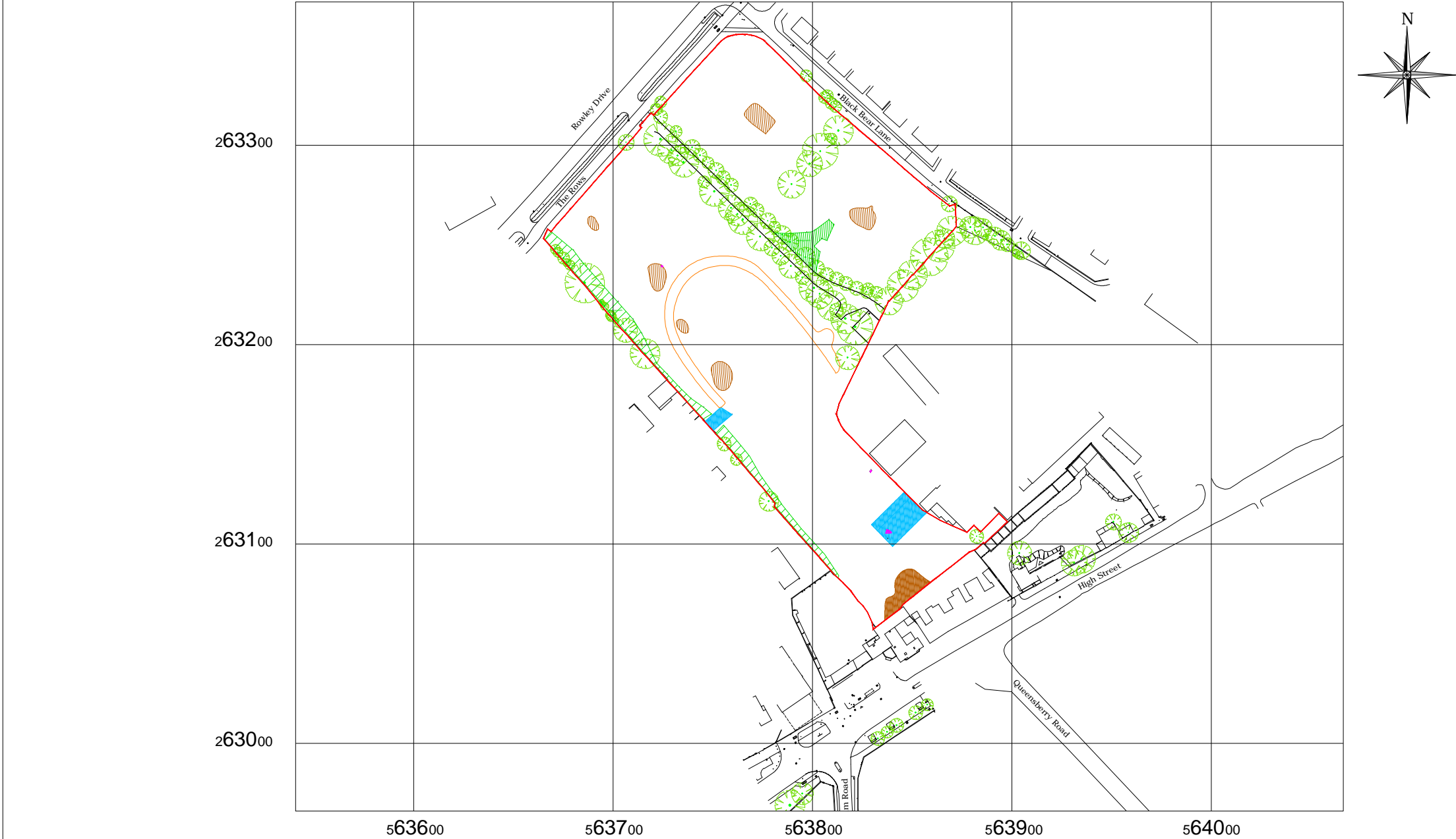
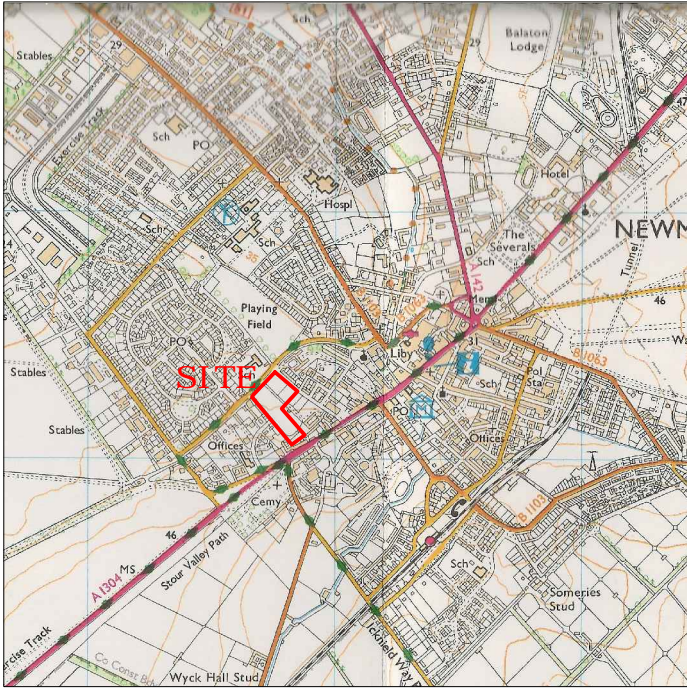
Discrete anomalies appear as increased positive responses present within a localised area. They are caused by a general increase in the amount of magnetic iron oxides present within the humic back-fill of for example a rubbish pit.

'Iron spike' anomalies

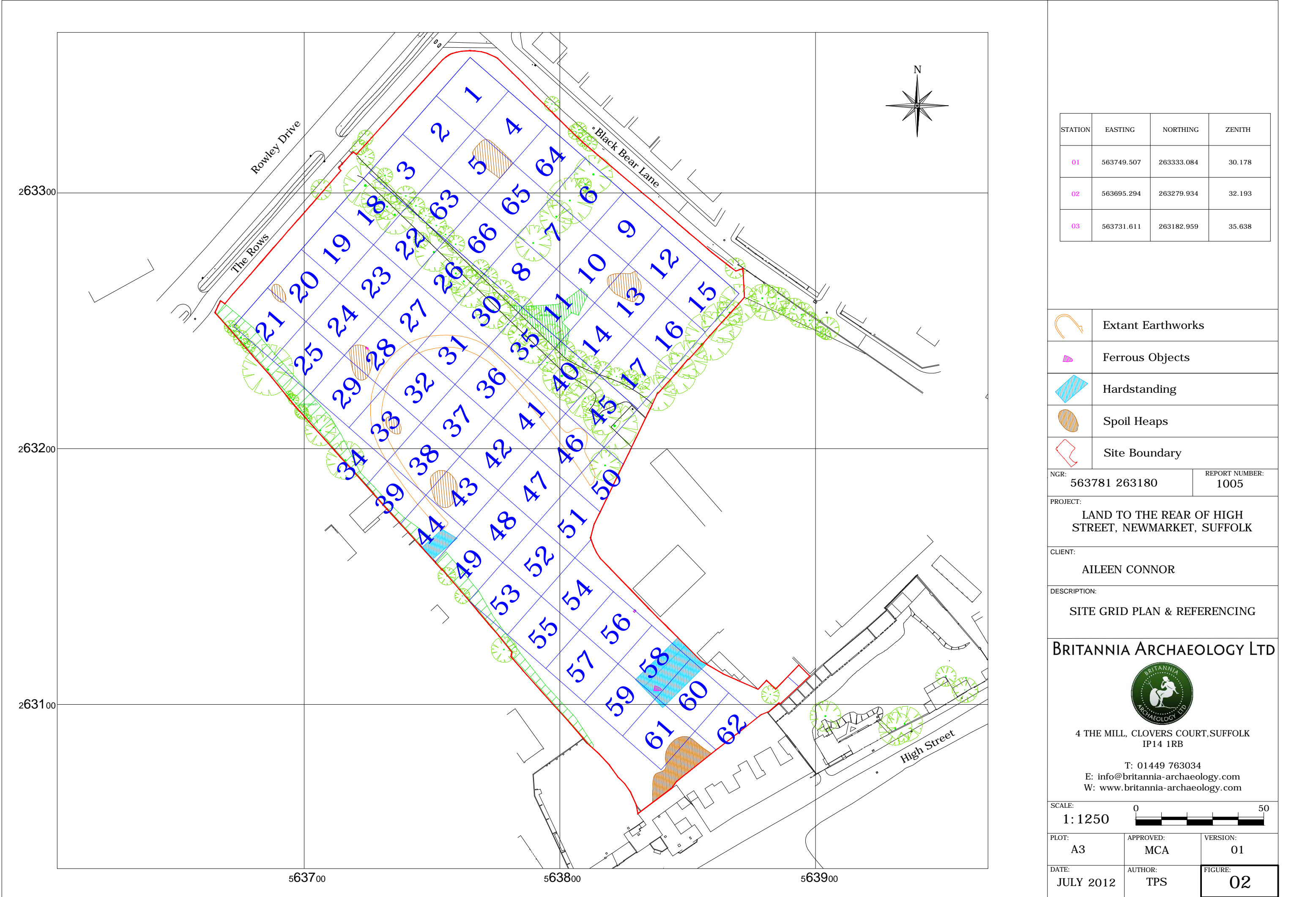
These strong isolated dipolar responses are usually caused by ferrous material present in the topsoil horizon. They can have an archaeological origin but are usually introduced into the topsoil during manuring.

Areas of magnetic disturbance

An area of magnetic disturbance is usually associated with material that has been fired. For example areas of burning, demolition (brick) rubble or slag waste spreads. They can also be caused by ferrous material, e.g. close proximity to barbwire or metal fences and field boundaries, buried services, pylons and modern rubbish deposits.



	Extant Earthwork	
	Ferrous Objects	
	Hardstanding	
	Spoil Heaps	
	Site Boundary	
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CLIENT: AILEEN CONNOR		
DESCRIPTION: SITE LOCATION PLAN		
<div>BRITANNIA ARCHAEOLOGY LTD</div> <div></div> <div>4 THE MILL, CLOVERS COURT,SUFFOLK IP14 1RB</div> <div>T: 01449 763034 E: info@britannia-archaeology.com W: www.britannia-archaeology.com</div>		
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PLOT: A3	APPROVED: MCA	VERSION: 01
DATE: JULY 2012	AUTHOR: TPS	FIGURE: 01



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03	563731.611	263182.959	35.638

	Extant Earthworks
	Ferrous Objects
	Hardstanding
	Spoil Heaps
	Site Boundary

NGR: 563781 263180	REPORT NUMBER: 1005
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PROJECT: LAND TO THE REAR OF HIGH STREET, NEWMARKET, SUFFOLK

CLIENT: AILEEN CONNOR

DESCRIPTION: SITE GRID PLAN & REFERENCING
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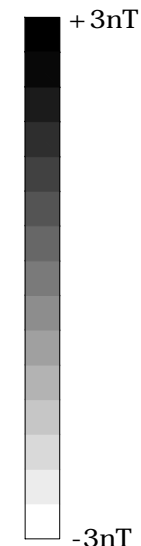
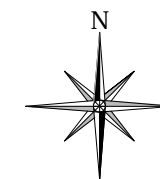
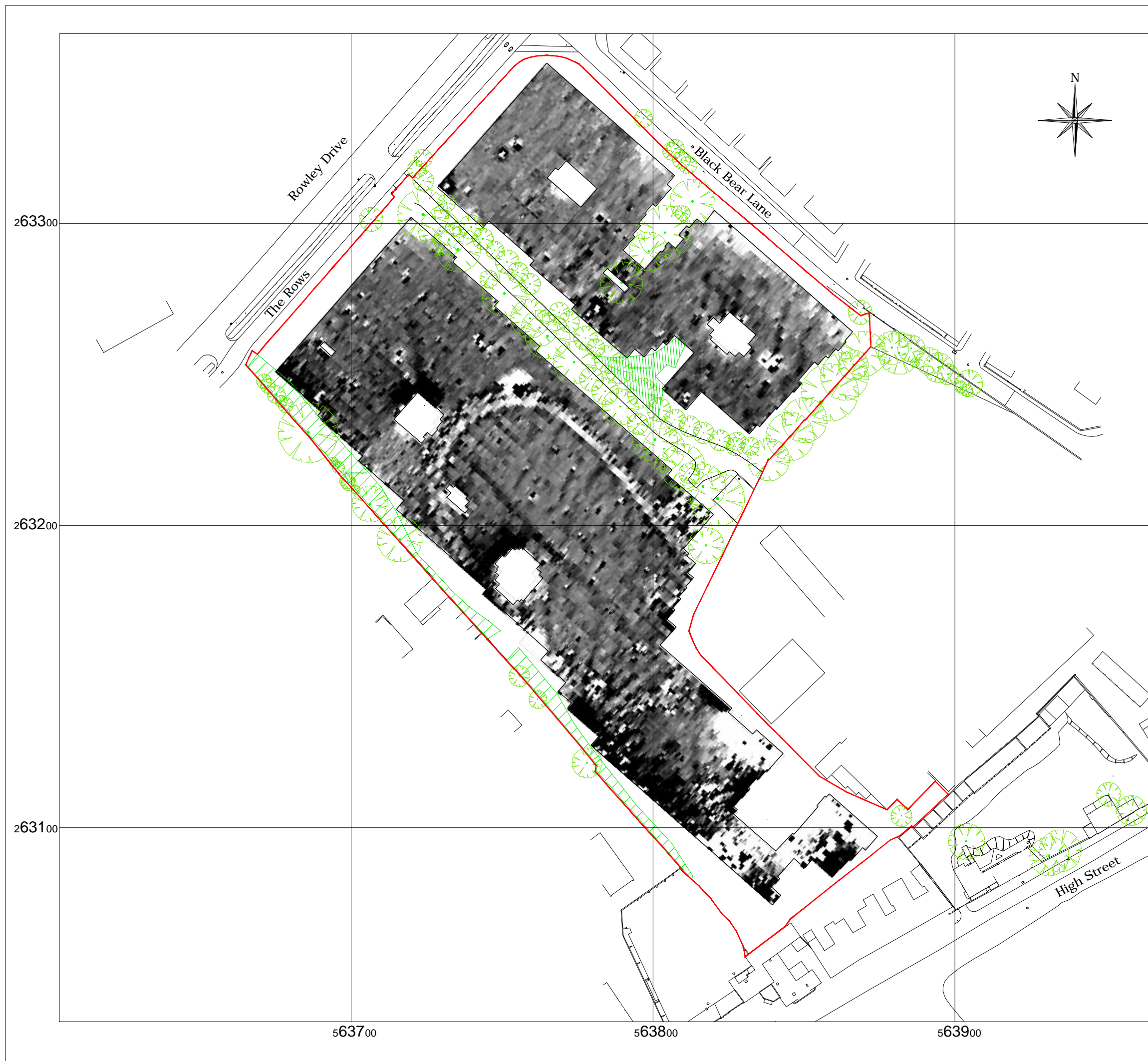





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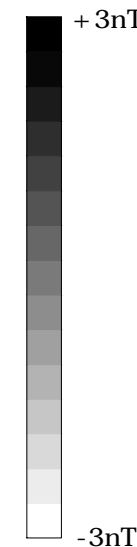
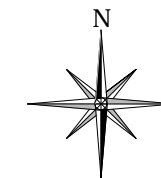
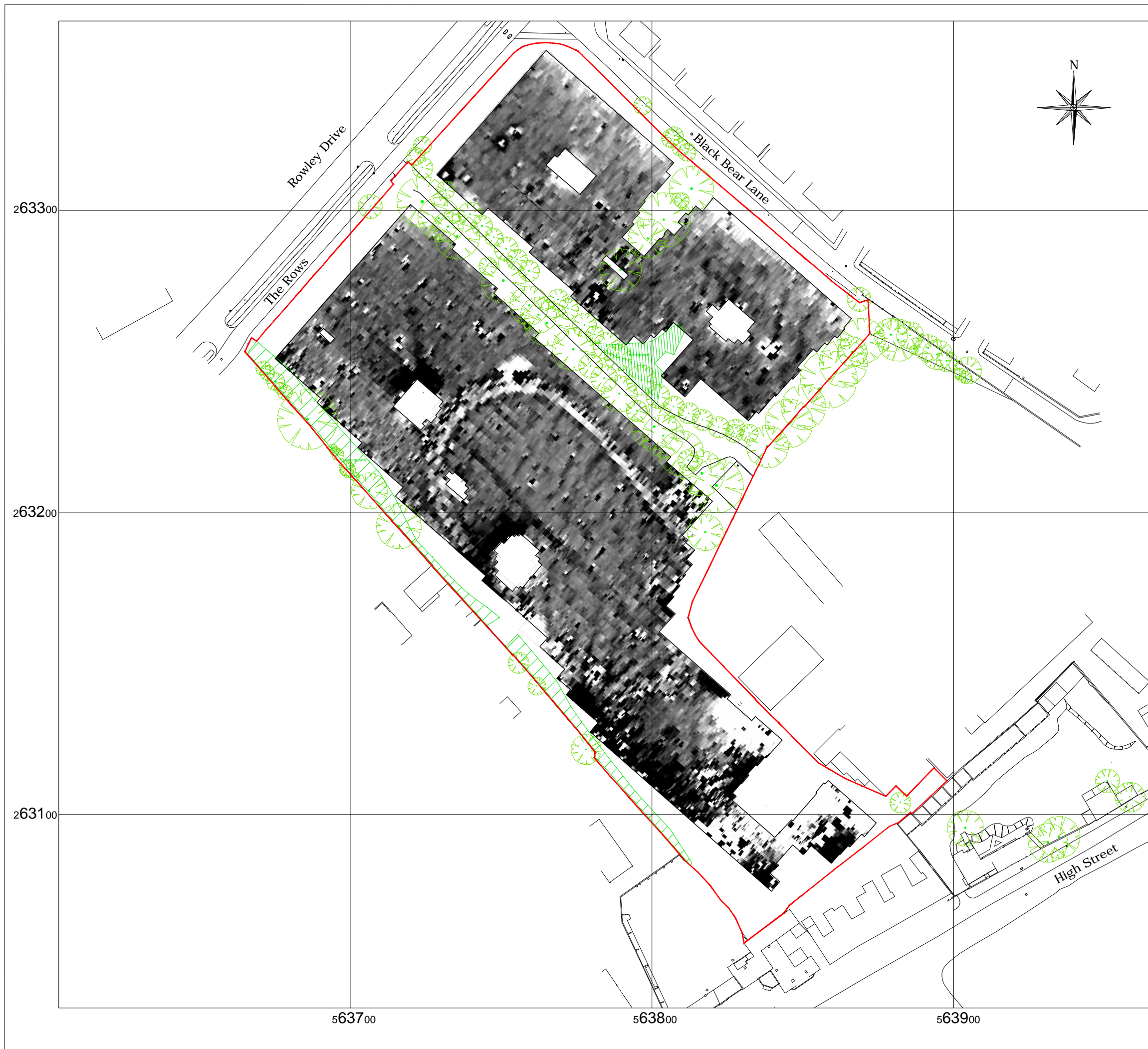
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DATE: JULY 2012	AUTHOR: TPS	FIGURE: 02





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PROJECT: LAND TO THE REAR OF HIGH STREET, NEWMARKET, SUFFOLK			
CLIENT: AILEEN CONNOR			
DESCRIPTION: CORRECTED MAGNETOMETER GREYSCALE PLOT			
BRITANNIA ARCHAEOLOGY LTD			
			
4 THE MILL, CLOVERS COURT, SUFFOLK IP14 1RB			
T: 01449 763034 E: info@britannia-archaeology.com W: www.britannia-archaeology.com			
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1: 1250			
PLOT:	APPROVED:	VERSION:	
A3	MCA	01	
DATE:	AUTHOR:	FIGURE:	
JULY 2012	TPS	03	






		Site Boundary	
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NGR: 563781 263180		REPORT NUMBER: 1005	
PROJECT: LAND TO THE REAR OF HIGH STREET, NEWMARKET, SUFFOLK			
CLIENT: AILEEN CONNOR			
DESCRIPTION: CORRECTED MAGNETOMETER XY TRACE PLOT			
BRITANNIA ARCHAEOLOGY LTD			
			
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T: 01449 763034			
E: info@britannia-archaeology.com			
W: www.britannia-archaeology.com			
SCALE: 1:1250			
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DATE: JULY 2012	AUTHOR: TPS	FIGURE: 04	



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CLIENT: AILEEN CONNOR			
DESCRIPTION: PROCESSED MAGNETOMETER GREYSCALE PLOT			
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 Site Boundary	
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PROJECT: LAND TO THE REAR OF HIGH STREET, NEWMARKET, SUFFOLK	
CLIENT: AILEEN CONNOR	
DESCRIPTION: PROCESSED MAGNETOMETER XY TRACE PLOT	
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