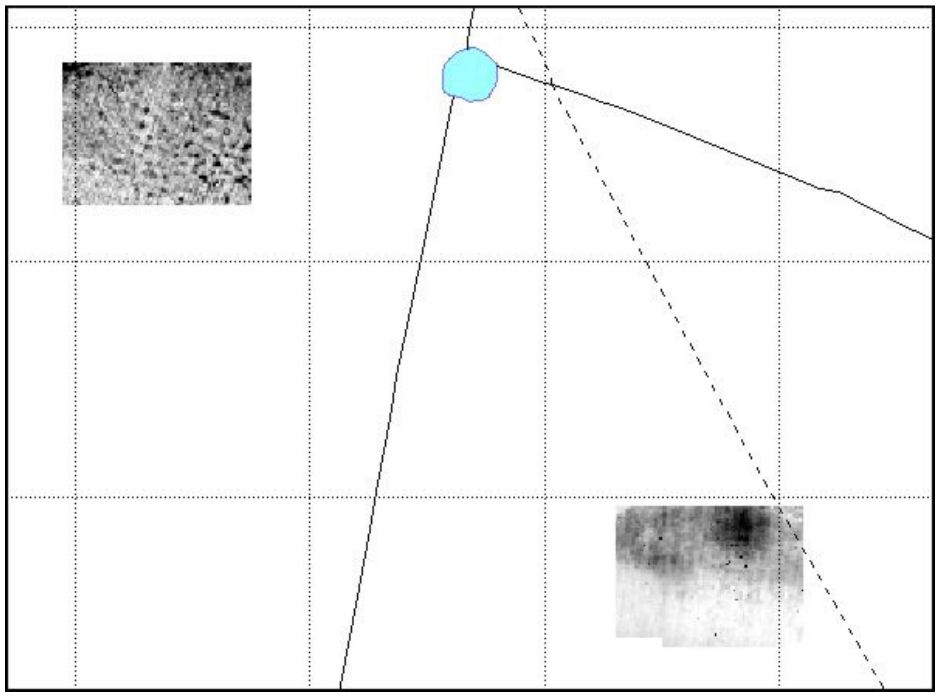

Earth resistance survey of land at Eaton Leys Farm, Bletchley Milton Keynes November 2015

Report No: 15/188

Author: John Walford

Illustrator: John Walford

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NGR: SP 888 329

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Earth resistance survey of land at Eaton Leys Farm, Bletchley Milton Keynes November 2015

Report No: 15/188

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1	13/11/2015	Pat Chapman	Mark Holmes	Andy Chapman	Client approval
2	20/11/2015				Minor edits

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OASIS REPORT

PROJECT DETAILS	Oasis Nos. molanort1-230225 & molanort1-230228	
Project name	Earth resistance survey of land at Eaton Leys Farm, Bletchley, Milton Keynes	
Short description	MOLA Northampton was commissioned to carry out an earth resistance survey at Eaton Leys Farm, Bletchley, following on from a magnetometer survey undertaken in 2014. The purpose of the latest work was to test the results of the 2014 survey and investigate whether earth resistance survey could provide any additional archaeological information. Five 0.48ha sample blocks were surveyed, two targeting known archaeology, two targeting doubtful archaeology and one targeting an apparently blank area of land. The results were not particularly informative, being dominated by anomalies of geological origin. Whilst a few features of possible archaeological interest were detected there was little correlation between the earth resistance survey data and the archaeological findings of the previous magnetometer survey, and there was no evidence for the known archaeological sites extending further than the previous survey had indicated.	
Project type	Geophysical survey [earth resistance]	
Site status	None	
Previous work	Magnetometer survey (Walford 2014a)	
Current land use	Arable and pasture	
Future work	Unknown	
Monument type/ period	Roman enclosures Medieval to early post-medieval ridge and furrow	
Significant finds	None	
PROJECT LOCATION		
County	Milton Keynes / Buckinghamshire	
Site address	Eaton Leys Farm, Bletchley, Milton Keynes	
Study area	2.4ha	
OS Easting & Northing	SP 888 329	
Height OD	*c* 65-80m aOD	
PROJECT CREATORS		
Organisation	MOLA Northampton	
Project brief originator	CgMs Consulting	
Project design originator	MOLA Northampton	
Director/Supervisor	John Walford	
Project Manager	John Walford	
Sponsor or funding body	CgMs Consulting	
PROJECT DATE		
Start date	05 October 2015	
End date	14 October 2015	
ARCHIVES	Location	Content
Physical	N/A	
Paper	MOLA Northampton	Site survey records
Digital		Geophysical survey & GIS data
BIBLIOGRAPHY	Journal/monograph, published or forthcoming, or unpublished client report	
Title	Earth resistance survey of land at Eaton Leys Farm, Bletchley, Milton Keynes, November 2015	
Serial title & volume	MOLA Northampton Reports 15/188	
Author(s)	John Walford	
Page numbers	6	
Date	13 November 2015	

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ABSTRACT

MOLA Northampton was commissioned to carry out an earth resistance survey at Eaton Leys Farm, Bletchley, following on from a magnetometer survey undertaken in 2014. The purpose of the latest work was to test the results of the 2014 survey and investigate whether earth resistance survey could provide any additional archaeological information. Five 0.48ha sample blocks were surveyed, two targeting known archaeology, two targeting doubtful archaeology and one targeting an apparently blank area of land. The results were not particularly informative, being dominated by anomalies of geological origin. Whilst a few features of possible archaeological interest were detected there was little correlation between the earth resistance survey data and the archaeological findings of the previous magnetometer survey, and there was no evidence for the known archaeological sites extending further than the previous survey had indicated.

1 INTRODUCTION

MOLA was commissioned by CgMs Consulting to conduct an earth resistance survey at Eaton Leys Farm, Bletchley, investigating a proposed development site that straddles the boundary of Buckinghamshire and Milton Keynes (NGR SP 888 329; Fig 1). The site had previously been investigated by a magnetometer survey (Walford 2014a) but Historic England expressed doubts about the reliability of such a survey over Oxford Clay geology and requested that sample areas be subject to earth resistance survey to test and augment the magnetometer survey results.

The resistance survey covered five 0.48ha sample blocks, two targeting known archaeology, two targeting doubtful archaeology and one targeting an apparently blank area of land (Fig 3). These blocks were surveyed on various days between the 5th and 14th October 2015.

2 BACKGROUND

2.1 Topography and geology

The 2014 survey area comprised 109ha of arable and pasture land, encompassing the proposed development site plus an adjoining parcel of land containing part of the scheduled remains of *Magiovinium* Roman town (Walford 2014a). The boundaries of this site are largely defined by Watling Street to the north, the A4146 Little Brickhill Bypass to the east and the River Ouzel to the south and west (Figs 1 and 2). The present survey covers a more restricted area, all the sample blocks being located within the proposed development site and the area of the scheduled remains being specifically avoided.

The survey area lies mainly between 65m and 80m aOD. It has an irregular topography but the overall trend is a downward slope to the west and south-west, onto the floodplain of the Ouzel. The geology of the area is varied, with an Oxford Clay bedrock overlain in places by spreads of terrace gravel, head and alluvium (BGS 2015). Field observations indicate that the gravels contain a significant fraction of flint whereas the head is

dominated by ironstone fragments derived from the Greensand scarp that rises to the east (*pers obs*).

2.2 Historical and archaeological background

The scheduled Roman town of *Magiovinium* is a well-known site, and was the subject of archaeological excavations in the 1980s and early 1990s when parts of its eastern suburbs were threatened by road developments (Neal 1987, Hunn *et al* 1997). Limited geophysical survey work was conducted across other parts of the town in 1999, revealing some elements of its layout. Both magnetometer survey and earth resistance survey were undertaken, with the former proving the more successful and informative of the two techniques (Bartlett 1999).

The 2014 magnetometer survey covered all of *Magiovinium* south of Watling Street and west of the A4146 and provided a clear view of the town's layout including its defences and elements of its street plan. The survey also detected a group of rectangular ditched enclosures, apparently of Roman date, lying *c* 1km to the south of the town at the southern end of the proposed development area (Fig 2). Relatively little was detected in the intervening area, although there were some traces of medieval ridge and furrow and a few other possible archaeological features (Walford 2014a).

3 METHODOLOGY

The earth resistance survey was undertaken in October 2015, in variable but generally fair weather. The ground was mostly dry at the start of the survey and, despite a few spells of showery rain, never became excessively wet.

Five sample blocks were surveyed, each measuring 80m x 60m (0.48ha). The corners of each block were located with a Leica Viva RTK GPS and internal 20m grid points were set out from these corners with a tape measure and optical square. Ordnance Survey National Grid co-ordinates for these sample blocks are listed in Appendix 1.

The instrument used for the survey was a Geoscan Research RM15 resistance meter. It was deployed in twin probe configuration with mobile probe spacing of 0.5m and the remote probes spaced a similar distance apart. This instrument configuration is standard for archaeological survey and its use accords with the guidelines issued by English Heritage and by the Chartered Institute for Archaeologists (EH 2008; CIfA 2014).

Measurements of earth resistance were collected at a spatial resolution of 1m x 1m within each grid square and were recorded to a precision of 0.1 Ohms (Ω). These measurements were downloaded, combined and processed with Geoplot 3.00u software. The only processing required was grid edge matching, which compensated for the minor offsets caused when the remote probes had to be relocated.

Plots of the processed data are presented in this report in the form of greyscale images at display ranges appropriate to each data set. These plots have been scaled, rotated and resampled (georectified) for display against the Ordnance Survey base mapping and are presented alongside interpretation plots and comparative extracts from the 2014 magnetometer survey.

4 SURVEY RESULTS

General comments

The earth resistance survey results from the different sample blocks have varying characteristics, reflecting broad variations in geology and land use. At one extreme, the readings from Field 10 are very low and tightly clustered, mainly ranging between 9Ω and 13Ω whilst, at the other extreme, the readings from Field 9 range broadly from 80Ω to 150Ω. Generally speaking, the higher resistance values were measured on the pasture fields, where the topsoil was compact, and the lower resistances on the arable fields where the soil was looser and absorbed water more readily after rain. There was also a trend towards lower resistance values over the Oxford Clay and higher resistance values over the head and terrace gravel.

Field 4 (Fig 3)

This survey block was positioned across part of a trackway and associated enclosures extending from the southern edge of *Magiovinium*, in an area where the underlying geology is mapped as Oxford Clay. The field had been rolled and drilled shortly prior to the survey and its surface was bare earth with a sparse cover of seedlings.

The results from this survey block are archaeologically uninformative and strongly dissimilar to the results of the magnetometer survey. The only clearly diagnostic anomalies are the tightly spaced linear trends, aligned from north-east to south-west, which can be attributed to modern ploughing. There is also one short, high resistance, linear anomaly which might represent a section of ditch, as it lies on the same axis as the previously detected enclosure ditches (Fig 3, 'a'). However, this is a tenuous suggestion, and the anomaly could more plausibly grouped with the many small high resistance anomalies of possible geological origin (*cf* Field 10) which are irregularly distributed across the bulk of the survey block.

Field 5 (Fig 4)

This survey block was positioned to investigate some weak and irregular magnetic anomalies of uncertain origin. It lay on a pronounced south-facing slope, straddling two different geologies; head on the higher ground and Oxford Clay further downslope. At the time of the survey the field was a mixed state of cultivation, with one part ploughed and the other part remaining under stubble.

The results from this block closely reflect the variations in topography and geology, with higher resistance values occurring upslope over the stony head deposits, lower resistance values occurring downslope over the clay and a moderately sharp boundary dividing the two zones (Fig 4, 'a'). No resistance anomalies correspond to the irregular magnetic anomalies that were targeted, but there are there some weak parallel linear trends which correspond to some exceptionally weak magnetic traces of ridge and furrow.

At the northern edge of the survey block there is a sub-circular area of higher resistance measuring *c* 20m across (Fig 4, 'b'). Although the regular shape of this might be thought to suggest a man-made feature, the anomaly more probably reflects a natural variation in the stoniness of the geology. To its east there is a subtle variation in the background 'texture' of the data, corresponding with an area where the ground conditions at the corner of the survey block changed from stubble to freshly ploughed soil (Fig 4, 'c'). At the opposite, south-western, corner there is a piece of blank data where a small number of readings were lost due to an instrument fault and could not be re-collected before the relevant part of the field was ploughed up.

Field 9 (Fig 5)

This survey block was positioned across an L-shaped magnetic anomaly which had been tentatively interpreted as part of an enclosure ditch or field boundary. The geology of this area is mapped as terrace gravels, with a transition to Oxford Clay close the south-eastern corner of the block. At the time of the survey the field was pasture with short grazed grass.

The results from this survey block clearly reflect the underlying geology, with a sharp boundary between zones of high and low resistance reflecting the change from terrace gravel to clay at the at the south-eastern corner of the block (Fig 5, 'a'). The correlation with the magnetometer survey results is poor, although there is a weak tendency for moderately low resistance values to coincide with the position of the L-shaped magnetic anomaly.

A series of short, parallel, moderately high resistance anomalies occur at the south-western corner of the survey area (Fig 5, 'b'). They are more tightly spaced than would be typical for ridge and furrow their alignment is implausible for modern ploughing, so an interpretation as field drains is considered most likely.

Towards the centre of the survey block there is a low resistance linear anomaly which may represent a section of ditch (Fig 5, 'c'). A smaller and more localised low resistance anomaly occurs midway along the western edge of the survey block (Fig 5, 'd'). This is clearly modern in origin as it corresponds to an area of bare, trampled ground around a parked trailer.

Field 10 (Fig 6)

This survey block was positioned to test a part of the site which the magnetometer results suggested to be entirely devoid of archaeology or other features of interest. It covered an area of Oxford Clay bedrock with no superficial drift. At the time of the survey the field was freshly rolled and drilled with sparse plant cover.

The results from this block are dominated by a 'spotty' background patterning which appears to arise from the underlying geology. Whilst the precise cause is unknown, it is notable that a very similar background pattern has been recorded in survey data collected over Oxford Clay on a site in Oxford itself (Walford 2014b, fig 3). Furthermore, there is a striking coincidence between the patterning of the present dataset and a pattern of natural cropmarks evident in an aerial photograph Field 10 (Google Earth coverage dated 26/06/2005).

Other features of the data are a slight trend towards lower resistance at the north-western edge of the survey block, close to a field boundary ditch (Fig 6, 'a'), and a concentration of higher resistance at the western corner, where the survey block overlapped onto the grass baulk at the margin of the field (Fig 6, 'b'). These anomalies probably reflect the greater compaction of the baulk and a slightly raised water table near the ditch.

The pattern of short linear trends apparent in the south-western end of the survey block (Fig 6, 'c') is thought to be a spurious data artefact. The trends all run strictly along the traverse lines and are restricted to an area where the mobile probes would have approached most closely to the remote probe location. Although a conventional stand-off distance was maintained (>30 x probe spacing, *as per* EH 2015, 26), some weak bias arising from interplay between variations in the probe-pair separation and mobile probe orientation is suspected as a possible cause.

Field 14 (Fig 7)

This survey block was positioned across part of a rectilinear enclosure complex which had been detected, but not fully resolved, by the magnetometer survey. It lay in an area where the geological mapping records terrace gravels to be present. At the time of the survey the field was pasture with short grass.

The results from this survey block can be characterised as a bland, relatively low resistance background overlain in the south-eastern half of the block by a mass of irregular high resistance anomalies. The distribution of anomalies bears no obvious relation to the layout of the enclosure ditches previously detected by magnetometer survey.

The cause of the high resistance anomalies is uncertain. Some of them tend towards a rectilinear layout reminiscent of ditches or building footings (Fig 7, 'a'), but they do not conform to the alignment of the known archaeology and are not regular enough for an archaeological interpretation to be fully convincing. On balance, an interpretation as geological anomalies, perhaps relating to pockets of terrace gravel over the Oxford Clay, seems more probable.

5 CONCLUSION

The earth resistance data presented here does not provide any substantive new insight into the archaeology of the survey area. Whilst there are a few resistance anomalies of uncertain origin, for which an archaeological interpretation is conceivable, there are none which can be confidently interpreted as archaeological. Many archaeological features which are known from the previous magnetometer survey have proved invisible to earth resistance survey, and it appears that the technique has been mostly responsive to superficial geological variations.

It is interesting to note that the earlier work by Bartlett on the adjacent site of *Magiovinium* showed a similar tendency for earth resistance results to be less informative than those from magnetometer survey (Bartlett 1999, figs 2-4). Whilst this could be a matter of coincidence, the fact that two surveys conducted at different times by different contractors have both recorded indifferent results hints that the lack of success may reflect fundamental difficulties with the nature of the local soil and geology rather than temporarily unfavourable soil moisture conditions.

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MOLA
13 November 2015

APPENDIX 1: SURVEY BLOCK CO-ORDINATES

OS National grid co-ordinates for the survey block corners

Field 4
488294.87, 233284.29
488874.87, 233284.29
488874.87, 233224.29
488294.87, 233224.29

Field 5
488030.98, 233095.86
488110.98, 233095.86
488110.98, 233035.86
488030.98, 233035.86

Field 9
488740.06, 232846.05
488820.06, 232846.05
488820.06, 232786.05
488740.06, 232786.05

Field 10
489012.32, 232610.79
489055.71, 232569.34
489000.29, 232511.35
488956.91, 232552.80

Field 14
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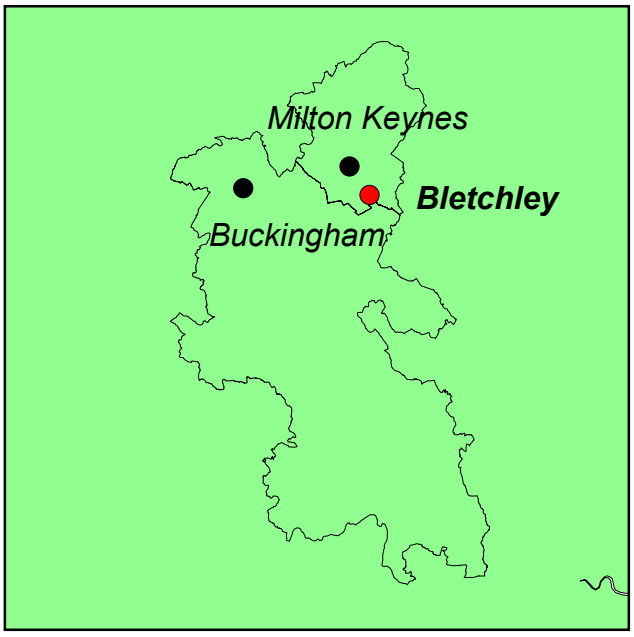
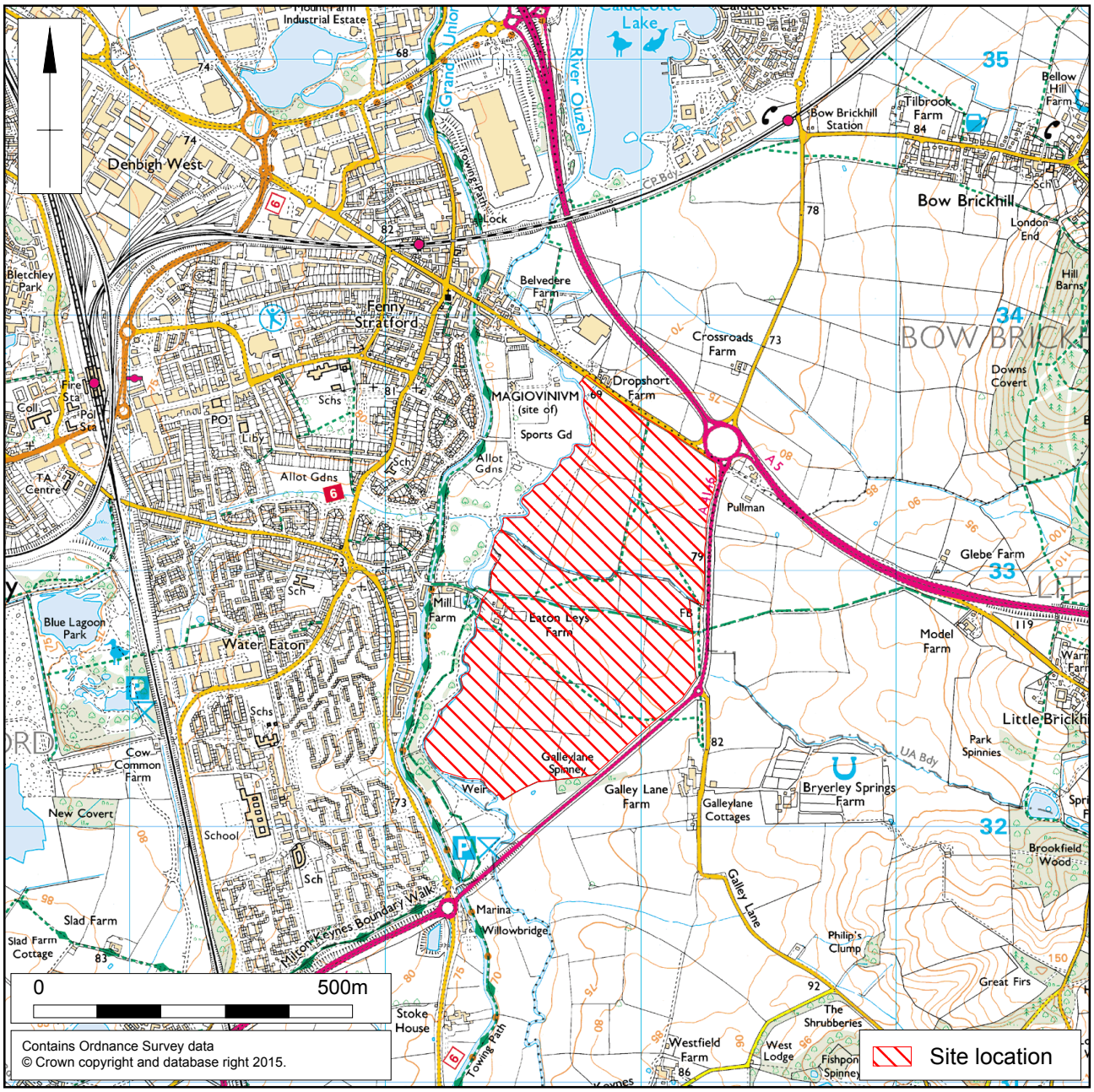
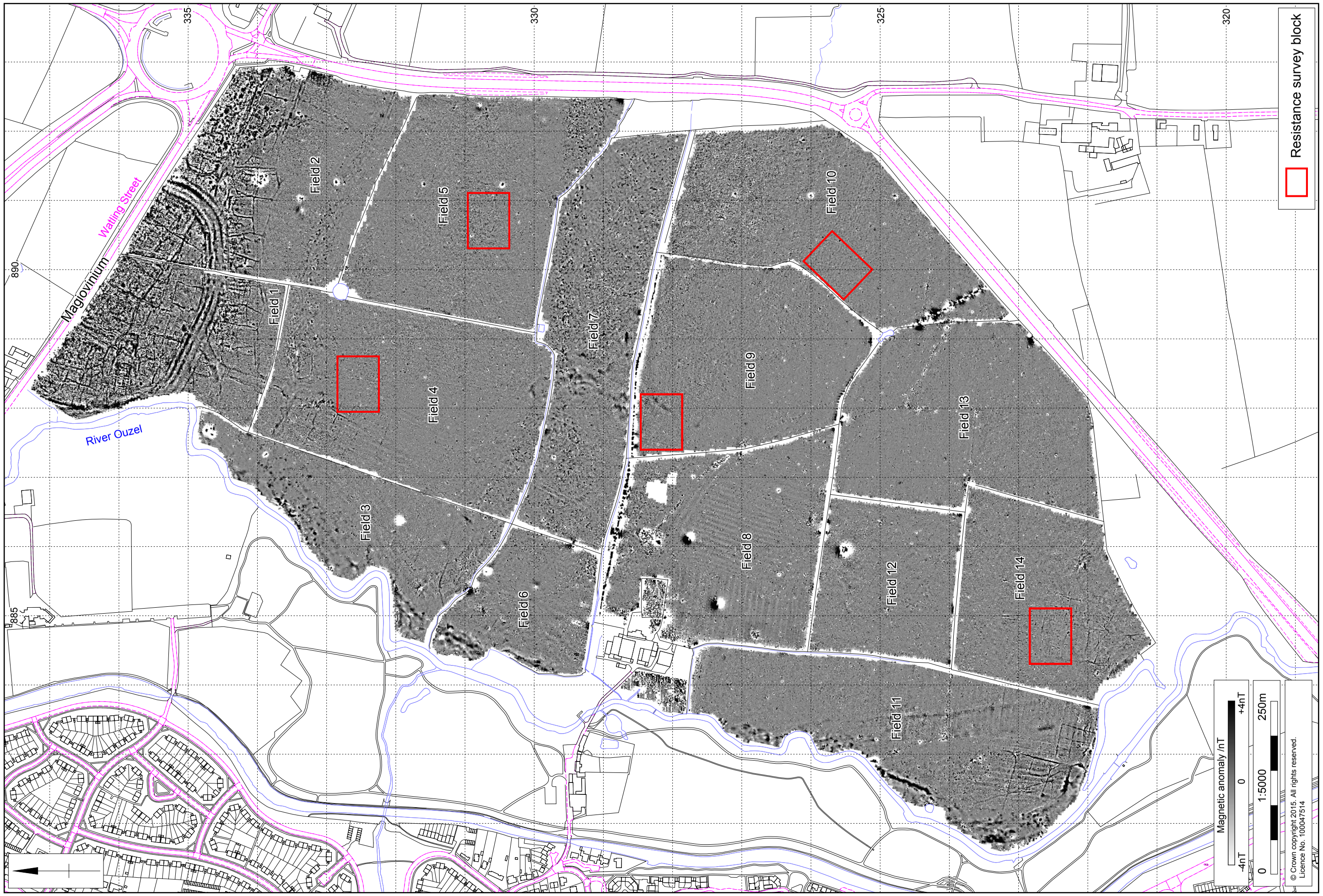




Scale 1:25,000

Site location Fig 1



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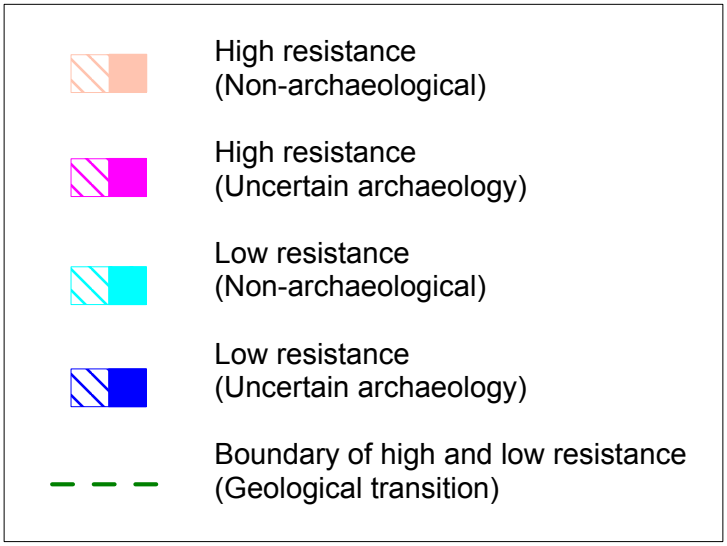
Magnetometer survey results (2014 survey) Fig 2

Keys for Figs 3 to 7

Earth reisistance survey interpretation key



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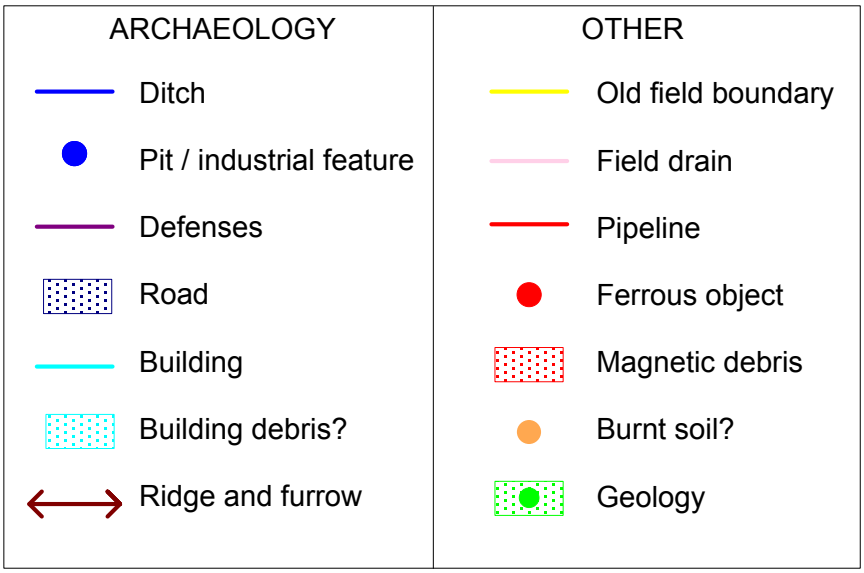
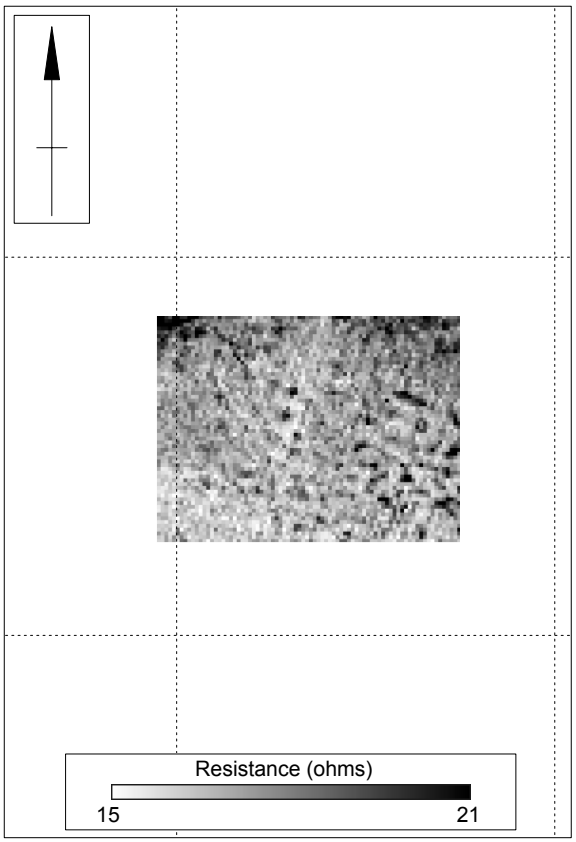
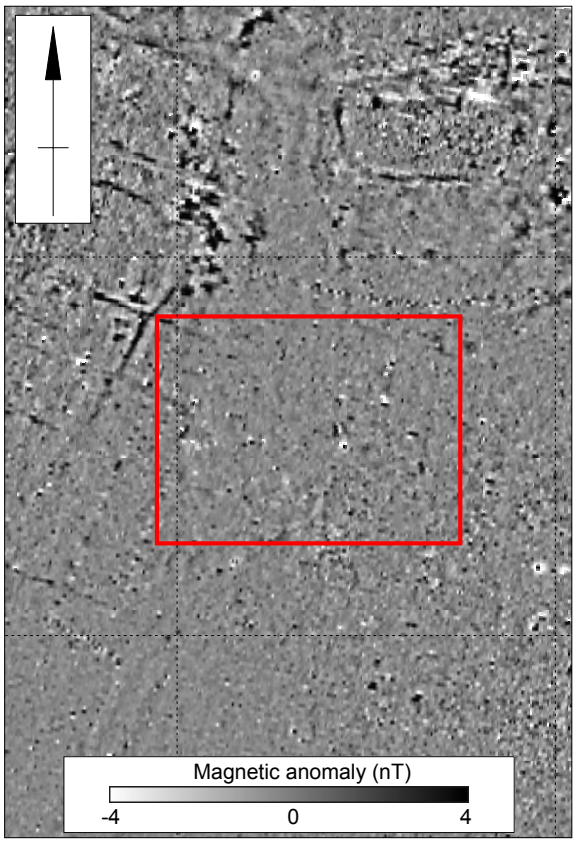


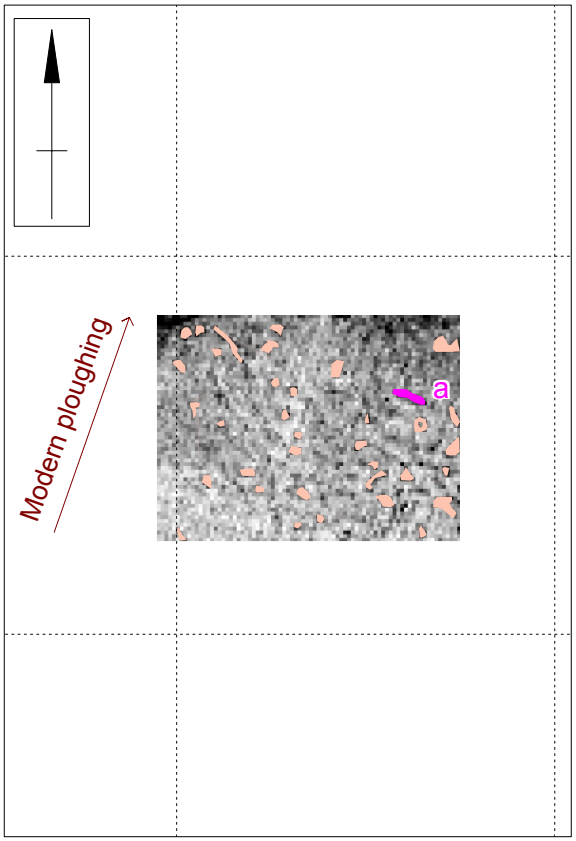


Earth resistance survey results

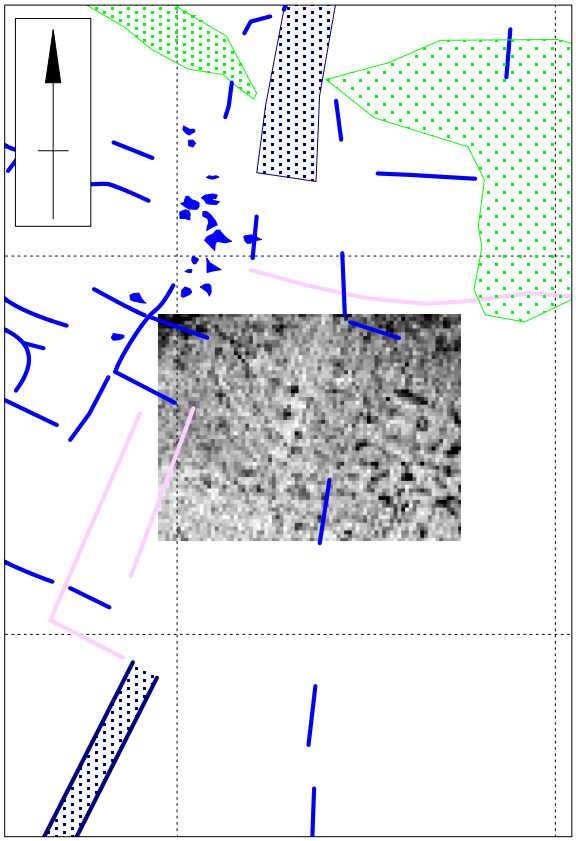


Magnetometer survey results

Earth resistance survey interpretation



Magnetometer interpretation and earth resistance results



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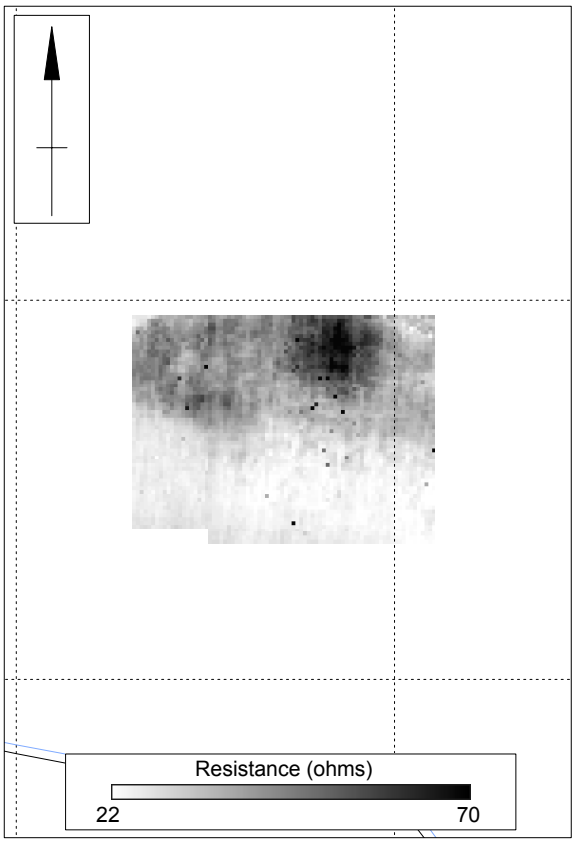
Results and interpretation (Field 4) Fig 3



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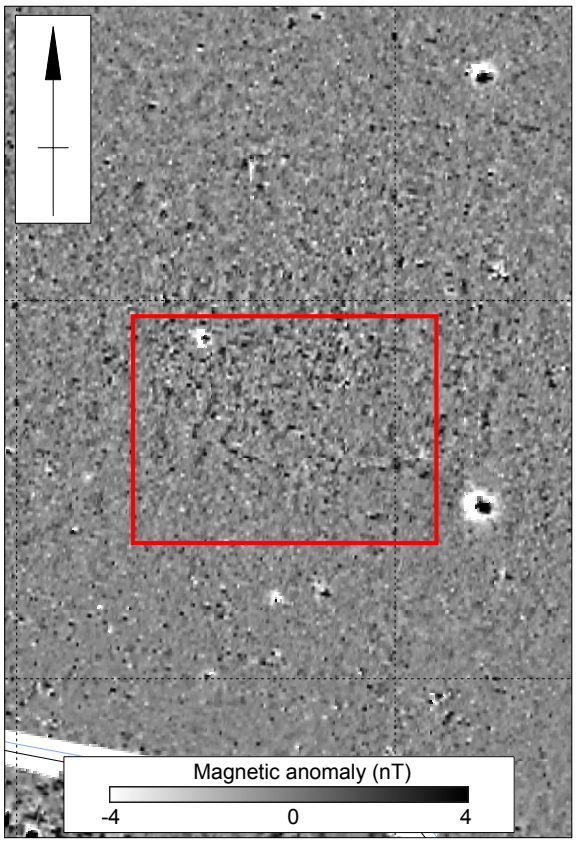
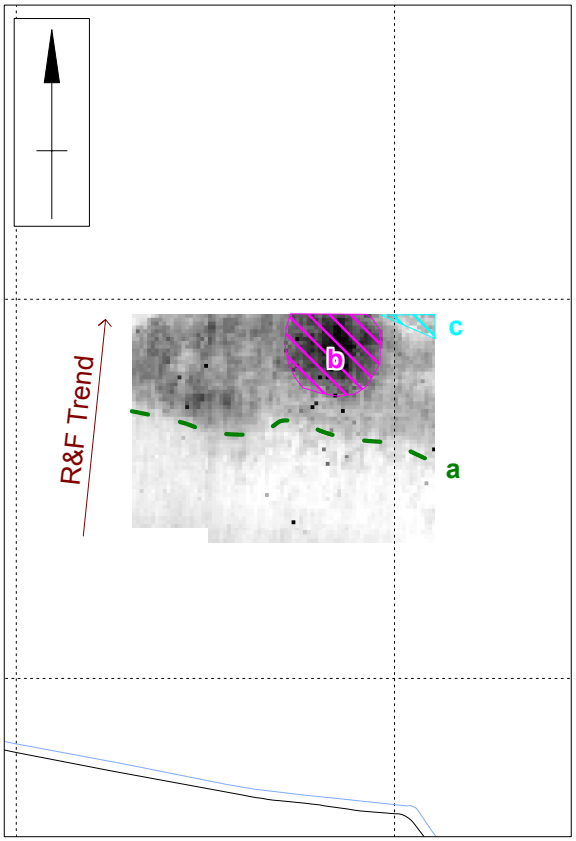
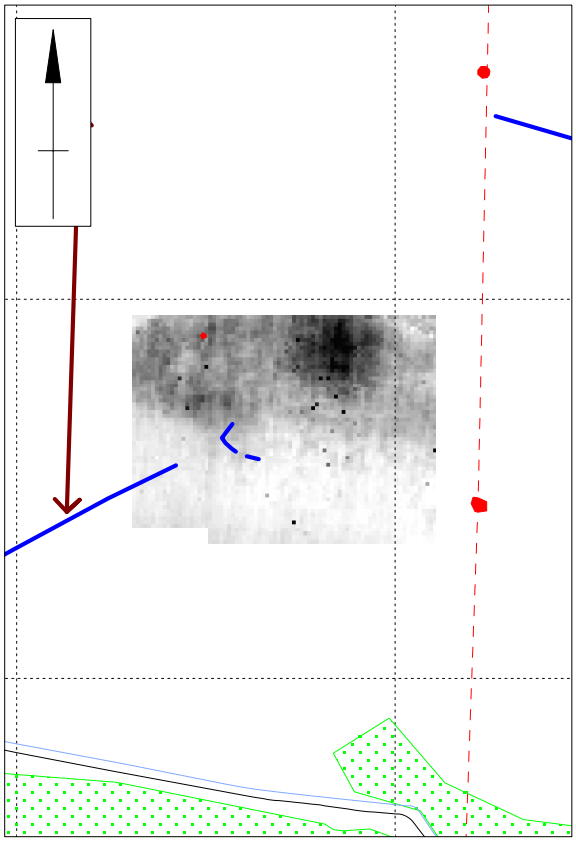


Magnetometer survey results

Earth resistance survey interpretation



Magnetometer interpretation and earth resistance results



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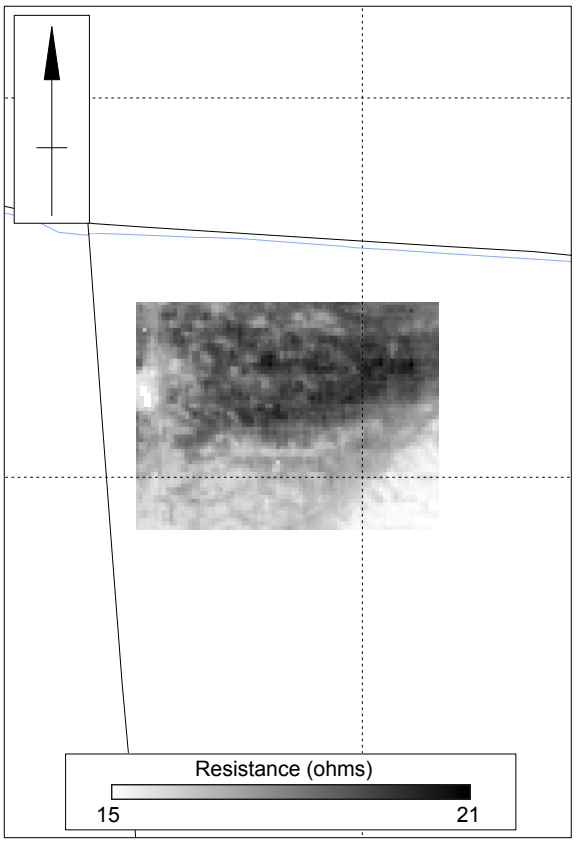
Results and interpretation (Field 5) Fig 4



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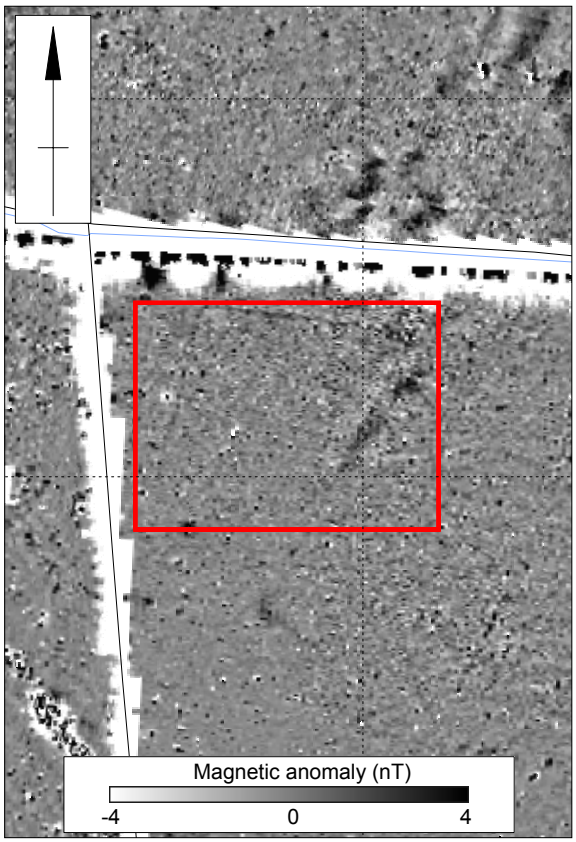
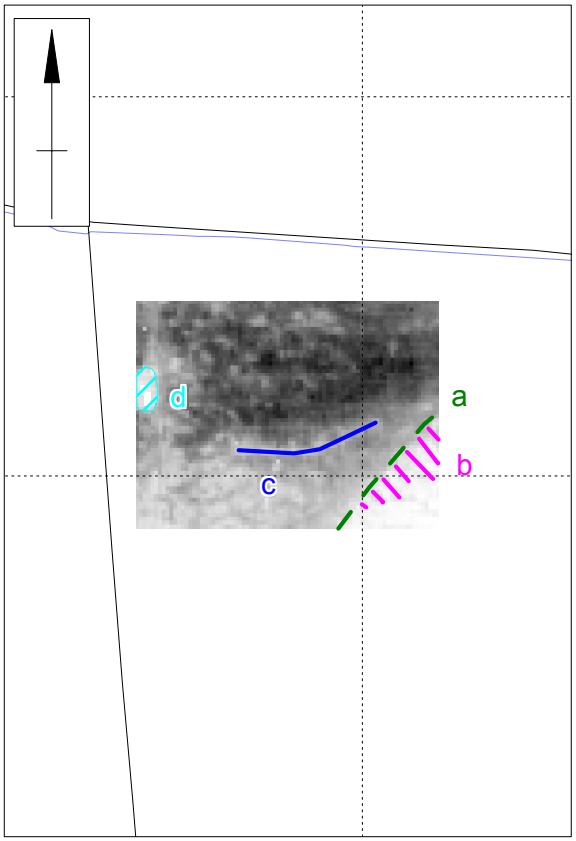


Magnetometer survey results

Earth resistance survey interpretation



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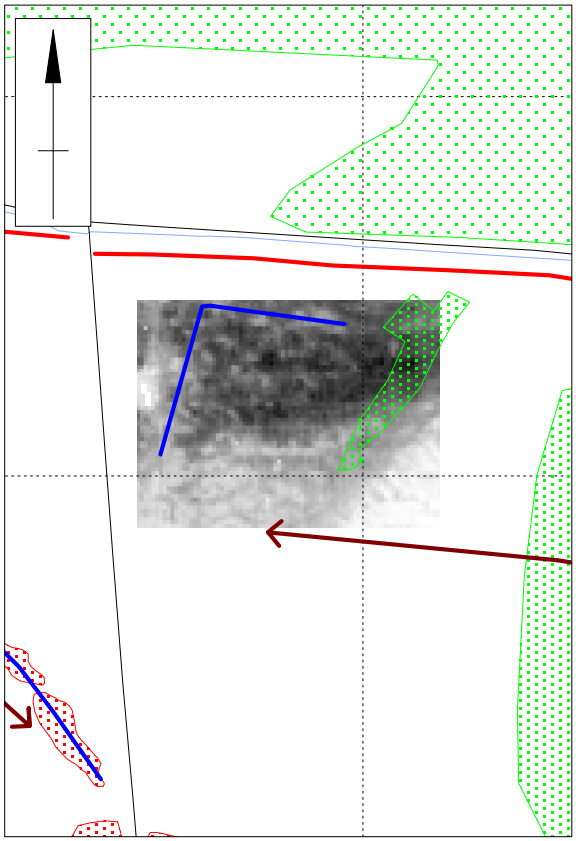

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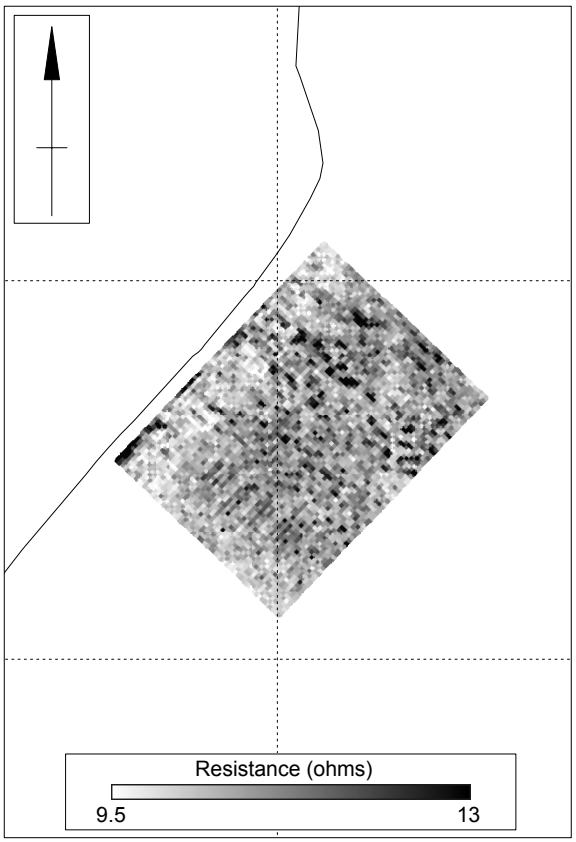
Results and interpretation (Field 9) Fig 5



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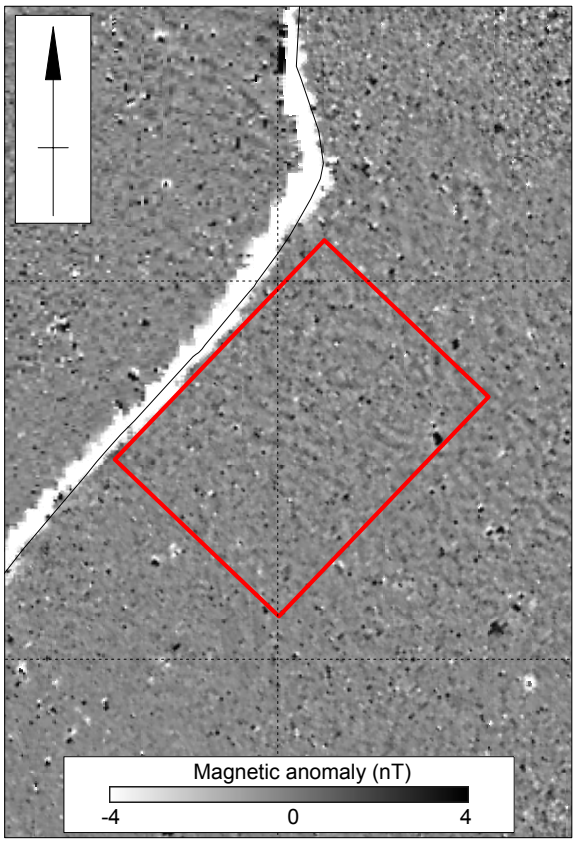
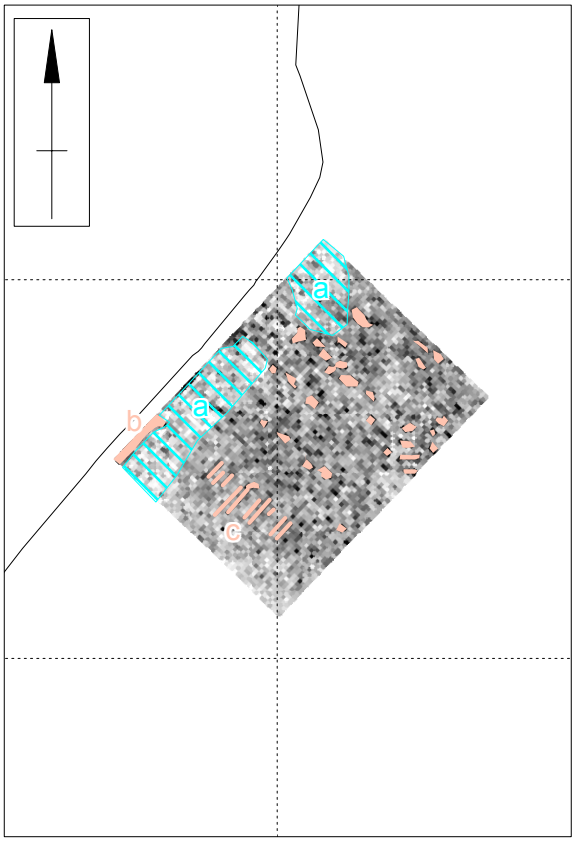


Magnetometer survey results

Earth resistance survey interpretation



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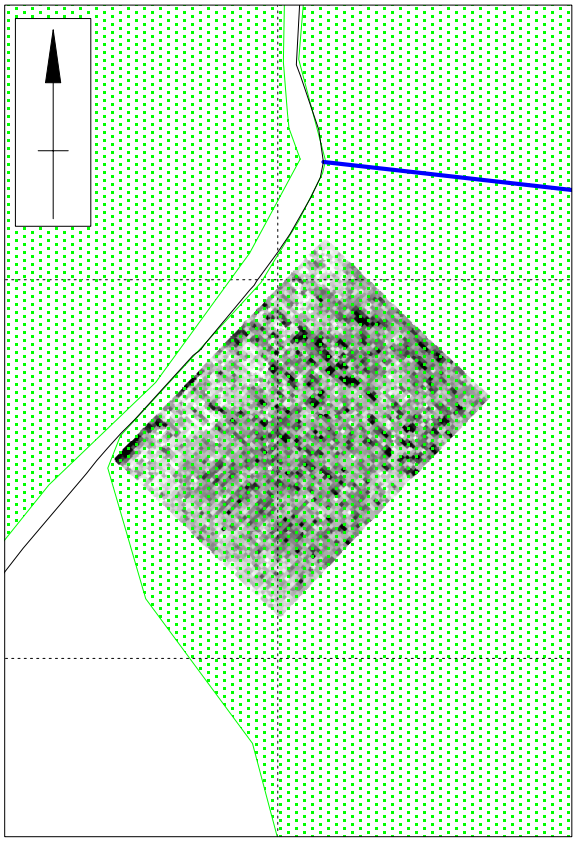

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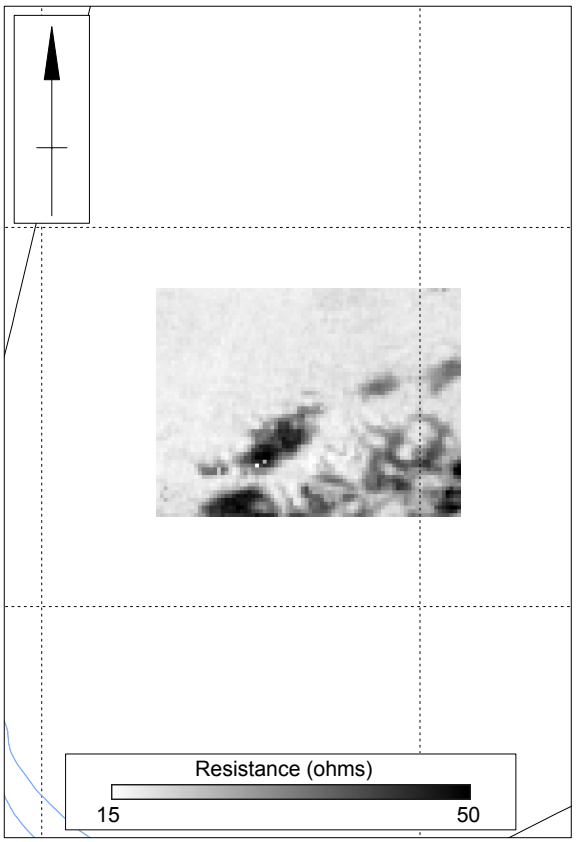
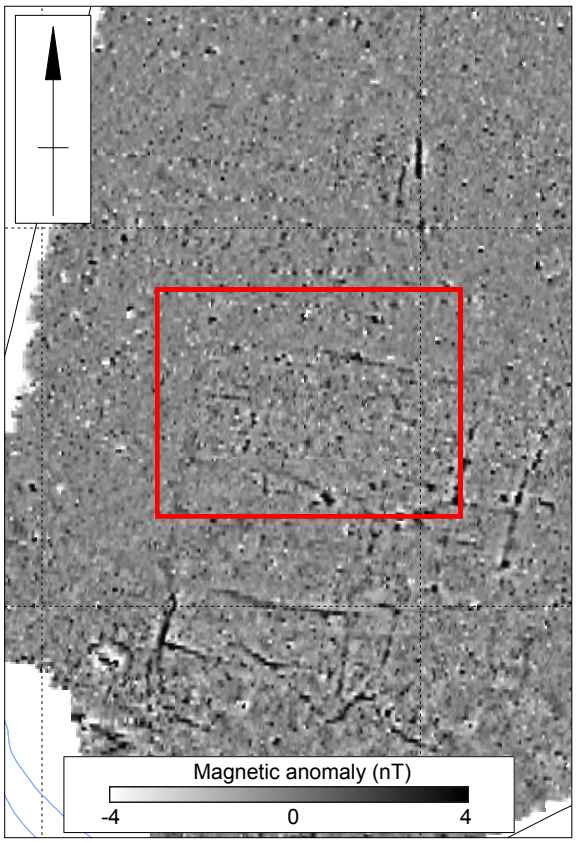
Results and interpretation (Field 10) Fig 6

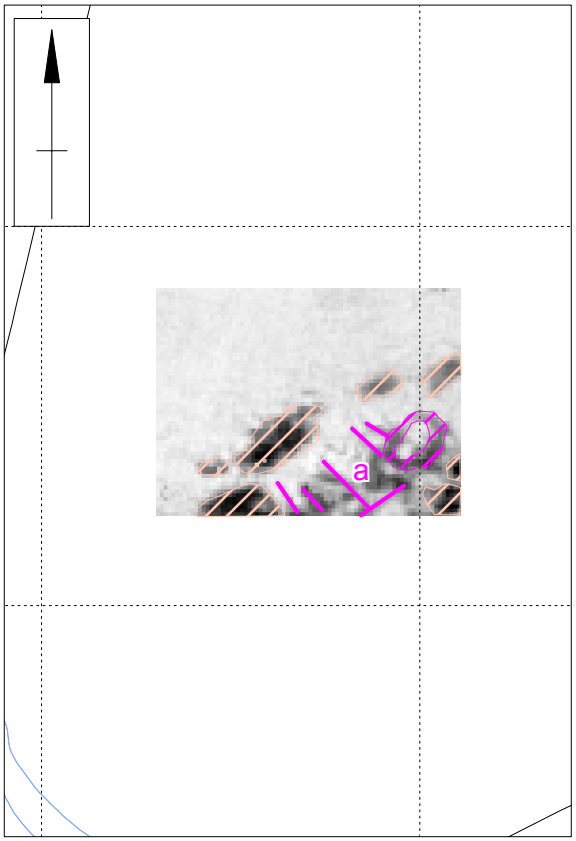


Earth resistance survey results

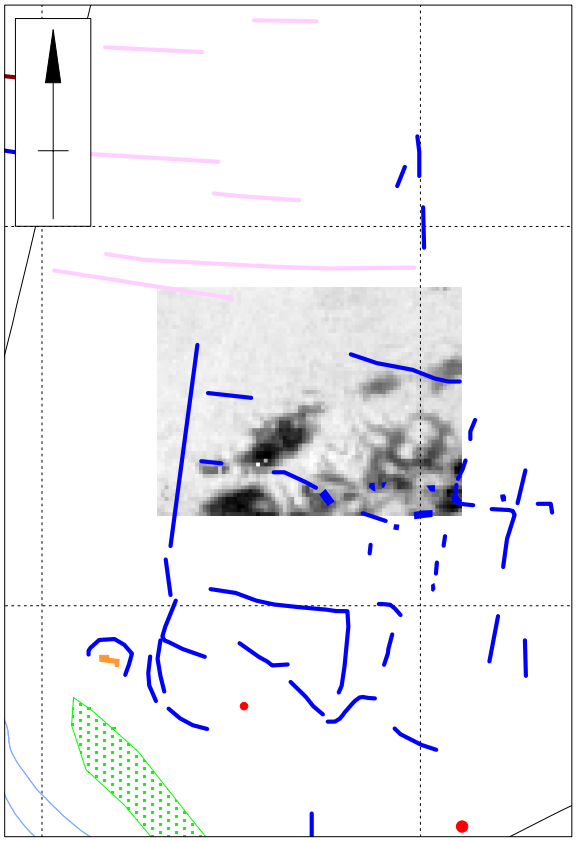


Magnetometer survey results

Earth resistance survey interpretation

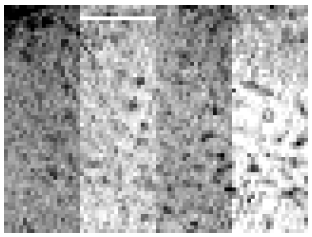


Magnetometer interpretation and earth resistance results



0 1:2000 100m

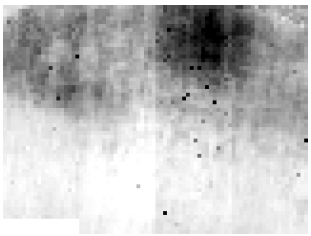
Results and interpretation (Field 14) Fig 7



Field 4

Resistance (ohms)

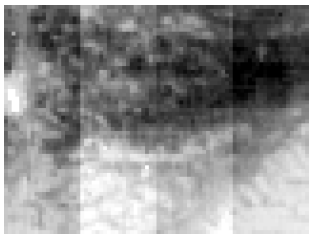
15 24



Field 5

Resistance (ohms)

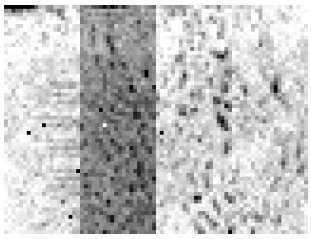
27 75



Field 9

Resistance (ohms)

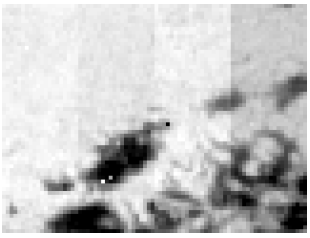
78 165



Field 10

Resistance (ohms)

10 16



Field 14

Resistance (ohms)

16 50

0 1:2000 100m

Scale 1:2000 Unprocessed earth resistance survey data (All fields) Fig 8

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