ABINGDON
OXFORDSHIRE

THE BARTON

Survey using Magnetometery
and Resistivity

12/13 September 2009

For
The Vale of White Horse District Council
Abbey House
Abingdon
Oxfordshire
OX14 3JE

Carried out by

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SUMMARY

Magnetometery and earth resistance surveys were carried out on this site centered on approx grid reference SU 503 976.

Magnetometery located little as there was too much ferrous interference.

The earth resistance survey located probable rubble spreads and walls which could be used in further work on this area.

2 INTRODUCTION

The Barton ruins are located approximately 0.5 kilometres noth - east of the centre of Abingdon and centred on approx SU 503 976.

The ruins and part of the park and adjoining houses are a Scheduled Ancient Monument.

Documentary sources indicate that there were buildings in this area since the 14th century and the present ruins are the remnants of the property demolished by the Council in the 1960's.

A geophysical survey was commissioned by the Oxfordshire Archaeological Unit on behalf of the Vale of White Horse District Council as part of a Heritage Lottery funded project to investigate sites in the Abingdon area which had been owned by Abingdon Abbey.

The area is currently a small park with part wooded and part used as a childrens play area. It is fairly level with a slight slope from north to south.

An area of approximately 80 metres x 40 metres, was surveyed using magnetometery and some 40 metres x 40 metres using resistivity. The extent of English Heritages Section 42 Licence prevented work near the standing remains and it was therefore not possible to relate the standing remains to the geophysical results

The field had short grass although trees, play equipment and the railings around the surviving ruins were obstructions to the survey. The metal fencing and the amount of ferrous debris in the soil led to the magnetometery results being poor. Similarly the trees were in leaf and this may have affected the resistivity results.

The geology is understood to be Kimmeridge clay possibly overlain by patches of limestone gravel.

3 SURVEY DESIGN AND EQUIPMENT

For sites such as this resistivity or ground penetrating radar are considered to be the most likely to produce results. The clay geology would have reduced the chances of radar producing results so this left resistivity.
The clients however wished also to have a magnetometery survey carried out.
English Heritage in their Section 42 licence, which permitted the survey, excluded the area of ruins inside the metal fence from their consent so this could not be surveyed.
The clients also wished the survey to take place during the weekend of the Heritage Open days although for sites with trees better results are often obtained in January.
The magnetometery survey was carried out with a Bartington Grad 601/2 fluxgate gradiometer as this is stable and does not require frequent re-balancing. Traverses were 1 metre apart with 8 readings being taken per metre along each traverse. Whilst 4 readings per metre are usual it was felt that 8 readings could show smaller features and the additional data processing time would not be significant for a relatively small survey area such as this.
A 20m x 20m size was adopted for each survey block as this enabled grids to be located in this confined area. The person carrying the gradiometer walked along strings with markings every metre to seek to ensure that the data was collected at the correct intervals.
Earth resistance (resistivity) was also used. A twin probe array was used with a TR Systems logger and a 0.5 metre sample interval with the mobile probes being 0.5 metres apart. This was chosen as it should locate features less than a metre and detect features up to a metre deep. The presence of modern houses in the area caused earth leakage interference problems with the resistivity readings which had to be filtered out by the equipment which trebled the time needed to take each reading.

The survey area was aligned at an angle to the standing remains in order to maximize the possibility of detecting archaeological features. The grid was set out using tapes and located by measurements to the houses and by using a Trimble Pro XR GPS system and pocket Fastmap software. Like all GPS systems this depends for its accuracy on the number of satellites being received and their position. It gives sub-metre accuracy by also receiving radio signals which correct the satellite information.

Processing was carried out using ArcheoSurveyor software as this is specifically designed to process data from these types of equipment.
Processing
For magnetometery the following processes were used:-
Processes: 9

1 Base Layer
2 Clip at 1.00 SD
3 Clip at 1.00 SD
4 De Stagger: Grids: All Mode: Both By: -6 intervals
5 Clip at 2.00 SD
6 Despike Threshold: 1 Window size: 3x3
7 Clip at 2.00 SD
8 Interpolate: Match X & Y Doubled.

9 Clip at 2.00 SD

For resistivity the following processes were used:-
Processes: 6

1 Base Layer
2 Clip from 14.63 to 1795.13 nT
3 Clip at 1.00 SD
4 Despike Threshold: 1 Window size: 3x3
5 Clip at 2.00 SD
6 Clip at 3.00 SD

4 LOCATION

The grid was set out using 20 metre square grids and a base line set out from the south east corner of the fence around the standing ruins. The fence is not as shown on the Ordnance survey map - hence the corner of grids 1,2 5 and 6 is not at the corner of the enclosure as it appears on the OS map.

Grid locations
NW corner grid 2(fence corner) 450411.2E 197434.2N
SW corner grid 2 450427.2E 197420.7N
NW corner grid 5 450398.6E 197420.1 N

SW corner grid 2 to:-
NE corner of house no 17 = 8.73m
NW corner of porch of house 17 =6.65m
NW corner of house 15 = 13.05m

5 SURVEY RESULTS

Magnetometery

The interpretation is shown on Plan 8g.

This shows very little apart from an east west feature in the south east of the survey area which was also detected using resistivity. Interference from steel fencing and debris in the soil caused the results to be poor.

Resistivity

The interpretation is shown on Plan 8k

On the colour plot areas of high resistance are shown red and low resistance blue.

The resistivity interpretation plot has numbering:-
1- Area of high resistance. Probably rubble or similar
2- Possible line of wall although its southern end is less clear and may have been damaged by later works to the area.
3- Probable rubble filled ditch or similar. This anomaly was also detected by magnetometery
4- Possible small wall or ditch.
5 – Possible wall

The main high resistance area is to the south of the ruins which could indicate that the main axis of the building was in that direction. There is a line of high resistance running westwards from the ruins which may be a wall or path. To the south east of the ruins is a linear feature which may be another wall and other fainter anomalies in this area could indicate other buildings or similar.
One problem with buildings is that when walls are robbed out the fill of the robber trench can sometimes be similar to ditch fills and thus wall alignments can show as ditches.
Another problem is that floors can impede water percolation and thus floors can produce areas of low resistivity measurements.
Trees, mainly to the west of the survey area will have affected the results.

6 CONCLUSIONS

The best results were given by resistivity which indicates the main rubble spread to the south of the standing ruins. Other possible building locations are suggested to the south east of the ruins whilst the area to their west has not yet been investigated.

Disclaimer

Any magnetometery survey will not be able to detect small features and those, such as graves, which have fills which are magnetically undetectable. Some soils show magnetic anomalies better than others and here earlier tests indicated that there are remains which are invisible magnetically.
Similarly for earth resistance differences in soil dampness are important and weather and soil conditions can change making features which are detectable one day undetectable shortly later.
In general if geophysics hasn't found anything it does not mean that there is nothing there.
For more detail on this please refer to the English Heritage guidelines by Andrew David.

Dissemination

Please let us know if you wish this to be kept confidential for longer than 3 months from the date of this report as, unless you wish otherwise, we shall then feel able to provide the results of the survey to persons who may be interested in it, such as the County Archaeologist and the Archaeology Data Service.

7 **Geophysical techniques-General notes**

Magnetometery

A magnetometer is designed to detect variations in the Earths magnetic field. These variations occur where the field has been changed by factors such as iron pipes and features of archaeological interest. To be detected these features have to have certain properties. They have to contain iron which can be magnetically enhanced by human settlement. The larger the difference the better it can be detected. This enhancement can be by being burnt or it can be caused by microbes which by some process tend to concentrate magnetic material. The two factors necessary are therefore to have iron in the soil and for this to have been changed where human activity (or bacteria) has altered it.

It is therefore very unlikely that features will be detected which are made exclusively of oolitic limestone or chalk as these deposits contain very little iron. Even if there has been a lot of human activity there has just not been the iron there for that activity to enhance. Fortunately the topsoils on chalk soils often have quite strong magnetic characteristics so they can reveal ditches and other features which are cut into the underlying chalk. It is this difference in one area having magnetically enhanced soil and others not having it which is detected. A road surfaced with limestone over an iron rich topsoil would similarly show as that area would have less magnetic enhancement than the surrounding soils.

The theory is all very well but the practicalities are a bit more difficult. The main problem is that the earth has a magnetic field of approximately 47,000 nanoTesla whilst the features which we are seeking to detect have a difference above the background level of 0.5 to 10 nanoTesla. Things are complicated further by the magnetic field then changing during the day by and by magnetic fields caused by railway trains, electricity pylons and other factors changing as well. In order to seek to overcome these problems the sensors which are used are put in gradiometer mode which means that they are mounted as pairs with one above the other. Our equipment has the sensors separated by 1 metre but other manufacturers make equipment where the separation is 0.5 metres. What happens then is that the earth's magnetic field is detected by both sensors but only the bottom one also detects most of the reading caused by archaeological features. The readings from the top sensor are automatically deducted from those of the bottom sensor and this gives the reading which should approximate to the reading of the archaeological features.

A magnetometer will detect ditch - like features better than it can detect shallow spreads even of the same volume. The orientation of the survey traverses can be of importance as the processing used to remove striping caused by minor balancing errors in the sensors can also remove some of the data from the archaeological features. It is therefore best to have a grid at an angle to the expected remains rather than being on the same alignment.

Magnetic anomalies are difficult to detect at the best of times and the amount which can be detected declines with the cube of the distance between the anomaly and the sensor. Therefore an anomaly which had a strength of 8 nanoTesla is only read as 2 nanoTesla by a sensor 1 metre away from it. We tend to carry ours with the bottom sensor approx 15cms from the ground surface. The equipment can therefore detect small shallow anomalies or deep ones provided that they are large. Alluvium covering weak archaeological anomalies can therefore make them undetectable.

Earth Resistance (also known as Resistivity)

This is, in theory, the simplest method as it relies on detecting the electrical resistance of the soil. In practice this is a bit more complex as it has been found that if you just place two probes into the ground then the current between them will change as the ground around the terminals becomes polarised. Then if you then stick the probes into the same area again you get a different reading. This is caused by the contact between the soil and the probes changing each time as different surface areas of grains touch the surface of the probes. To overcome this various arrays of probes have been developed but these rely on the current being sent via one set of probes and read by another set. There are various arrays such as Wenner, Schlumberger, pole- pole and Twin. The most commonly used are twin and pole- pole both of which involve having a pair of remote probes at least 15 metres away from the area being surveyed (assuming 0.5 metres between the probes in the survey area). For twin the remote probes are spaced approx 0.5metres apart and this is increased to over 15metres for pole-pole.

Earth resistance is largely dependent upon the moisture content of the soil as a ditch will often have silts which retain moisture whilst the natural soil around may be more freely draining. Of course the opposite can happen, as rubble filled ditches can be more freely drained than the surrounding soils. Similarly walls tend to be drier and give higher resistance values than the soil around them.

Various pieces of equipment are used which can give between one and four readings at a time. Out equipment unfortunately only takes one reading at a time. Usually these have probes which are separated by 0.5 metres which can give a depth of reading of almost 1 metre-depending upon soil conditions and probe array. A 1 metre separation between the probes in the survey area, (the mobile probes), can go even deeper.

This method is good for finding walls but has the drawback of being far slower than magnetometery-about one third of the speed at best. The data often needs less processing than magnetometery data although high pass filtering can be useful to remove the effects of geology on a site, and de-spike used to remove the effect of the occasional poor reading caused by the probes hitting stones on the soil surface. The other main drawback of this method is that as it is greatly influenced by the amount of moisture in the soil. In the summer soil conditions can be too dry to get good results and in the winter the opposite can be the case. Often, however, something shows at most times of the year, it is just that at optimum times the clarity of the features is far better.
Interpreting resistivity results can have its problems which include:-
Walls usually have high resistance but robbed out walls can have low resistance.
Ditches usually have low resistance but if they are filled with rubble or gravel they can have high resistance.
Paved surfaces can resemble broad walls but sometimes the paving ponds groundwater creating a low resistance area.

Processing

Magnetometery

We use the program ArcheoSurveyor to process the data. In general one should avoid over processing as it can create spurious features. However the presence of large anomalies caused by iron pipes means that the data has to be clipped as otherwise the plots would show little more than the largest anomalies.
After clipping We use a zero mean traverse which removes striping in the plot caused by the magnetometers not being balanced with each other and going out of balance during a survey. Webalance the magnetometers at the start of work and at lunchtime to reduce the drift and in hot weather even more frequently. That being said, these magnetometers are far more stable than their predecessors.
The next process is destagger. This removes the zig zag effect of walking lines at slightly different speeds. As we use a marked string to ensure the location of each reading and as we tend to get a half metre stagger and are now concluding that this may be an error within the equipment rather than a walking error.
Despike is used to remove interference from iron nails and similar debris.
Compression filters are used to amplify the responses as otherwise some sites with low responses appear to be very flat.

Resistivity

This generally needs less processing. Clipping and de-spiking can stop occasional high readings caused by poor contact from distorting the survey plot. Edge matching can also reduce distortions caused when grids have been surveyed in different days with different amounts of soil moisture.

General

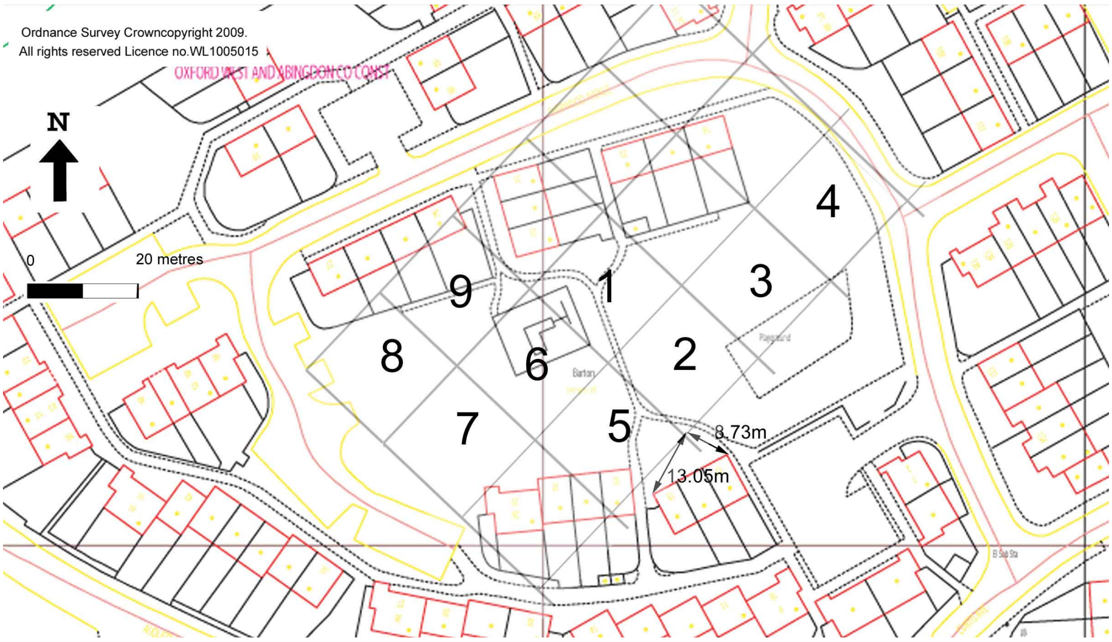
The relatively recent availability of automatic data logging, reasonably priced computer memory and processing software has made it possible to survey far larger areas than were previously practicable.

Further Reading

The best reference book on this is Seeing Beneath the Soil by A. J. Clark, 1990. Other books by I Scollar Archaeological Prospecting and Remote Sensing Cambridge University Press 1990 and by Gaffney and Gater Revealing the Buried Past Tempus, 2003 are also useful. Andrew David's guide Geophysical survey in archaeological field evaluation English Heritage, 2008 gives a good overview of techniques and what to expect in reports. Our website www.archaeologicalgeophysics.co.uk gives examples of sites and other details.

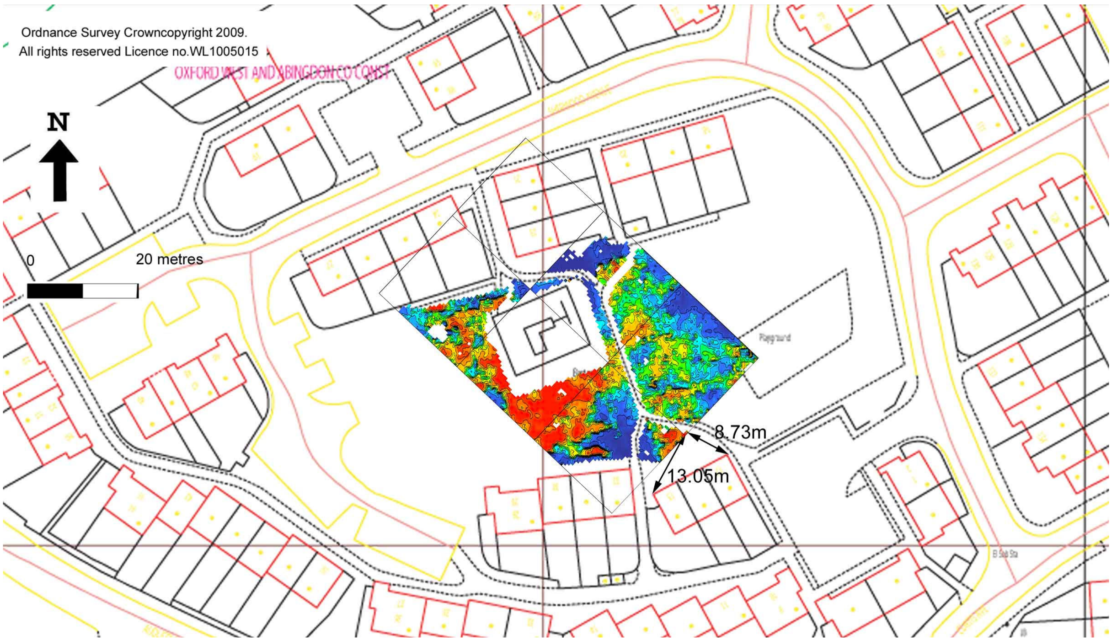
8a Location – Grids

Magnetometery grid numbering



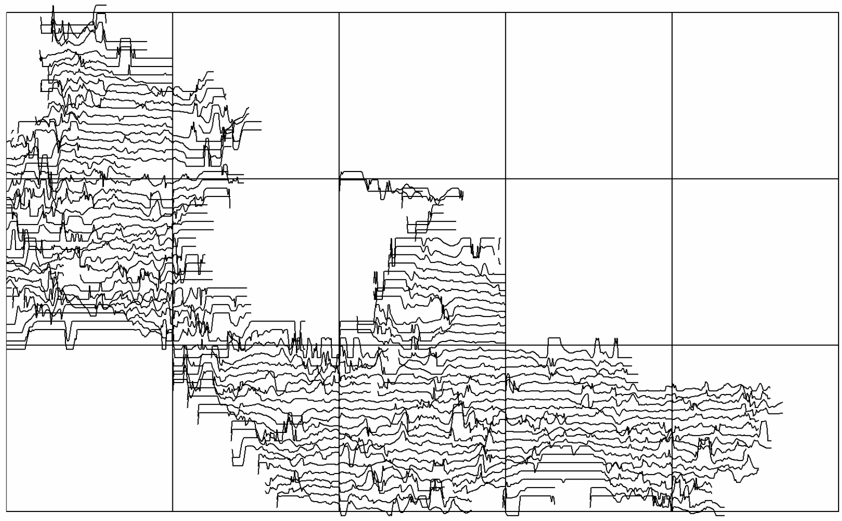
8b Magnetometery survey

8c Resistivity Survey

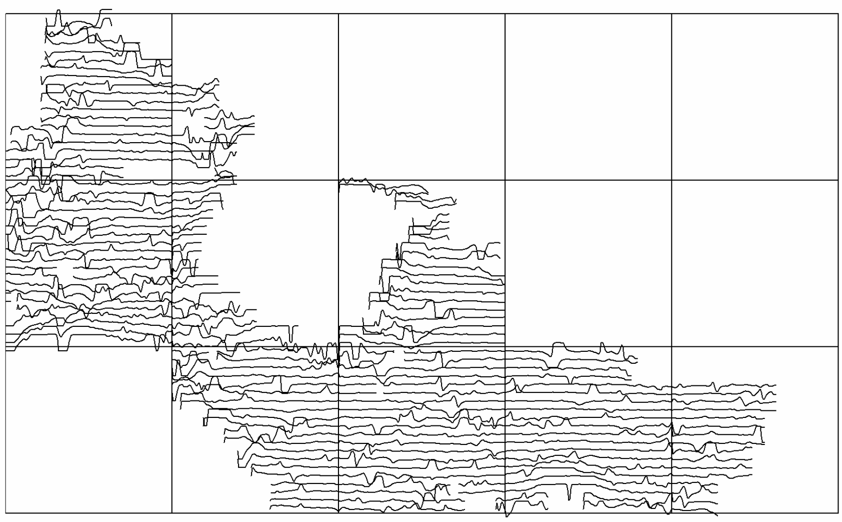


8d and e magnetometery trace plots

Trace plot original data clipped +/- 100nT

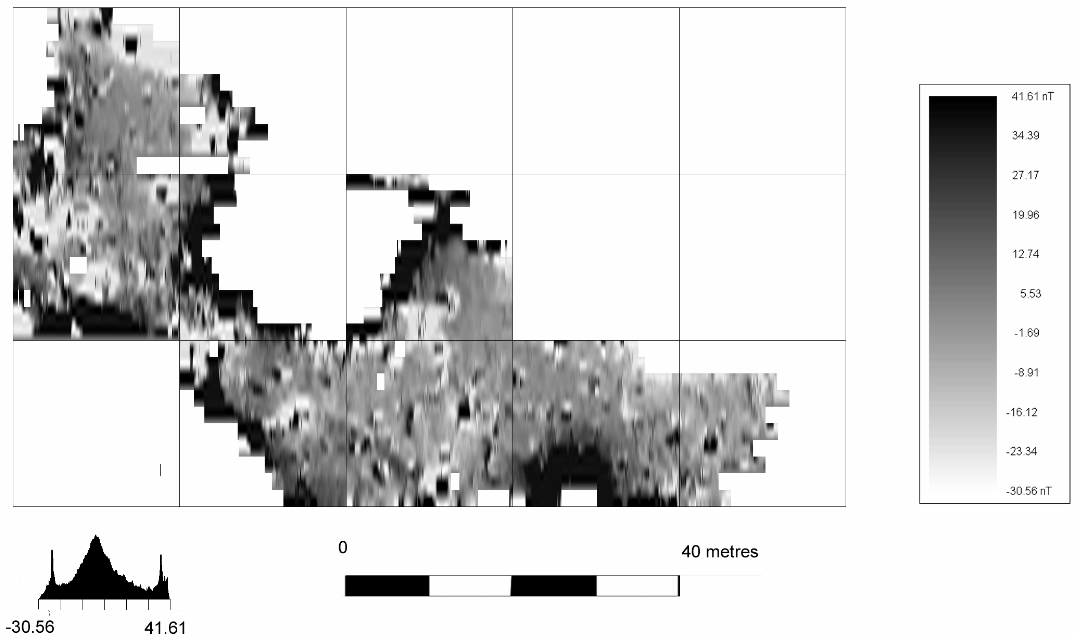


Trace plot of processed data

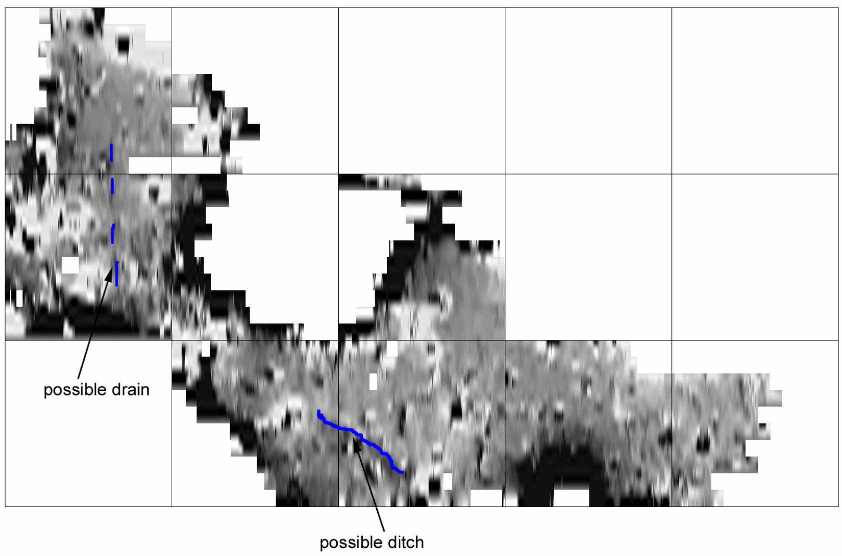


8f and g magnetometery greyscale and interpretation

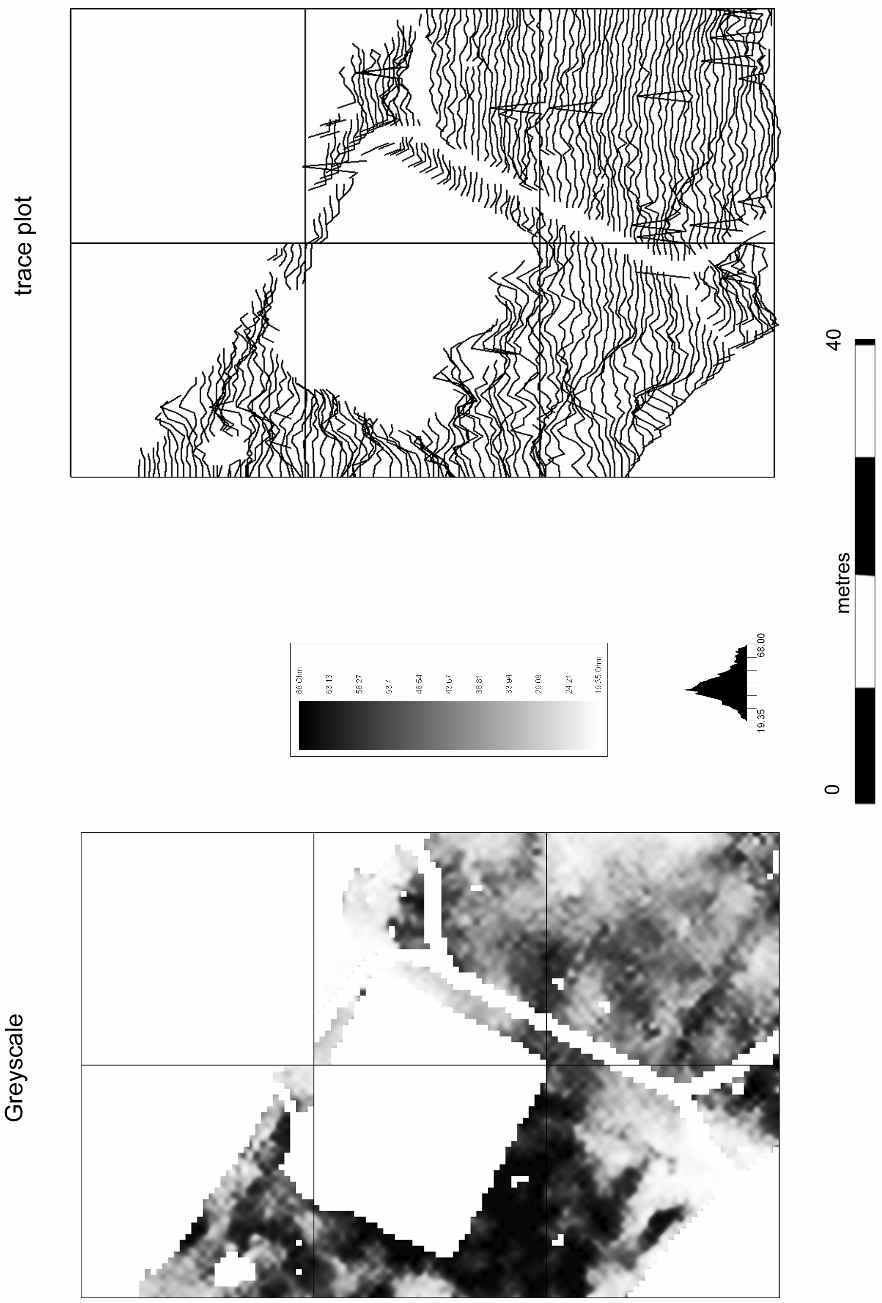
Greyscale plot



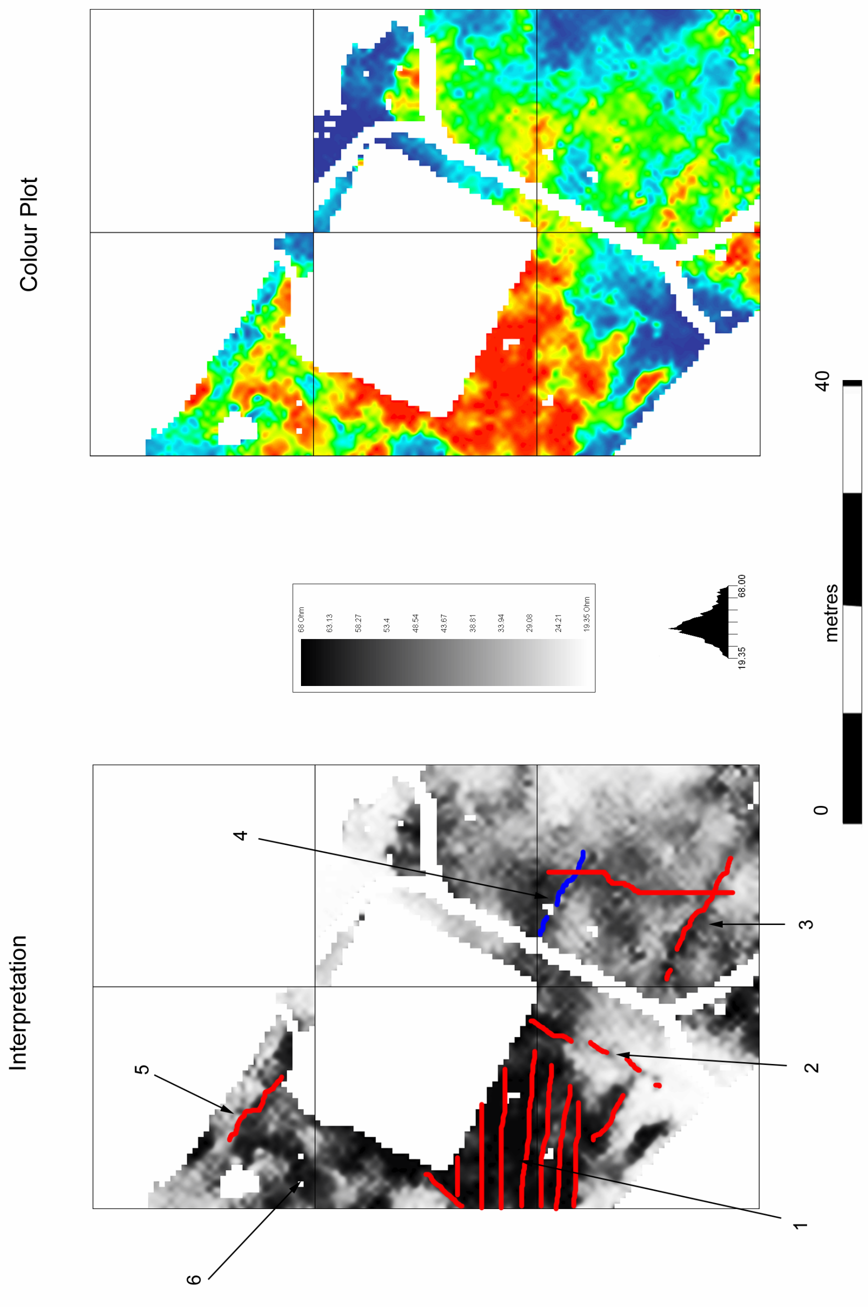
Interpretation



8h and i Resistivity trace and greyscale plots



8j and k Restivity colour and interpretation


Colour Plot
Interpretation
1
2
3
4
5
6
68 Ohm
63.13
58.27
53.4
48.54
43.67
38.81
33.94
29.08
24.21
19.35 Ohm
19.35
68.00
0
metres
40

Survey Details

Name of site: The Barton, Abingdon

County: Oxfordshire

NGR grid reference (Centre of survey to nearest 100m):**SU 503 976**

Start date: 12 Sept 09 **End date: 13 Sept 09**

Geology at site (Drift and Solid): **Kimmeridge clay with limestone gravel**

Known archaeological sites / monuments covered by the survey
(Scheduled Monument No. or National Archaeological Record No. if known)
The Barton ruins

Archaeological sites / monument types detected by the survey
(Type and Period if known. "?" where any doubt).
Probable medieval building location.

Surveyor (Organisation, if applicable, otherwise individual responsible for the survey):
Abingdon Archaeological Geophysics

Name of client, if any:
Vale of White Horse District Council

Purpose of survey:
To investigate the extent of the ruins

Location of:

a) **Primary archive, i.e. raw data, electronic archive etc:**
As Surveyor above

b) **Full report:**
As Surveyor above and with client

Technical Details

(Please fill out a separate sheet for each survey technique used)

1 **Type of survey** (Use term from attached list or specify other):
Magnetometery

Area surveyed, if applicable (In hectares to one decimal place):
0.3ha

Traverse separation, if regular:
1m

Reading / sample interval:
8per metre

Type, make and model of instrumentation:
Bartington Grad 601/2 gradiometer

2 **Type of survey** (Use term from attached list or specify other):

Resistivity

Area surveyed, if applicable (In hectares to one decimal place):
0.1ha

Traverse separation, if regular:
0.5m

Reading / sample interval:
0.5m

Type, make and model of instrumentation:
TR/CIA resistance meter

For resistivity survey:

Probe configuration:
Twin

Probe spacing:
0.5m

Land use **at the time of survey** (Use term / terms from the attached list or specify other):**Park**

Additional remarks (Please mention any other technical aspects of the survey that have not been covered by the above questions such as sampling strategy, non standard technique, problems with equipment etc):
The exclusion of the area of the standing remains from the area permitted in the S42 licence prevented the survey from being related to the standing remains.

List of terms for survey type

Magnetometer (includes gradiometer)
Resistivity
Resistivity profile
Magnetic susceptibility
Electro-magnetic survey
Ground penetrating radar
Other (please specify)

List of terms for land use

Arable
Grassland – pasture
Grassland – undifferentiated
Heathland
Moorland
Coastland – inter-tidal
Coastland – Above high water
Allotment
Archaeological excavation
Garden
Lawn
Orchard
Park
Playing field
Built-over
Churchyard
Waste ground
Woodland
Other (please specify)