

GSB

PROSPECTION Ltd

GEOPHYSICAL SURVEY REPORT 2009/29

Norman Cross Camp Cambridgeshire



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Specialising in Shallow and Archaeological Prospection

GSB Survey No. 2009/29

Norman Cross Camp, Cambridgeshire

NGR	TL 160 912
Location	Norman Cross, approximately 3 miles southwest of Peterborough and just off Junction 16 of the A1(M).
County	Cambridgeshire.
District	City of Peterborough.
Parish	Yaxley CP.
Topography	Flat with some extant earthworks.
Current land-use	Pasture.
Soils	The site soils belong to the Hanslope association (411d) soils which consist of slowly permeable calcareous clayey soils. Some slowly permeable non-calcareous clayey soils (SSEW 1983).
Geology	Grey mudstone with sporadic thin limestones (BGS 172).
Archaeology#	Norman Cross Camp (monument no. 364539) is a Napoleonic era prisoner of war camp consisting of several large barrack blocks and other buildings constructed between 1796-7. Monument Number 364539.
Study Area	450 x 350m.
Survey Methods	Detailed fluxgate gradiometer survey.

Aims

To evaluate survival rates of sub-surface archaeology and the accuracy of existing plans of the camp; this in time will help management of the site and inform local planning departments in regard to current or future plans for development of the site or areas surrounding the site. This work forms part of a wider evaluation being carried out by Channel 4's **Time Team**.

Summary of Results*

The area surveyed within the site clearly shows the defensive ditches surrounding the camp. Barrack blocks have been identified along with punishment cells (black holes), hospital buildings, guard towers and other structures. The noisy dataset reflects the extent of demolition rubble spread across the site. Anomalies located outside the camp, towards the northeast have the potential of reflecting interments.

Project Information

Project Co-ordinator: E Wood MifA
Project Assistants: J Adcock & Dr J Gater
Date of Fieldwork: 14th-16th July 2009
Date of Report: 26th August 2009

*It is essential that this summary is read in conjunction with the detailed results of the survey.

Taken from Mower and Robinson 2009.

Survey Specifications

Method

The 20m survey grid was set out and tied in to the Ordnance Survey (OS) grid using a Trimble R8 real time kinematic (RTK) differential GPS system by **Dr H Chapman**.

Technique	Traverse Separation	Reading Interval	Instrument	Survey Size
Magnetometer - Scanning (Appendix 1)	-	-	-	-
Magnetometer – Detailed (Appendix 1)	1m	0.25m	Bartington Grad 601-2	4.18ha
Resistance – Twin Probe (Appendix 1)	-	-	-	-
Ground Penetrating Radar (GPR) (Appendix 1)	-	-	-	-

Data Processing

	Magnetic	Resistance	GPR
Zero Mean Traverse	Y	-	-
Step Correction	Y	-	-
Interpolate	Y	-	-
Low Pass Filter	Y	-	-

Presentation of Results

Report Figures (Printed & Archive CD): Location, data plots and interpretation diagram on base map (Figures 1-3).

Reference Figures (Archive CD): Data plots at 1:500 for reference and analysis. (See List of Figures).

Plot Formats: See Appendix 1: Technical Information, at end of report.

General Considerations

Conditions for survey were generally good as the fields consisted of short pasture. Gaps within the results are where data could not be collected due to large trees.

Smaller scale ferrous anomalies ("iron spikes") are present in the survey areas, their form best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris in the topsoil and are commonly assigned a modern origin. While the most prominent of these are highlighted on the interpretation diagram, they are not discussed in the text below unless considered relevant.

Results of Survey

1. Magnetic Survey

Area 1

- 1.1 The outline of the prison camp is visible on aerial photographs and the ditches still survive as well-preserved earthworks; as such the magnetic survey could be targeted on specific areas of interest.
- 1.2 Rectangular blocks of increased responses (A) indicate the location of prisoner barracks as marked on the 1797; they measure approximately 32m by 11m although few specific wall lines have been identified.
- 1.3 Within the southwest quadrant anomalies (B) correlate to the position of ‘black holes’ – punishment cells, a baking house and a turnkeys building. The outline of these buildings can be clearly seen within the demolition material surrounding (B). Other increased responses within this vicinity may relate to prisoners’ ovens in which they cooked their own food.
- 1.4 The hospital complex lies within the northeast quadrant in which there is a large area of increased response. Within these anomalies a number of positive and negative linear trends (C) are visible which potentially locate wall remains of either the hospital itself or the surgeon’s house.
- 1.5 The 1797 plan shows a single guard house in the northern section of the defences; however the data show two anomalies (D) roughly 8m x 5m. From the results it is unclear whether the guard houses were in use at the same time or are from different time periods; however another undated plan does show a second structure.
- 1.6 An octagonal blockhouse was sited in the centre of the prison camp; the magnetic data show an increased response (E) which is likely to relate to this, though again the results lack any specific detail.
- 1.7 A large ferrous anomaly can be seen at the easternmost limits of the data due to a gas pipe. This has produced a large magnetic halo and, as such, has masked the archaeological remains.

Area 2

- 1.8 This area was surveyed in order to locate a cemetery known to have existed beyond the northeast corner of the camp. Burials are always difficult to detect within geophysics especially magnetic surveys, however a trench was positioned over an anomaly with an approximately east-west orientation. A number of interments were discovered; it is possible that similar magnetic anomalies could indicate further burials but the geophysical evidence is at best tentative.

2. Conclusions

- 2.1 The magnetic data have largely corroborated the known layout of Norman Cross Camp. Prisoners’ barracks have been identified along with punishment cells, a baking house, a turnkeys building and the hospital. Most of the geophysical data show an increased response which is likely to be from demolition rubble. A potential second guard tower has been identified along the northern defences, despite only one having been recorded on the 1797 plan.

- 2.2 Outside of the camp, excavation trenches over some responses revealed burials; in two instances multiple interments were discovered. It remains uncertain as to whether other similar magnetic anomalies all relate to further burials.

References

- BGS 172 *British Geological Survey Sheet 172, Ramsey. Solid and drift edition 1:50 000.*
- Mower J and Robinson B 2009 *Proposed Archaeological Evaluation at Norman Cross Camp, Cambridgeshire. Unpublished Report.*
- SSEW 1983 *Soils of England and Wales. Sheet 4, Eastern England. Soil Survey of England and Wales.*

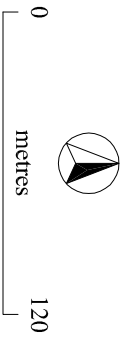
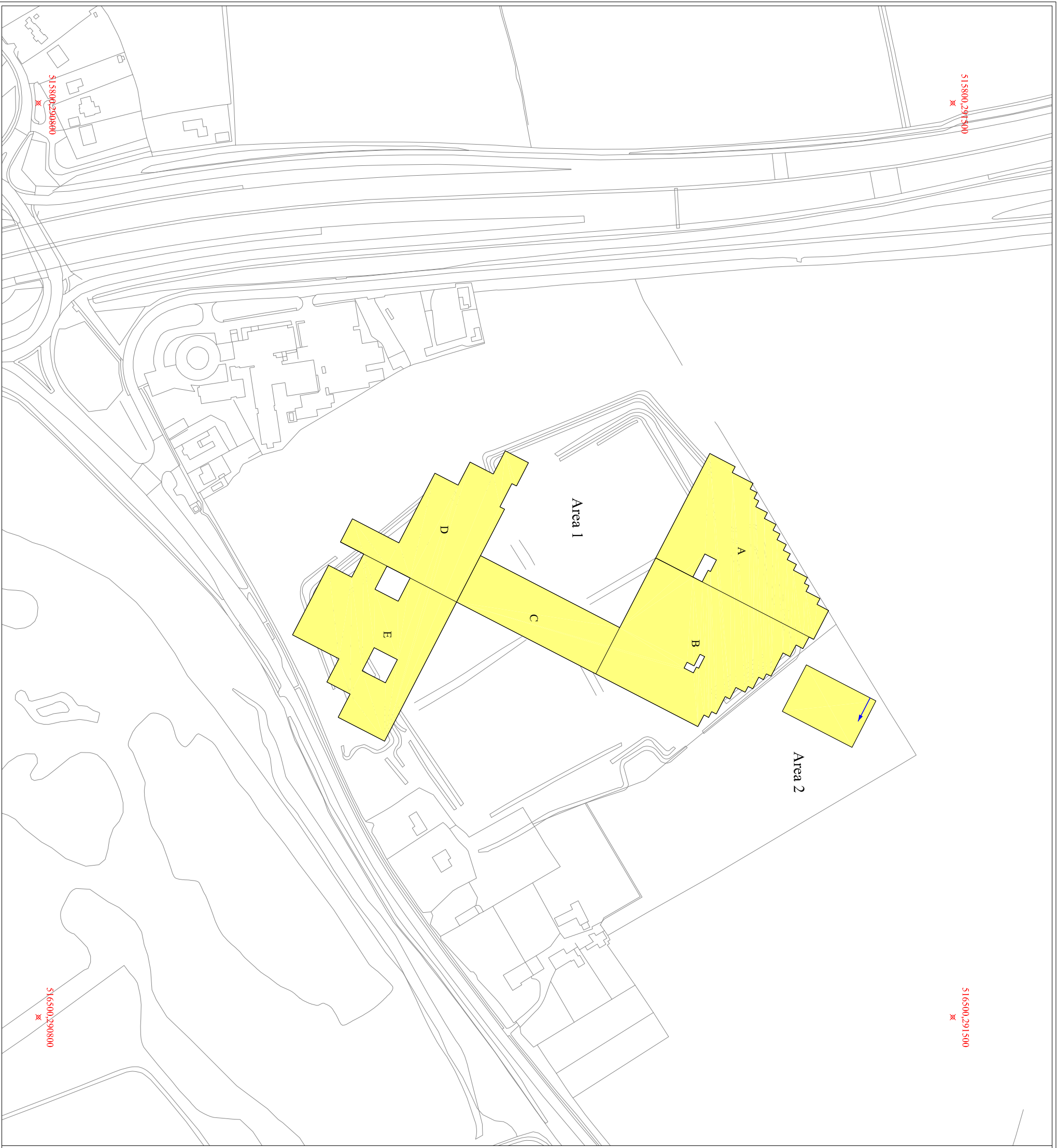
List of Figures

Report Figures

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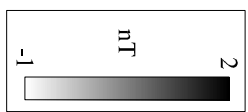
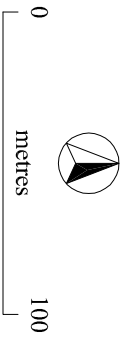
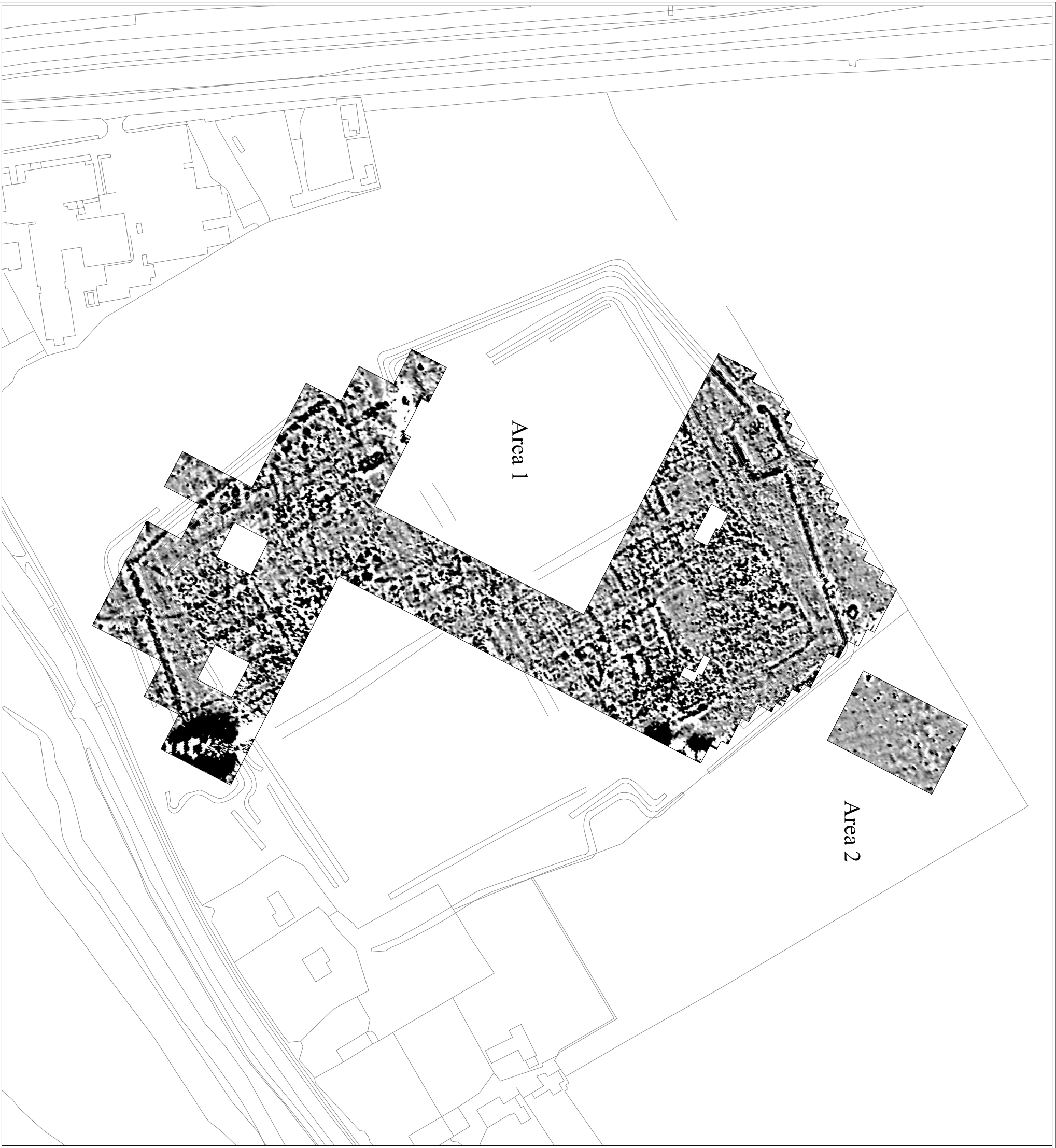
Reference Figures on CD

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| Figure A10 | Area 2: XY Trace Plot & Greyscale Image | 1:500 |

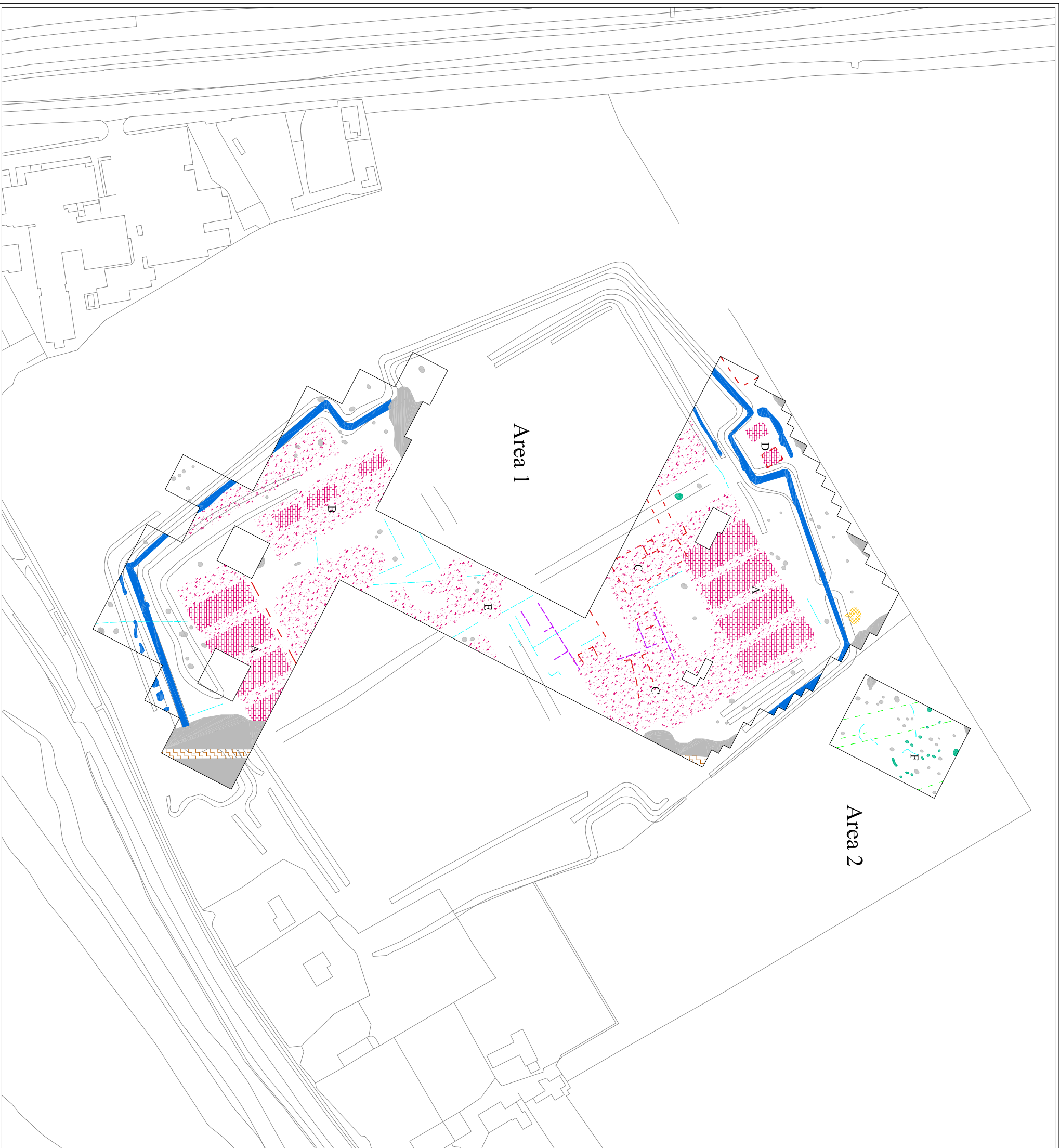













- Gradiometer Survey
- Direction of Traverse

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2009/29 Norman Cross Camp, Cambridgeshire
Location of Survey Areas
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Figure 1



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Summary Greyscales
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Figure 2



-  Increased Response - Buildings
-  Increased Response - Demolition Spread
-  Ditch - Defences
-  Positive Response - ?Walls
-  Negative Response - ?Walls
-  Uncertain - ?Burials
-  Trends
-  Ploughing
-  Bonfire
-  Pipe
-  Ferrous



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2009/29 Norman Cross Camp, Cambridgehire

Location of Survey Areas

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Figure 3

Appendix 1: Technical Information

Instrumentation

Fluxgate Gradiometer: Geoscan FM36/256 and Bartington Grad601-2

Both the Geoscan and Bartington instruments comprise two fluxgate sensors mounted vertically apart; the distance between the sensors on the former is 500mm, on the latter 1000mm. The gradiometers are carried by hand, with the bottom sensor approximately 100-300mm from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. The fluxgate gradiometer suppresses any diurnal or regional effects. Generally, features up to 1m deep may be detected by this method. Having two gradiometer units mounted laterally with a separation of 1000mm, the Bartington instrument can collect two lines of data per traverse.

Resistance Meter: Geoscan RM15

This instrument measures the electrical resistance of the earth, using a system of four electrodes (two current and two potential.) Depending on the arrangement of these electrodes an exact measurement of a specific volume of earth may be acquired. This resistance value may then be used to calculate the earth resistivity. The most common arrangement is the Twin Probe configuration which involves two pairs of electrodes (one current and one potential): one pair remain in a fixed position, whilst the other measures the resistance variations across a grid. The resistance is measured in ohms and, when calculated, resistivity is in ohm-metres. The resistance method as used for standard area survey employs a probe separation of 0.5m, which samples to a depth of approximately 0.75m. The nature of the overburden and underlying geology will cause variations in this depth.

GPR: Sensors & Software Noggin Smartcart

The Noggin system includes an onboard digital video logger (DVL III), 250 MHz or 500MHz antenna, an odometer wheel and battery. It is, therefore, a fully integrated system. The built-in software uses the integrated odometer to provide an accurate distance measurement to the response. The data are recorded in digital format and can be processed to produce depth slice maps, 2D sections or 3D cubes.

Display Options

XY Trace

This involves a line representation of the data. Each successive row of data is equally incremented in the Y axis, to produce a stacked profile effect. This display may incorporate a hidden-line removal algorithm, which blocks out lines behind the major peaks and can aid interpretation. The advantages of this type of display are that it allows the full range of the data to be viewed and shows the shape of the individual anomalies. The display may also be changed by altering the horizontal viewing angle and the angle above the plane. The output may be either colour or black and white.

Greyscale

This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Relief Plot

This is a method of display that creates a three dimensional effect by directing an imaginary light source on a given data set. Particular elements of the results are highlighted depending on the angle of strike of the light source. This display method is particularly useful when applied to resistance data to highlight subtle changes in resistance that might otherwise be obscured.

3D Surface Plot

This is similar to the XY trace, but in 3 dimensions. Each data point of a survey is represented in its relative position on the x and y axes and the data value is represented in the z axis. This gives a digital terrain, or topographic effect.

Radargram

Radargram comprise a record of reflection intensity against the time taken for the emitted energy to travel from the transmitter down to the reflector and back to the receiver. The resultant plot is effectively a vertical section through the ground along the line of the traverse, with time (depth) on the vertical axis, displacement on the horizontal axis and reflection intensity as a grey or colour scale.

Time Slice

If a number of radargrams are collected over a grid, or in conjunction with GPS data, it is possible to reconstruct the entire dataset into a 3D volume. This can then be resampled to compile 'plan' maps of response strength at increasing time offsets (typically converted to show approximate depth), thus simplifying the visualisation of how anomalies vary beneath the surface across a survey area.

Volume Plot

Rather than looking at discrete slices of data from the 3D volume, it is possible to strip away all reflections with intensity below a user-defined threshold, leaving just the strongest anomalies. This serves to create a rendered 3D model of the most substantial subsurface deposits which can then be rotated or enlarged/reduced to either animate the display or view it from any perspective.

Data Processing

Zero Mean Traverse	This process which sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set. It is usually only applied to gradiometer data.
Step Correction	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors
Interpolation	When geophysical data are presented as a greyscale, each data point is represented as a small square. The resulting plot can sometimes have a 'blocky' appearance. The interpolation process calculates and inserts additional values between existing data points. The process can be carried out with points <i>along</i> a traverse (the <i>x</i> axis) and/or <i>between</i> traverses (the <i>y</i> axis) and results in a smoother greyscale image.
Despike	In resistance survey, spurious readings can occasionally occur, usually due to a poor contact of the probes with the surface. This process removes the spurious readings, replacing them with values calculated by taking the mean and standard deviation of surrounding data points. It is not usually applied to gradiometer data.
High Pass Filter	Carried out over the whole a resistance data-set, the filter removes low frequency, large scale spatial detail, such as that produced by broad geological changes. The result is to enhance the visibility of the smaller scale archaeological anomalies that are otherwise hidden within the broad 'background' change in resistance. It is not usually applied to gradiometer data.
GPR Filters	There are a wide range of GPR filters available and their application will vary from project to project. The most commonly used are: Dewow (removes low frequency, down-trace instrument noise); DC-Shift (re-establishes oscillation of the radar pulse around the zero point); Bandpass Filtering (suppresses frequencies outside of the antenna's peak bandwidth thus reducing noise); Background Removal (can remove ringing, instrument noise and minimize the near-surface 'coupling' effect); Migration (collapses hyperbolic tails back towards the reflection source).

Tie-in Techniques and Information

Tapes
A number of points on each survey grid are recorded by triangulating to at least two fixed points on the base map. If there is a lack of 'hard detail' in the mapping, some form of survey marker will be left <i>in-situ</i> for reference. NOTE: When re-establishing the grid (for excavation or other post-survey work) only data from the supplied tie-in diagram should be used and NOT the report figures.
Electronic Distance Measurers (EDM) / Total Stations (TST)
This type of instrument measures the distance and angle to features with reference to a fixed point. Where possible the EDM will be set up over a point that can be re-established with relative ease, e.g. over map detail, a survey marker or at a point measurable by tapes. Distances and angles to permanent points of reference and/or map detail are recorded as well as at least two points per survey grid. NOTE: When re-establishing the grid (for excavation or other post-survey work) only data from the supplied tie-in diagram should be used and NOT the report figures.
Global Positioning Systems (GPS)
Using a roving receiver unit, these systems record the longitude, latitude and altitude of a given point by triangulating between a network of satellites. For survey-grade measurements, the accuracy is refined by integrating data from a fixed base station or local reference network. In addition to grid points, elements of map detail are collected to assess the existing base-map accuracy and, in worst-case scenarios, use the data on a non-georeferenced map. If the supplied mapping is found to be inaccurate, it is sometimes necessary to shift the position of GPS points (keeping their relative positions fixed) within the site plan to correlate cartographic features with the 'real-world' co-ordinates; this should be considered when using GPS to re-establish an existing survey grid (see note below). It should be noted that the accuracy of any GPS-positioned point is dependent upon both the system and the satellite geometry at the time of survey. On projects where multiple contractors have used GPS, the possibility of compound errors between original survey grid creation, tie-in information and grid re-establishment should be borne in mind when positioning trenches over recorded anomalies. NOTE: If re-establishing the grid with a GPS (for excavation or other post-survey work), use only the co-ordinates recorded on the tie-in diagram or, if supplied, the GPS data file included on the Archive CD; relative positions in the report diagrams may be correct but absolute co-ordinates can vary if discrepancies in the base mapping have been encountered.

Terms Commonly used in the Interpretation of Results

Magnetic

Archaeology	This term is used when the form, nature and pattern of the response are clearly or very probably archaeological. These anomalies, whilst considered anthropogenic, could be of any age.
? Archaeology	The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Areas of Increased Magnetic Response	These responses show no visual indications on the ground surface and are considered to have some archaeological potential.
Industrial	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.
? Natural	These are anomalies that are likely to be natural in origin i.e. geological or pedological.
Ridge and Furrow	These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.
Ploughing Trend	These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.
Uncertain Origin	Often, anomalies (both positive and negative) will be recorded which stand out from the background magnetic variation yet show little to suggest an exact origin. This may be because the characteristics and distribution of the responses straddle the categories of “?Archaeology” and “?Natural” or that they are simply of an unusual form.
Trend	This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.
Areas of Magnetic Disturbance	These responses are commonly found in places where modern ferrous or fired materials are present e.g. brick rubble. They are presumed to be modern.
Ferrous Response	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.

Resistance

Archaeology	High or low res responses are clearly or very probably archaeological. These anomalies, whilst considered anthropogenic, could be of any age.
? Archaeology	The interpretation of such anomalies is often tentative, with the anomalies exhibiting either weak signal strength or forming incomplete archaeological patterns. They may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions e.g. palaeochannels or magnetic gravels.
? Natural	These are anomalies that are likely to be natural in origin i.e. geological or pedological.
? Landscaping / topography	These are regular and broad linear anomalies that are presumed to be the result of ancient cultivation. In some cases the response may be the result of modern activity.
Vegetation	These are isolated or grouped linear responses. They are normally narrow and are presumed modern when aligned to current field boundaries or following present ploughing.
Trend	This is usually an ill-defined, weak, isolated or obscured linear anomaly of unknown cause or date.

GPR

Wall /Foundation/ /Vault /Culvert etc.	High amplitude anomaly definitions used when other evidence is available that supports a clear archaeological interpretation.
Archaeology	Anomalies whose form, nature and pattern indicate archaeology but where little or no supporting evidence exists. If a more precise archaeological interpretation is possible, for example the responses appear to respect known local archaeology, then this will be indicated in the accompanying text. As low amplitude responses are less obvious features it is unlikely that they would have a definitive categorisation.
? Archaeology	When the anomaly could be archaeologically significant, given its discrete nature, but where the distribution of the responses is not clearly archaeological. Interpretation of such anomalies is often tentative, exhibiting either little contrast or forming incomplete archaeological patterns.
Historic	Responses showing clear correlation with earlier map evidence.
?Historic	Responses relating to features not directly recorded on earlier maps but which appear to respect features that are. May form patterns suggestive of formal gardens, landscaping or footpaths.
Area of Anomalous Response	An area in which the response levels are very slightly elevated or diminished with respect to the 'background'. Where no obvious surface features or documentary evidence can explain this spread of altered reflectivity it is assumed to denote some kind of disturbance, though the origins could be of any age and either anthropogenic or natural. Possible explanations are changes in subsurface composition and groundwater 'ponding'.
Natural	Anomalies relating to natural sub-surface features as indicated by documentary sources, local knowledge or evidence on the surface.
?Natural	Responses forming patterns akin to subsoil/geological variations either attenuating or reflecting greater amounts of energy. An archaeological origin such as rubble spreads or robbed out remains cannot be dismissed.
Trend	An ill defined, weak or isolated linear anomaly of unknown cause or date.
Modern	Reflections that indicate features such as services, rebar or modern cellars correlating with available evidence (maps, communications with the client, alignment of drain covers etc.).
?Modern	Reflections appearing to indicate buried services but where there is no supporting evidence. Also applies to responses which form patterns, or are at a depth which suggests a modern origin. An archaeological source cannot be completely dismissed.
Surface	Responses clearly due to surface discontinuities, the effects of which may be seen to 'ring' down through radargrams and so incorrectly appearing in the deeper time-slices.