CARISBROOKE CASTLE PRIVY GARDEN, Isle of Wight: August 2006.

Geophysical survey report.

Introduction

Geophysical surveys of an area of approximately 0.1 hectares were conducted over the Privy Garden, immediately S of St. Nicholas' chapel, in the SW corner of Carisbrooke Castle on the Isle of Wight (Monument No. 22021). The site of the castle is known to have been used as a high status inhumation cemetery in the 6th Century, it was also a Saxon burgh, fortified and reinforced over the centuries with the construction of the Motte and Bailey Castle making the site the only medieval castle on the island (Russell, Jennings *et al.* 2006, 2). A chapel to St. Nicholas was first mentioned in the Domesday Book and the current site of the chapel is known to have been rebuilt on at least twice. The area now called the Privy Garden is known to have been an enclosed space since 1700, with various historical references naming it as a garden, though it is also believed that there was an enclosed cemetery associated with the chapel at some point (Russell, Jennings et al. 2006, 5). Historical photographs indicate the Privy Garden area to be heavily planted, possibly as a vegetable garden, in the late 19th century. Later aerial photographs reveal that by 1923 the garden was grassed over with a row of trees or shrubs planted to either side of the main steps to the W and a third parallel row to the S edge of the chapel. These had been replaced with large open beds by 1976 which were themselves grassed over by 2003 (Russell 2006b, Figs 16-26).

Previous archaeological investigations at the castle revealed timber buildings and inhumations in an area E of the Privy Garden. Two deep 11th century defensive ditches were also recorded, the projection of which suggests they may also run through the NE corner of the Privy Garden (Russell, Jennings et al. 2006, Fig 3b).

The aim of this geophysical survey, conducted as part of a wider archaeological evaluation for a Properties Development Programme to re-design and re-present the Privy Garden (Russell, Jennings et al. 2006, 2), was to attempt to locate and record buried archaeological features and suggest suitable targets for excavations the following month. An area immediately to the E had previously been excavated by Young and the archaeology revealed suggests the potential for remains of timber buildings, inhumations and defensive features beneath the garden (Russell, Jennings et al. 2006, 3, 6). However, the excavations also revealed a considerable depth to natural in certain parts of the site, overlain by a complex sequence of levelling layers (Russell, Jennings et al. 2006, 6). If this deep overburden was also present in the adjacent Privy Garden, the potential for recording small, discrete targets such as timber post settings and burials would be limited.

The site (centred on SZ485877) lies on shallow well drained calcareous silty soils of the Upton 1 association (Soil Survey of England and Wales 1983), developed over Upper and Middle Chalk (British Geological Survey 1976). At the time of the survey the site was enclosed by a path and wall to the E, banked ground to the S and W, and a path and the chapel to the N. The garden area was under short grass and the ground was extremely dry. However, an overnight shower caused a moisture difference between the two survey grid-squares surveyed by earth resistance.

Method

The garden was divided into two 30m by 30m grid squares for the purposes of the geophysical survey (Figure 1), although the confined nature of the area meant that neither grid was complete. The grid squares were located using a real-time kinematic Global Positioning System (GPS).

Magnetometer survey

Magnetometry was chosen in an attempt to locate ditches, pits and inhumations. The latter are notoriously difficult to detect geophysically, but as examples already excavated at the site are known to be rich in grave goods there was the potential to record a response to clusters of ferrous material. The survey was conducted over the shaded area in Figure 1 with two Bartington *Grad601* fluxgate gradiometers following the standard method outlined in note 2 of Annex 1, except with readings collected at 0.5m traverses intervals. A plot of the data-set is superimposed over the Ordnance Survey (OS) base map at a scale of 1:500 on Figure 2. Additionally an X-Y traceplot and linear greyscale plot of the data are presented at a scale of 1:500 on Figure 3.

Corrections made to the measured values displayed in the plots were to zero-mean each instrument traverse to correct for instrument heading errors. The data from some grid-squares was also ‘destaggered’ to correct for slight traverse displacement errors by maximising the correlation between adjacent traverses. To improve the visual intelligibility of the traceplot presented in Figure 3B, the data-set has had the magnitudes of extreme values truncated to 150nT/m.

Earth resistance survey

Subsequent to the magnetometer survey, an earth resistance survey was conducted over the site in order to locate ditches and previous garden features such as paths or planting beds which might be visible through their different moisture contents. Measurements were collected with a Geoscan RM15 resistance meter, MPX15 multiplexer and an adjustable PA20 electrode frame in the Twin-Electrode configuration. Readings were collected using the standard method outlined in note 1 of Annex 1 but with mobile electrode separations of 0.5m and 1.0m, taking readings at 0.5m along each traverse thereby producing two data-sets of different depths. The sample densities for these were 0.5m x 0.5m for the 0.5m electrode separation and 0.5m x 1.0m for the 1.0m electrode separation. All data has been ‘despiked’ to remove isolated high readings caused by poor electrical contact. Additionally a contrast enhancement (Wallis) filter was applied to both data-sets. A linear greyscale plot of the raw 0.5m data is superimposed over the base OS map at a scale of 1:500 in Figure 4. Plots of the 0.5m and 1m data-sets are additionally presented as both X-Y traceplots and linear greyscale plots of the raw data and equal area greyscale plots of the filtered data, all at a scale of 1:500, in Figure 5.

Results

Magnetometer survey

A graphical summary of the significant anomalies discussed below is provided on Figure 6. Numbers in [ ] refer to annotations in this figure.

The general magnetic response in this area was high, with background levels >±1nT/m. Modern disturbance is evident across the site with numerous dipolar responses showing no obvious patterning being indicative of ferrous litter. Two strongly magnetic linear anomalies [M1-2] suggest recent intervention either modern services or, more likely given their position, paths constructed using a thermoremanent material such as clinker. [M1] approximately correlates with a path visible on a historical photograph, although it is not clear from this of what it is constructed.

Several discrete areas of positive magnetic readings are clustered around [M3]. These may be areas more deeply buried ferrous material, or possibly indications of thermoremanent activity. The increased magnetic response [M4] is possibly related to the flower bed that used to be present here, though a similar response has not been noted in the location of those to the W.

There are numerous other isolated positive magnetic responses across the survey area, e.g. [M5]. These may relate to archaeological features, but are probably buried ferrous objects of more modern date.

Earth resistance

A graphical summary of the significant anomalies from the 0.5m and 1m datasets discussed below is provided on Figure 7. Numbers in [ ] refer to annotations in this figure.

Both grids surveyed with electrical resistance were affected by a soil moisture deficit. The response was much improved over the N grid owing to an overnight shower of rain before it was surveyed. By contrast, the S grid exhibits a much greater degree of measurement noise caused by contact resistance and this is most evident in the 1m data set. The general lack of variation observed in the 0.5m dataset to the S may be evidence of fewer anomaly-producing features, but could also be due to high contact resistance making the system less sensitive to subsurface electrical contrasts.

A high resistance linear anomaly [R1] correlates with the path on the historical photograph, and the magnetic anomaly [M1]. The latter is much broader than [R1], extending further N: most likely due to the strong magnetic nature of the path make-up. However, [R1] shows additional detail, including a forked division with the northern branch [R1a] continuing in the same direction and the southern one [R1b] running orthogonally to the S after ~3m. There is only a faint trace of this continuing into the S survey grid. To the W and running parallel, is a second possible linear high resistance anomaly [R2]: together these appear to demarcate a rectangular area of higher resistance, with the area immediately to the E exhibiting much lower resistance readings. Where these anomalies extend into the S survey grid their electrical contrast becomes lower making it hard to ascertain their overall form and thus their function.

W of [R2] is a rectilinear area of low resistance [R3], corresponding to one of the old flower beds. Again, the lack of a similar response to the known bed to the S is probably due to the deficiency of moisture in the soil when this grid was surveyed. However, the lack of response to the bed adjacent to the chapel, in the same grid as [R3], suggests it was perhaps filled with a different material, perhaps also evidenced by the higher magnetic response here. The anomaly [R3] is only visible in the 0.5m dataset indicating the causative feature is fairly shallow. However, using different electrode separations to infer depth estimates is difficult on this site due to the very high soil moisture deficit.

There is a possible further high resistance linear anomaly [R4] parallel to [R1] extending E from the S extent of [R1b], suggestive of a further path possibly running between the steps in the banks to the W and a now blocked entrance to the garden to the E. However, [R4] runs along the survey grid-edge and due to the general poor quality of response cannot be confidently characterised as an archaeological anomaly.

The high resistance linear anomaly [R5] near the corner of the chapel transept may well be related to a former structural feature such as a buttress. Further faint narrow high resistance anomalies [R6] S of the W end of the chapel, may possibly be archaeological in origin, however, their low contrast with the surrounding area reduces the reliability of this interpretation.

Discussion

The excavation of three trenches (see Figure 1) was subsequently undertaken by English Heritage's Archaeological Projects team in September 2006. Various plans and context sheets have been examined by the author and discussed with Dr Vicky Crosby, a member of the excavation team, and the interim summary report has also been consulted.

The magnetic survey revealed few distinct anomalies, however, the strong response [M1], appears to relate to the line of a gravel path. The gravel was underlain by a deposit of ceramic building material, including building rubble, pottery and metalwork (Russell 2006a, 4), which would explain the high magnetic response here. However, it should be noted that much of the response was recorded N of the position of the observed path. This may be due to an accumulation of further magnetic material adjacent to it, which may have been physically small in quantity or not coherent enough to create a noticeable feature.

The earth resistance survey more successfully recorded significant archaeological features. The main E-W gravel path recorded in Trench 1 was also recorded as anomaly [R1]. The trench was positioned near the apparent fork in the resistance anomaly, and the beginning of the S branch [R1b] has been recorded as an area of chalk rubble. Despite the discovery of further structural features in Trench 1, such as a flint and green sandstone wall, there are no other obvious parallels between the resistance and the excavation data here. This is likely to be due to the very dry conditions at the time of the survey resulting in little difference in volumetric water content between the wall material and the surrounding soil resulting in no measurable electrical contrast.

The anomaly [R1b] was also located in trench 2, where a hardcore path, overlying a flint deposit was noted. Both the flint deposit and hardcore layer would explain the high earth resistance measurements here. The low readings immediately E of the path may have been due to the fill of a machined flower bed, though this feature was not fully excavated or recorded so no definitive connection can be made. Much of the area to the W of and including the path at [R1b] was underlain by a chalky rubble deposit, which probably accounts for the generally higher levels of resistance here. The response recorded at [R2] broadly correlates with a rubbly levelling layer, and a large rubble pit discovered along its course corresponds to over-range resistance readings. A drop in readings between [R1b] and [R2] might be explained by a ‘possible flower bed’ recorded between them.

The low resistance anomaly [R3] was confirmed as the location of a flower bed. Slightly higher resistance readings to the S correspond to an area of orange-brown clay believed to be a levelling layer deposited prior to the grassing over of the flower beds (Russell 2006a, 4).

Conclusion

The magnetic survey was dominated by a high background response and the effects of ferrous litter. A lack of obvious patterning to the clusters of anomalies has limited their interpretation. However, the location of two possible paths was noted.

The earth resistance survey was more successful, locating several paths and one large flower bed. Further structural remains may also have been identified, but the majority of anomalies would appear to relate to more recent garden phases of the area. It should also be noted that the majority of these responses were in the N of the survey area. At the time of surveying the S grid it is possible the ground was too dry to be an effective electrical conductor.

Initial comparison with excavation evidence suggests only features recorded in Trenches 1 and 2 appear to show correlation, albeit limited, with the geophysical survey. However, even here major features, such as part of the large 11th century defensive ditches first recorded by Young to the E (Russell 2006a, 2), did not produce a response in either geophysical survey. A gravel path recorded in Trench 2 immediately S of the flower bed is not identifiable in the earth resistance survey, although [R4] may be a continuation of this to the E and other paths to the W of the bed do correspond to higher resistance readings.

Both the lack of greater comparability between survey and excavation and the relatively few anomalies recorded by either geophysical technique may, in part, be due to the overburden noted across the site, particularly to the south (Russell 2006a, 3, 5). Recent features, such as the known flower beds were relatively near-surface and even these proved fairly difficult to detect. However, older features had been further compromised by a considerable depth of levelling material. This topsoil was reminiscent of a ‘town dump’ – containing large quantities of mixed-date ceramic debris and scraps of metal (S Jennings pers comm.). The depth of material alone would have restricted the ability to detect features buried beneath it using either technique, but its composition undoubtedly introduced an element of magnetic noise that would have obscured weaker anomalies.

In addition the general dryness of the ground reduced the effectiveness of the earth resistance survey.

Surveyed by:	R Briscoe L Martin	Date of survey:	16-17/8/2006
Reported by:	L Martin	Date of report:	9/1/2007

Geophysics Team,
English Heritage.

List of enclosed figures.

Annex 1: Notes on standard procedures

1) **Earth Resistance Survey:** Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all aligned parallel to one pair of the grid square's edges, and each separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metres from the nearest parallel grid square edge. Readings are taken along each traverse at 1 metre intervals, the first and last readings being 0.5 metres from the nearest grid square edge.

   Unless otherwise stated the measurements are made with a Geoscan RM15 earth resistance meter incorporating a built-in data logger, using the twin electrode configuration with a 0.5 metre mobile electrode separation. As it is usually only relative changes in earth resistance that are of interest in archaeological prospecting, no attempt is made to correct these measurements for the geometry of the twin electrode array to produce an estimate of the true apparent resistivity. Thus, the readings presented in plots will be the actual values of earth resistance recorded by the meter, measured in Ohms (Ω). Where correction to apparent resistivity has been made, for comparison with other electrical prospecting techniques, the results are quoted in the units of apparent resistivity, Ohm-m (Ωm).

   Measurements are recorded digitally by the RM15 meter and subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to Fort Cumberland using desktop workstations.

2) **Magnetometer Survey:** Each 30 metre grid square is surveyed by making repeated parallel traverses across it, all parallel to that pair of grid square edges most closely aligned with the direction of magnetic N. Each traverse is separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metre from the nearest parallel grid square edge. Readings are taken along each traverse at 0.25 metre intervals, the first and last readings being 0.125 metre from the nearest grid square edge.

   These traverses are walked in so called 'zig-zag' fashion, in which the direction of travel alternates between adjacent traverses to maximise survey speed. Where possible, the magnetometer is always kept facing in the same direction, regardless of the direction of travel, to minimise heading error. However, this may be dependent on the instrument design in use.

   Unless otherwise stated the measurements are made with either a Bartington *Grad601* or a Geoscan FM36 fluxgate gradiometer which incorporate two vertically aligned fluxgates, one situated either 1.0m or 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. Both instruments incorporate a built-in data logger that records measurements digitally; these are subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to Fort Cumberland using desktop workstations.

It is the opinion of the manufacturer of the Geoscan instrument that two sensors placed 0.5 metres apart cannot produce a true estimate of vertical magnetic gradient unless the bottom sensor is far removed from the ground surface. Hence, when results are presented, the difference between the field intensity measured by the top and bottom sensors is quoted in units of nano-Tesla (nT) rather than in the units of magnetic gradient, nano-Tesla per metre (nT/m).

3) **Resistivity Profiling:** This technique measures the electrical resistivity of the subsurface in a similar manner to the standard resistivity mapping method outlined in note 1. However, instead of mapping changes in the near surface resistivity over an area, it produces a vertical section, illustrating how resistivity varies with increasing depth. This is possible because the resistivity meter becomes sensitive to more deeply buried anomalies as the separation between the measurement electrodes is increased. Hence, instead of using a single, fixed electrode separation as in resistivity mapping, readings are repeated over the same point with increasing separations to investigate the resistivity at greater depths. It should be noted that the relationship between electrode separation and depth sensitivity is complex so the vertical scale quoted for the section is only approximate. Furthermore, as depth of investigation increases the size of the smallest anomaly that can be resolved also increases.

Typically a line of 25 electrodes is laid out separated by 1 or 0.5 metre intervals. The resistivity of a vertical section is measured by selecting successive four electrode subsets at increasing separations and making a resistivity measurement with each. Several different schemes may be employed to determine which electrode subsets to use, of which the Wenner and Dipole-Dipole are typical examples. A Campus Geopulse earth resistance meter, with built in multiplexer, is used to make the measurements and the Campus Imager software is used to automate reading collection and construct a resistivity section from the results.

References

British Geological Survey 1976 Isle of Wight, England and Wales, Drift Geology, Parts of Sheets 330, 331, 344, 345, 1:50000.

Russell, M 2006a *Carisbrooke Castle: Privy Garden Evaluation. Interim summary report 2006.* English Heritage, Portsmouth: Unpublished.

Russell, M 2006b *Desk-based Assessment of the Privy Garden at Carisbrooke Castle, Newport, Isle of Wight*. English Heritage, Portsmouth: Unpublished.

Russell, M, Jennings, S, Cromwell, T, Robinson, D, Webb, D, Lyons, E, Pattison, P, Martin, L and Wilson, V 2006 *Privy Garden, Carisbrooke Castle: Archaeological Evaluation. Project Number 4992. Project Design.* English Heritage, Portsmouth: Unpublished.

Soil Survey of England and Wales 1983 Soils of England and Wales, Sheet 6, South East England, 1:250000.

Figure 1

CARISBROOKE CASTLE, ISLE OF WIGHT
Location of geophysical surveys, August 2006.

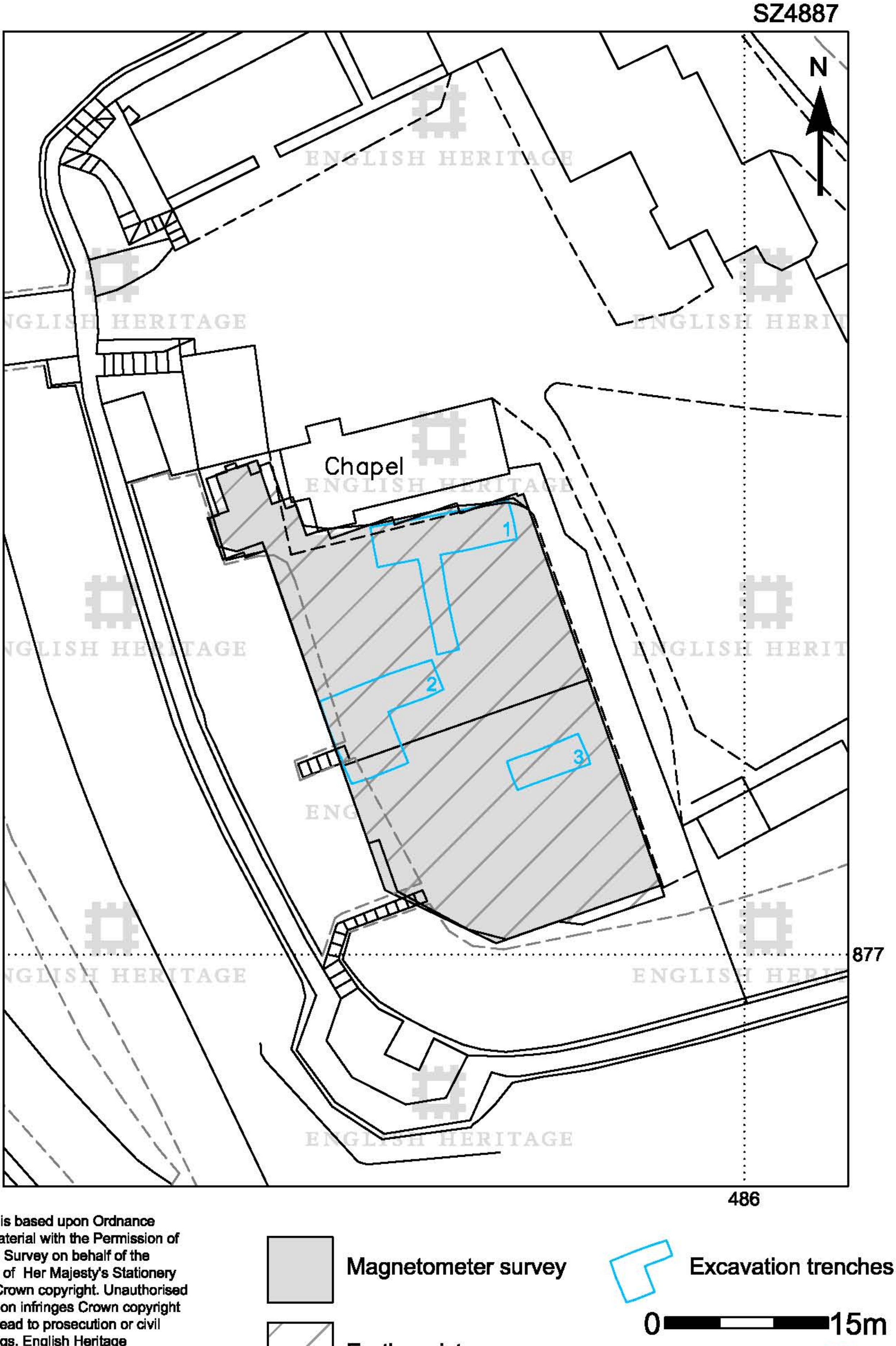

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Figure 2

CARISBROOKE CASTLE, ISLE OF WIGHT
Location of magneotmeter survey, August 2006.

SZ4887

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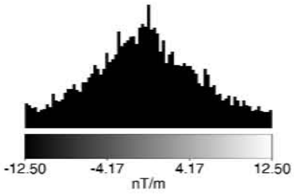

0 15m
1:500

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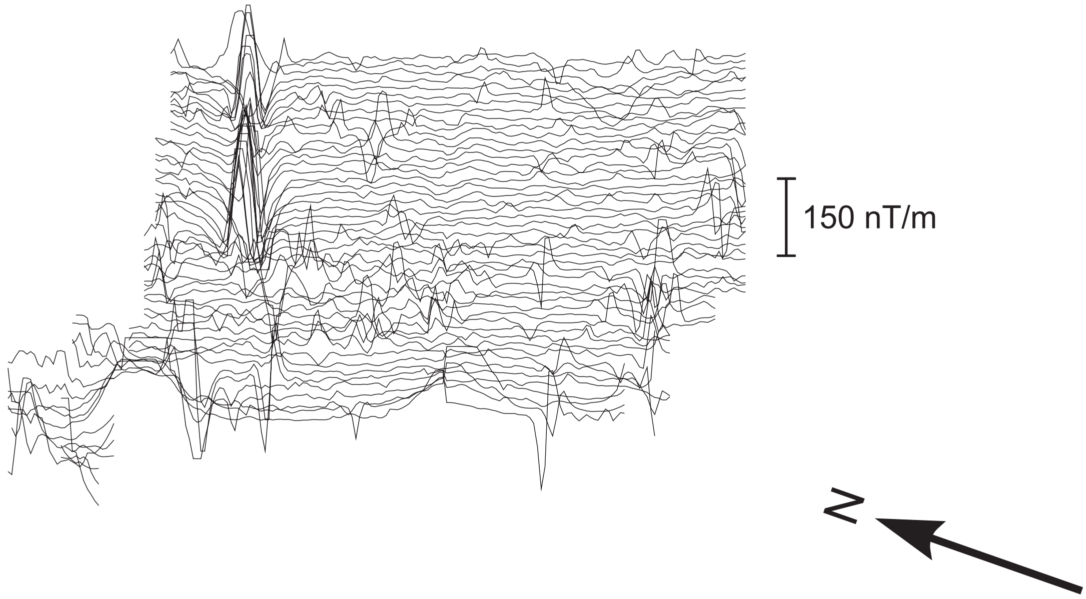
CARISBROOKE CASTLE PRIVY GARDEN, ISLE OF WIGHT
Magnetometer survey, August 2006.

Figure 3

A) Traceplot of magnetometer data.



B) Linear greyscale plot of magnetometer data.

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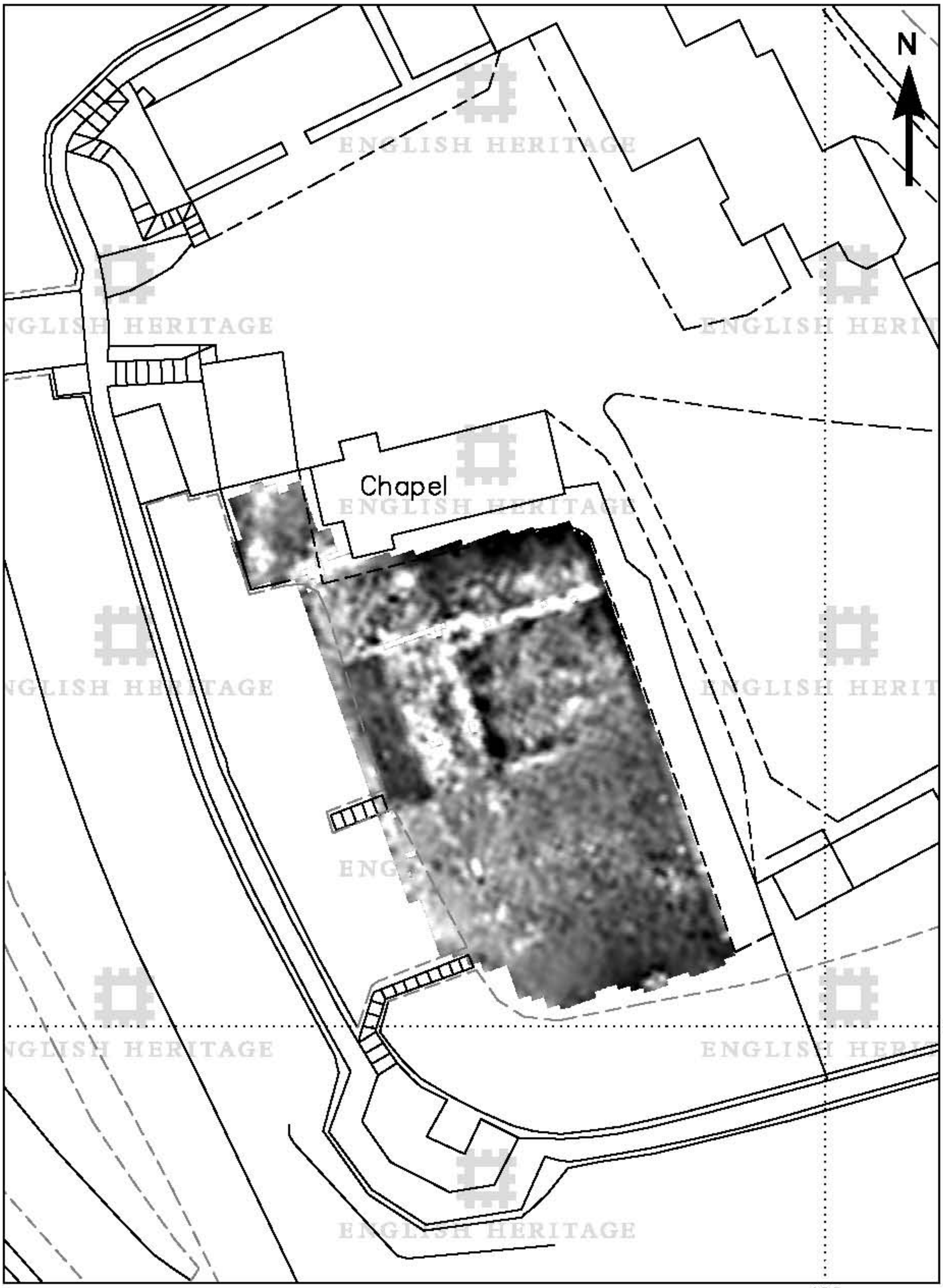
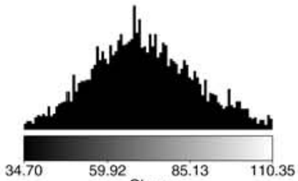
Figure 4

CARISBROOKE CASTLE, ISLE OF WIGHT
Location of earth resistance survey, August 2006.





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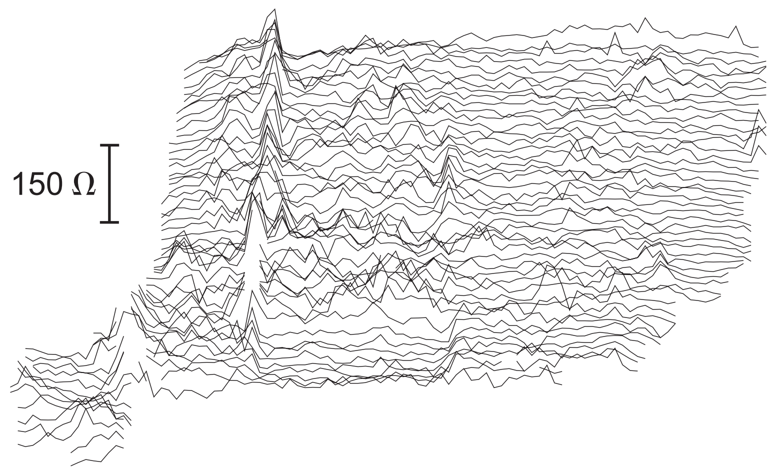
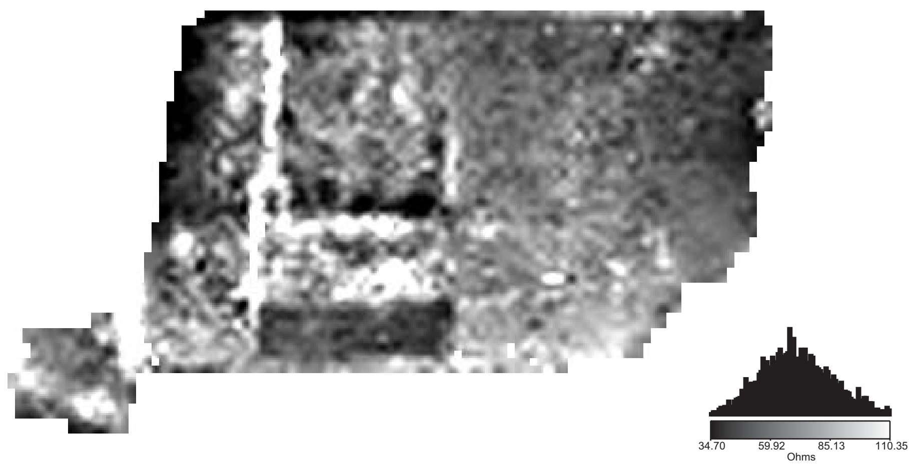
CARISBROOKE CASTLE PRIVY GARDEN, ISLE OF WIGHT
Earth resistance survey, August 2006.

Figure 5

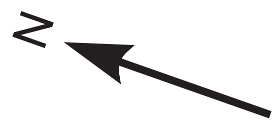
A) Traceplot of resistance data at half metre probe spacing.



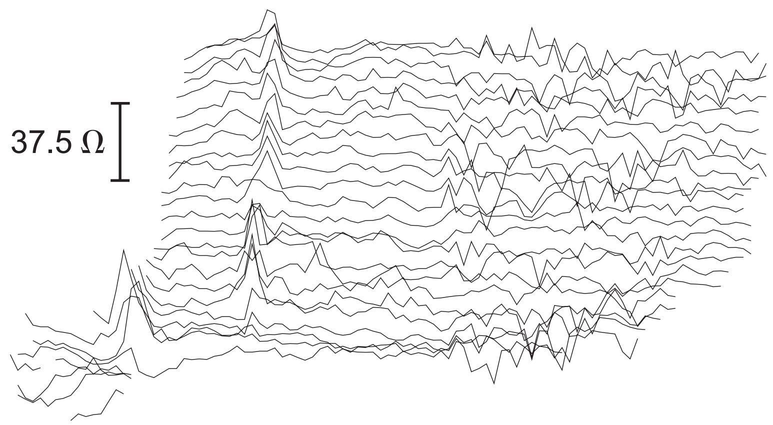
B) Linear greyscale plot of resistance data at half metre probe spacing.



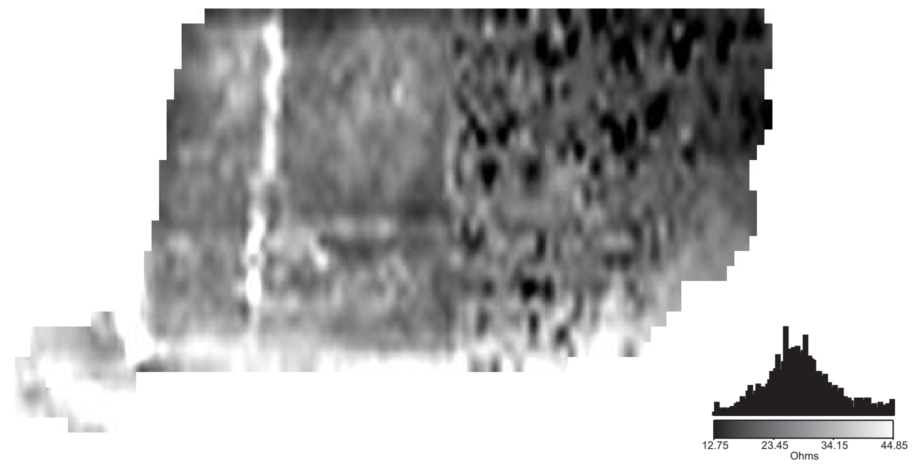
C) Greyscale plot of contrast enhanced resistance data at half metre probe spacing.



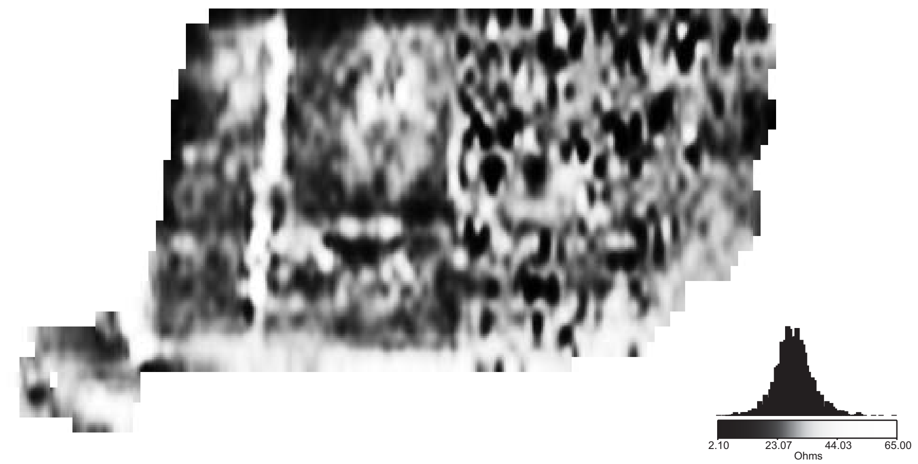
D) Traceplot of resistance data at one metre probe spacing.



E) Linear greyscale plot of resistance data at one metre probe spacing.



F) Greyscale plot of contrast enhanced resistance data at one metre probe spacing.



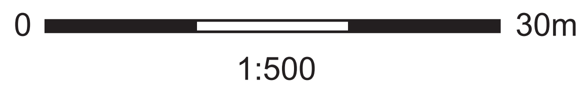


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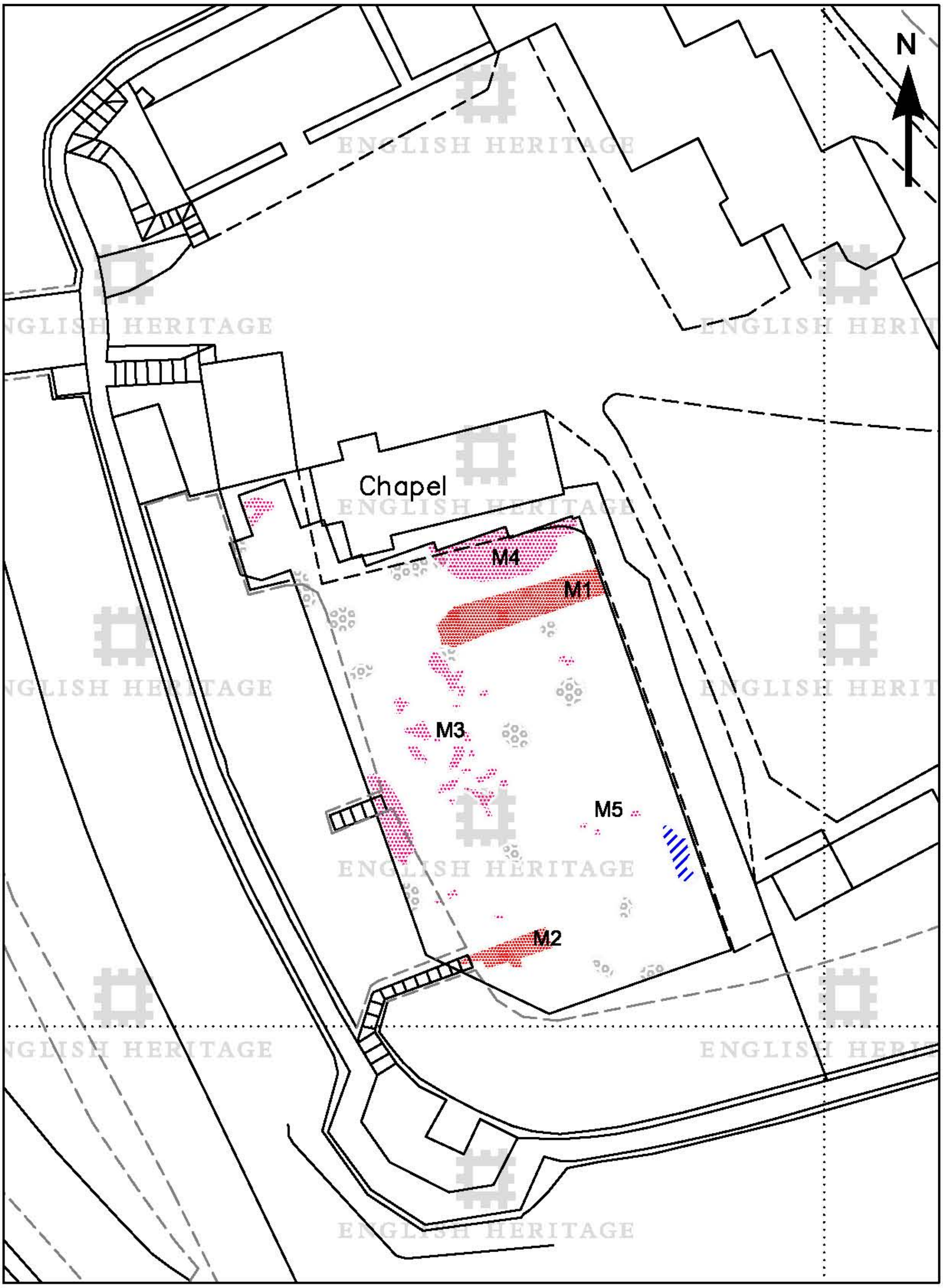
Figure 6

CARISBROOKE CASTLE, ISLE OF WIGHT

Graphical summary of significant magnetic anomalies, August 2006.



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Strong positive magnetic anomaly

Positive magnetic anomaly

Area of magnetic disturbance

Negative magnetic anomaly

0 15m

1:500

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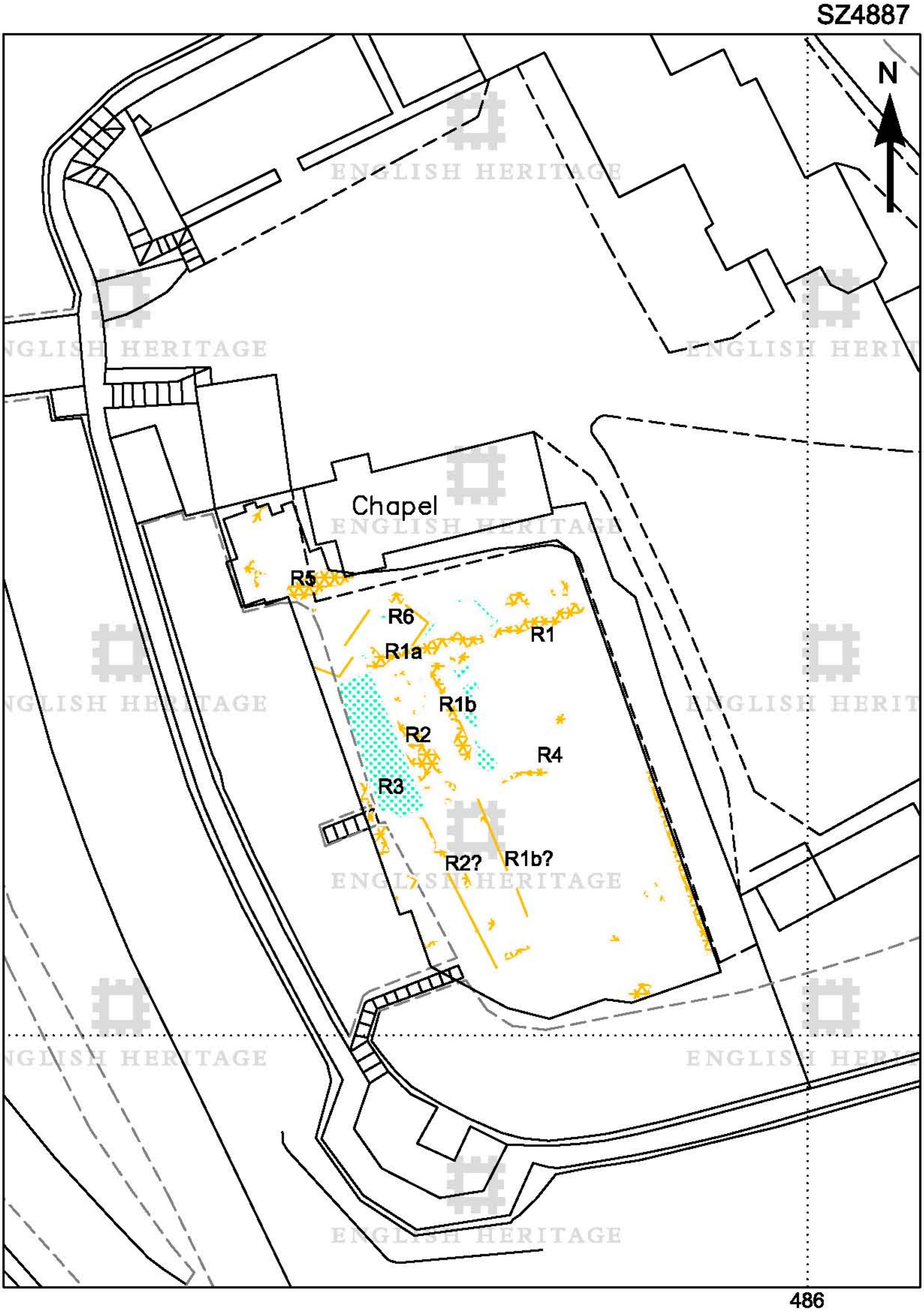
Figure 7

CARISBROOKE CASTLE, ISLE OF WIGHT
Graphical summary of significant earth resistance anomalies, August 2006.



High resistance anomaly

Low resistance anomaly

0 15m

1:500

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