FRESTON CAUSEWAYED ENCLOSURE, Suffolk.

Report on geophysical survey, August 2007.

Introduction

Geophysical surveys covering an area of approximately 2.9 hectares were conducted over the NE quadrant of Freston causewayed enclosure (SAM No. SF183) which lies due south of Ipswich and is now bisected by the B1080 road. The enclosure consists of two concentric courses of interrupted ditches with a palisade ditch in between (Hegarty and Newsome 2004, 21), centred around a spring in a now shallow dry valley (Oswald, Dyer *et al.* 2001, 75). The enclosure was first identified in 1969 through aerial photography (Oswald, Dyer *et al.* 2001, 155), although the main published sources are from 1976 (ibid.) and the site was not fully transcribed until 1995 (Hegarty and Newsome 2004, 21). A building has been recorded just inside the perimeter of the NE course of the enclosure measuring approximately 37m x 9m and demarcated by a series of postholes along the longer sides and narrow ditches across the shorter, with additional partitioning across the ends (Hegarty and Newsome 2004, 65). This might be a very scarce example of a Neolithic long house in association with the causewayed enclosure (Oswald, Dyer et al. 2001, 126) but is also similar in plan to Anglo-Saxon halls to which the enclosure palisade may alternatively relate (Hegarty and Newsome 2004, 65-6). Two large pits recorded between the structure and enclosure ditches could be either Saxon Sunken Featured Buildings (SFBs) or relate to the Neolithic ditches (Hegarty and Newsome 2004, 66). Either date for the building would make it of potentially national importance. However, the structure has only been identified on one photo, from 1976, and the land has been under arable cultivation for at least 35 years, therefore the current state of preservation is undetermined (Newsome 2007).

The aim of this geophysical survey was to investigate the immediate area of the long-house and as much of the surrounding causewayed ditches as possible in an attempt to better locate the features on the ground and provide further detail about the nature and extent of the archaeological remains.

The site (centred on TM169380) lies on deep often stoneless coarse loamy soils of the Tendring association (Soil Survey of England and Wales 1983), developed over Glacial Sand and Gravel over Red Crag, London Clay and Oldhaven Beds (British Geological Survey 1965). The field had been recently harvested of a wheat crop and undergone initial cultivation.

Method

All areas for survey were divided into grids of 30m squares, located using a real-time kinematic Global Positioning System (GPS).

Magnetometer survey
Magnetometer survey was chosen in an attempt to map the enclosure ditches and any associated activity. An initial survey was carried out using standard sampling intervals over that part of the field in which remains associated with the enclosure were likely to be present. However, this methodology would be unlikely to detect the small discrete post holes associated with the building remains so a targeted, higher resolution survey was conducted in their vicinity.

Standard sample density survey
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. A linear greyscale plot of the data-set is superimposed over the base OS map at a scale of 1:2500 in Figure 2. Additionally an X-Y traceplot and linear greyscale plot of the data are presented at a scale of 1:1500 in Figure 4.

Corrections made to the measured values displayed in the plots were to zero the median of each instrument traverse to correct for instrument heading errors and to 'despike' the data through the application of a 2m by 2m thresholding median filter (Scollar, Tabbagh *et al.* 1990, 492). This latter operation reduces the distracting, localised, high-magnitude effects produced by surface iron objects. Some adjacent grids were additionally edge-matched to eliminate sharp changes in base levels between them. To improve the visual intelligibility of the traceplot presented in Figure 3A, the data-set has had the magnitudes of extreme values truncated to ±30nT/m.

High resolution survey
The survey was conducted over the hatched area in Figure 1 with two Bartington *Grad601* fluxgate gradiometers following the standard method outlined in note 2 of Annex 1 but with a sample interval of 0.5m x 0.125m.

A linear greyscale plot of the data-set is superimposed over the base OS map at a scale of 1:1000 in Figure 3. Additionally an X-Y traceplot and linear greyscale plot of the data are presented at a scale of 1:500 in Figure 5.

Corrections made to the measured values displayed in the plots were to zero the median of each instrument traverse to correct for instrument heading errors and to 'despike' the data. Some grid-squares were additionally 'destaggered' to correct measurement position offsets caused by variations in the operator's pace. This was achieved by maximising the correlation between adjacent traverses and the corrected grids were then edge-matched with the remaining data.

Earth resistance survey
Subsequent to the magnetometer surveys, an earth resistance survey was conducted over the location of the long-house.

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 with mobile electrode separations of 0.5m, taking readings at 0.5m along traverses. The data was 'despiked' to remove isolated high readings due to poor electrical contact and additionally processed using a 3m high-pass Gaussian filter to reduce large-scale background trends.

A linear greyscale plot of the filtered data is superimposed over the base OS map at a scale of 1:1000 in Figure 6. Plots of the raw data-set are additionally presented as both an X-Y traceplot and equal area greyscale plot at a scale of 1:500, in Figure 7.

Results

Magnetometer survey

A graphical summary of the significant anomalies discussed below is provided on Figure 8. Numbers in [ ] refer to annotations in this figure.

Magnetic response in the survey area was varied, with background measurements often outside the range between ±1nT/m. Areas of strong magnetic disturbance were recorded in the vicinity of field boundaries. Linear positive and negative magnetic anomalies [M1] on the NW edge of the survey area correlate with the boundary of the plough land and the grass verge. The data was also dominated by a patterning of discrete responses less than 2m across which would ordinarily be identified as pit-type anomalies of potential archaeological interest. However, their frequency and distribution irrespective of other significant anomalies suggests a geomorphological explanation is more probable. A similar phenomenon was recorded at Sutton Hoo where it was thought they may relate to iron rich deposits or tree-boles (Linford 2002). It is also possible that they relate to isolated concentrations of clay within the gravel drift. Only those with a stronger magnetic signature or considered of possible greater significance due to their positioning are depicted on Figure 8.

Segmented, linear, positive magnetic responses [M2] of varying strength correlate with the transcription of cropmark evidence for the causewayed enclosure. As with the cropmark evidence, the geophysical anomalies decrease in magnitude to the S. The downward sloping topography here suggests the cause may be an increased overburden of either colluvium or possibly alluvium if the nearby spring had indeed once been active enough to feed a nearby tributary of the River Stour as has been suggested (Oswald, Dyer et al. 2001, 75). Either movement of soil might increase the burial depth of any archaeological features and so obscure them from identification through geophysical and cropmark evidence.

Negative responses [M3] adjacent to the middle of the section of the enclosure ditches recorded by the magnetometer are suggestive of activity abutting them and within the enclosure. Also inside the enclosure, several amorphous areas of both negative and weakly enhanced magnetic response [M4] possibly relate to anthropogenic activity such as digging for clay (reducing the local magnetic signal) or burning (increasing the local magnetic signal).

Both discrete positive magnetic responses and linear zones of weaker magnetic enhancement [M5] have been recorded in the vicinity of the long-house and would appear to relate to the N end and SE side of the building. However, no specific evidence for discrete post-holes was recorded even in the higher resolution survey. This is perhaps unsurprising given their small expected size (~0.5m in diameter) relative to the observed variation in background response. The continuous ditches of the shorter sides, though narrow, have provided a moderately better target.

Further discrete magnetic responses within the bounds of the enclosure may be of archaeological significance but this supposition is based purely on their positioning as there is little to distinguish them from similar anomalies outside the enclosure in terms of the magnitude and character of their response.

Outside the enclosure there are few distinct anomalies. However, a broad band of enhance magnetisation [M6], fading to the N, may tentatively be interpreted as a trackway. Although it appears to be in line with a causeway between the enclosure ditches, its actual nature and relationship with the enclosure cannot be ascertained by geophysical survey.

Earth resistance

A graphical summary of the significant anomalies discussed below is provided on Figure 9. Numbers in [ ] refer to annotations in this figure.

The earth resistance survey has mainly responded to near surface modern activity. A band of high resistance and interrupted linear low resistance anomalies [R1] correlate with the grass verge surrounding the field and the interface between that and the ploughing headland. Two directions of modern ploughing have been recorded: firstly across the ploughing headland and secondly across the main part of the field. Portions of these are illustrated at [R2-3].

A broad band of high resistance [R4] is roughly positioned in the area of the enclosure ditches, however, neither the anomaly’s width nor alignment satisfactorily correlates with the magnetometer and cropmark evidence. Some areas of higher readings within this band appear to coincide with individual ditches of the enclosure, but it is difficult to discern whether this is a true relationship or purely coincidental.

Conclusion

The earth resistance survey has not demonstrated any obvious response to the buried archaeology. Despite the generally wet summer, the gravels at the site may be too well drained to allow deeply buried features to retain sufficient moisture to be detected beneath the plough soil.

However, the magnetometer results have corroborated the cropmark evidence for the ditches of causewayed enclosure, although the palisade trench has proved elusive. Some anomalies have been found in the location of the long-house but, without prior knowledge, it would not have been possible to deduce the presence of a structure here on the strength of the geophysical evidence alone. However, taken in combination they do indicate that remains of the NE part of the structure are still in existence. The lack of clear response to the rest of the building may simply be due to the high and varied background response in which small and shallow features, such as post holes, would be unlikely to contain sufficient magnetised material (both in strength and quantity) to produce a clear anomaly. Two areas of enhanced magnetisation correlate with the two large pits recorded on the aerial photographs. Again they were not sufficiently strong or discrete to identify independently from the magnetic results, and as such do not provide additional information to help elucidate their cause as either SFBs or large pits of an earlier date.

Viewing the geophysical evidence as a whole there is a suggestion of increased activity within the enclosure and very little activity outside it. However, the broad distribution of localised, discrete magnetic anomalies across the entire survey area is likely to be non-anthropogenic in origin.

Surveyed by: A Payne
L Martin

Date of survey: 20-23/8/2007

Reported by: L Martin

Date of report: 3/12/2007

Geophysics Team,
English Heritage.

List of enclosed figures.

Figure 1 Location plan of survey area over base OS map (1:2500).

Figure 2 Linear greyscale plot of magnetometer data over base OS map (1:2500).

Figure 3 Linear greyscale plot of high resolution magnetometer data over base OS map (1:1000).

Figure 4 Traceplot and linear greyscale plot of magnetometer data (1:1500).

Figure 5 Traceplot and linear greyscale plot of high resolution magnetometer data (1:500).

Figure 6 Linear greyscale plot of filtered earth resistance data over base OS map (1:1000).

Figure 7 Traceplot and greyscale plots of raw earth resistance data (1:500).

Figure 8 Graphical summary of significant magnetometer anomalies over base OS map (1:2500).

Figure 9 Graphical summary of significant earth resistance anomalies over base OS map (1:1000).

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

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Figure 1

FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK

Location of geophysical survey, August 2007.

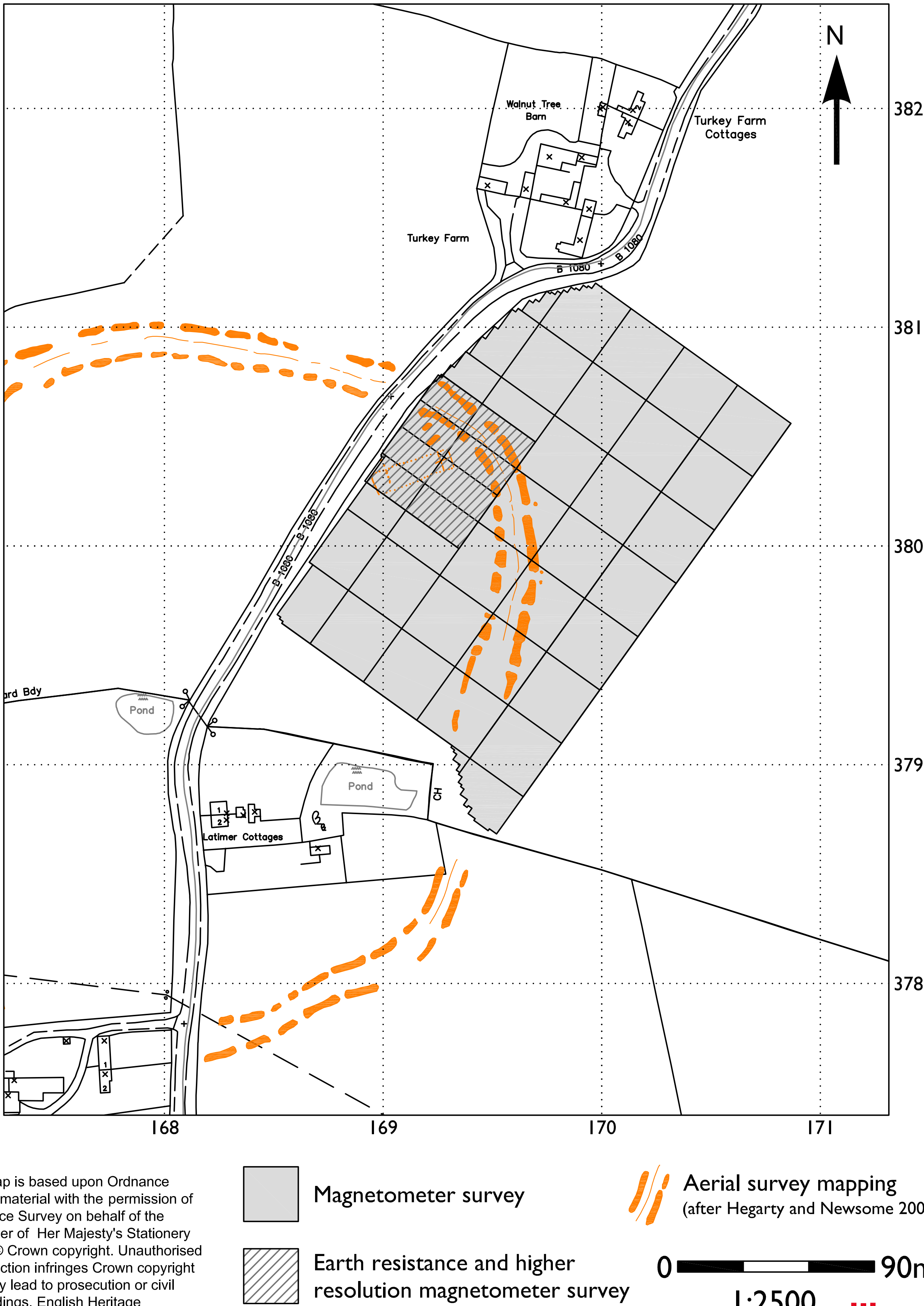

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Figure 2

FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK
Magnetometer survey, August 2007.

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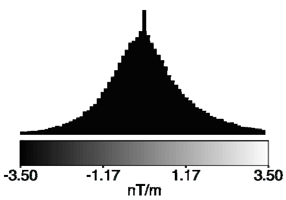

Aerial survey mapping (after Hegarty and Newsome 2004)

0 90m

1:2500

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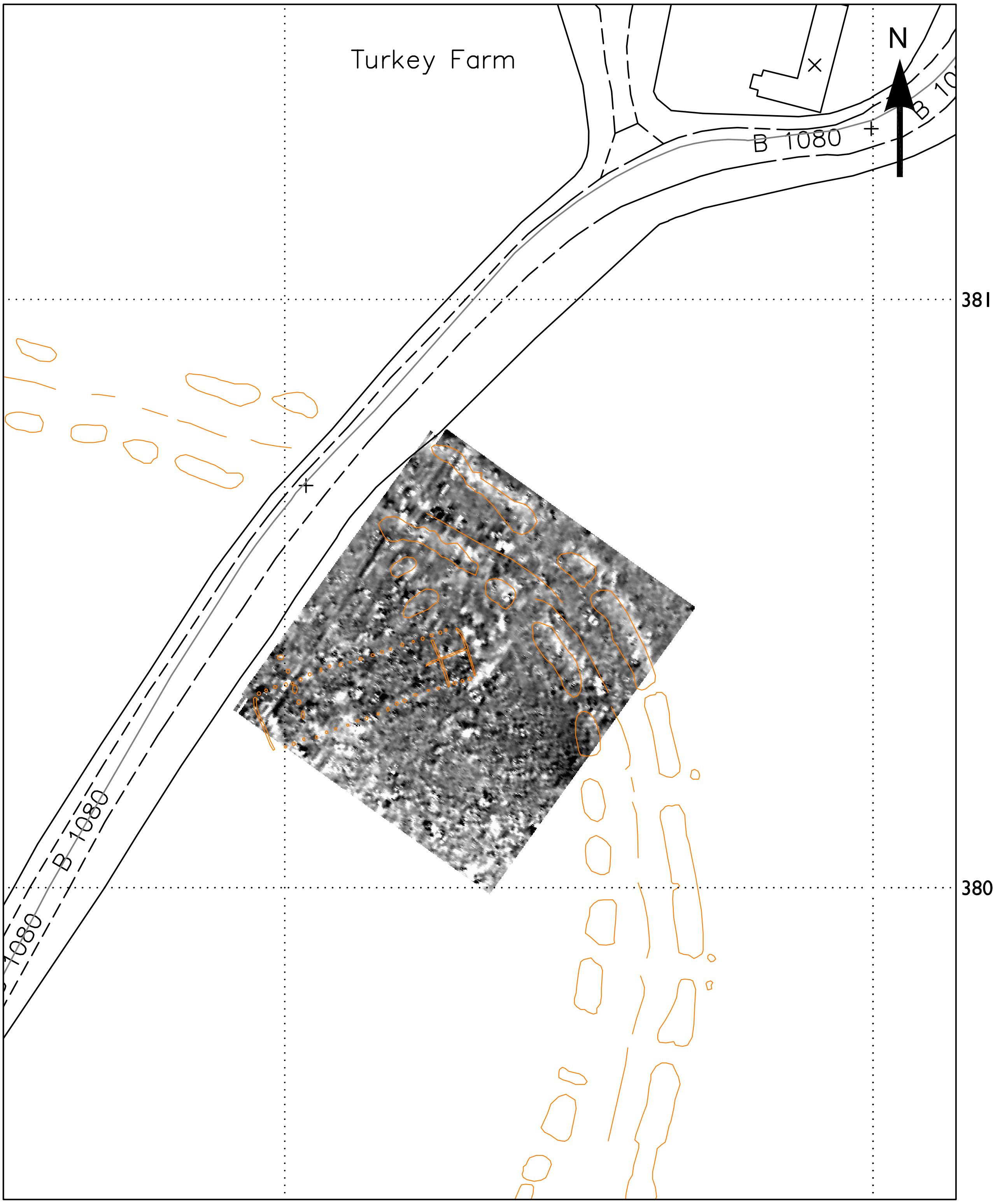
Figure 3

FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK

High resolution magnetometer survey, August 2007.



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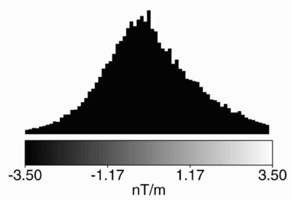

Aerial survey mapping (after Hegarty and Newsome 2004)

0 30m

1:1000

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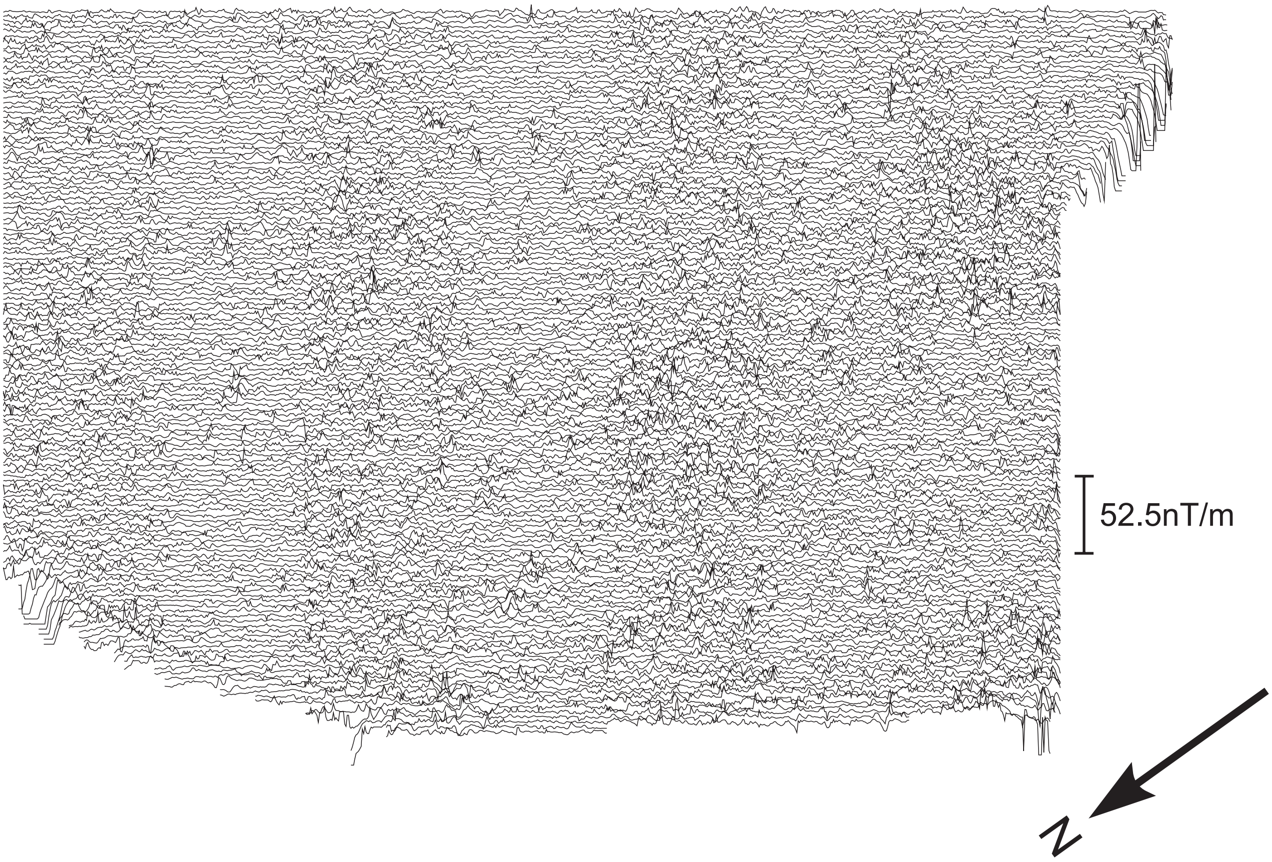
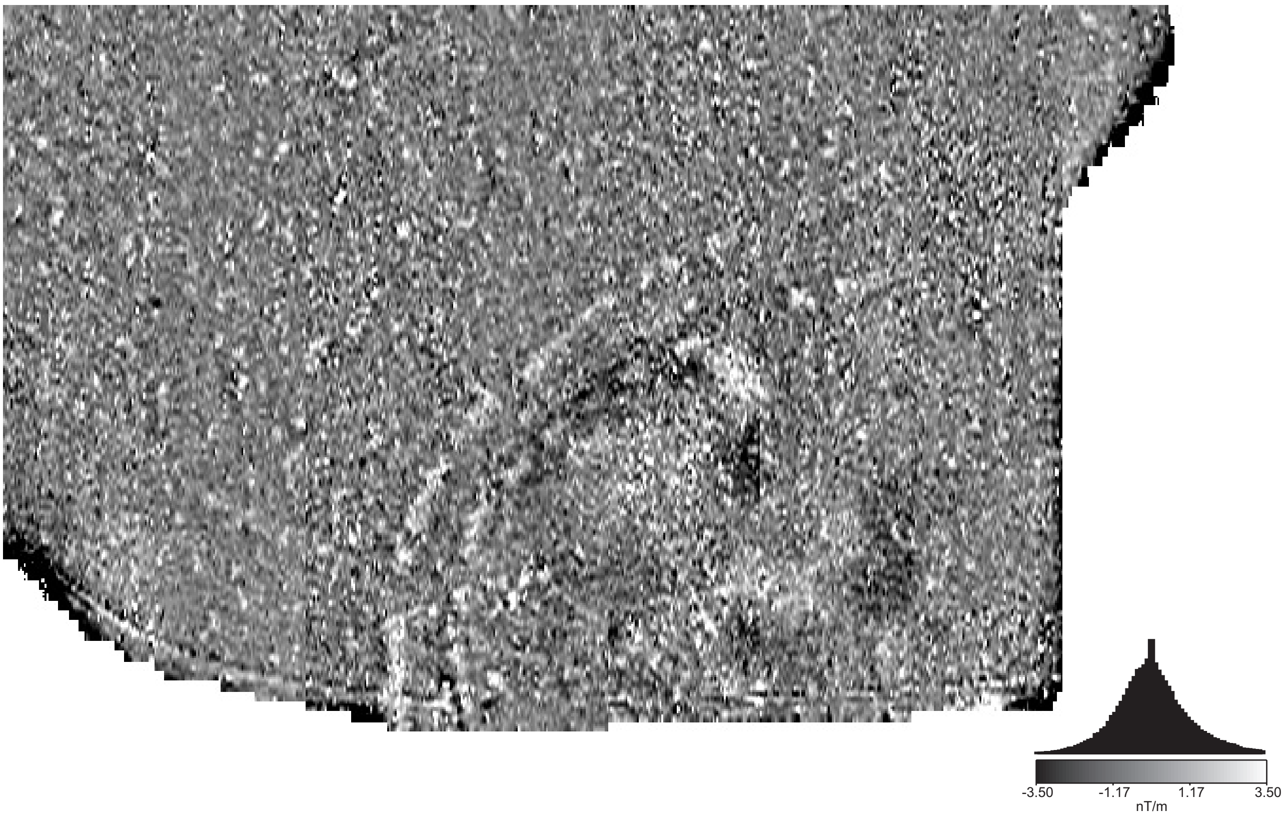
FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK
Magnetometer Survey, August 2007

Figure 4

A) Traceplot of raw data



B) Linear greyscale plot of raw data



0 90m

1:1500

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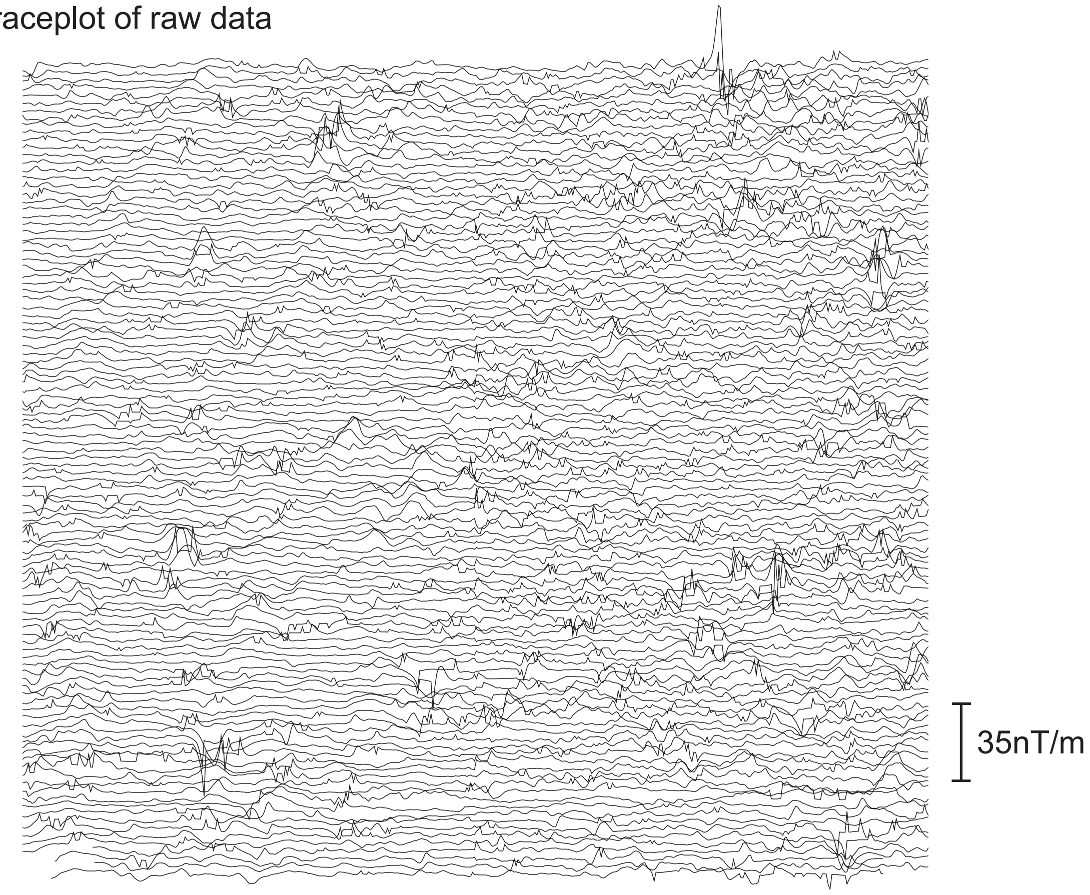
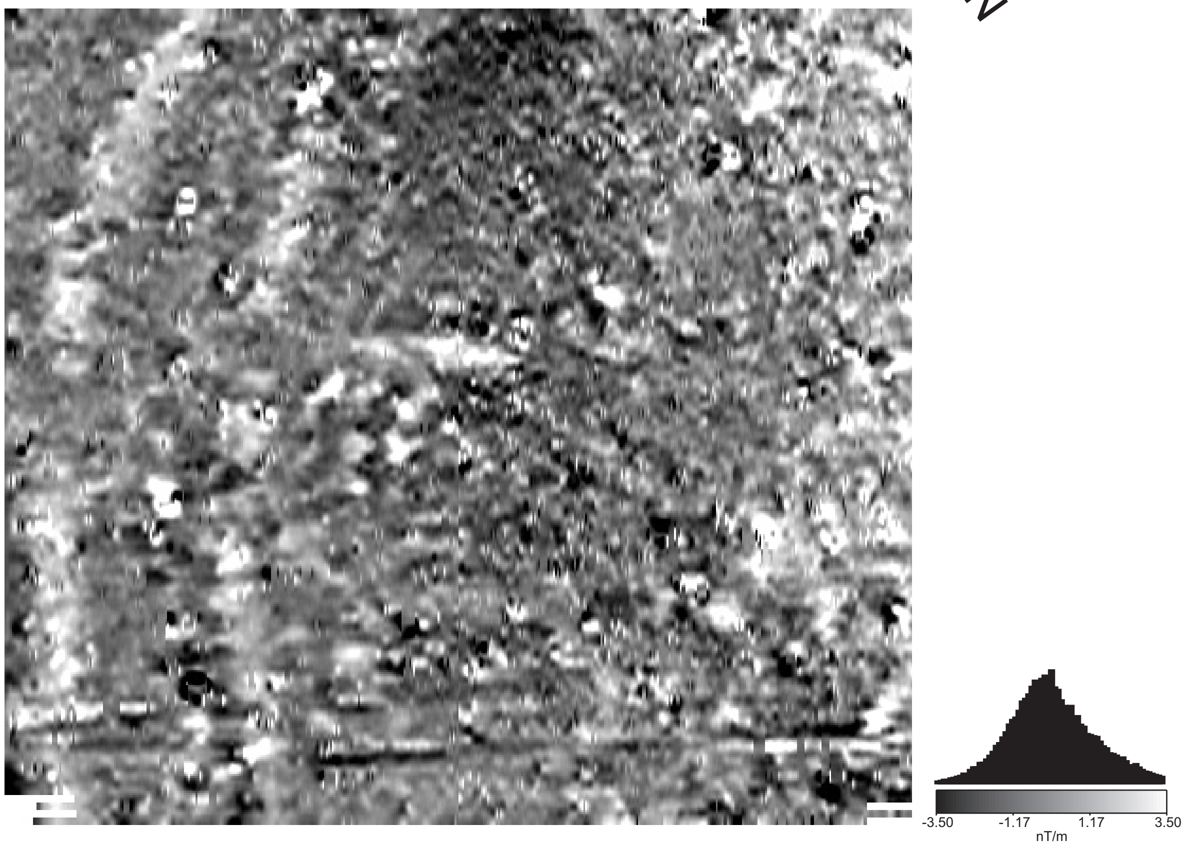
FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK
High Resolution Magnetometer Survey, August 2007

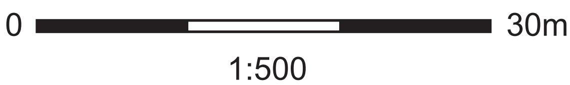
Figure 5

A) Traceplot of raw data



B) Linear greyscale plot of raw data





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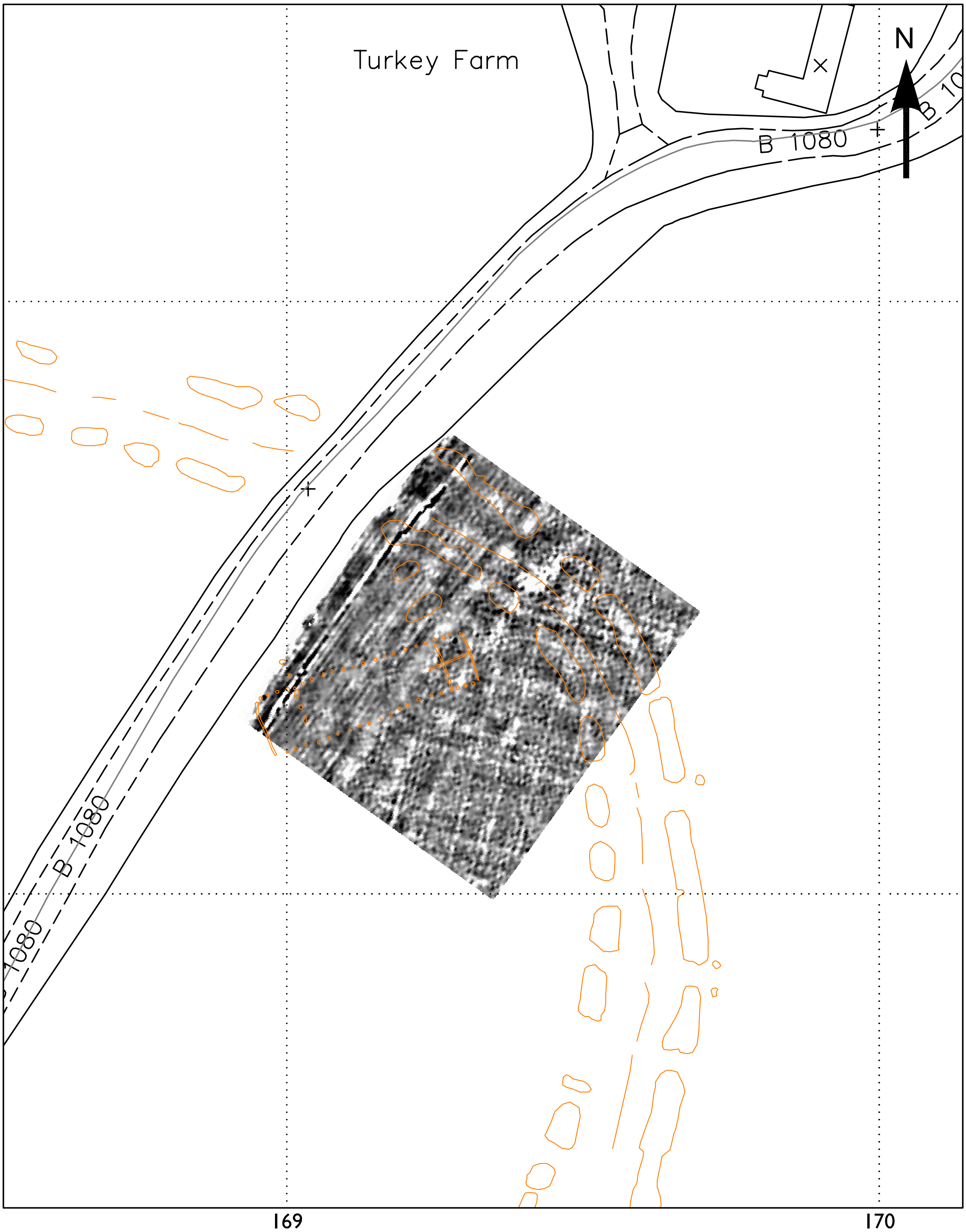
Earth resistance survey, August 2007.



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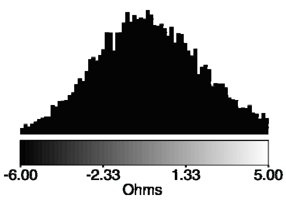

Aerial survey mapping (after Hegarty and Newsome 2004)

0 30m

1:1000

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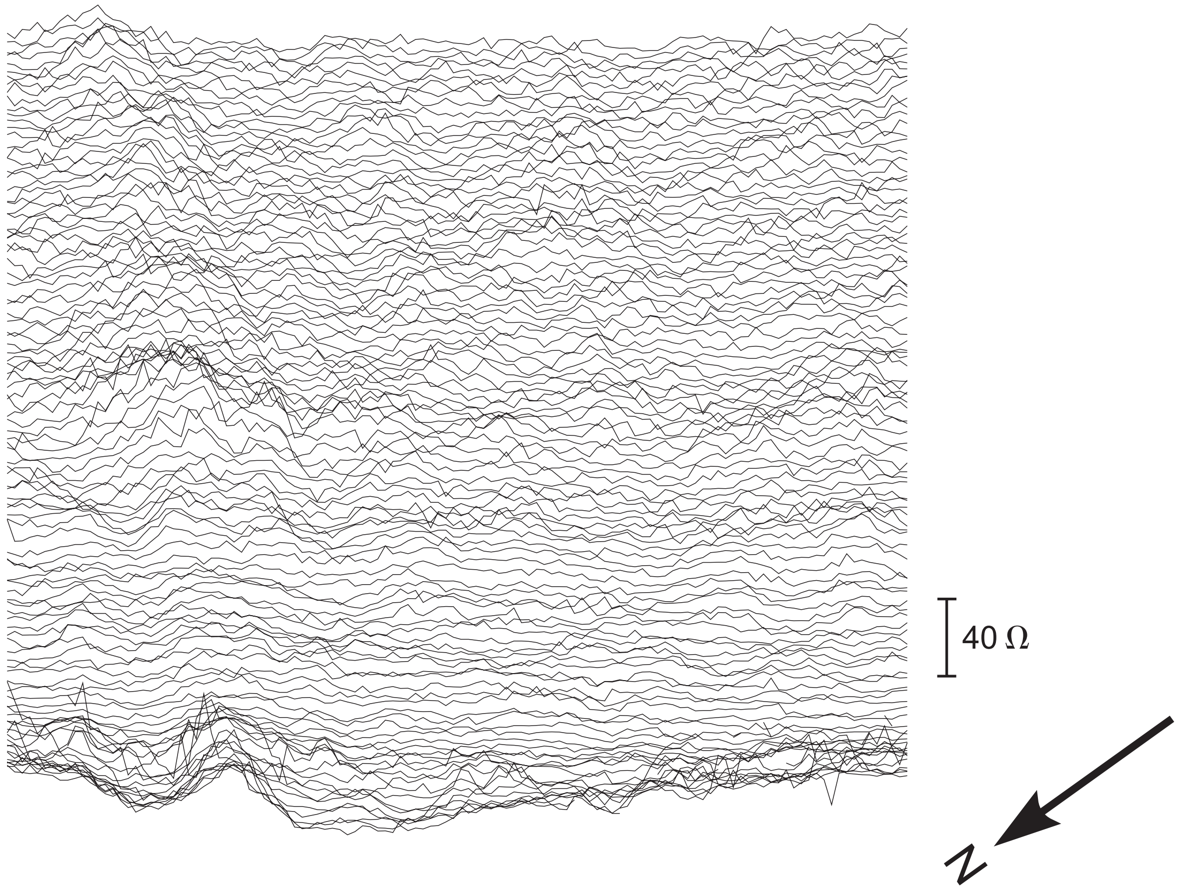
FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK
Earth Resistance Survey, August 2007

Figure 7

A) Traceplot of raw data



B) Equal area greyscale plot of raw data

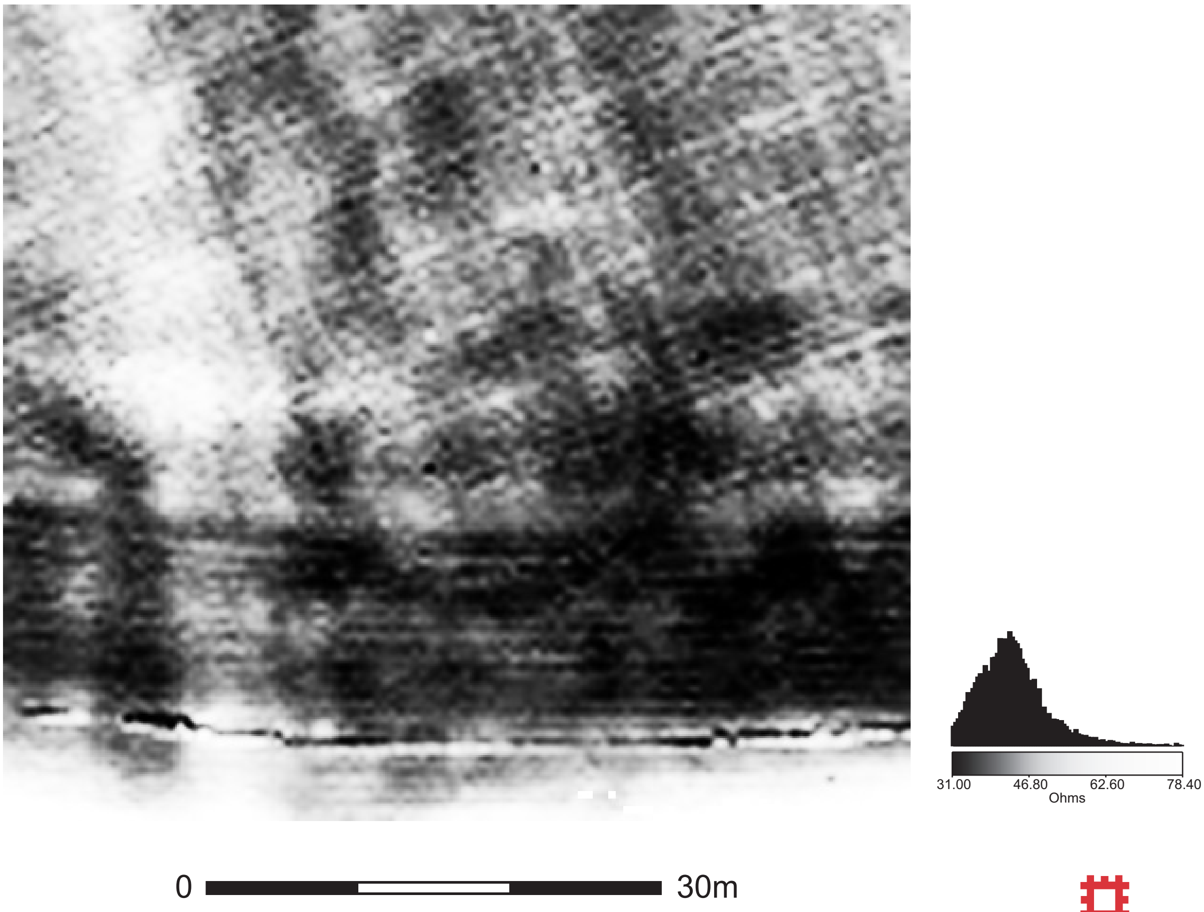


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Figure 8

FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK

Graphical summary of significant magnetometer anomalies, August 2007.

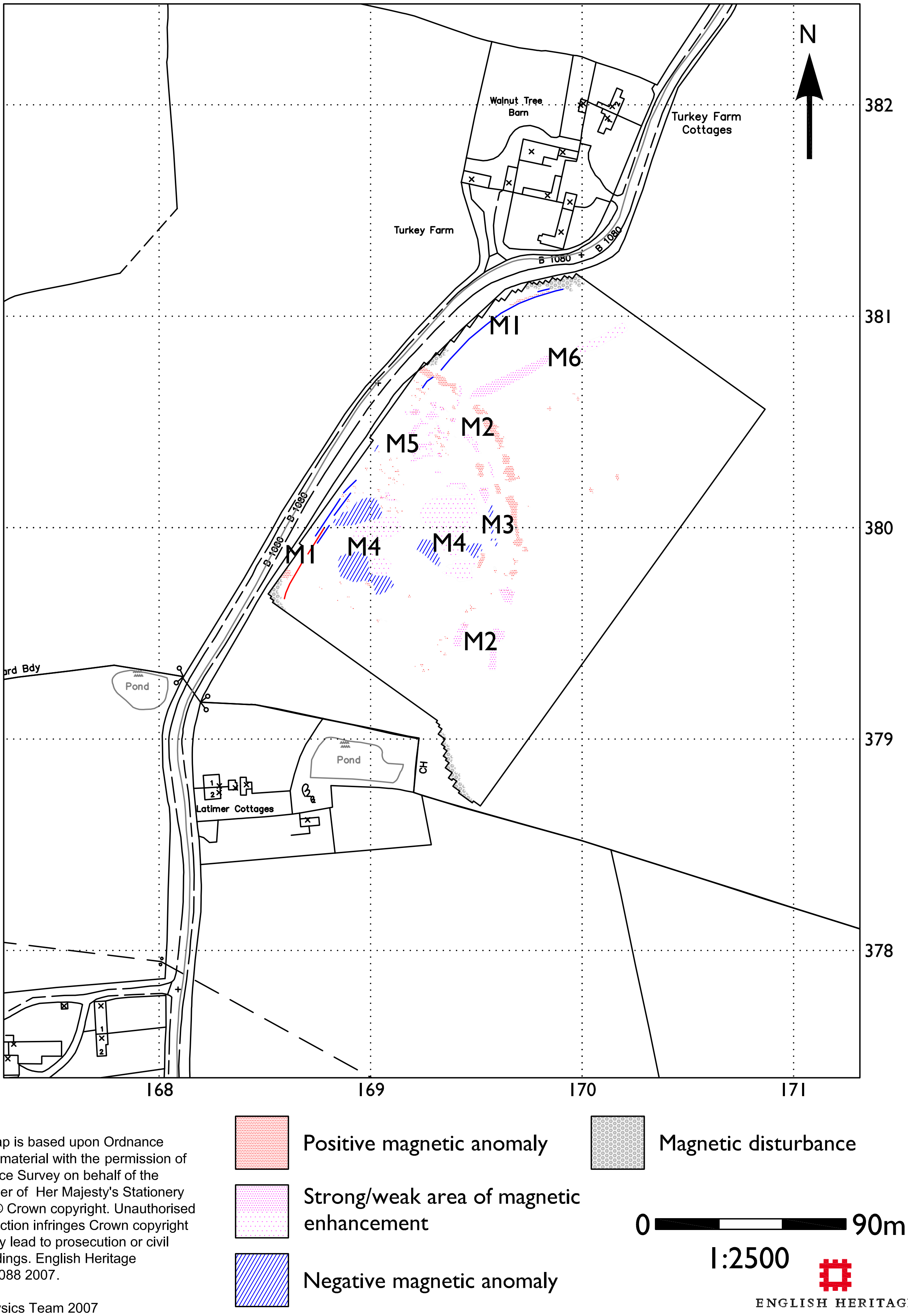

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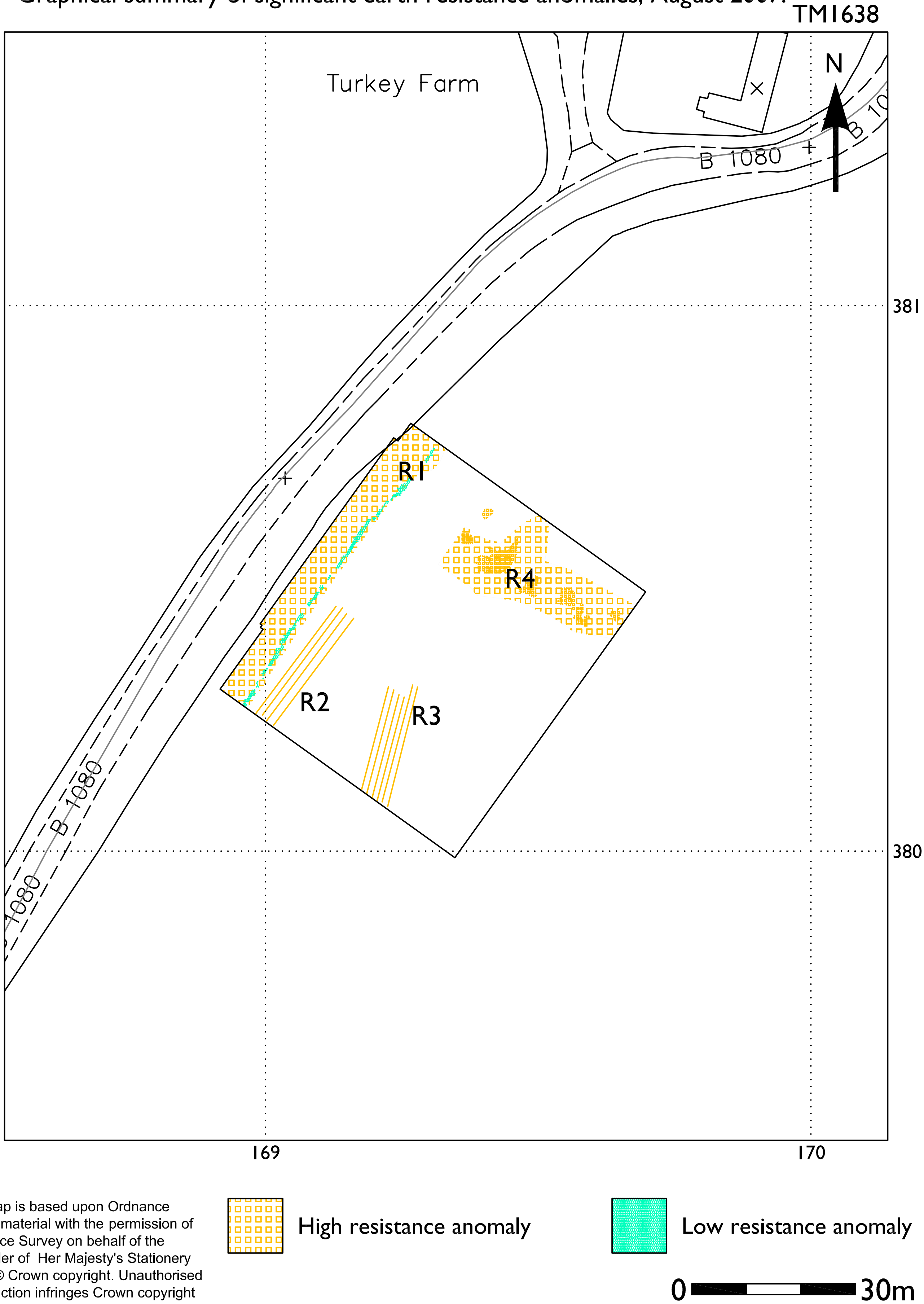
Figure 9

FRESTON CAUSEWAYED ENCLOSURE, SUFFOLK

Graphical summary of significant earth resistance anomalies, August 2007.



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