Historic England

Geophysics

Verlucio and Environs Project, Bowood Estate, Calne Without, Wiltshire
Report on Geophysical Surveys, February 2018

Neil Linford, Paul Linford and Andrew Payne

Discovery, Innovation and Science in the Historic Environment

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VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE REPORT ON GEOPHYSICAL SURVEYS, FEBRUARY 2018

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SUMMARY

Caesium magnetometer and Ground Penetrating Radar (GPR) surveys were conducted over a series of cropmarks, including the site of the Nuthills Roman villa, Bowood Estate, Calne Without, Wiltshire, as part of the Verlucio and Environs project. The vehicle-towed caesium magnetometer survey (13.3ha) covered cropmark remains of a rectilinear enclosure, possibly of Iron Age or Roman date and an extensive complex of enclosure ditches and field systems surrounding the site of the Nuthills Roman villa, whilst the GPR coverage (5.6ha) targeted the site of the possible buildings. The results of the magnetic survey enhance the cropmark record and suggest a far more elaborate system of enclosures some of which may, in part, have survived into more recent field boundaries. There is also evidence in the magnetic data for extensive structural remains and potentially significant thermoremanent anomalies. The GPR survey has confirmed the presence of structural remains associated with a number of buildings and other fragments of walls. Together with the enclosure complex defined by the magnetic surveys the number, varied orientation and apparent form of the buildings suggest, perhaps, a site of greater ritual significance than a farmstead villa.

CONTRIBUTORS
The geophysical fieldwork was conducted by Neil Linford, Paul Linford and Andrew Payne.

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ARCHIVE LOCATION
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DATE OF SURVEY
The fieldwork was conducted between 5th to 9th February 2018 and the report completed on 25th June 2018. The cover image shows the caesium magnetometer survey in progress over the Nuthills Roman villa.

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INTRODUCTION

Caesium magnetometer and Ground Penetrating Radar (GPR) surveys were conducted over a series of cropmarks, including the site of the Nuthills Roman villa, Bowood Estate, Calne Without, Wiltshire, as part of the Verlucio and Environs project (Roberts 2017). This project has been developed following the success of the wider area West Wiltshire National Archaeological Identification Survey (NAIS) which recognised the significance of the site at Verlucio and recommended a separate phase of investigation (Last *et al.* 2016). Verlucio, currently the only unscheduled fortified Roman town in southern Britain, developed as a settlement on the Roman road between Bath and London via Silchester (route XIV in the Antonine Itinerary), which later formed part of a major Anglo-Saxon boundary known as Wansdyke. The NAIS project showed that the environs around the core of Verlucio have outstanding archaeological potential including the sites of the Nuthills and Bromham Roman villas, the roadside settlement east of Verlucio and several large square double-ditched enclosures (Figure 1). Overall, this small town and its landscape may present one of the most important unprotected landscapes of Roman date in England, with the later prehistoric precursor sites and post-Roman developments being equally informative in assessing the overall significance of this region.

The aim of the geophysical survey at the Bowood Estate was to further investigate cropmark remains of a fragmented coaxial ditch-defined field system surrounding the Nuthills Roman villa (AMIE Monument HOB UID 212025, NHLE 1004723) and two large ditched, possibly Iron Age, settlement enclosures (AMIE Monument HOB UID 1578116) also mapped from aerial photographs within the enclosure system. A further large double-ditched rectilinear enclosure is known from cropmarks to the north at 'The Waste' (AMIE Monument HOB UID 1578150), possibly the site of an Iron Age or Roman temple. It is bisected by a band of trees within which parts of the outer enclosure ditch and traces of an internal bank have been detected as slight earthworks on lidar images.

Sandy and coarse loamy soils of the Frilford (544a) together with calcareous clayey soils of the Evesham 2 (411b) associations have developed over Cretaceous Lower Greensand to the east, with the site of the Nuthills villa itself sitting on a raised knoll of Jurassic limestone of the Corallian Group (Geological Survey of Great Britain 1974; Soil Survey of England and Wales 1983). The fields were fallow at the time of the survey following harvest of a maize crop in the autumn, leaving an uneven service along extant rows of stubble with some deep vehicle ruts. Weather conditions were generally bright and fine, although very cold with some intermittent flurries of snow at times.

METHOD

Magnetometer survey

Magnetometer data were collected along the instrument swaths shown on Figure 2 using an array of Geometrics G862 caesium vapour sensors mounted on a non-magnetic sledge (Linford *et al.* 2015). The sledge was towed behind a low-impact All-Terrain Vehicle (ATV) which housed the power supply and data logging electronics. Five sensors were mounted 0.5m apart in a linear array transverse to the direction of travel and, vertically, ~0.36m above the ground surface. For survey in the westernmost field in the area of The Waste a sixth sensor was fixed 1.0m directly above the centre of this array to act as a gradient sensor, however, owing to a fault no gradient sensor was used for the surveys in the other two fields. The sensors sampled at a rate of 25Hz resulting in an along-line sample density of ~0.15m given typical ATV travel speeds of 3.5-4.0m/s. As the five non-gradient sensors were 0.5m apart, successive survey swaths were separated by approximately 2.5m to maintain a consistent traverse separation of 0.5m. Navigation and positional control were achieved using a Trimble R8 Global Navigation Satellite System (GNSS) receiver mounted on the sensor platform 1.65m in front of the central sensor and a second R8 base station receiver established using the Ordnance Survey VRS Now correction service. Sensor output and survey location were continuously monitored during acquisition to ensure data quality and minimise the risk of gaps in the coverage.

After data collection the corresponding readings from the gradient sensor, where available, were subtracted from the measurements made by the other five magnetometers to remove any transient magnetic field effects caused by the towing ATV or other nearby vehicles. The median value of each instrument traverse was then adjusted to zero by subtracting a running median value calculated over an 80m 1D window (see for instance Mauring *et al.* 2002). This operation corrects for any remaining biases added to the measurements owing to the diurnal variation of the Earth's magnetic field. Owing to rows of standing maize stubble and deep wheel ruts caused by agricultural machinery on the softer ground, a periodic linear signal was apparent in the data from each field oriented in the direction of the maize planting rows. This was isolated using a directional cosine filter and Butterworth high-pass filter applied to a Fourier transform of the data set. The isolated periodic signal was then subtracted from the original data. For the two fields where gradient sensor data was not available, its output was simulated by applying 1m upward continuation to a Fourier transform of the data set and then subtracted this from the original. As the system was only used without a gradient sensor in areas well away from sources of transient magnetic fields (such as moving vehicles on an adjacent road), this was found to be an effective substitute. Results of both processing steps are illustrated in insets (A) to (D) in Figures 7 and 9. A linear greyscale image of the combined magnetic data is shown superimposed over the base

Ordnance Survey (OS) mapping in Figure 4, minimally processed versions of the range truncated data (± 60nT/m) are shown as trace plots in Figures 6 and 8 and greyscale images of the processed data in Figures 7(E) and 9(E).

Ground Penetrating Radar survey

A 3d-Radar MkIV GeoScope Continuous Wave Step Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the survey collecting data with a multi-element DXG1820 vehicle-towed, ground coupled antenna array (Linford *et al.* 2010). A roving Trimble R8 Global Navigation Satellite System (GNSS) receiver, together with a second R8 base station receiver established using the Ordnance Survey VRS Now correction service, was mounted on the GPR antenna array to provide continuous positional control for the survey. Measurements were collected along the instrument swaths shown on Figure 3. Data were acquired at a 0.075m x 0.075m sample interval across a continuous wave stepped frequency range from 60MHz to 2.99GHz in 4MHz increments using a dwell time of 2ms. A single antenna element was monitored continuously to ensure data quality during acquisition together with automated processing software to produce real time amplitude time slice representations of the data as each successive instrument swath was recorded in the field (Linford 2013).

Post-acquisition processing involved conversion of the raw data to time-domain profiles (through a time window of 0 to 75ns), adjustment of time-zero to coincide with the true ground surface, background and noise removal, and the application of a suitable gain function to enhance late arrivals. Representative profiles from the GPR survey are shown on Figure 10. To aid visualisation amplitude time slices were created from the entire data set by averaging data within successive 2.5ns (two-way travel time) windows (e.g. Linford 2004). An average sub-surface velocity of 0.13m/ns was assumed following constant velocity tests on the data, and was used as the velocity field for the time to estimated depth conversion. Each of the resulting time slices therefore represents the variation of reflection strength through successive ~0.16m intervals from the ground surface, shown as individual greyscale images in Figures 5, 11 and 12. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

A semi-automated algorithm has been employed to extract the vector outline of significant anomalies shown on Figure 14. The algorithm uses edge detection to identify bound regions followed by a morphological classification based on the size and shape of the extracted anomalies. For example, the location of possible pits is made by selecting small, sub circular anomalies from the data set (Linford and Linford 2017).

RESULTS

Magnetometer survey

A graphical summary of significant magnetic anomalies [**m1-41**] discussed in the following text superimposed on base OS map data is provided in Figure 13.

The Waste

The double-ditched rectilinear enclosure initially identified from cropmarks is defined as a series of positive linear anomalies, [**m1**] and [**m2**], of varying magnetic field magnitude ranging from 3 to 16nT/m. In general, the inner ditch appears to be slightly weaker compared to the outer ditch with some localised more enhanced sections ~16nT/m in magnitude for example at [**m3**] and [**m4**]. The geophysical evidence indicates that the double ditches are not precisely parallel in some places, such as where the gap between them widens towards the NE corner of the enclosure. To the east of the enclosure the ditch circuit is disrupted by an area of intense of disturbance [**m5**], probably associated with the sand quarry shown on historic mapping (OS Historic County Mapping Series: Wiltshire 1904 - 1939 Epoch 3). An approximately 8m wide gap in the outer ditch is found at [**m6**], although there is no corresponding entrance visible through the inner ditch, but if present this may be obscured by the wooded cover bisecting the enclosure. South of the enclosure at [**m7**] a linear ditch anomaly of similar width and with magnitude ~4nT/m can be discerned at the edge of the survey area. While this may represent a previous boundary to the adjacent house plot, historic mapping shows the plot boundary occupying the same footprint on all maps on which it appears back to the first Epoch (OS Historic County Mapping Series: Wiltshire 1843 - 1893 Epoch 1). It might therefore represent the edge of a second enclosure which extends west out of the survey area under the A342 road.

A moderate degree of background disturbance is found in both the arable fields encompassing the enclosure with a considerable number of localised sub-circular positive anomalies, which may represent pits, and more irregular responses likely to represent tree-throws, geological variation or perhaps small scale quarrying. A higher concentration of these localised positive anomalies appears to be found between the inner and outer ditches, for example at [**m8**] and [**m9**] but their density apparently diminishes inside the inner ditch. This distribution may suggest a zonation of different activities within the enclosure. One notable larger pit-type response [**m10**] is found near the NE corner of the inner ditch and its location, perhaps, may be of greater significance.

To the east of the enclosure the concentration of localised positive anomalies [**m11**] continues as far as a NNW-SSE aligned boundary ditch or track-way [**m12**] of unknown date also shown on the aerial photography. The density of

anomalies reduces considerably further to the east, indicating, perhaps, the significance of the discrete anomalies found between the enclosure and [**m12**].

Nuthills villa

The area surrounding the scheduled Nuthills villa site contains a complex of strongly magnetised, ditched enclosures with peak magnitudes of response up to 50nT/m, bounded on the north and east by a perimeter ditch [**m13**]. Additional rectilinear enclosures [**m14**] and [**m15**] extend further to the west of [**m13**] and a weaker response to a possible enclosure is also suggested to the north at [**m16**], although this is only partially described within the survey area.

The complex character of the anomalies bounded by [**m13**] suggests several phases of activity, with the core of the site consisting of a pair of, not necessarily contemporary, sub-circular "banjo" type enclosures [**m17**] and [**m18**], and their distinctive double ditched entrance approaches [**m19**] and [**m20**] running to the east where they may, possibly meet beyond the limit of the survey. Further ditches [**m21-23**] run orthogonally from the entrance approaches [**m19**] and [**m20**] to form a wider complex of associated enclosures, but some of these, for example at, [**m21**] also cut across the banjo enclosures suggesting they may represent later adaptations.

Comparison of the two banjo enclosures suggests [**m17**] is more circular in plan than [**m18**], which is composed of straighter, angular ditch segments and this may indicate different periods of construction. The series of rectilinear enclosures to the south and west of the banjo enclosures appear to have been incorporated into the main complex, with the ditch of the west enclosure [**m25**] overlapping and potentially subsuming the western ditch of [**m17**]. Many of the enclosures in the complex contain scatters of discrete anomalies indicative of occupation activity such as pits, hearths and ovens, with some very pronounced responses [**m26-28**] suggestive of strongly magnetised semi-industrial kilns or furnaces. Additional semi-industrial anomalies are found further to the west at [**m29**], associated with a small sub-rectangular enclosure [**m30**] bounded to the north by a ditch [**m31**] running east to the main enclosure complex.

A rectilinear pattern of positive and negative response [**m32**] within the sub-circular banjo enclosure [**m17**] is indicative of buried masonry associated with the Nuthills Roman villa, and is similar to results from other sites on Jurassic limestone (see for example Payne 2012; Linford et al. 2014). Other responses, such as [**m33-35**], are also probably indications of Roman masonry structures. A weak positive curvilinear anomaly [**m36**] towards the centre of the second banjo enclosure [**m18**] may represent traces of an internal ring-gully type ditch of a timber hut-circle, with a weak narrow positive linear anomaly [**m37**]

immediately to the south possibly suggesting the location of a further E-W aligned rectilinear building.

A double linear boundary ditch [**m38**] is found on the lower ground to the northeast beneath the raised plateau occupied by the Nuthills complex, changing direction to the south where it becomes a single broader linear response [**m39**]. The course of [**m38**] follows a previous field boundary shown on historic mapping (OS Historic County Mapping Series: Wiltshire 1843 - 1893 Epoch 1) and these ditches also contain some strong ferrous anomalies of unknown significance. It is possible that [**m38**] and [**m39**] may represent a long-lived boundary in the landscape, surviving until the more recent enlargement of the field. Magnetic activity falls off considerably beyond [**m38**] and [**m39**] suggesting it may demarcate the eastern extent of the activity associated with the enclosure complex. While two weak, more irregular linear anomalies [**m40**] and [**m41**] do occur towards the northeastern limit of the survey coverage in an area of damp lower lying ground, these may have a natural origin such as former water channels.

Ground Penetrating Radar survey

A graphical summary of the significant GPR anomalies [**gpr1-32**] discussed in the following text, superimposed on the base OS map data, is provided in Figure 14.

Significant reflections have been recorded to approximately 60ns before the signal begins to become attenuated. The very near surface data shows the location of vehicle ruts [**gpr1**] and the agricultural pattern from the extant maize stubble [**gpr2**] which has adversely influenced the quality of the data. There is also some variation in the response across the site, with a greater degree of signal attenuation found over the lower lying ground to the east. It is unclear whether this is due to a change in the geology, soil type, or localised waterlogging.

Anomalies from the structural remains are evident from approximately 7.5ns (0.49m) onwards and indicate a number of substantial buildings, presumably all of Roman date, which do not share an obvious common orientation. The most substantial of these [**gpr3**] has dimensions of 20m x 30m with evidence for internal room divisions and possibly a peristyle or colonnade. There is also some indication of surviving floors, or internal rubble layers, shown by the laminar response within the walls [**gpr4**] between 10.0 and 17.5ns (0.65 to 1.14m), with the magnetic data suggesting the presence of thermoremanent anomalies, possibly even a hypocaust. The full extent of [**gpr3**] is difficult to gauge from the radar data alone as the magnetic anomalies suggest a wider extent of enclosure ditches to the south sharing the same alignment as the structural remains. Further comparison with the magnetic data shows that the

NE corner of [**gpr3**] is built over the course of the underlying banjo enclosure ditch (cf [**m17**]), perhaps explaining why the deepest wall foundations are found to the north of this building extending to approximately 37.5ns (2.44m).

Immediately to the east a second building [**gpr5**] has dimensions of 16m x 13m with some evidence for an entrance in the centre of the southern wall, and a possible room division [**gpr6**] approximately 5m square found in the NE corner (cf [**m35**]). Despite the close proximity between [**gpr3**] and [**gpr5**] they do not share a common rectilinear alignment, indeed [**gpr5**] seems orientated directly with the parallel approach ditches of the banjo enclosure (cf [**m19**]) with the eastern wall of [**gpr5**] extending beyond the main circular ditch [**gpr7**] and [**m17**], perhaps suggesting the deliberate incorporation of the entrance to the earlier enclosure within the Roman building.

A third building [**gpr8**] is found a similar distance to the south, again located partially within the main banjo enclosure. The full extent of [**gpr8**] is difficult to assess from the radar data, but suggests dimensions of approximately 50m x 13m with a better degree of resolution, or perhaps survival, to the west of the building. There are few apparent internal details within [**gpr8**] beyond a central area of amorphous response [**gpr9**] which correlates with an apparent discontinuity in the outer walls, perhaps in part associated with the course of the banjo enclosure ditch [**gpr7**], and a 6m square room [**gpr10**] slightly offset from the NE corner of the building. The response to [**gpr10**] is persistent through the data set from between 10.0 and 40.0ns (0.65 to 2.6m) suggesting deeper wall footings than the rest of the building, perhaps to support additional upper stories. There is some evidence suggesting the north wall of [**gpr8**] passes through [**gpr10**] either creating an internal subdivision or, perhaps, that [**gpr10**] was constructed as a later addition to the main building. A linear wall-type anomaly [**gpr11**] runs parallel to [**gpr8**] 5m south immediately beyond the sub-circular banjo ditch, and whilst it is difficult to suggest [**gpr11**] forms part of the main building it certainly shares a similar near E-W orientation, together with elements of the enclosure ditch system to the south [**gpr28**] and [**gpr29**]. An amorphous, rubble-type response [**gpr12**] is found to the east of [**gpr8**] between approximately 22.5 and 42.5ns (1.46 to 2.76m). It is unclear whether this forms part of the structural remains but it appears to respect the southern boundary suggested by [**gpr11**].

A further group of building remains are found to the north east of the sub-circular banjo enclosure [**m17**] and these all share a similar E-W alignment with [**gpr8**]. To the north [**gpr13**] appears as a building with dimensions of 24m x 7m exhibiting more shallow wall footings, found in the data between 7.5 and 20.0ns (0.49 to 1.3m), and including subdivided rooms to the north [**gpr14**] and west [**gpr15**]. Approximately half of [**gpr13**] appears to be constructed across the main ditch of the northerly banjo enclosure [**m18**] with some potential evidence for deliberate rubble packing [**gpr16**] of the ditch, and

a curious linear alignment of the corresponding magnetic anomaly [**m18**] with the walls of the building.

An approximately 11m square building [**gpr17**] is located over the southern course of the banjo ditch [**m18**], which includes a central 6m square division [**gpr18**], perhaps suggestive of a temple cella, and a smaller room extending from the SE corner [**gpr19**]. Immediately to the south of [**gpr17**], and again sharing the same orientation, is a larger more fragmented structure [**gpr20**] with dimensions of approximately 30m x 10m. There is evidence for a corridor or colonnade inside the north wall of [**gpr20**] with some further internal wall divisions [**gpr21**] and a small subdivided room [**gpr22**] found in the NW corner of the building. Additional structural remains are found immediately to the north at [**gpr23**], and possibly either adjoin [**gpr20**], or form a separate small building. Again, a short section of the underlying banjo enclosure ditch [**m18**] appears to have been deliberately in-filled with rubble and [**gpr23**] is built across this. A short section of wall [**gpr24**] is found further to the east within a segment of one of the enclosure ditches, although this anomaly is rather fragmented and if it does represent the east wall of [**gpr20**] would extend the E-W dimension of this building to approximately 38m. Taken as a whole the distribution of building remains is similar perhaps, in terms of the size, morphology and distribution, to sites such as Uley and Lydney (Lewis 1966; Woodward and Leach 1993; Wilson and Wilson 2011).

Beyond this central complex of building remains the radar has identified low amplitude anomalies partially corresponding to the ditches revealed by the magnetic survey. It is of interest to note that only the most magnetically enhanced segments of the ditches, for example the rectilinear anomalies at [**gpr25-27**] and eastern arc of the banjo enclosure [**gpr7**] appear well defined in the radar data. This may, in part, reflect a stronger contrast with the underlying geology or, perhaps, a difference in the ditch fills. The response to the banjo enclosure ditch [**gpr7**] continues to approximately 40ns (suggesting a possible estimated depth of ~2.6m) before the signal becomes attenuated.

Elements of the more subtle network of ditches to the south are also replicated in the radar [**gpr28**] and suggest a more variable nature to the fills, through the contrasting high and low amplitude response with depth, for example at [**gpr29**]. There is also some more tentative evidence for building rubble [**gpr30**] within this network of ditched enclosures, although these may not necessarily represent structural remains. Further high amplitude reflectors are found as a diffuse linear band [**gpr31**] to the north and, perhaps, seem more likely to represent the underlying geology. Some low amplitude ditch type anomalies [**gpr32**] are also found here which partially correlate with the magnetic response.

CONCLUSIONS

Magnetic survey successfully confirmed the location of the double rectilinear enclosure identified from aerial photography in the area known as The Waste and provided some additional detail particularly within the inner ditch circuit. The wider magnetic response in this area is more difficult to interpret, due in part to intervention from historic sand quarrying and the impact of ploughing. A much denser pattern of activity was revealed in the magnetic results to the southeast over the Nuthills villa, enhancing the aerial record and suggesting a multi-phase complex of field systems and boundaries centred around two sub-circular banjo enclosures. Evidence for Roman structural remains suggested by the magnetic survey was confirmed by the radar coverage, revealing a far larger complex of sizeable buildings than would, perhaps, be expected from a rural villa site. Comparing results from the two techniques (see Figure 15) suggests a strong correlation between the location of the buildings and the earlier banjo enclosures, perhaps indicating a greater ritual significance to the Roman settlement. Certainly the size, distribution and morphology of the buildings revealed by the geophysical survey suggest, perhaps, comparison with temple complex sites such as Uley and Lydney.

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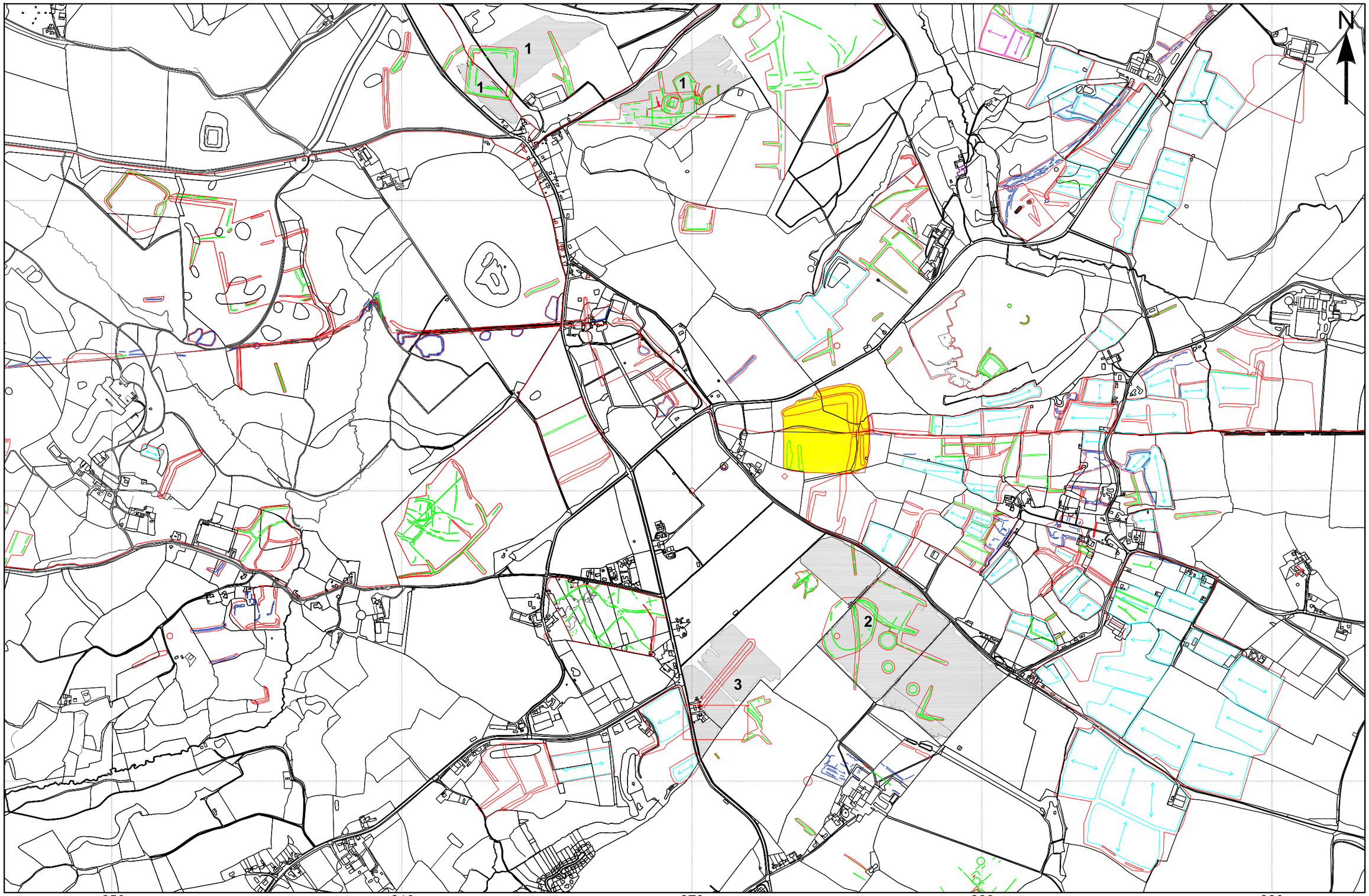
VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE

Figure 1

Location of geophysical surveys, January to March 2018

ST9767



0 750m

1:12500

Verlucio Roman town

HE geophysical survey areas [1-3]

1. Bowood Estate sites
2. Bromham House Farm
3. Bromham villa

aerial mapping evidence:
- ridge and furrow
- bank
- scarp
- ditch

NRHE monument polygons

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Figure 2

Location of caesium magnetometer instrument swaths, February 2018

0 150m

1:3000

Caesium magnetometer survey swaths

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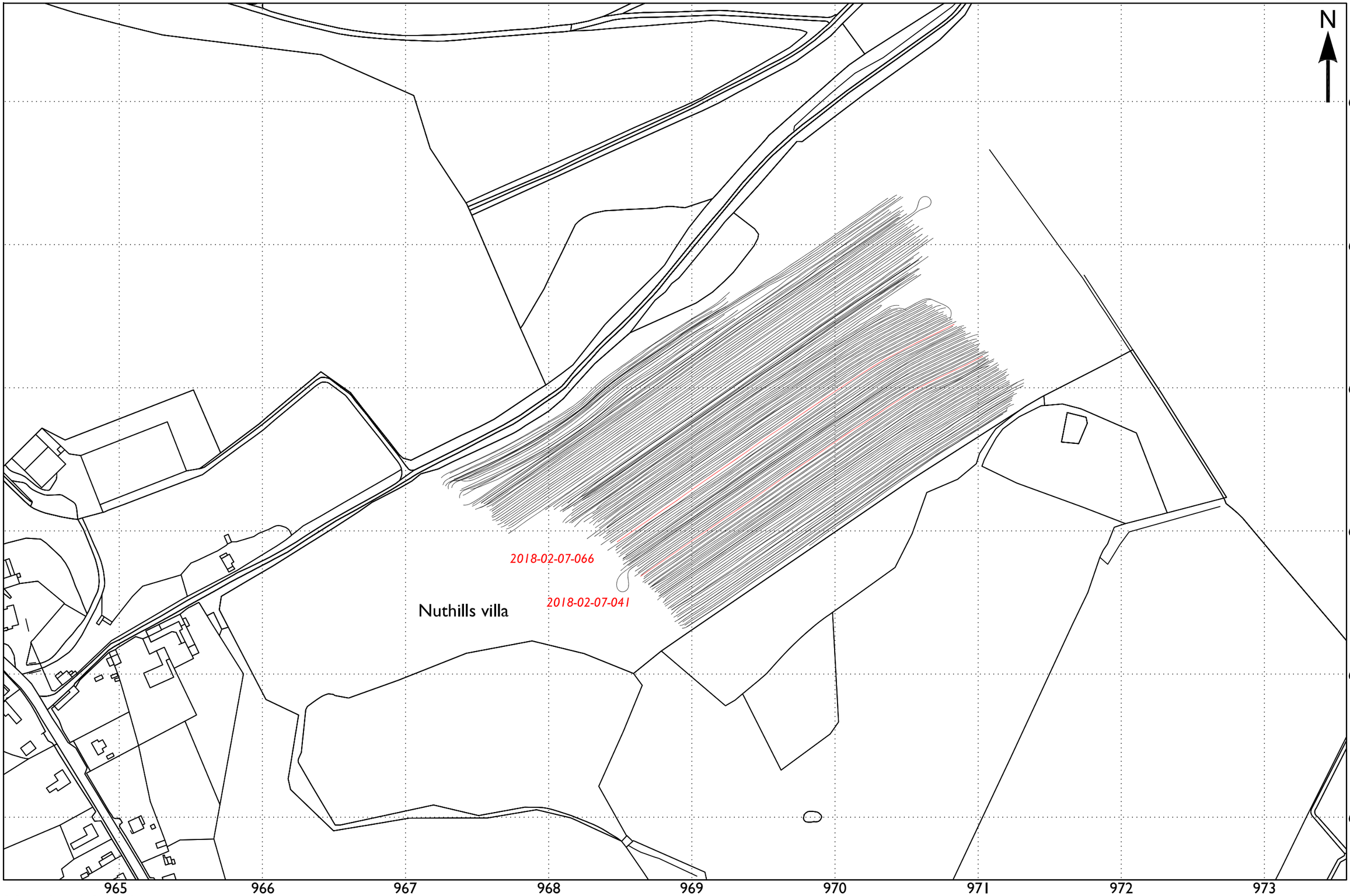
Figure 3

Location of GPR instrument swaths, February 2018



0 150m

1:2500

2018-02-07-041 Location of selected GPR profiles shown on Figure 10

Ground Penetrating Radar survey swaths

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Figure 4

Location of caesium magnetometer surveys, February 2018

0 150m

1:3000

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Figure 5

GPR amplitude time slice between 15.0 and 17.5ns (0.98 - 1.14m), February 2018

0 150m

1:2500

2018-02-07-041 Location of selected GPR profiles shown on Figure10

Low *High*

relative reflector strength

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Figure 6

VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE

Caesium magnetometer survey, February 2018

Trace plot of minimally processed data from The Waste area

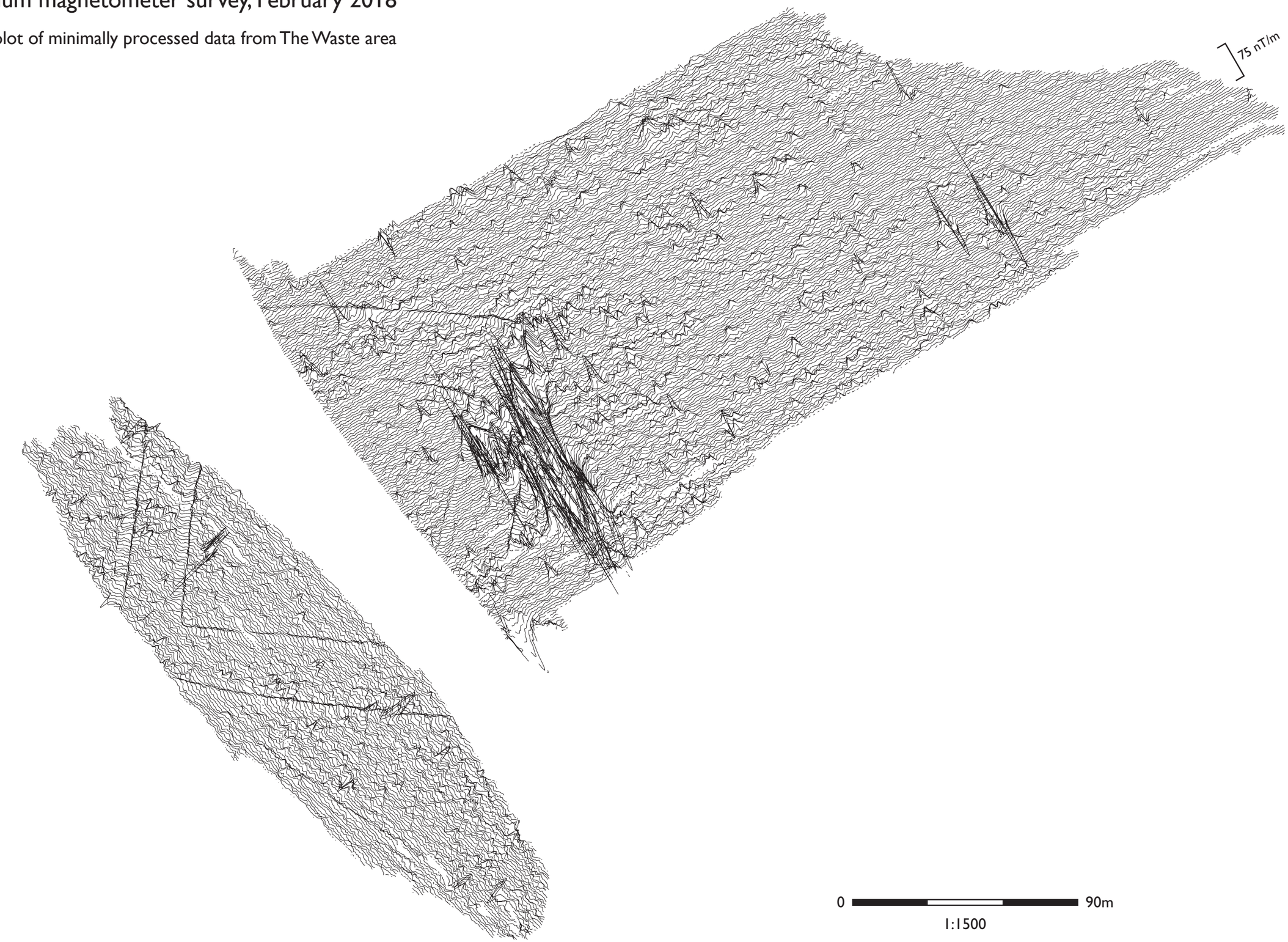

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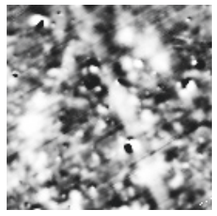
Figure 7

VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE
Caesium magnetometer survey, February 2018

Equal area greyscale image of processed data from The Waste area with insets illustrating processing steps

(A) Unprocessed total field intensity data

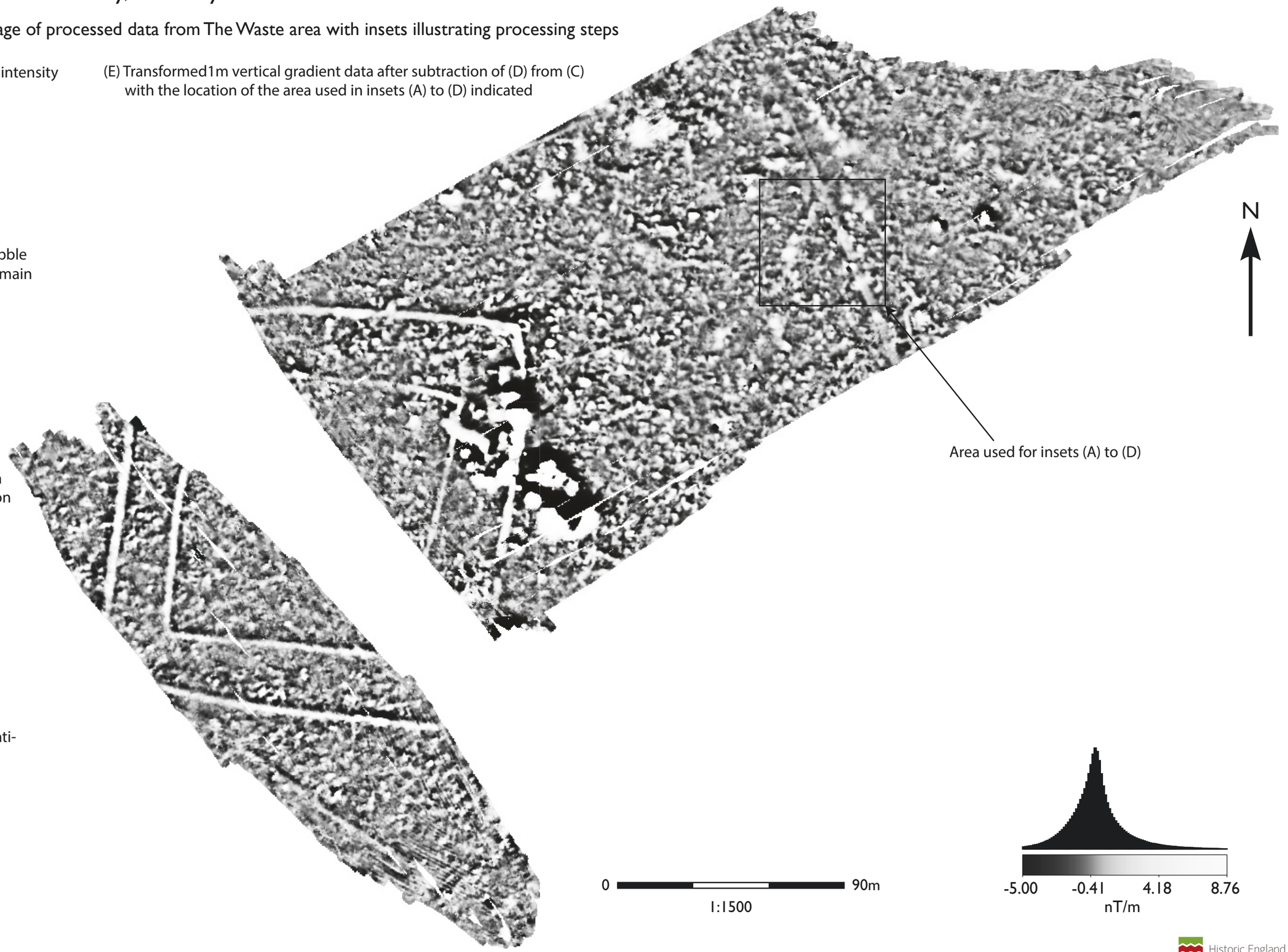


(B) Signal due to maize stubble rows isolated by FFT domain directional cosine filter (intensity exaggerated)

(C) Total field intensity data from (A) after subtraction of maize stubble signal shown in (B)

(D) Simulated gradiometer data set derived by FFT domain 1m upward continuation of data from (C) (eastern field only)

(E) Transformed1m vertical gradient data after subtraction of (D) from (C) with the location of the area used in insets (A) to (D) indicated



N

Area used for insets (A) to (D)

0 90m

1:1500

-5.00 -0.41 4.18 8.76

nT/m

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Figure 8

VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE
Caesium magnetometer survey, February 2018

Trace plot of minimally processed data from Nuthills Villa area

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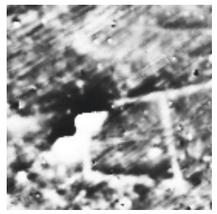
Figure 9

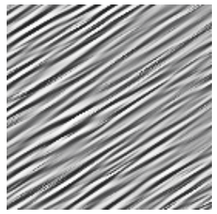
VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE
Caesium magnetometer survey, February 2018

Equal area greyscale image of processed data from Nuthills Villa area with insets illustrating processing steps

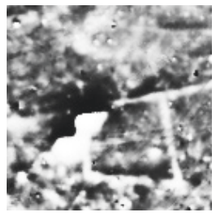
(A) Unprocessed total field intensity data



(B) Signal due to maize stubble rows isolated by FFT domain directional cosine filter (intensity exaggerated)



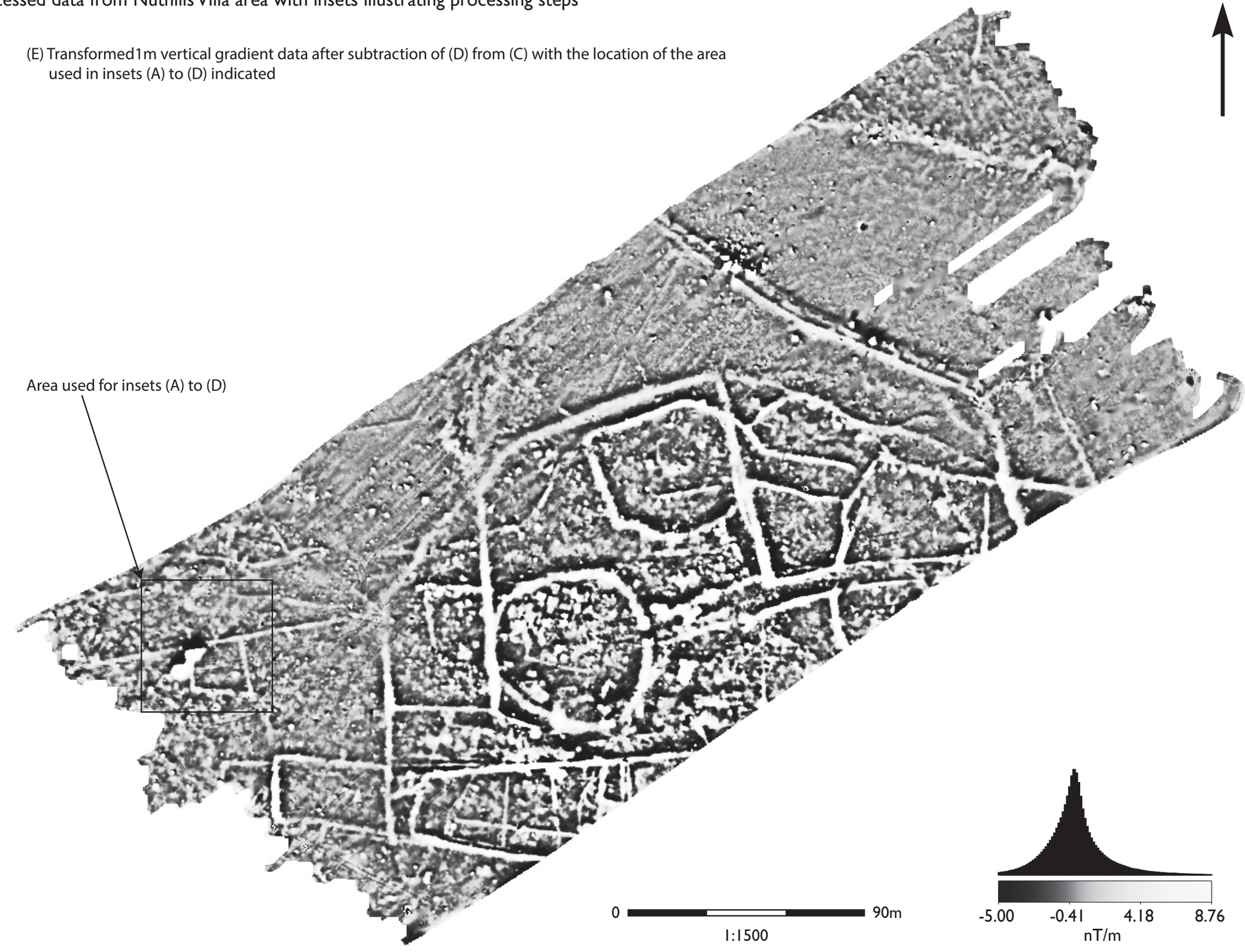
(C) Total field intensity data from (A) after subtraction of maize stubble signal shown in (B)



(D) Simulated gradiometer data set derived by FFT domain 1m upward continution of data from (C)

(E) Transformed1m vertical gradient data after subtraction of (D) from (C) with the location of the area used in insets (A) to (D) indicated

Area used for insets (A) to (D)



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VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE

Figure 10

Topographically corrected GPR profile, February 2018

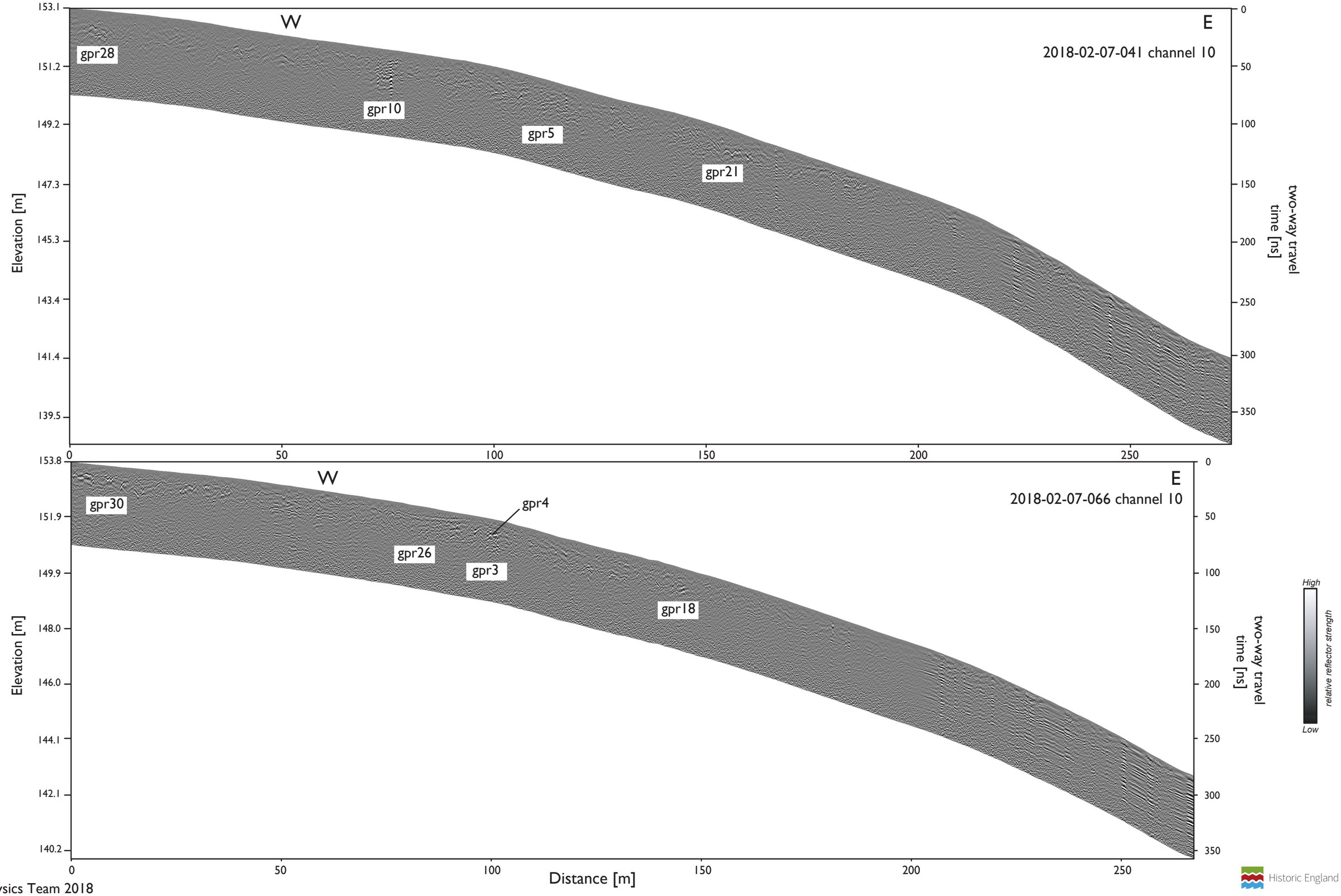

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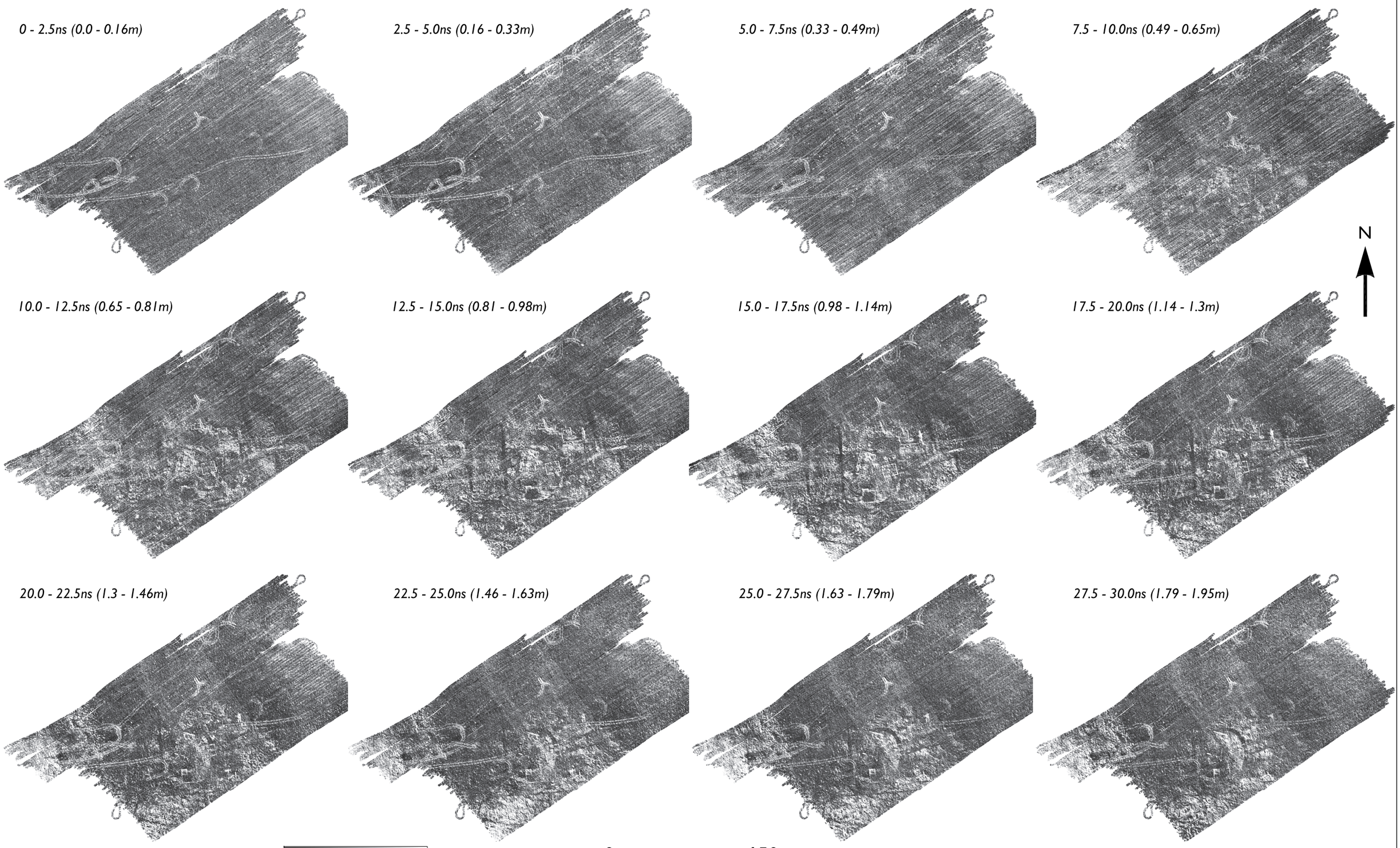
Figure 11

GPR amplitude time slices between 0.0 and 30.0ns (0.0 - 1.95m), February 2018



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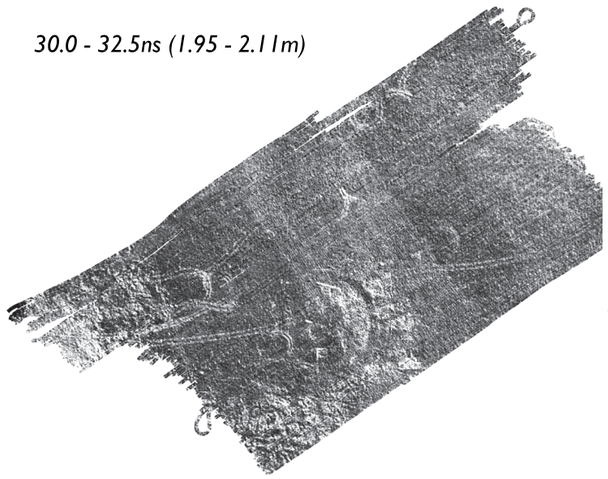
VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE

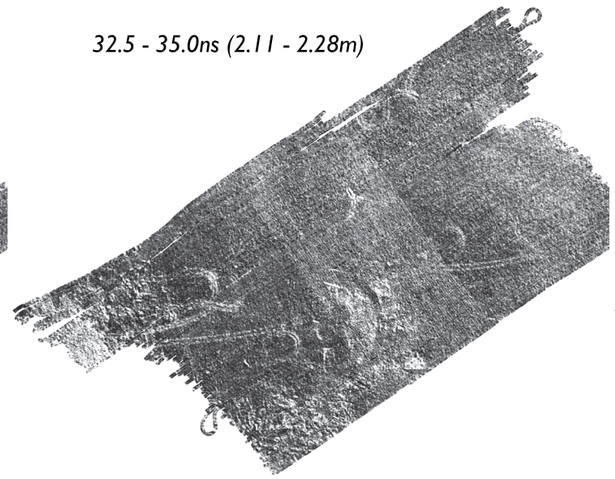
Figure 12

GPR amplitude time slices between 30.0 and 60.0ns (1.95 - 3.9m), February 2018

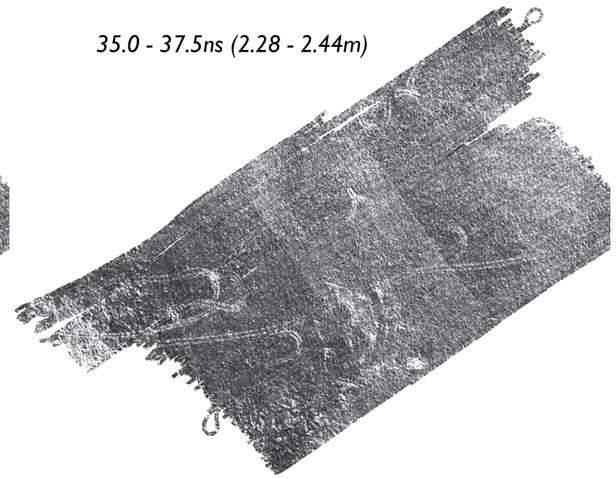
30.0 - 32.5ns (1.95 - 2.11m)



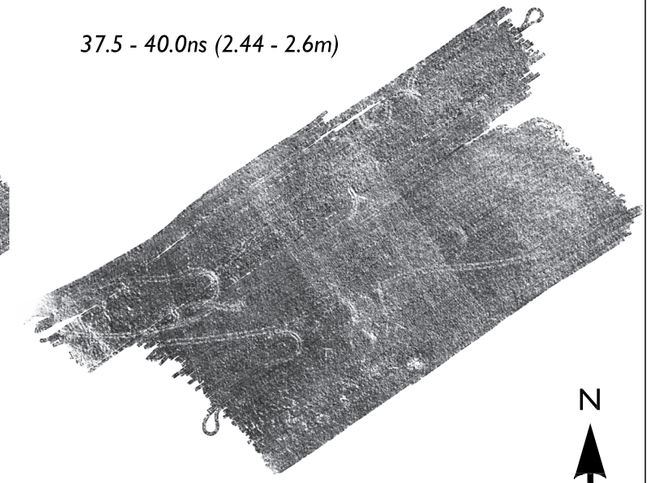
32.5 - 35.0ns (2.11 - 2.28m)



35.0 - 37.5ns (2.28 - 2.44m)

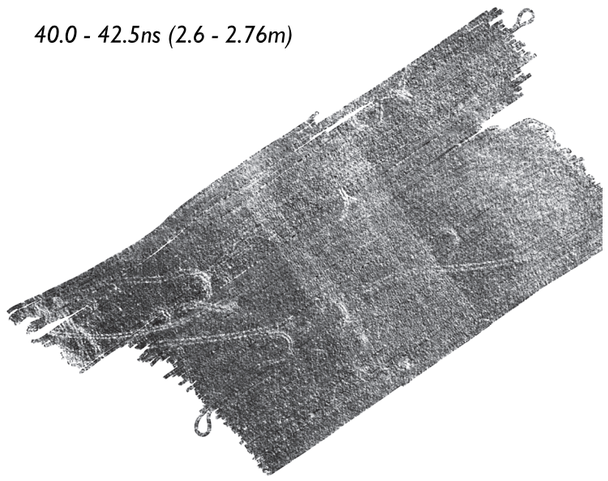


37.5 - 40.0ns (2.44 - 2.6m)

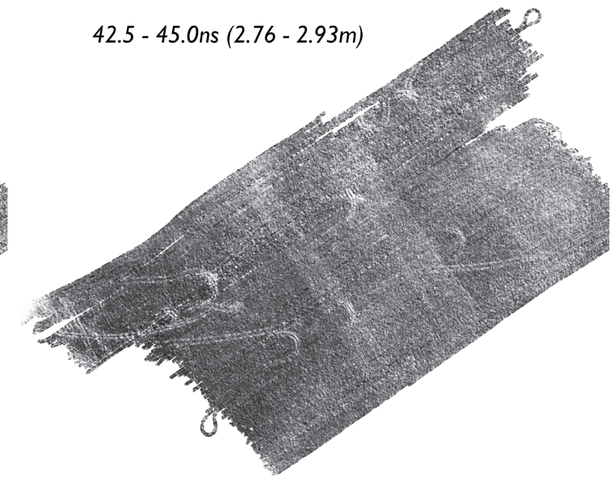


N

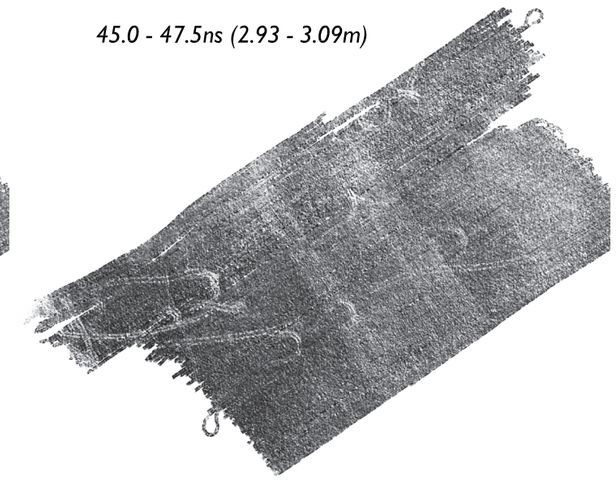
40.0 - 42.5ns (2.6 - 2.76m)



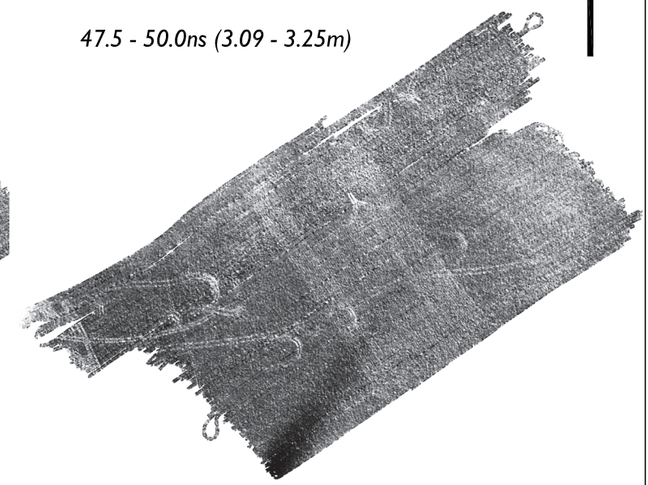
42.5 - 45.0ns (2.76 - 2.93m)



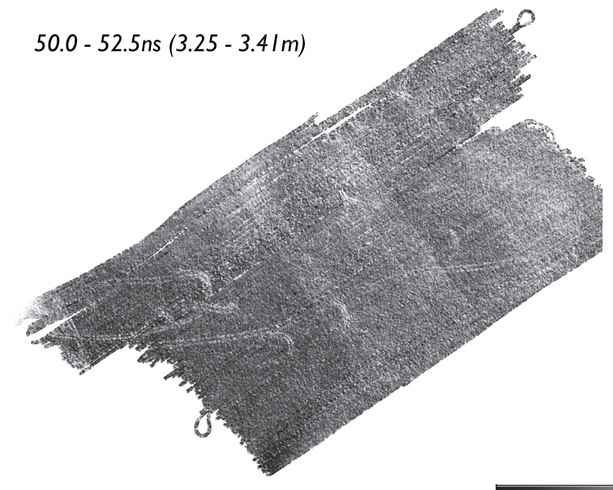
45.0 - 47.5ns (2.93 - 3.09m)



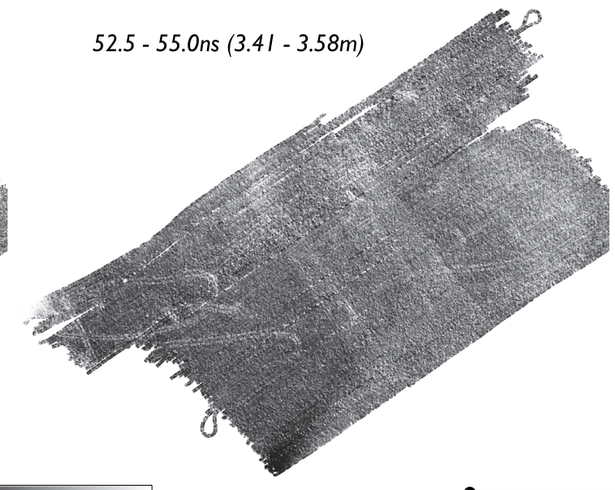
47.5 - 50.0ns (3.09 - 3.25m)



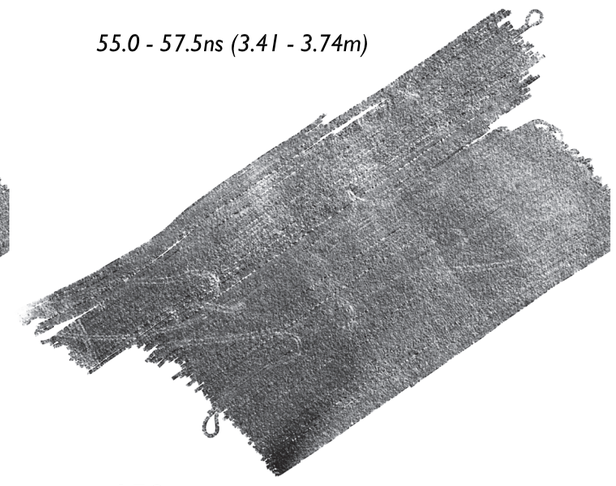
50.0 - 52.5ns (3.25 - 3.41m)



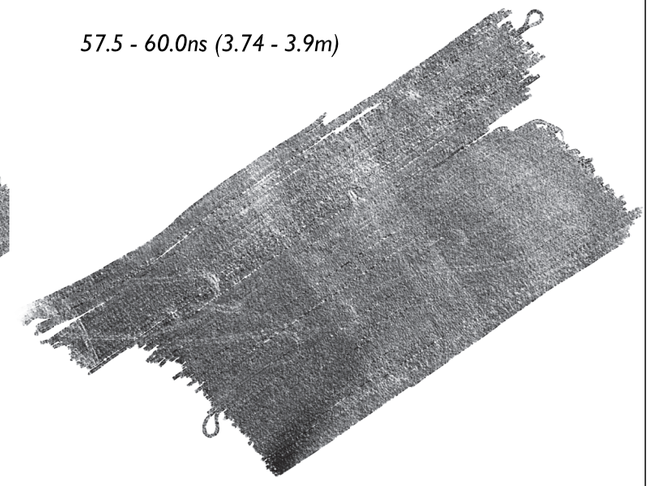
52.5 - 55.0ns (3.41 - 3.58m)



55.0 - 57.5ns (3.41 - 3.74m)



57.5 - 60.0ns (3.74 - 3.9m)



Low *High*

relative reflector strength

0 150m

1:4000

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Figure 13

Graphical summary of significant magnetic anomalies, February 2018

ST9668

N

686

685

684

683

682

681

680

962 963 964 965 966 967 968 969 970 971 972

The Waste

Nuthills villa

m1 m2 m3 m4 m5 m6 m7 m8 m9 m10 m11 m12 m13 m14 m15 m16 m17 m18 m19 m20 m21 m22 m23 m24 m25 m26 m27 m28 m29 m30 m31 m32 m33 m34 m35 m36 m37 m38 m39 m40 m41

0 150m

1:3000

positive magnetic

negative magnetic

strong positive magnetic

raised magnetic

magnetic noise

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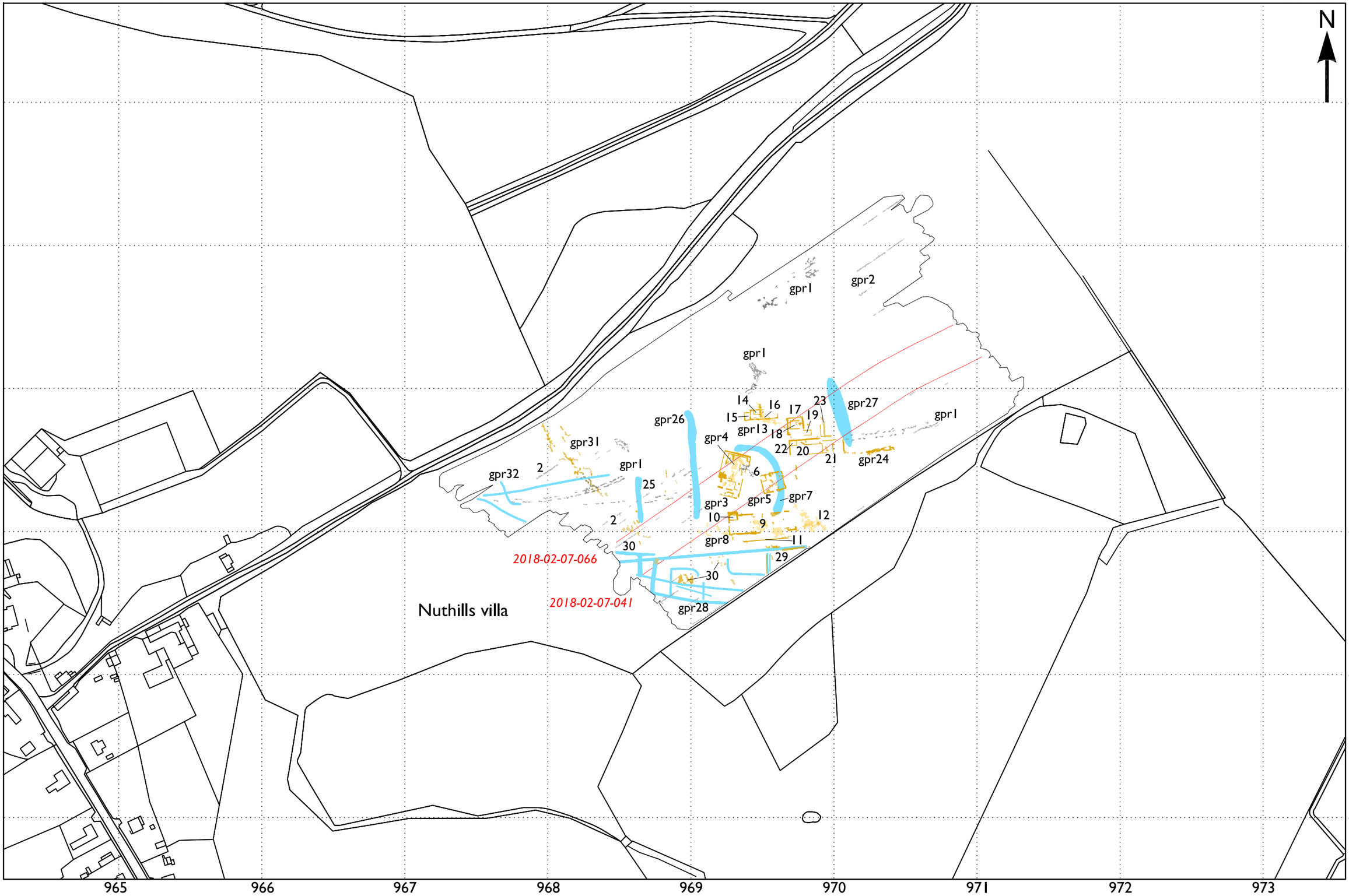
Figure 14

Summary of significant GPR anomalies, February 2018



0 150m

1:2500

2018-02-07-041 Location of selected GPR profiles shown on Figure 10

low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

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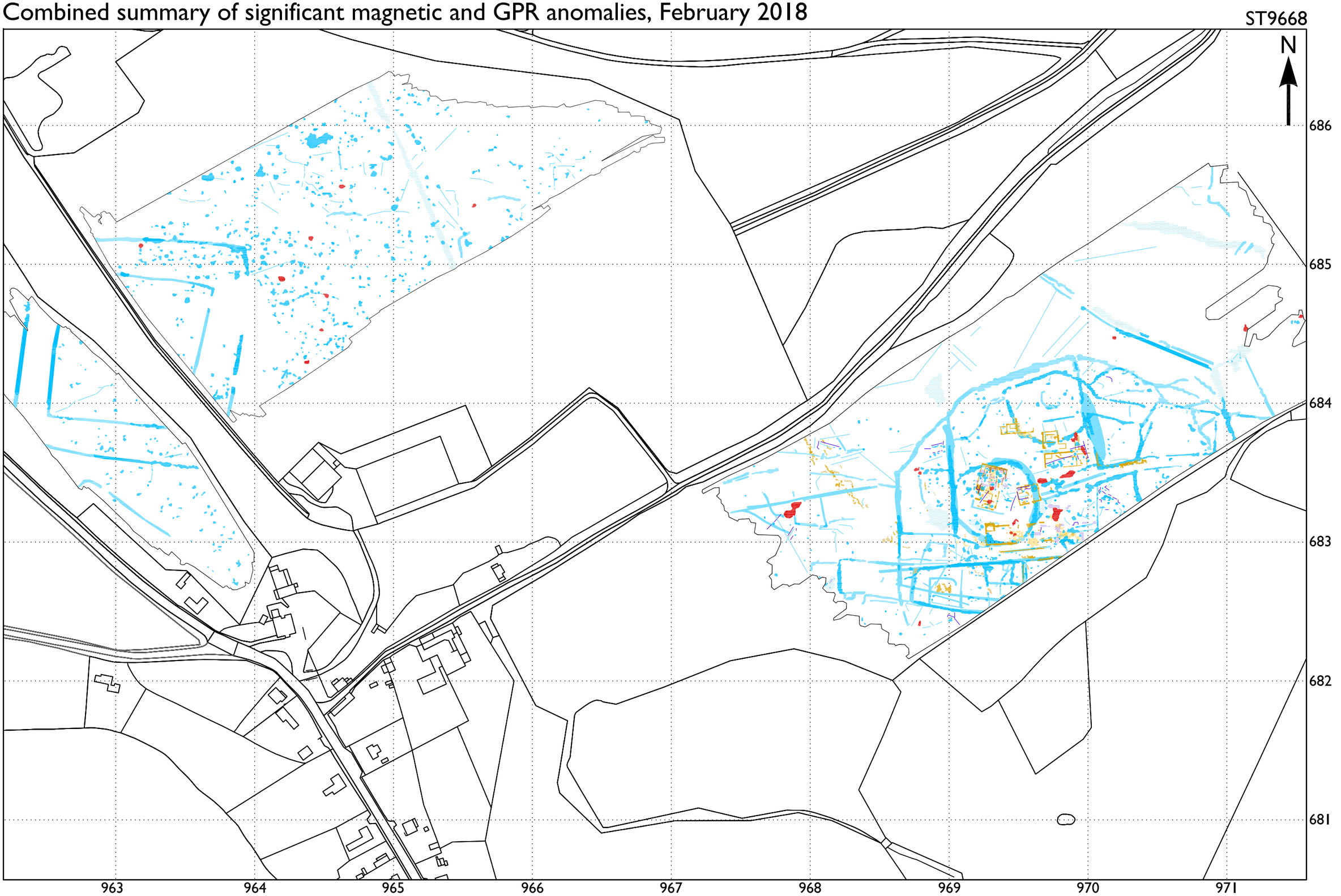
VERLUCIO AND ENVIRONS PROJECT, BOWOOD ESTATE, CALNE WITHOUT, WILTSHIRE

Figure 15

Combined summary of significant magnetic and GPR anomalies, February 2018



0 150m

1:2500

thermoremanent

ditch/pit type anomalies

structural remains / rubble

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