Historic England

Geophysics

Silchester Environs Project, Little London Roman Tilery, Pamber, Hampshire Report on geophysical survey, July 2015

Neil Linford, Paul Linford and Andrew Payne

Discovery, Innovation and Science in the Historic Environment

Research Report Series no. 41-2016

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

REPORT ON GEOPHYSICAL SURVEY, JULY 2015

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NGR: SU 6226 5971

ISSN 2059-4453 (Online)

SUMMARY

Caesium magnetometer and Ground Penetrating Radar (GPR) surveys were conducted as part of the University of Reading Silchester Environs Project survey programme over a suspected Roman tile production site, based on earlier finds of Roman tile waster material, at Little London, Pamber, Hampshire. Results from both techniques were partially affected by known C19th clay pit workings associated with the brick making industry in the area, although beyond this disturbance the vehicle towed caesium magnetometer survey (5ha) identified linear anomalies and a cluster of high magnitude discrete thermoremanent responses characteristic of the remains of a group of kiln type structures. GPR survey (3.1ha) provided complementary detail of the anomalies mapped by the magnetometer survey and the historical land use of the area.

CONTRIBUTORS

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

ACKNOWLEDGEMENTS

The authors are grateful to Ben and Charles Kolo••• ••of Chitty Farm, Silchester, who kindly allowed access for the survey to take place.

ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

DATE OF SURVEY

The fieldwork was conducted between 21st to 22nd July 2015 and the report completed on •th October 2016. The cover image shows the vehicle towed caesium magnetometer array being prepared for survey close to the northern boundary of the site.

CONTACT DETAILS

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INTRODUCTION

Caesium magnetometer and Ground Penetrating Radar (GPR) surveys were conducted at the Little London Roman Tilery site, ~2.5km south of Silchester Roman Town, Hampshire, as part of the Historic England contribution to the Silchester Environs Survey (RASMIS 7226), undertaken in partnership with the University of Reading (Barnett and Fulford 2015). This project aims to investigate the origins and early development of the Iron Age and Roman town at Calleva Atrebatum (Silchester, Hampshire), through a study of prehistoric settlement, activity and agriculture in the hinterland of the Iron Age *Calleva* to address the local context for the emergence of the *oppidum*.

The geophysical survey component of the project aims to test the magnetic and GPR response over the varying gravel, clay and chalk geologies of the Silchester area, using a vehicle towed high sensitivity caesium vapour magnetometer array together with a high sample density multi channel GPR system. It is hoped that this will complement the extensive fluxgate magnetometer and GPR coverage conducted by the University of Reading, particularly where the geophysical response has proved indistinct. Trial sites for ground based survey have been identified from aerial photography and lidar coverage within the project area (Figure 1), including the plough truncated remains of long, linear earthwork banks crossing the landscape where these survive in areas of woodland and may extend into the surrounding farmland (Linford 2015).

The survey at the Little London Roman Tilery site, approximately 1km to the west of the Silchester to Winchester Roman road route (AMIE 915200), was conducted over the site of a suspected Roman tile production site (AMIE 240340; Hants AHBR No. 26713), identified through finds of Roman ceramic building material (Ant. J., Vol. 6, 1926, pp.75-6), in the hope it may confirm the presence of any surviving kilns and other significant anomalies.

The site is situated on plateau gravel drift deposits over silty clay/mudstone, sandy silts of the Eocene Bracklesham Beds Group and sandy clayey silts of the Windlesham Formation, over which soils of the Wickham 4 Association have developed (Geological Survey of Great Britain 1974 ; Soil Survey of England and Wales 1983). The field was under grass at the time of the survey and weather conditions during the field work were sunny and dry.

METHOD

Magnetometer survey

The magnetometer data was collected along the instrument swaths shown on Figure 2 using an array of six high sensitivity Geometrics G862 caesium vapour magnetometer sensors mounted on a non-magnetic sledge. This sledge was towed behind a low impact, All Terrain Vehicle (ATV) which also provided the power supply and housed the data logging electronics. Five of the sensors were mounted in a linear array transverse to the direction of travel 0.5m apart and, vertically, ~0.2m above the ground surface. The sixth was fixed 1.0m directly above the central magnetometer in the array to act as a gradient sensor. The sensors were set to sample at a rate of 16Hz based on the typical average travel speed of the ATV (3.2m/s) giving a sampling density of ~0.2m by 0.5m along successive swaths. Each swath was separated from the last by approximately 2.5m, navigation and positional control being achieved using a Trimble R8 Global Navigation Satellite System (GNSS) receiver mounted on the sensor platform 1.75m 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 was monitored during acquisition to ensure data quality and minimise the risk of gaps in the coverage due to the use of a grid-less system.

After data collection the corresponding readings from the gradient sensor were subtracted from the measurements made by the other five magnetometers to remove any transient magnetic field effects caused by the towing ATV. The median value of each instrument traverse was then adjusted to zero by subtracting a running median value calculated over a 60m 1D window. This operation corrects for slight biases added to the measurements owing to the diurnal variation of the Earth's magnetic field and any slight directional sensitivity of the sensors. A linear greyscale image of the combined magnetic data is shown superimposed over the base Ordnance Survey (OS) mapping on Figure 4 and minimally processed versions of the range truncated data ($\pm$100nT/m) are shown as a traceplot and a histogram equalised greyscale image on Figures 6 and 7 respectively.

Ground Penetrating Radar survey

A 3d-Radar MkIV GeoScope Continuous Wave Stepped-Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the survey collecting data with a multi-element GX1820 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 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 50ns), 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 8. To aid visualisation amplitude time slices were created from the entire data set by averaging data within successive 2.4ns (two-way travel time) windows (e.g. Linford 2004). An average sub-surface velocity of 0.117m/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, shown as individual greyscale images in Figures 9 and 10 therefore represents the variation of reflection strength through successive ~0.14m intervals from the ground surface. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

RESULTS

Magnetometer survey

A graphical summary of the significant magnetic anomalies, [**m1-23**] discussed in the following text, is provided in Figure 11.

An extensive area of pronounced disturbance [**m1**] coincides with a wide shallow depression in the ground surface that indicates the extent of C19th clay pits, associated with the adjacent brickworks shown on historic mapping to the west of the Silchester Road Copse (AMIE Monument HOB UID 1602418; OS Historic County Mapping Series: Hampshire 1872 Epoch 1). The intense and variable response from [**m1**] is likely to relate to backfilling and dumping of building waste material in the former extraction area to level the ground surface prior to the field reverting to allotments and, more recently, agricultural use (B Kowolowski *pers comm*). Further strong disturbance [**m2-5**], evident along the course of the field boundaries, is likely to be of relatively recent origin, although an area of raised response at [**m6**] may, possibly, represent further clay pit workings infilled with less magnetic material.

Two sets of parallel field drains [**m7**] and [**m8**] are visible as weak alternating positive and negative linear anomalies, possibly truncated by the clay pit at [**m1**].

A number of linear positive anomalies [**m9-12**] to the SE, are indicative of ditched boundaries or trackways, and appear to be associated with a group of very intense, discrete responses [**m13-20**] ranging from 100-200 nT/m in peak magnitude, likely to represent thermoremanent kiln type structures. Other less substantial kiln type anomalies may be present at [**m21**] and [**m22**] with further possible spreads of magnetic material [**m23**], perhaps representing areas of waster deposits, associated with the possible tile production site. Scattered isolated pit-type anomalies recorded in the undisturbed parts of the survey area, may be of archaeological significance but could also relate to natural tree-throw disturbance.

Ground Penetrating Radar survey

A graphical summary of the significant GPR anomalies, [**gpr1-13**], discussed in the following text, are shown superimposed on the base OS map data on Figure 12.

Significant reflections have been recorded to approximately 40ns before the signal begins to be attenuated, presumably due to the presence of underlying clay deposits. The very near surface data between 0 and 2.4ns (0 to 0.14m) is largely dominated by the surface micro-topography, including the predominant cultivation pattern and the course of animal run [**gpr1**] and footpath [**gpr2**] routes established over the site. The location of the clay pit [**gpr3**] is only partially described in the more limited GPR coverage with a more pronounced, high amplitude response at [**gpr4**] to the west. Linear anomalies [**gpr5**] between 7.2 and 14.4ns (0.41 to 0.81m) correlate with the field drains [**m7**] and [**m8**] identified by the magnetic survey, and these appear to be truncated by the presence of the clay pit [**gpr3**] to the south.

A parallel linear anomaly [**gpr6**] may represent the course of the trackway leading to the clay pit shown on the historic mapping (OS Historic County Mapping Series: Hampshire 1872 Epoch 1), but much of the GPR survey area beyond the clay pit is partially obscured between 4.8 and 16.8ns (0.27 to 0.95m) by a high amplitude response [**gpr7**] to the underlying geomorphology. From approximately 12ns (0.68m) onwards some more discrete high amplitude reflectors are resolved within [**gpr7**], although it is difficult to suggest whether these represent more significant pit-type anomalies or accumulations of natural clay or gravel. Two discrete high amplitude anomalies [**gpr8**] between 4.8 and 7.2ns (0.27 to 0.41m), both with a diameters of ~2m, could possibly represent small kilns, although there is only a partial correlation with a high amplitude magnetic response.

A series of low amplitude, ditch-type anomalies at [**gpr9-11**] correspond, in part, with some areas of raised magnetic response, although it is difficult to interpret these more fully. Two more amorphous areas of low amplitude response [**gpr12**] and [**gpr13**] appear to be associated with small depressions in the ground surface within the area containing the thermoremanent magnetic anomalies.

CONCLUSIONS

The magnetic survey has successfully identified approximately 8 probable kiln structures at the site, with some further less certain outliers. These appear to be clustered in groups of two or three and the majority are located close to anomalies suggestive of probable linear boundaries and access trackways apparent in both the magnetic and GPR data sets. Trial excavation would be required to fully confirm the Roman origin of the kiln type anomalies, but this seems likely from the ceramic material recovered in the vicinity of the site.

LIST OF ENCLOSED FIGURES

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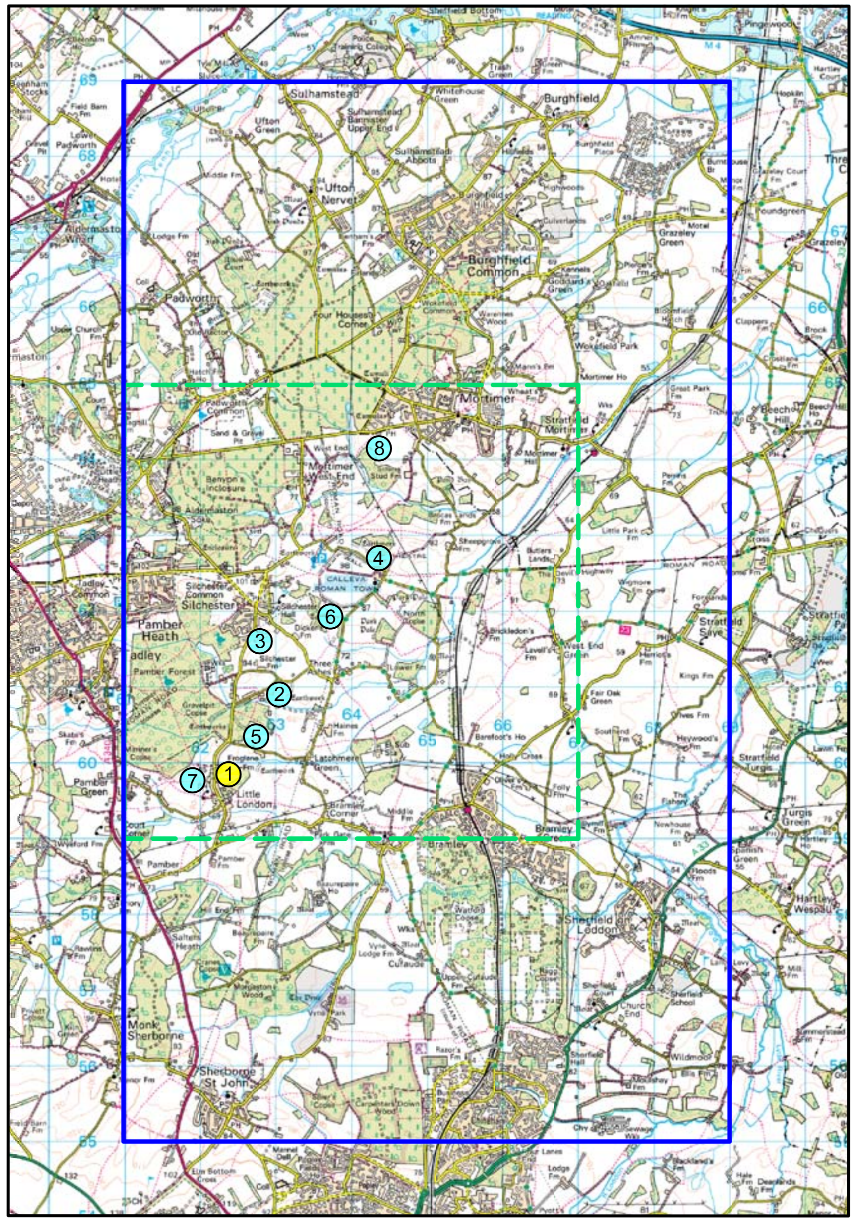
Figure 1

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Location of survey

(A)



Core project area

Detailed OS mapping area (B)

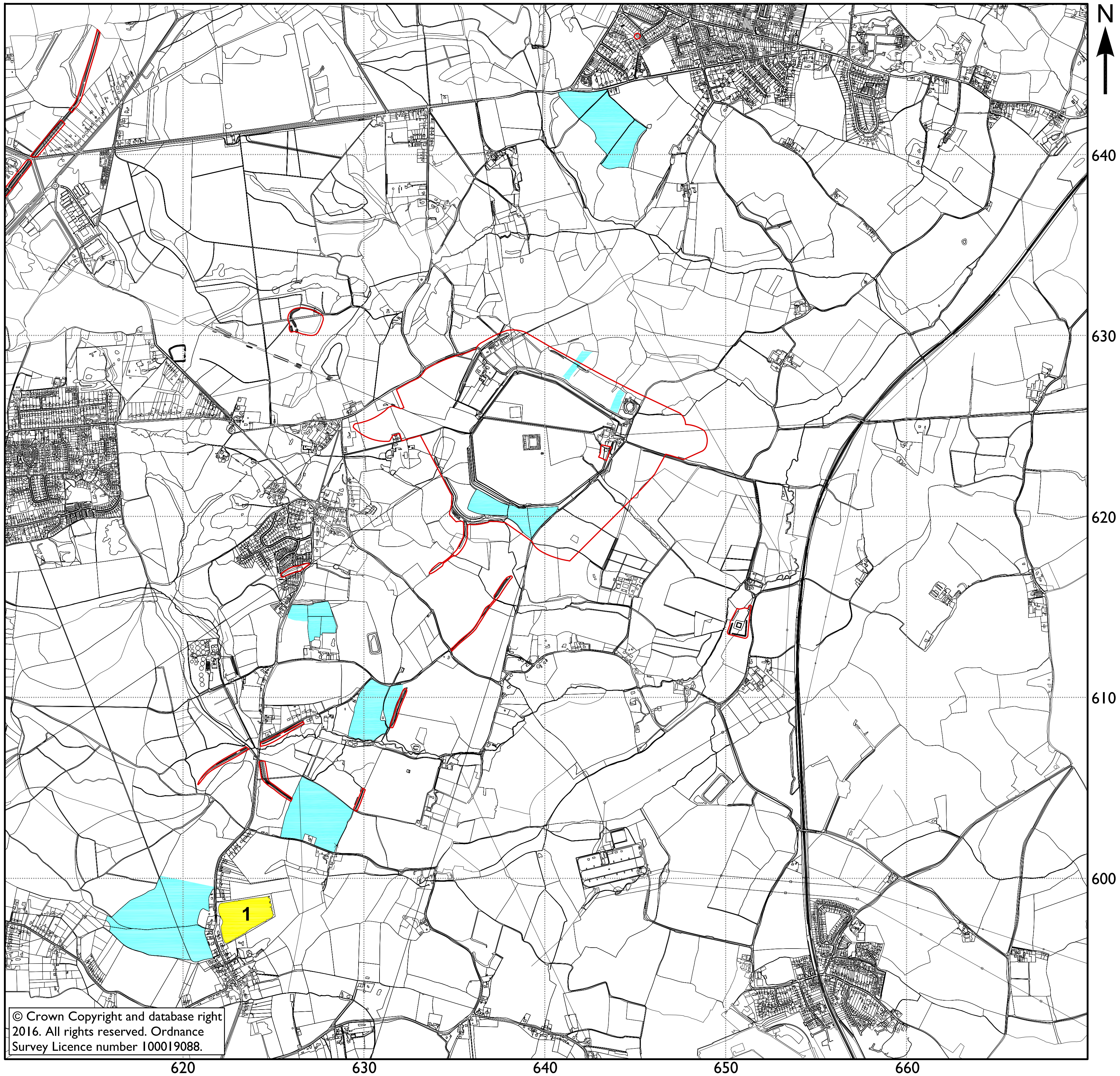
0 3km
1:100000

HE geophysical survey locations:

1. Little London Roman tilery
2. Woods Farm Dyke
3. Silchester Farm
4. Chitty Farm
5. Bridle's Copse
6. Rampier Copse
7. King's Hogsty Copse
8. Simms's Copse

SU6159

(B)



0 1500m
1:25000

1 Little London Roman tilery survey area

Other HE geophysical survey areas

Scheduled areas

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Figure 2

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Location of caesium magnetometer instrument swaths, July 2015

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Figure 3

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Location of GPR instrument swaths, July 2015

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Figure 4

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Location of caesium magnetometer survey, July 2015

0 90m

1:2500

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Figure 5

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

GPR amplitude time slice between 9.6 - 12.0ns (0.54 - 0.68m), July 2015

0 90m
1:2500

Low High
relative reflector strength

2015-07-21-047 Location of selected GPR profiles shown on Figure 8

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Figure 6

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Traceplot of minimally processed caesium magnetometer data, July 2015

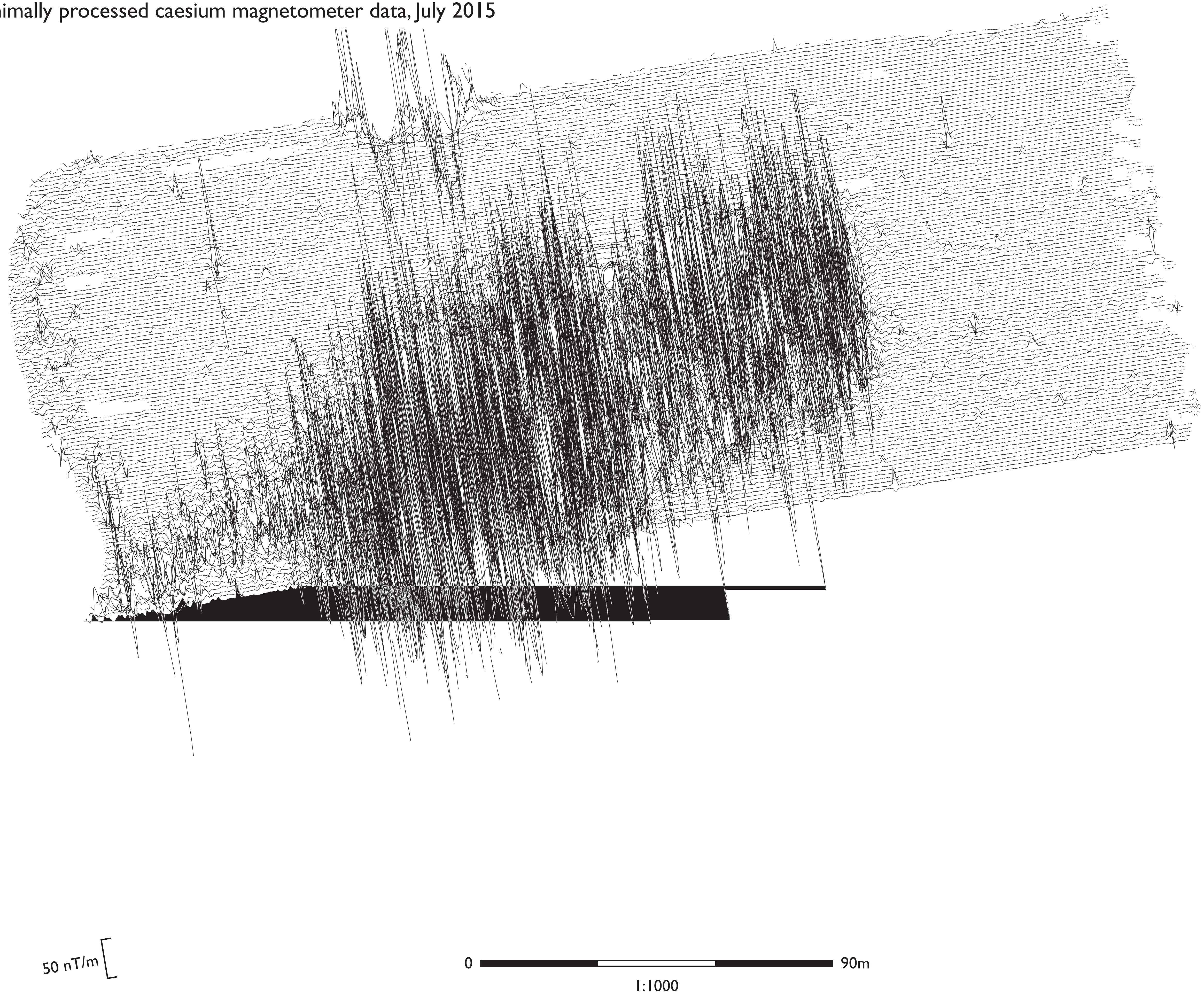

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Figure 7

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Equal area greyscale image of minimally processed caesium magnetometer data, July 2015

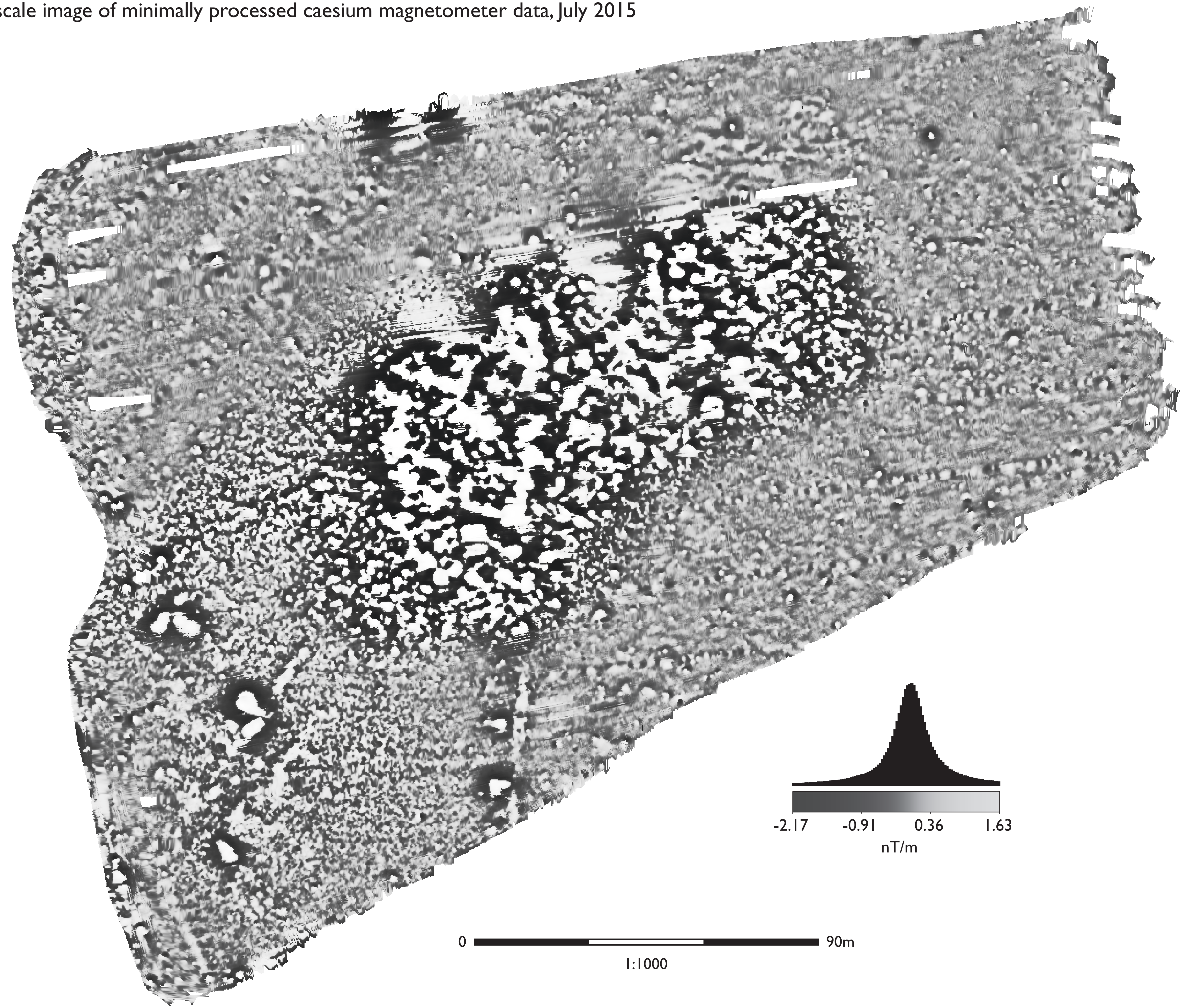

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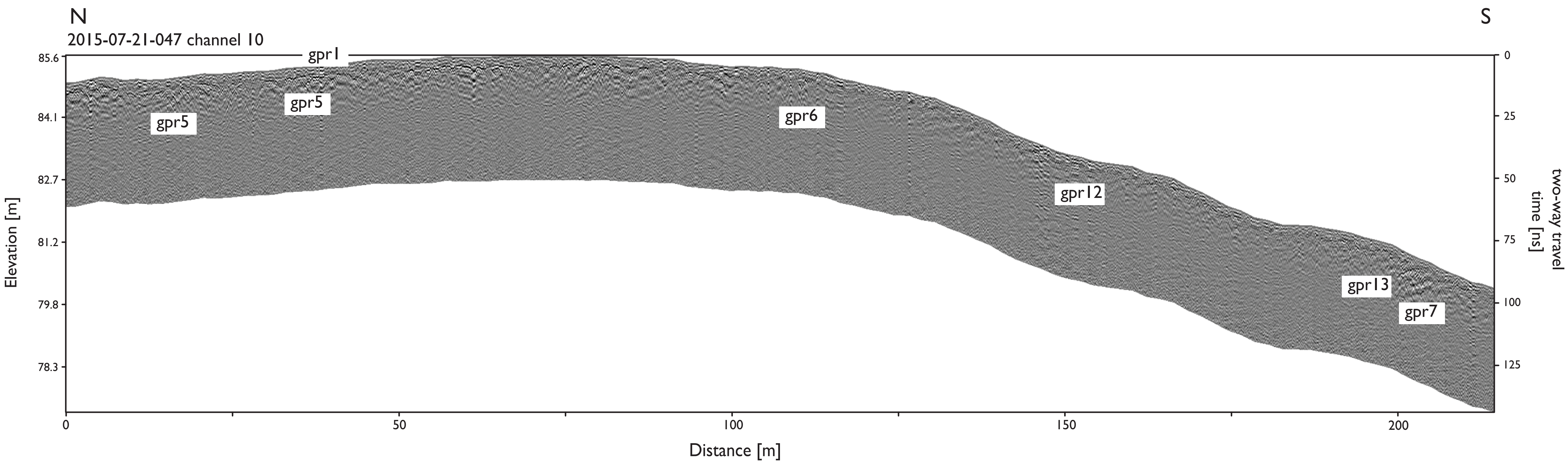
Figure 8

Topographically corrected GPR profiles, July 2015



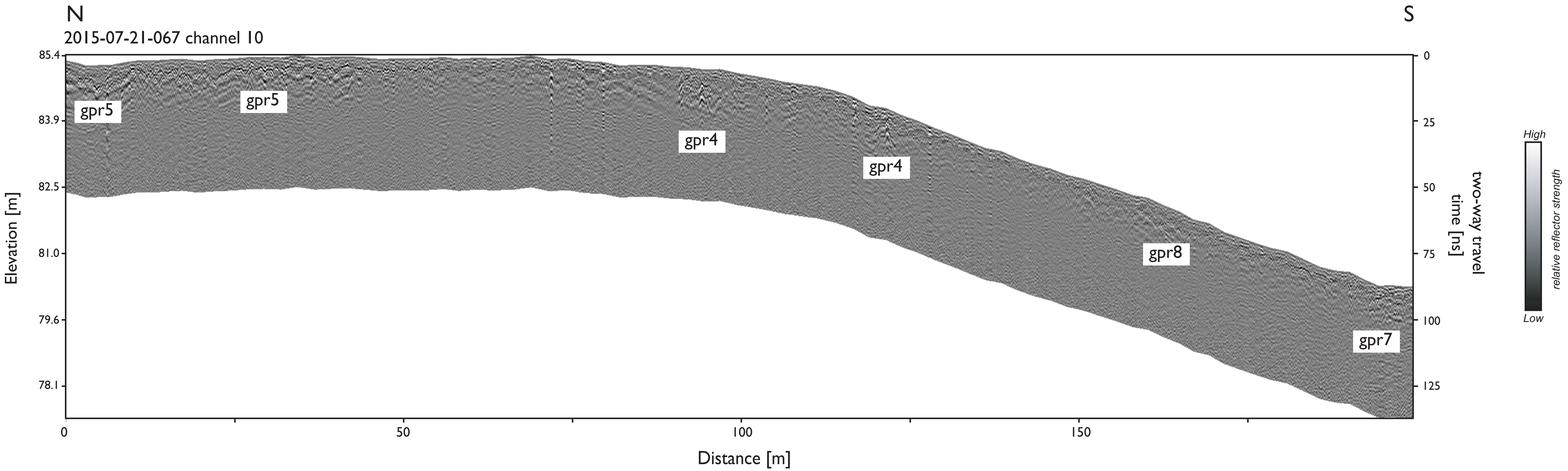


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Figure 9

SILCHESTER ENVIRONS SURVEY, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE
GPR amplitude time slices between 0.0 and 24.0ns (0 to 1.36m), July 2015

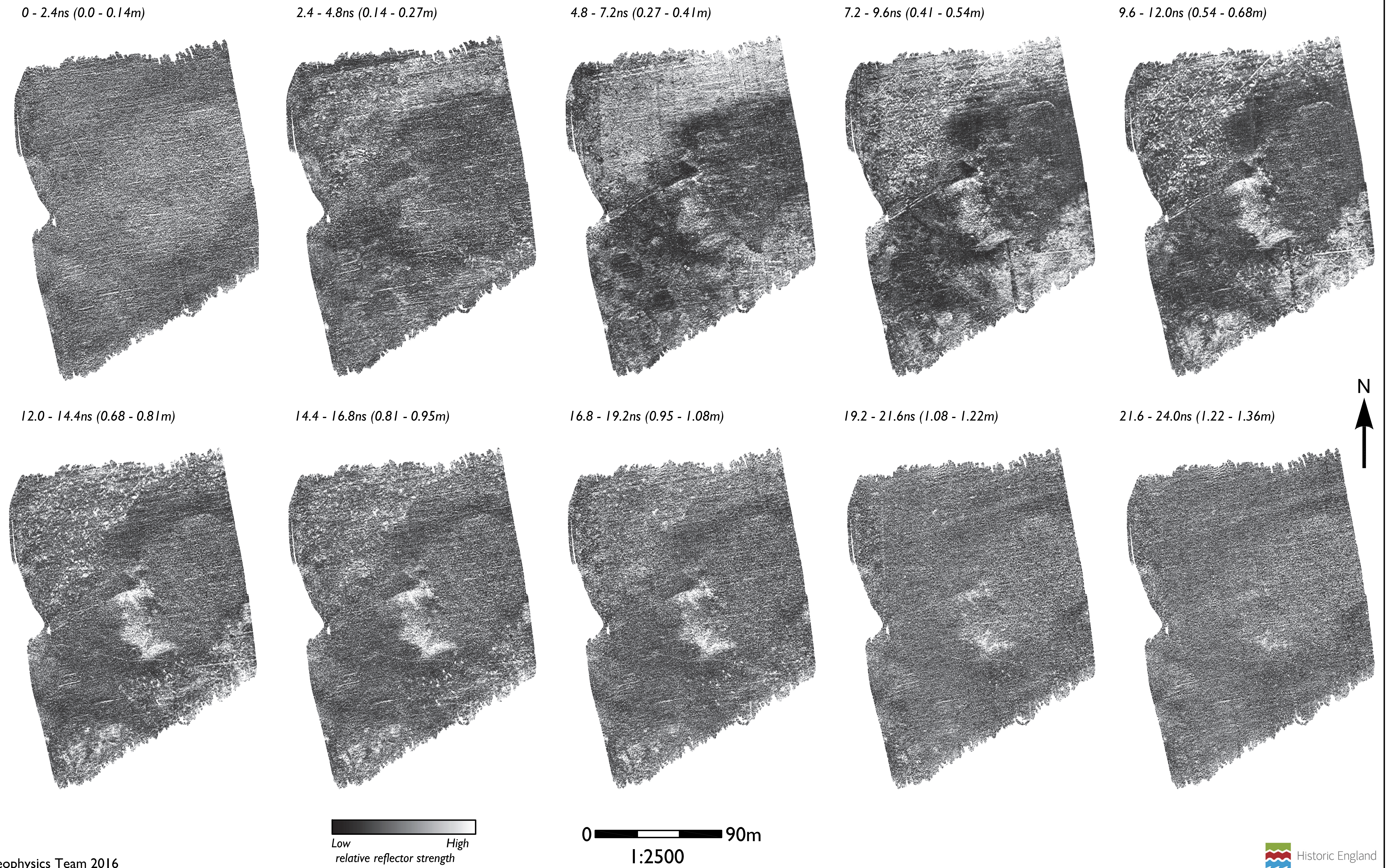

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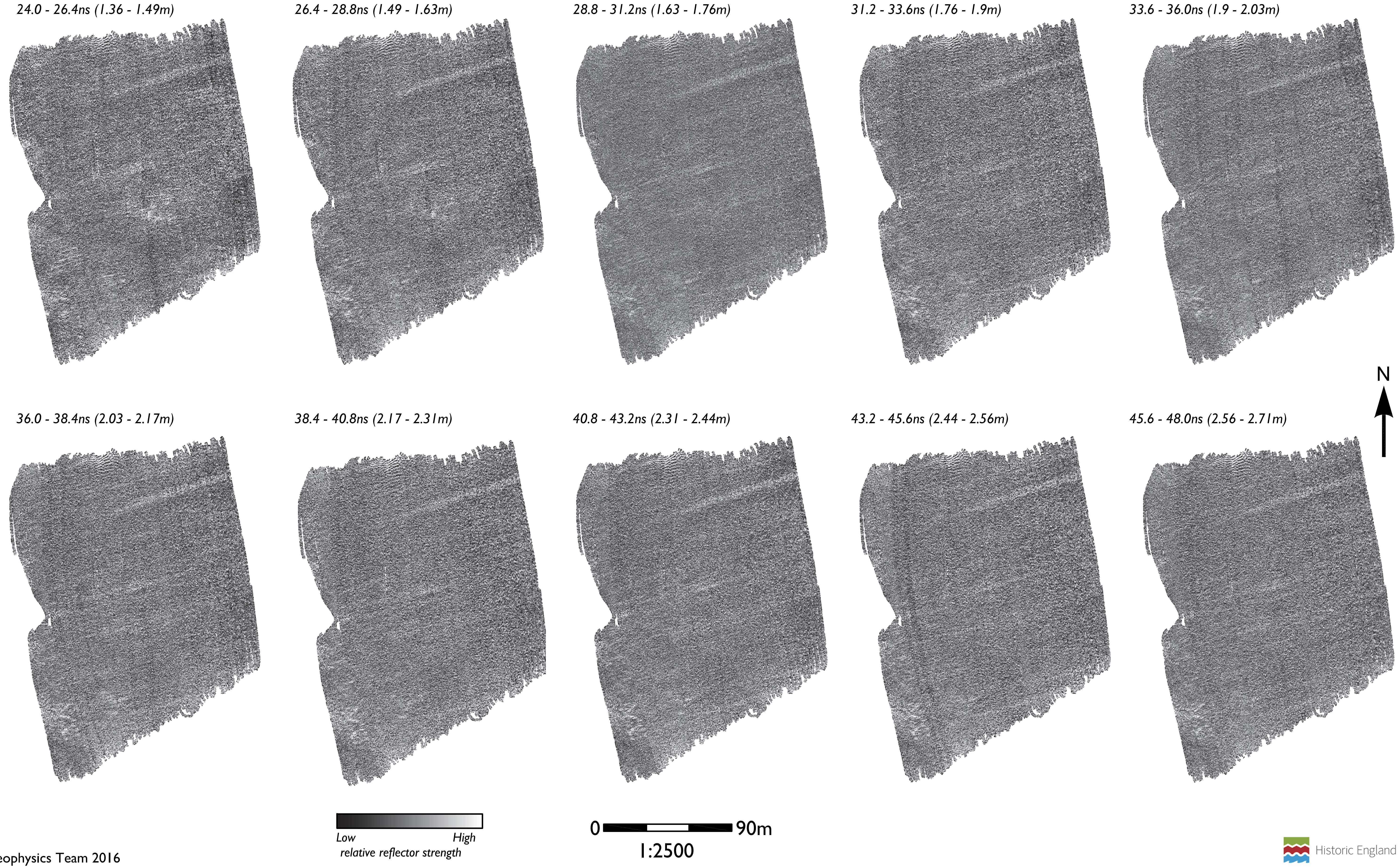
Figure 10

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE
GPR amplitude time slices between 24.0 and 48.0ns (1.36 to 2.71m), July 2015



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Graphical summary of significant magnetic anomalies, July 2015

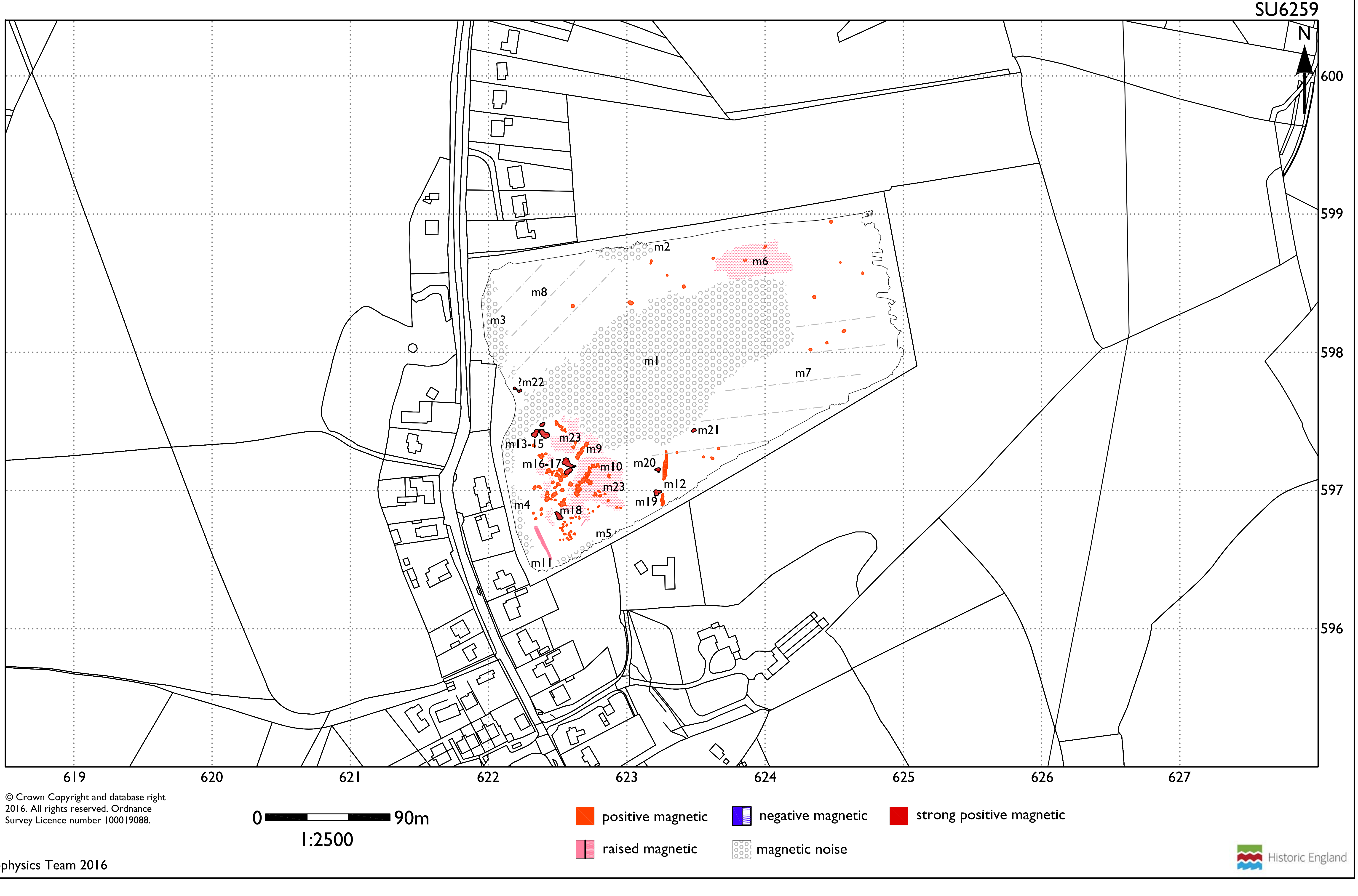

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Figure 12

SILCHESTER ENVIRONS PROJECT, LITTLE LONDON ROMAN TILERY, PAMBER, HAMPSHIRE

Graphical summary of significant GPR anomalies, July 2015

0 90m

1:2500

low amplitude reflectors

high amplitude reflectors

anomalies of known or recent origin

2015-21-07-047 Location of selected GPR profile shown on Figure 8

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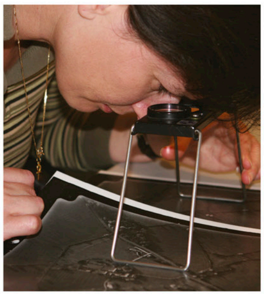


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ISSN 2046-9799 (Print)
ISSN 2046-9802 (Online)