Historic England

Geophysics

Silchester Environs Project, King's Hogsty Copse, Pamber, Hampshire Report on Geophysical Survey, July 2016

Neil Linford, Paul Linford and Andrew Payne

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SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

REPORT ON GEOPHYSICAL SURVEY,

JULY 2016

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SUMMARY

Caesium magnetometer and Ground Penetrating Radar (GPR) surveys were conducted as part of the University of Reading Silchester Environs Project over the location of a prehistoric enclosure noted on a single aerial photograph, at King's Hogsty, Pamber, Hampshire. The vehicle towed caesium magnetometer survey (9.9 ha) responded mainly to previous ploughing, a modern footpath and buried electricity cable, and the underlying sand and gravel geology, however, no obvious archaeological activity has been detected. The vehicle towed GPR survey (3.9 ha) was targeted over the enclosure which was detected as a subtle low amplitude response to the enclosure ditch at a depth suggesting a shallow basal layer of more organic rich material. There is also an additional, low amplitude ditch-type anomaly to the north of the enclosure, possibly a former field boundary and a closely spaced pattern of parallel field drains. Some deeper anomalies appear to reflect the underlying geology and demonstrate a similar extent to the same response in the magnetic data.

CONTRIBUTORS

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

ACKNOWLEDGEMENTS

The authors are grateful to the landowner for allowing access for the surveys to be conducted.

ARCHIVE LOCATION

Fort Cumberland, Portsmouth.

DATE OF SURVEY

The fieldwork was conducted between 25th and 26th July 2016 and the report completed on 8th May 2019. The cover image (A Payne) shows the vehicle towed GPR array in the field during the survey.

CONTACT DETAILS

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CONTENTS

INTRODUCTION

Caesium magnetometer and Ground Penetrating Radar (GPR) surveys were conducted at King's Hogsty, Pamber, 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 (Creighton and Fry 2016). 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, was conducted over farmland immediately adjacent to King's Hogsty Copse, and covered an enclosure, trackway and boundaries of possible Iron Age or Roman date, revealed as crop marks on aerial photographs to the west of Little London (AMIE Monument HOB UID 1602419). The possible Iron Age enclosure is recorded on a single aerial photograph taken in the 1950s, questioning the survival of this monument. Both magnetic and GPR techniques had been successfully deployed over the site of a Roman Tile kiln, situated approximately 150m to the east of the enclosure (Linford *et al.* 2016).

The site is situated on greenish sand and loam of the Eocene Bracklesham Beds with some plateau gravel drift deposits overlain by fine loamy soils with slowly permeable subsoils of the 572j Bursledon association (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 hot, sunny and generally dry.

METHOD

Magnetometer survey

Magnetometer data was collected along the instrument swaths shown on Figure 2 using an array of six 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, ~0.25m above the ground surface. The sixth was fixed 1.0m directly above the centre of this array to act as a gradient sensor. 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 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 a 50m 1D window (see for instance Mauring *et al.* 2002). This operation corrects for biases added to the measurements owing to the diurnal variation of the Earth's magnetic field and any slight directional sensitivity of the sensors. An equal area greyscale image of the combined magnetic data is shown superimposed over the base Ordnance Survey (OS) mapping in Figure 4 and minimally processed versions of the range truncated data ($\pm$100nT/m) are shown as a trace plot and a histogram normalised greyscale image in Figures 6 and 7.

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 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 0.108m/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, therefore represents the variation of reflection strength through successive ~0.13m intervals from the ground surface in Figures 9 to 12. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

Due to the size of the resultant data set a semi-automated algorithm has been employed to extract the vector outline of significant anomalies shown on Figure 12. 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.

RESULTS

Magnetometer survey

A graphical summary of significant magnetic anomalies [**m1-10**] discussed in the following text superimposed on base OS map data is provided in Figure 11.

The magnetic survey and has responded mainly to previous ploughing [**m1-3**], a modern footpath [**m4**], field drains [**m5**], a buried electricity cable [**m6**] and the underlying sand and gravel geology defined by a more disturbed background response [**m7**]. However, no obvious archaeological activity has been detected; in particular over the location of the enclosure noted on aerial photography, perhaps due to the underlying geology not being conducive to the formation of magnetic contrasts. Some of the discrete localised positive anomalies scattered across the area, for example [**m8-10**], may represent pits although no clear patterns are evident. Occasional stronger localised positive anomalies could represent occupation activity associated with burning, response to the geomorphology or more deeply buried ferrous material.

Ground Penetrating Radar survey

A graphical summary of the significant GPR anomalies, [**gpr1-4**] discussed in the following text, superimposed on the base OS map data, is provided in Figure 12.

Significant reflections have been recorded throughout the 50ns two-way travel time window, although there are few significant later reflections beyond ~25ns The very near-surface data show evidence for the foot paths crossing the site and the most recent agricultural pattern. The prehistoric enclosure has been detected most clearly as a subtle low amplitude response to the enclosure ditch [**gpr1**] between approximately 4.8 and 9.6 ns (0.26 to 0.53m), perhaps suggesting a shallow basal layer of more organic rich material. There is also an additional, low amplitude ditch-type anomaly [**gpr2**] to the north of the enclosure, possibly a former field boundary and a more sinuous ditch [**gpr3**] approaching the enclosure from the south. A closely spaced pattern of parallel field drains [**gpr4**] are visible through a similar depth range and will, no doubt, be cut through the surviving enclosure ditches. Some deeper anomalies appear to reflect the underlying geology and demonstrate a similar extent to the same response in the magnetic data.

CONCLUSIONS

Despite the success of the magnetic survey technique over the adjacent Roman tilery immediately to the east of the site, few significant anomalies could be identified from this data set. The ditch of the prehistoric enclosure failed to produce a discernible magnetic response, although the GPR revealed a shallow low amplitude anomaly emphasising the varying geophysical response of the geology and soils in the project area, and the importance of using multiple techniques. The GPR survey also revealed a network of land drains cut through the enclosure ditch and evidence for a previous plough pattern extending to a similar depth as the surviving archaeological remains.

LIST OF ENCLOSED FIGURES

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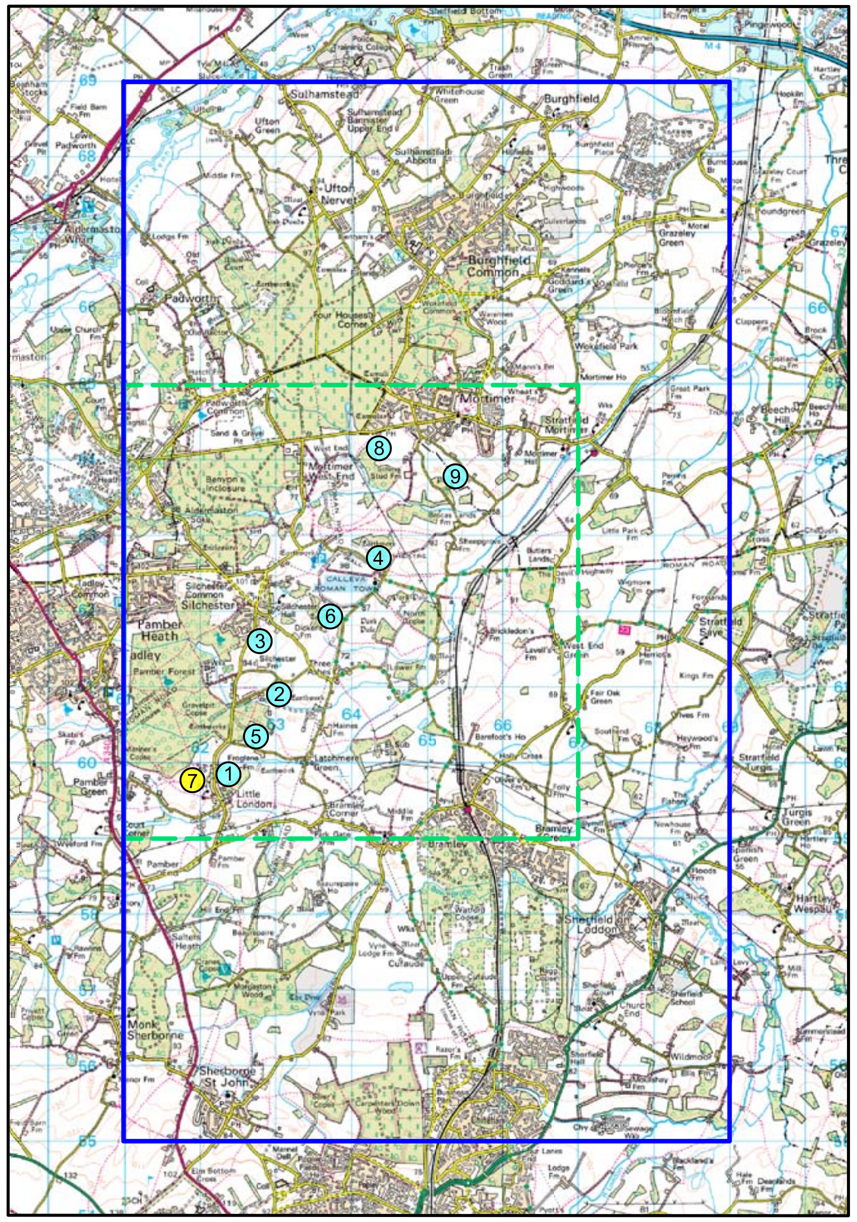
Figure 1

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Location of survey

(A)



Core project area

Detailed OS mapping area (B)

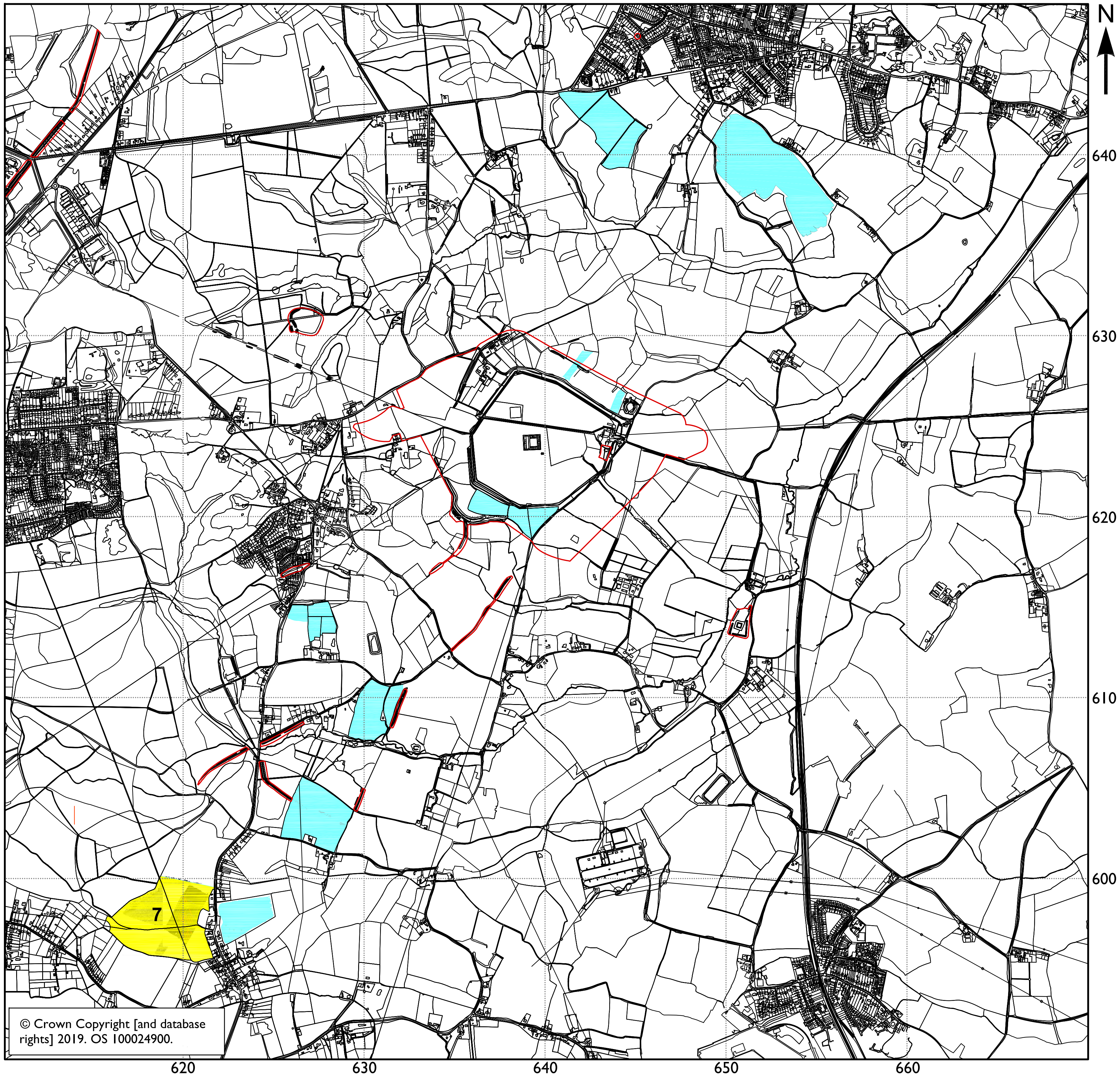
0 3km
1:100000

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
9. Windabout Copse

SU6159

(B)



0 1500m
1:25000

7 King's Hogsty Copse survey area

Other HE geophysical survey areas

Scheduled areas

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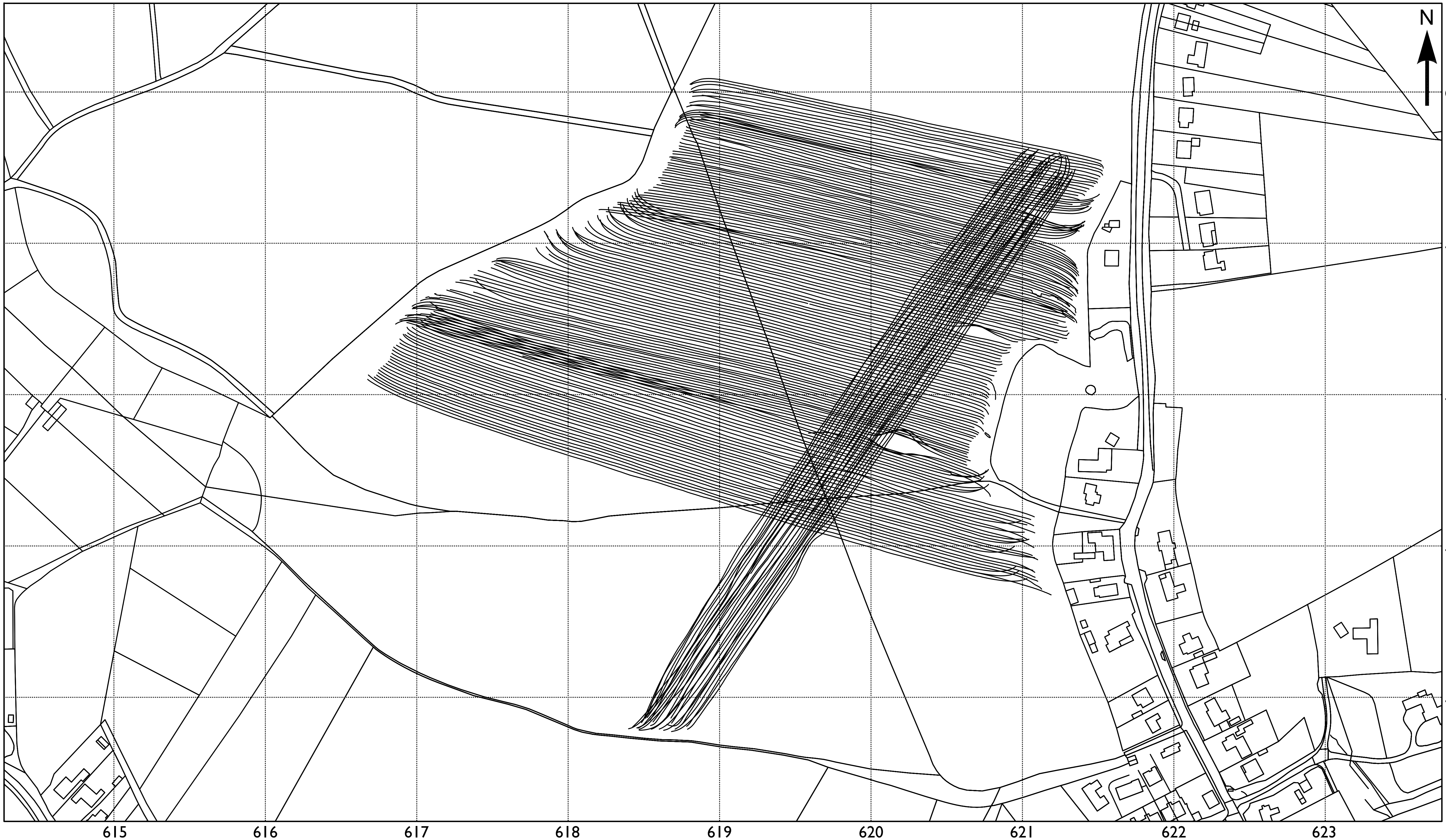
Figure 2

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Location of caesium magnetometer instrument swaths, July 2016



0 90m

1:2500

Caesium Magnetometer survey swaths

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Figure 3

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE
Location of GPR instrument swaths, July 2016

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Figure 4

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Location of caesium magnetometer survey, July 2016

0 90m
1:2500

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Figure 5

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE
GPR amplitude time slice between 4.8 - 7.2ns (0.26 - 0.4m), July 2016

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Figure 6

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Trace plot of minimally processed caesium magnetometer data, July 2016

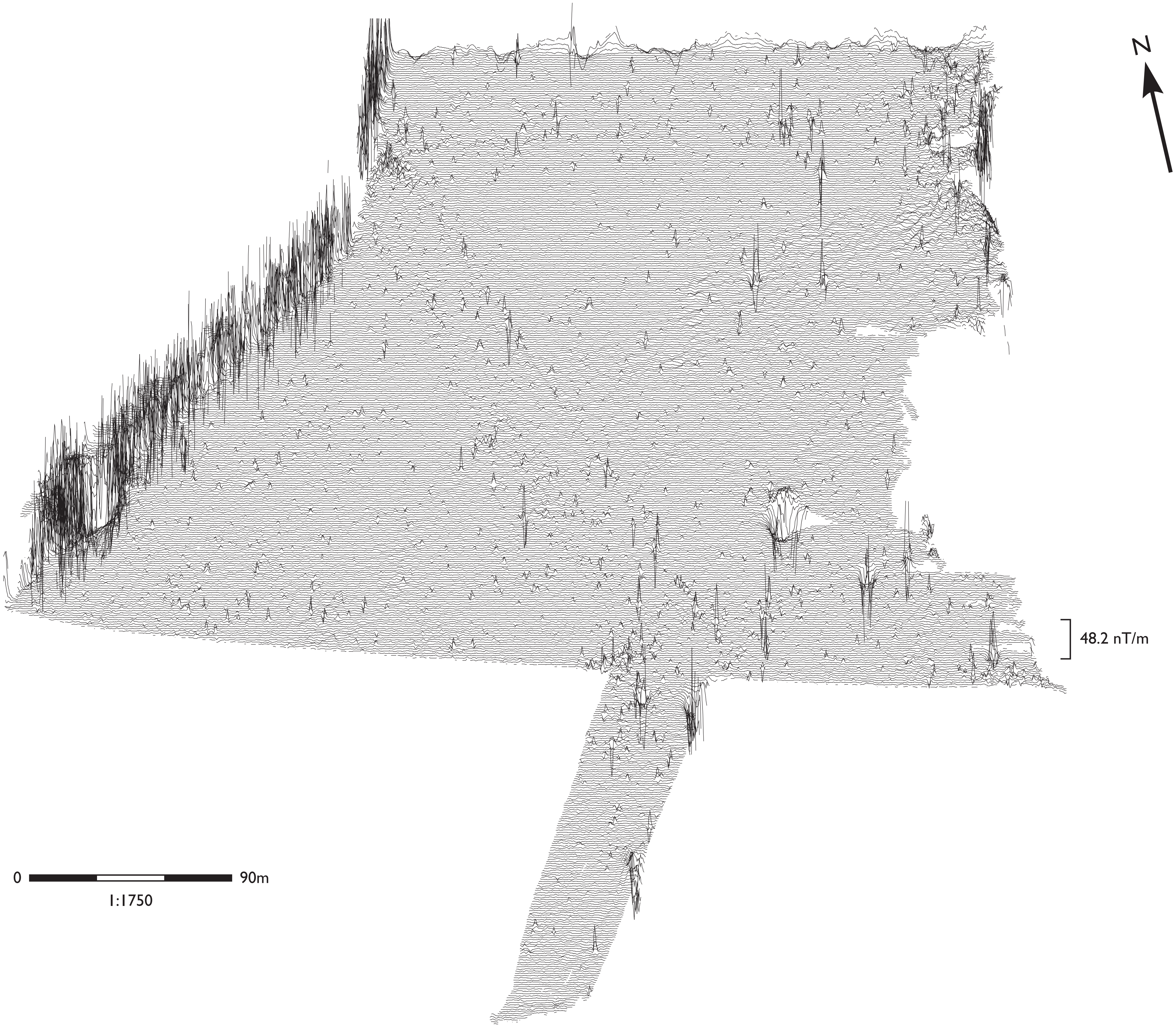

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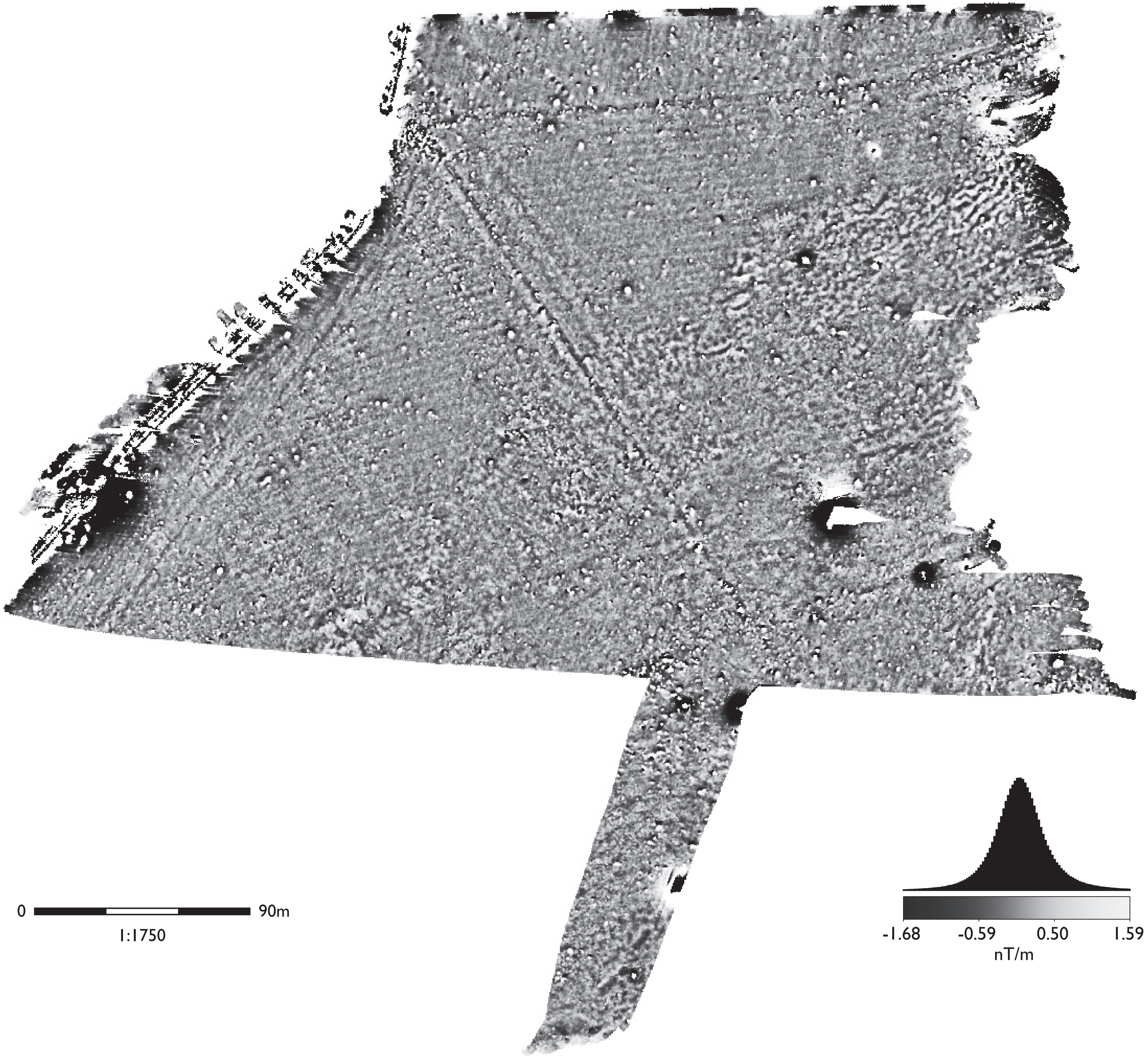
Figure 7

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Histogram normalised greyscale image of minimally processed caesium magnetometer data, July 2016



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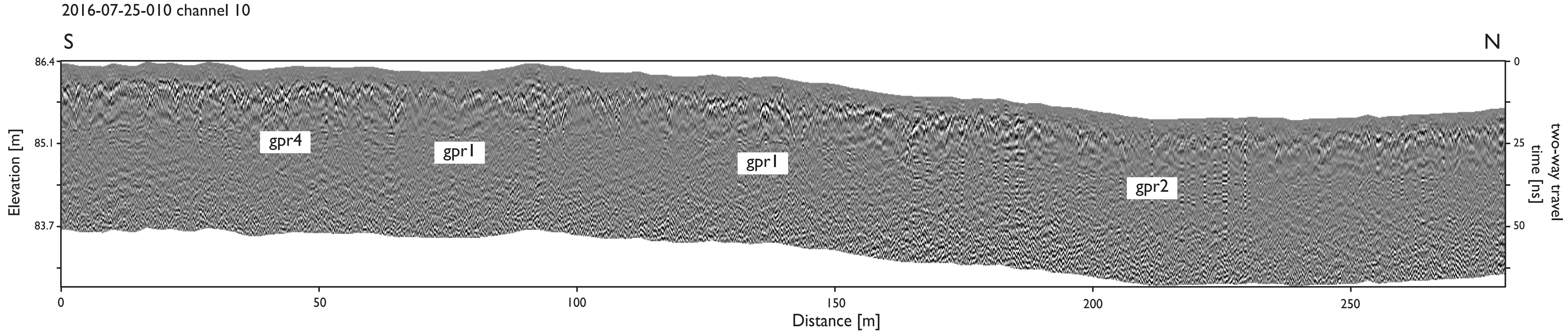
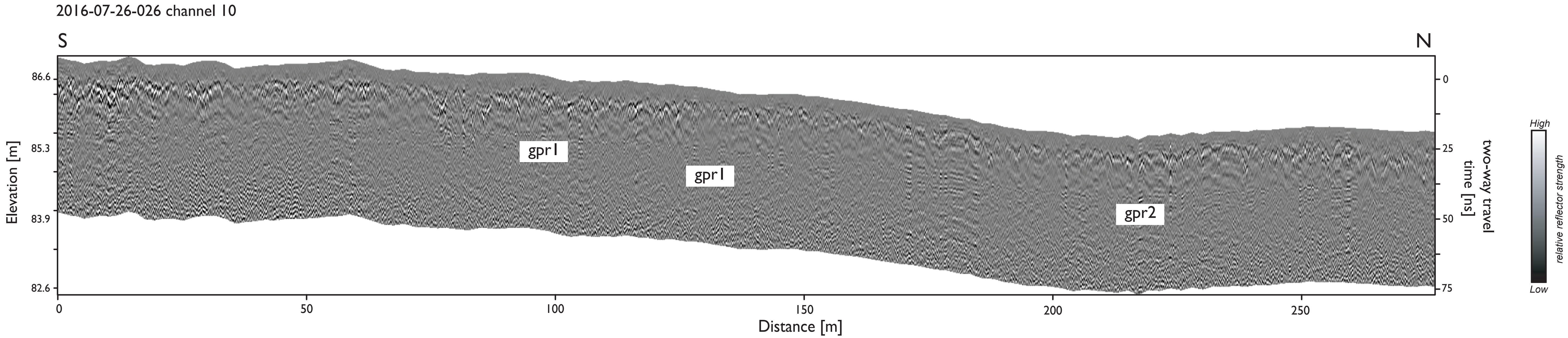
SILCHESTER ENVIRONS PROJECT, KINGS'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Figure 8

Topographically corrected GPR profiles, July 2016





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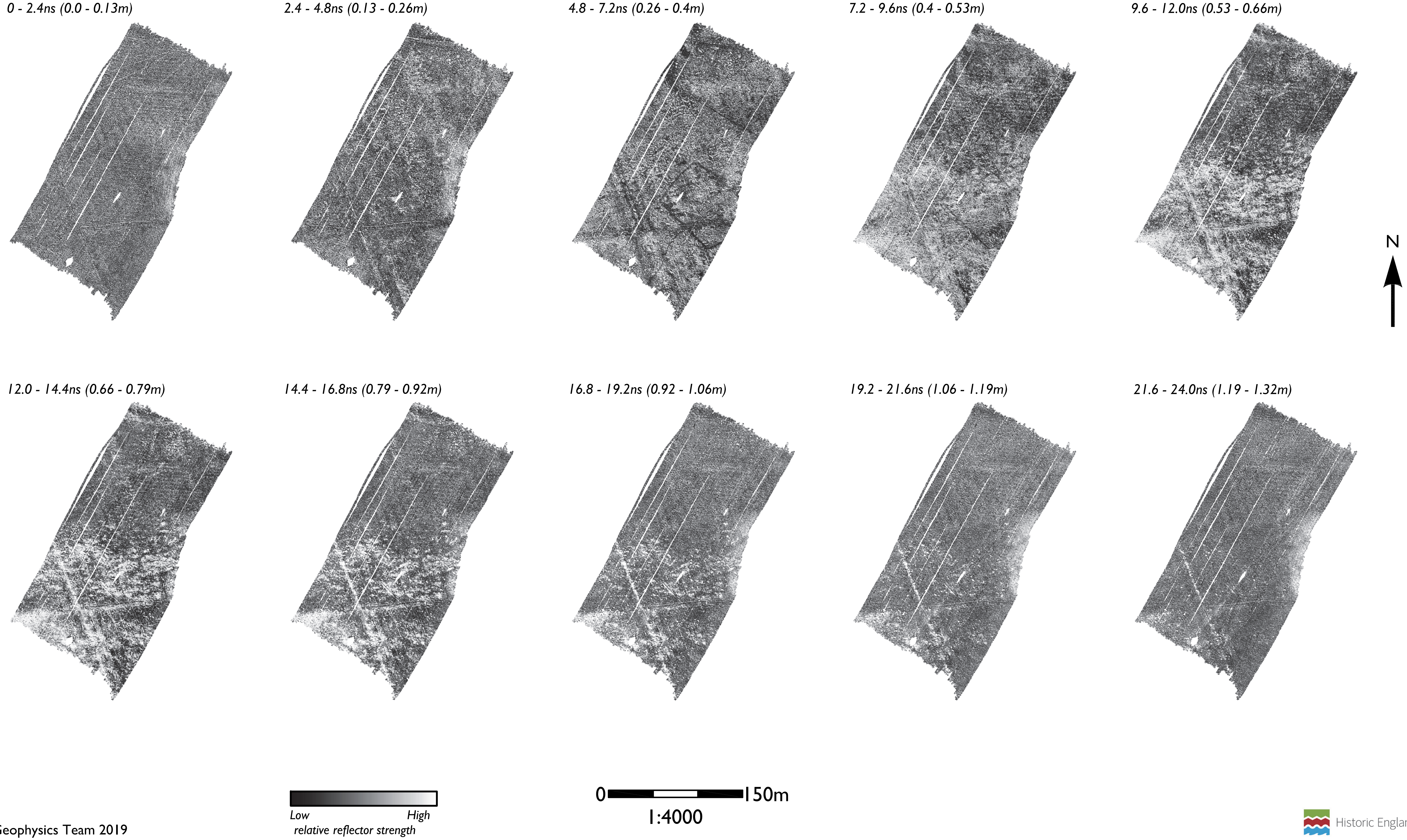
SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE
GPR amplitude time slices between 0.0 and 28.8ns (0.0 - 1.22m), July 2016

Figure 9



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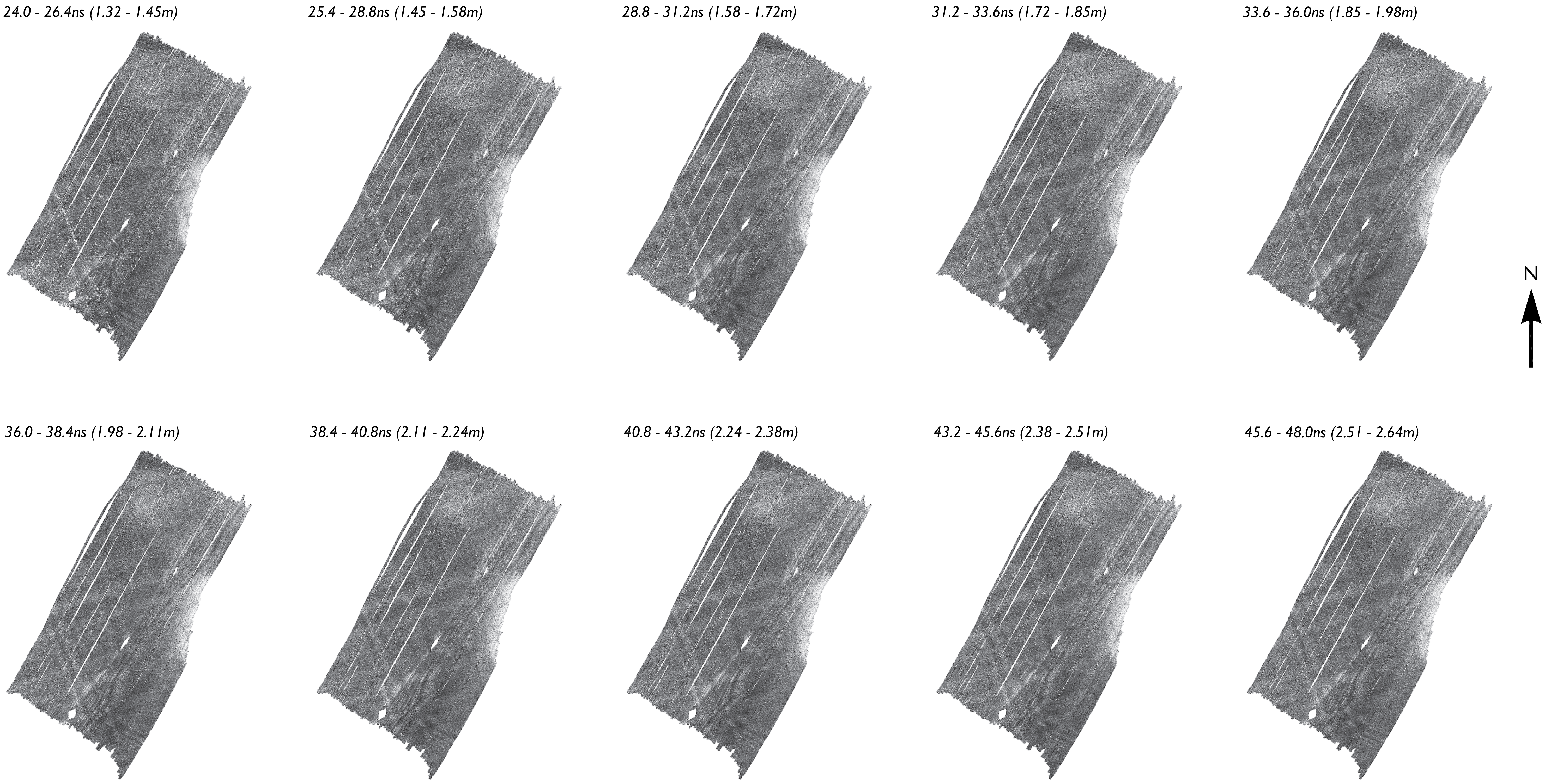
SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE
GPR amplitude time slices between 28.8 and 48.0ns (1.22 - 2.64m), July 2016

Figure 10



Low *High*
relative reflector strength

0 150m
1:4000

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Figure 11

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE

Graphical summary of significant magnetic anomalies, July 2016

SU6159

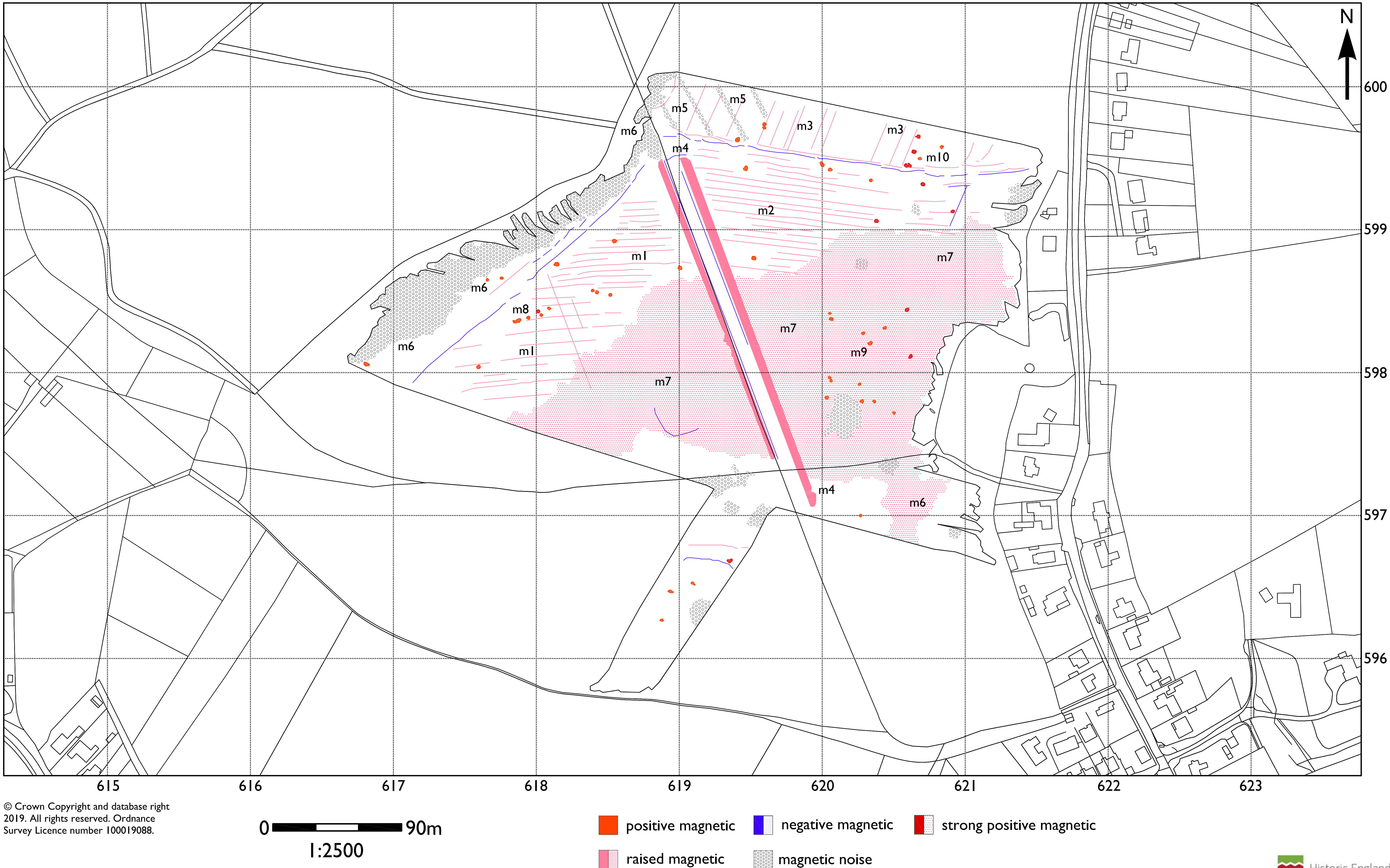

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Figure 12

SILCHESTER ENVIRONS PROJECT, KING'S HOGSTY COPSE, PAMBER, HAMPSHIRE
Graphical summary of significant GPR anomalies, July 2016

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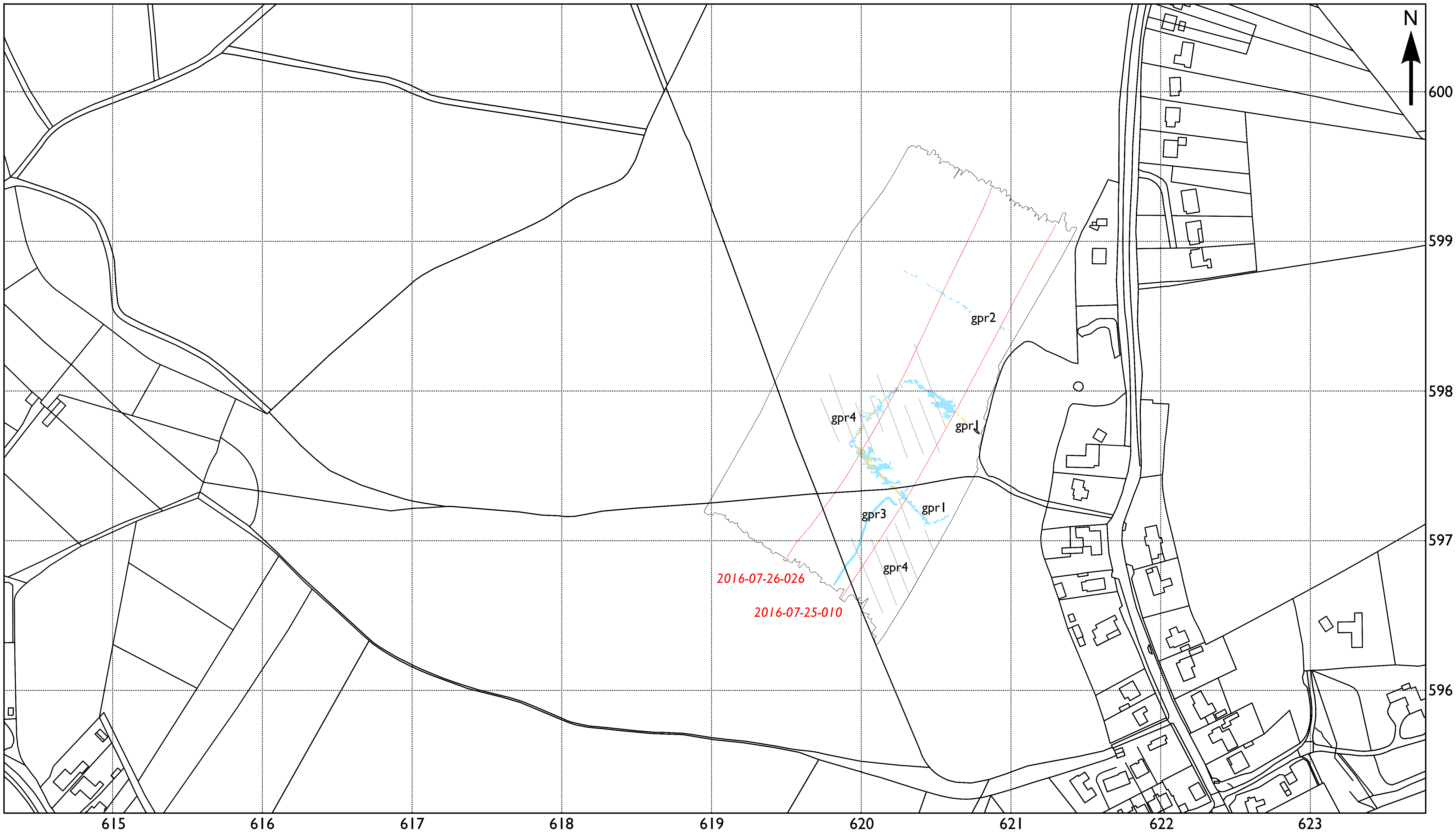

0 90m
1:2500

low amplitude reflectors
high amplitude reflectors
anomalies of known or recent origin
2015-07-25-001 Location of selected GPR profile shown on Figure 8

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