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Osborne House, East Cowes, Isle of Wight

Report on Geophysical Survey, July 2024

Megan Clements and Neil Linford

Geophysics

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Summary

A Ground Penetrating Radar (GPR) survey was conducted at Osborne House, East Cowes, Isle of Wight, to determine the presence of both voids and other anomalies of interest on the upper and pavilion terraces adjacent to the north elevation of the house. The aim of the survey (0.1ha) was to advise the English Heritage Trust following a request to locate underlying voids and other sensitive features to avoid damage from a temporary scaffold required to assist with repairs to the house. Anomalies associated with surface water drainage and services beneath the gravel paths were identified together with the water supply to the fountain. Possible evidence for subsurface irregularities or voiding associated with cellars extending under the garden terraces has been identified in the immediate vicinity of the house. The results also suggest the vaulted space beneath the stairs to the lower garden extends further towards the house.

Contributors

The fieldwork was completed by Megan Clements and Neil Linford.

Acknowledgements

The authors are grateful for the help provided by colleagues from the English Heritage Trust in coordinating access for the survey to take place. The cover image shows the GPR survey in progress looking towards the upper terrace fountain (photograph taken by N Linford).

Archive location

Historic England, Fort Cumberland, Fort Cumberland Road, Portsmouth, PO4 9LD.

Date of survey/research/investigation

The fieldwork was conducted between the 16th and 17th of July 2024. The report was completed on 31st of July 2024.

Contact details

Dr Neil Linford, Geophysics Team, Historic England, Fort Cumberland, Fort Cumberland Road, Portsmouth, PO4 9LD.
Tel: 02392 856761. Email: Neil.Linford@HistoricEngland.org.uk.

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Introduction

A Ground Penetrating Radar (GPR) survey was conducted at Osborne House, East Cowes, Isle of Wight, to determine the presence of both voids and other anomalies of interest on the upper and pavilion terraces adjacent to the north elevation of the house. The survey was requested by the English Heritage Trust in advance of temporary scaffolding to be erected against the north elevation of the house requiring a substantial ballast support for wind loading located to avoid underlying voids and other sensitive features. The survey was conducted under the Shared Services Agreement and addressed Historic England corporate plan activity “5.2 Work with English Heritage Trust to support the National Collection”.

Osborne House is a Grade I listed building (National Heritage List for England (NHLE): 1223802, Historic England 1979) set within a registered Park and Garden (NHLE: 1000929, Historic England 1987). The House was the home to Queen Victoria and the Royal Family for many years and the house and gardens are now open as a museum to the public. The principal, north-east garden front opens onto two levels of interlocking L-shaped terraces, each retained by walls surmounted by pierced cement balustrades with urns (terraces, walls, statuary, and fountains listed grade II). These were constructed in 1847-53 by Thomas Cubitt's firm under the supervision of Prince Albert and his advisor in art, Ludwig Gruner, and restored in 1997-9. The Upper Terrace is laid to intricate geometric parterres set in gravel and planted with seasonal bedding; while those outside the Pavilion are edged in white-painted stone. The parterres outside the Main Wing are set in grass surrounds and are centred on a tiered fountain. The present gravel on the Upper Terrace replaces the original coloured metallic lava by Orsi and Armani (Historic England 1987).

The site lies over Hamstead Member clay, silt and sand, with superficial gravel, sand, clay, silt deposits of the Wootton Gravel Complex Member (Geological Survey of Great Britain 2013; British Geological Survey 2024). Slightly acidic loamy and clayey soils with impeded drainage to the east, and freely draining slightly acidic loamy soils to the west of the Sonning 1 association (581b) have developed over the site (Soil Survey of England and Wales 1983; Soilscapes 2024). However, soils over the Upper Terrace are more likely to consist of unknown backfill and gravel to level the gardens and visitor paths.

The survey was conducted over the accessible gravel paths of the Upper Terrace and along stone paving incorporating some metallic grates abutting the house. Weather conditions were warm and dry throughout the survey.

Method

Ground Penetrating Radar

A 3d-Radar (Kontur) MkIV GeoScope Continuous Wave Step Frequency (CWSF) Ground Penetrating Radar (GPR) system was used to conduct the survey collecting data with a hand operated multi-element DXG0908 ground coupled antenna array (Linford et al. 2010; Eide et al. 2018). A roving Trimble R8s Global Navigation Satellite System (GNSS) receiver was mounted on the GPR antenna array, that together with a second R8s base station was used to provide continuous positional control for the survey collected along the instrument swaths shown on Figure 1. The GNSS base station receiver was adjusted to the National Grid Transformation OSTN15 using the Trimble VRS Now Network RTK delivery service. This uses the Ordnance Survey's GNSS correction network (OSNet) and gives a stated accuracy of between 0.01 and 0.015m per point with vertical accuracy being half as precise. Where proximity to the standing buildings compromised the use of a GNSS receiver a Trimble S7 tracking total station and active reflector prism mounted on the GPR array was used to provide continuous positional control.

Data were acquired at a 0.075m by 0.075m sample interval across a continuous wave step frequency range from 40MHz to 2.99GHz in 4MHz increments using a dwell time of 10ms. 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 full GPR survey data set are shown on Figure 3. 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 0.145m/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 approximately 0.18m intervals from the ground surface, shown as individual greyscale images in Figures 4 and 5. Further details of both the frequency and time domain algorithms developed for processing this data can be found in Sala and Linford (2012).

Results

Ground Penetrating Radar

A graphical summary of the significant GPR anomalies, [**gpr1-24**] discussed in the following text, superimposed on the base OS map data, is provided in Figure 6.

The accessible area available for survey was partially constrained by the width of the gravel paths, minor obstructions associated with the standing building, and protective HERAS fencing. Reflections have been recorded throughout the 75ns two-way travel time window, although there are few significant responses beyond a two-way travel time of approximately 35.0ns (2.54m) where the signal is more heavily attenuated. The very near-surface response between 0.0 and 2.5ns (0.0 to 0.18m) contains anomalies due to the metal grills [**gpr1**] over the light-wells adjacent to the house and ferrous utility inspection covers [**gpr2**] found on the gravel paths throughout the upper terrace. The high-amplitude anomalies due to [**gpr1**] and [**gpr2**] reverberate between the antenna and the causative metallic features visible on the ground surface, producing artefacts throughout the dataset.

A prominent linear anomaly [**gpr3**] falls away from the steps to the garden from the house towards the fountain bowl between 5.0 and 17.5ns (0.36 to 1.27m), together with a less pronounced response [**gpr4**] immediately to the north. It seems most likely that both [**gpr3**] and [**gpr4**] are associated with the supply or drainage of water to the fountain, although it is unclear whether the plant room housing the fountain pump is situated beneath the entrance steps to the house or under the surface grill immediately to the north. Other high-amplitude anomalies [**gpr5**] correspond with the paving at the base of the steps from the house but responses at [**gpr6-10**] are more difficult to interpret and could possibly be associated with near-surface voids or other sub-surface irregularities.

High and low-amplitude linear anomalies [**gpr11**] extend from the fountain bowl and continue to the double staircase descending from the upper terrace to the lower gardens. Individual profiles of the GPR data suggest [**gpr11**] corresponds with the vaulted ceiling beneath the terrace visible from the lower garden (Figure 3). The accessible space below the staircase terminates in a vertical wall with ventilation grills, although [**gpr11**] suggests the vaulting and possible void space extends further beneath the upper terrace to the fountain bowl. More fragmented linear anomalies [**gpr12**] are found across the upper terrace and appear to represent either surface drainage for the gravel paths or water supply pipes for irrigation. In places, the linear anomalies [**gpr12**] extend from visible surface inspection covers or drain grates [**gpr2**].

An area of more amorphous high-amplitude response [**gpr13**] is found between 5.0 and 15.0ns (0.36 to 1.09m) adjacent to the house and appears to continue beyond the stone paving onto the gravel path, possibly suggesting either voiding or localised change to the subsurface material.

Further fragmented anomalies [**gpr14**] are found immediately beyond the drawing room facing onto the pavilion terrace. It is difficult to suggest a more precise interpretation of [**gpr14**] although these may be associated with drainage or other services. Two of these anomalies [**gpr15**] have a more circular form and could be associated with elements of a previous garden design. An area of high-amplitude anomalies at [**gpr16**], visible in the very-near surface data, could be associated with the continuation of cellarage visible at this location further under the pavilion terrace.

Linear high-amplitude anomalies [**gpr17**] are found beneath the broad gravel path surrounding the pavilion terrace and seem most likely to be associated with surface water drainage. A more subtle, low-amplitude linear anomaly [**gpr18**] following the centre of the path on the northern extent of the terrace may possibly be associated with a trench for a water supply or shallow gully, although there is no apparent evidence for any pipe work. Areas of both high [**gpr19-22**] and low amplitude [**gpr23**] response are also found beneath the gravel path but are more difficult to interpret. However, it is possible that [**gpr19-23**] are associated with either the original ground surface underlying the terrace or material introduced to level the site, perhaps associated with a dipping layer seen on the profiles here ([**gpr24**] on Figure 3).

Conclusions

The Ground Penetrating Radar (GPR) survey has successfully identified anomalies associated with surface water drainage and services beneath the gravel paths through the upper and pavilion terrace gardens. The water supply from the house to the upper terrace fountain has also been located together with anomalies within the immediate vicinity of the building. Further investigation of the anomalies close to the building is recommended to determine whether they may, possibly, be associated with subsurface irregularities or voiding associated with cellars extending under the garden terraces. Anomalies due to the vaulted ceiling visible in the accessible space underneath the stairs to lower garden have been imaged. The data also suggests this space extends further back beneath the terrace towards the house from the accessible area under the stairs.

List of Enclosed Figures

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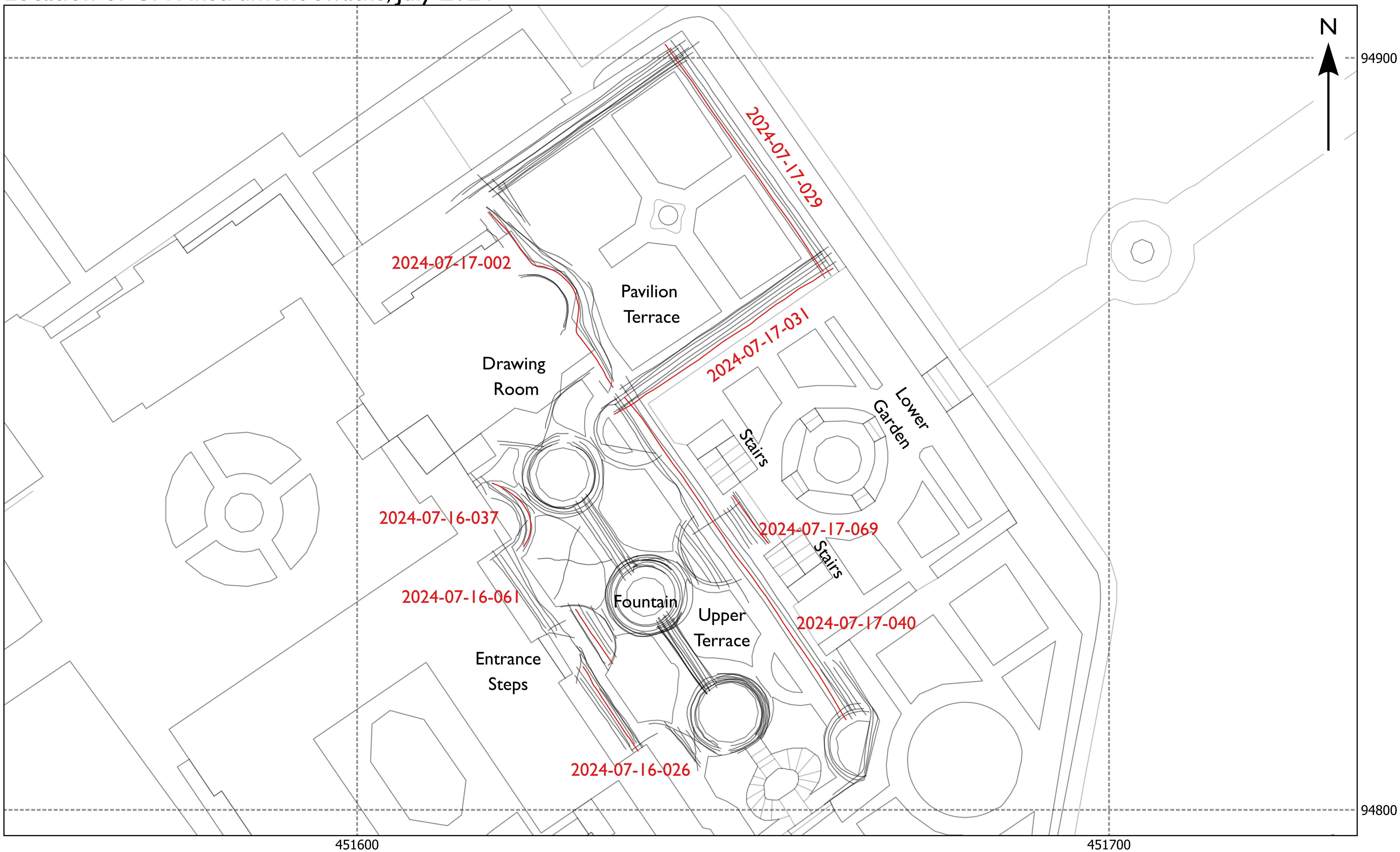
Figure 1

OSBORNE HOUSE, EAST COWES, ISLE OF WIGHT

Location of GPR instrument swaths, July 2024



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0 20 40 60 m

1:500

GPR Survey Swaths

Location of selected GPR profiles shown on Figure 3

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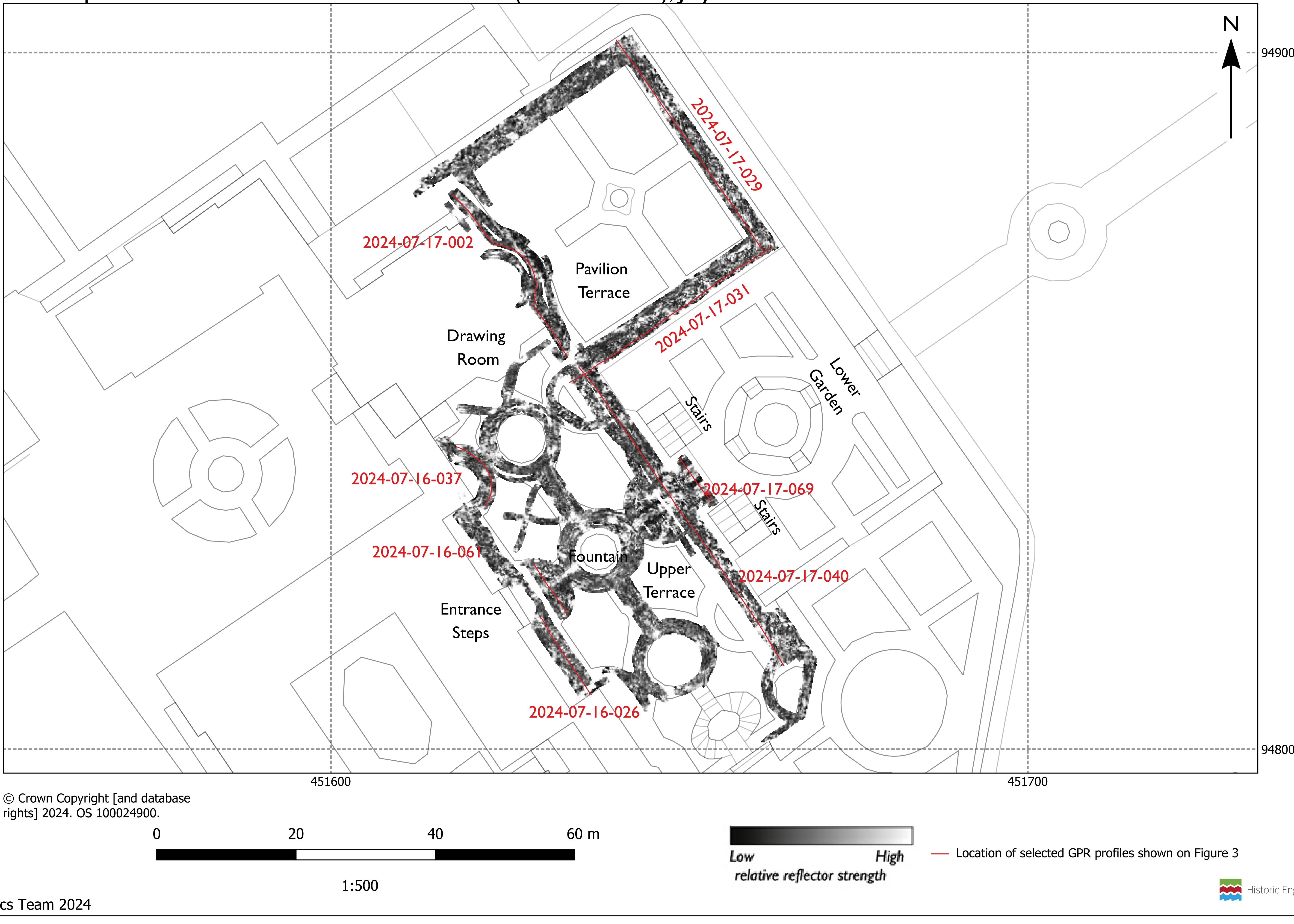
Figure 2

OSBORNE HOUSE, EAST COWES, ISLE OF WIGHT

GPR amplitude time slice between 12.5 and 15.0ns (0.91 to 1.09m), July 2024



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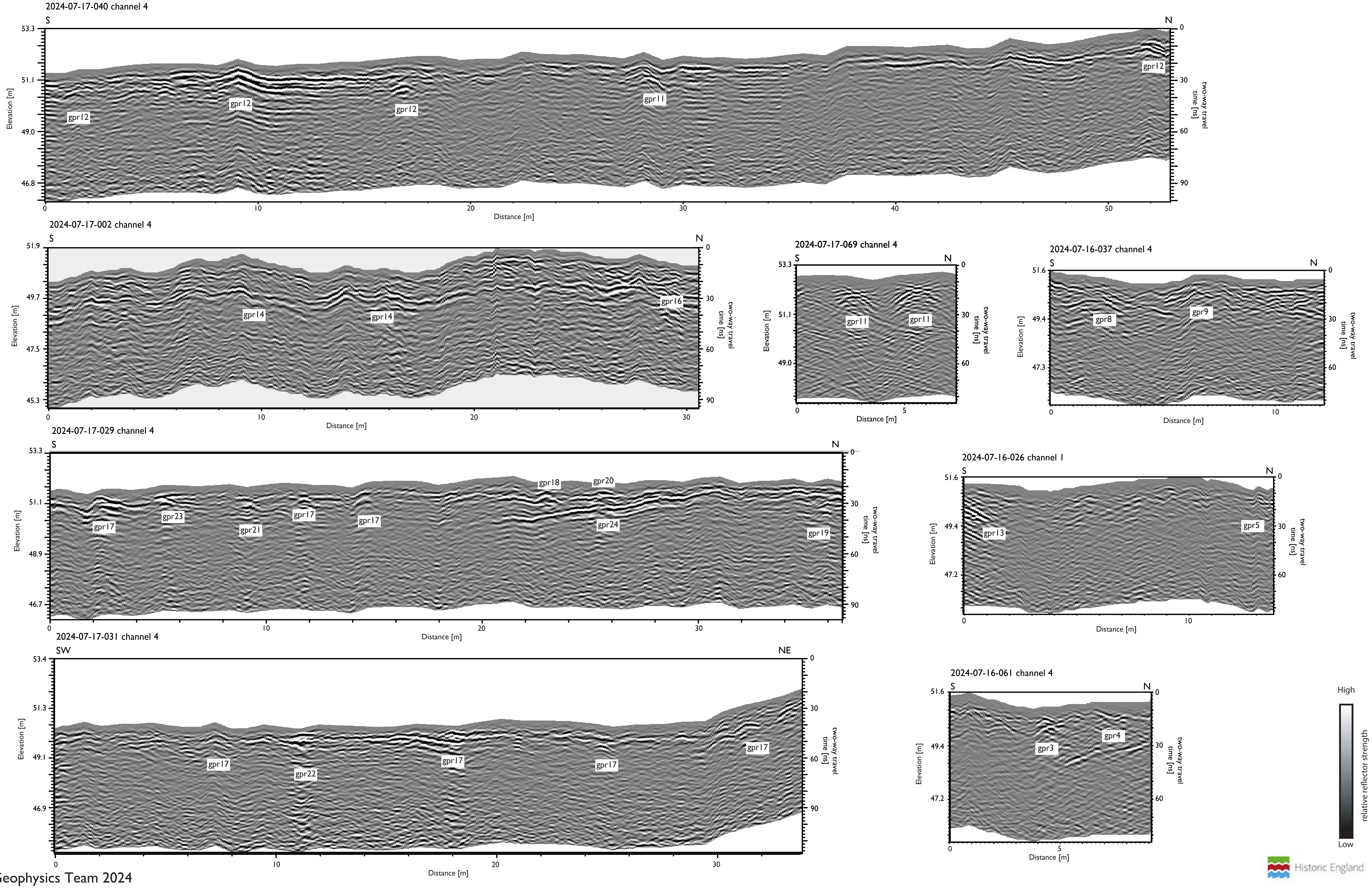
OSBORNE HOUSE, EAST COWES, ISLE OF WIGHT
Representative topographically corrected GPR profiles, July 2024

Figure 3



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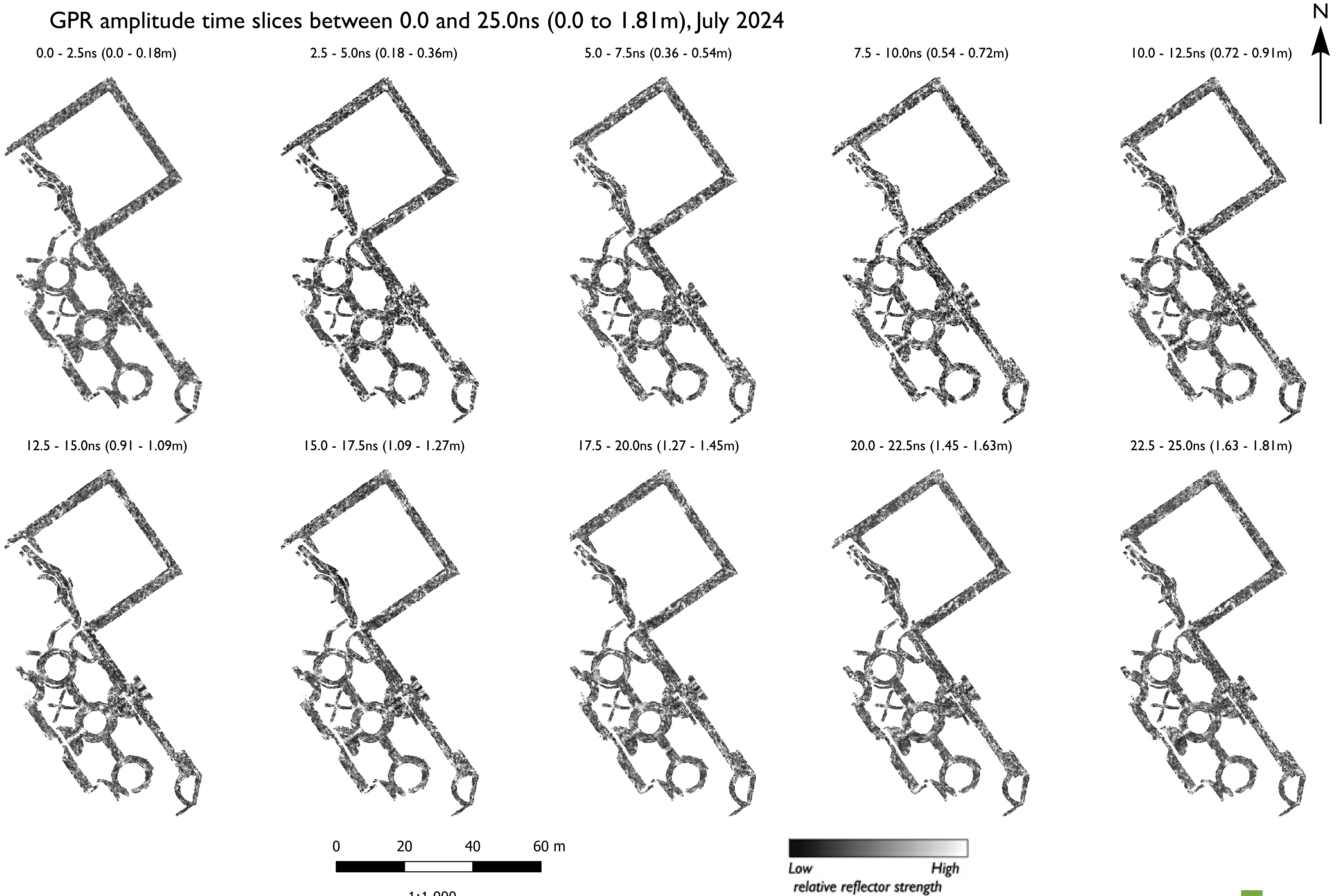
OSBORNE HOUSE, EAST COWES, ISLE OF WIGHT

GPR amplitude time slices between 0.0 and 25.0ns (0.0 to 1.81m), July 2024

Figure 4



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OSBORNE HOUSE, EAST COWES, ISLE OF WIGHT

GPR amplitude time slices between 25.0 and 50.0ns (1.81 to 3.62m), July 2024

Figure 5

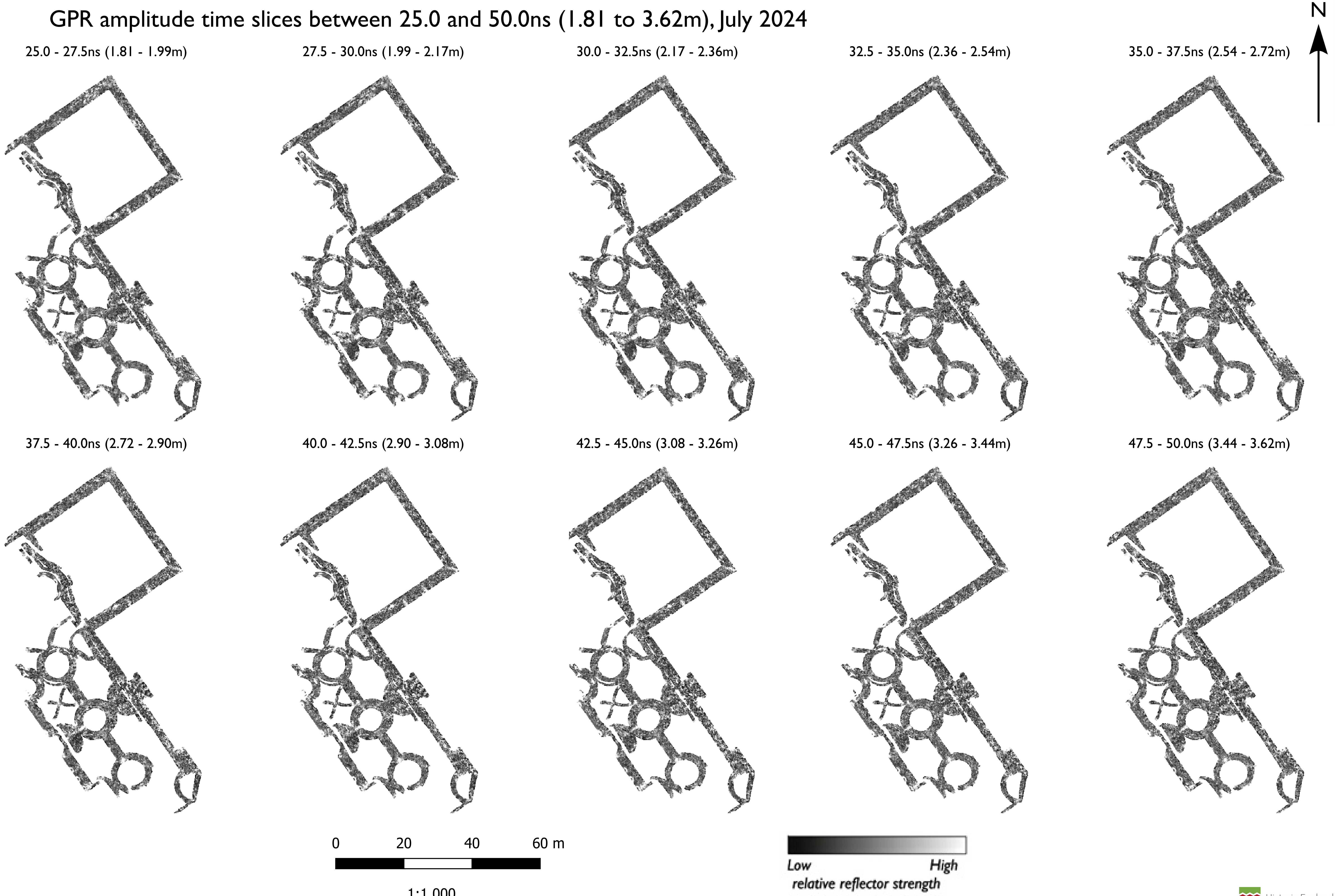

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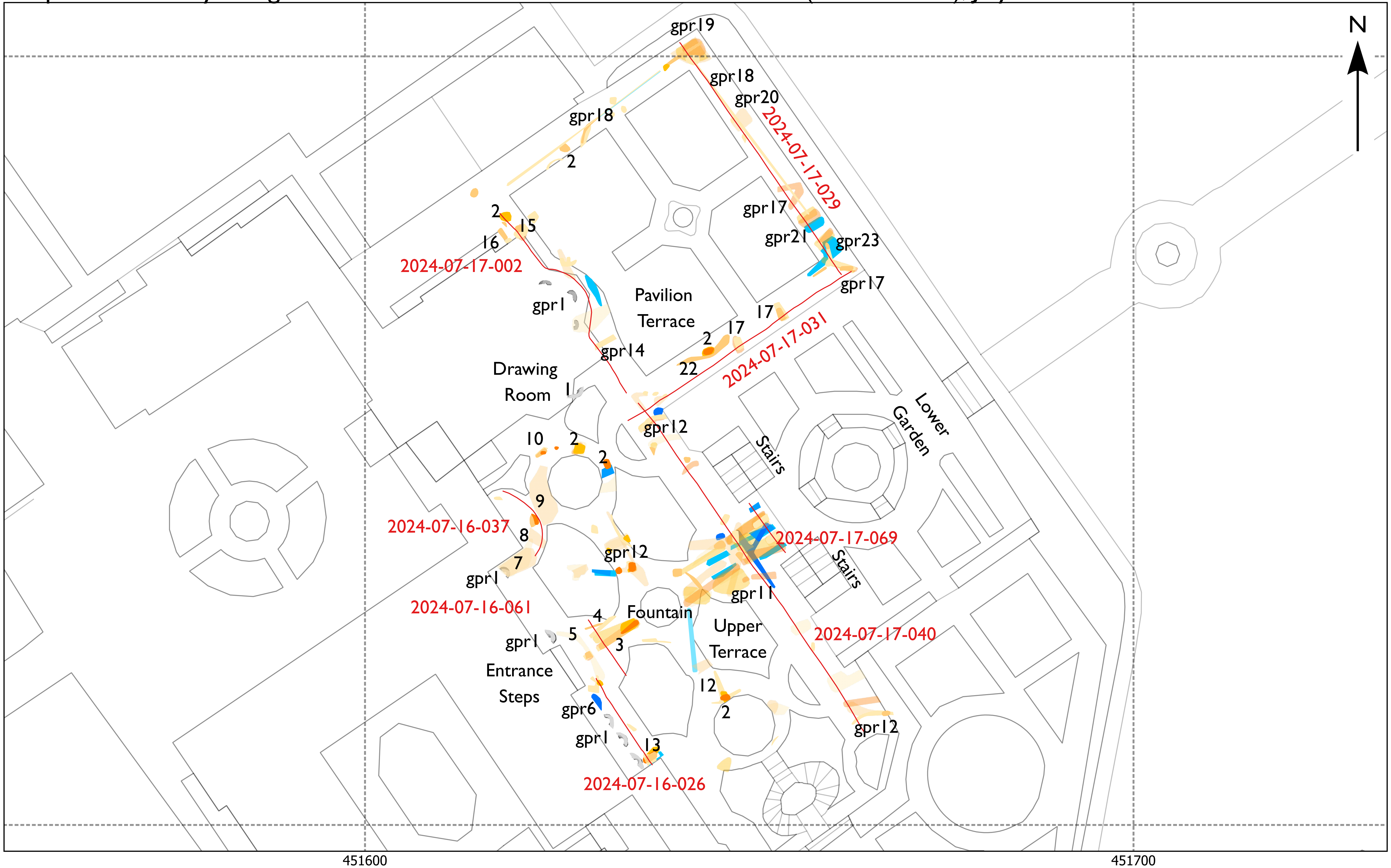
Figure 6

OSBORNE HOUSE, EAST COWES, ISLE OF WIGHT

Graphical summary of significant GPR anomalies between 0.0 and 50.0ns (0.0 to 3.62m), July 2024



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0 20 40 60 m

1:500

High Amplitude Reflectors 0.0 - 50.0ns

High Amplitude Reflectors (diffuse) 0.0 - 50.0ns

Low Amplitude Reflectors 0.0 - 50.0ns

Anomalies of Recent or Known Origin 0.0 - 50.0ns

Location of selected GPR profiles shown on Figure 3

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