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Thetford Town OCN Project: Nuns' Bridges Open Space

Report on Geophysical Survey, July 2024

Megan Clements and Neil Linford

Geophysics

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Nuns Bridge
Nuns' Bridge Road
Thetford, Norfolk, IP24 3EL

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Summary

A Ground Penetrating Radar (GPR) survey was conducted over a 0.75ha area of open green known as Nuns' Bridges open space, Thetford, Norfolk, as part of the Thetford Town Old County Number (OCN) Project. The aim of the project is to investigate a number of OCN sites within Thetford that will allow Historic England's East of England Regional Team to make decisions regarding the management of the sites. The possible location of the town's defensive ditch has been identified along with a number of anomalies that may hold archaeological significance.

Contributors

The geophysical fieldwork was conducted by Megan Clements and Neil Linford.

Acknowledgements

The authors are grateful for the assistance of the Historic England East of England Regional Office colleagues for arranging access to the site and for Thetford Town Council for their permission to conduct the survey on their land. The cover image shows the open area and the towed GPR array (photo by Neil Linford).

Archive location

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

Date of survey

The Ground Penetrating Radar survey was conducted on the 24th of July 2024. The report was completed on the 16th of October 2024.

Contact details

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Contents

Introduction

A Ground Penetrating Radar (GPR) survey was conducted over a 0.75ha area of open green within Thetford, Norfolk, bound by Mill Lane to the north and Nuns' Bridge Road to the south-east, known as Nuns' Bridges open space. This survey is part of the wider Thetford Town OCN (Old County Number) Project. The aim of the project and the geophysical surveys is to investigate a number of OCN sites south of the Little Ouse River (Figure 1, see Went 2022; Clements 2024; Clements and Linford 2024a, 2024b). This will enable the East of England Regional Team to have a better understanding of the monuments within the town and to be able to make decisions regarding their on-going management and designation. This report concerns the National Heritage List for England (NHLE) Scheduled Monument 1003940, 'Site of Saxon town: Nuns' Bridges open space' (Historic England 2024). The current scheduling covers the green areas on either side of Mill Lane, the car park, and other open spaces to the south-east of Nuns' Bridges Road.

In 1957, excavations consisting of test holes and slot trenches were conducted in and around the scheduled area to assess the extent of late Saxon occupation. An early 19th-century topographical history refers to a 'Roman fortress' close to Nuns' Bridges. The excavations identified a steep scarp over the area developed as Nunsgate as stepped but likely natural in origin. Otherwise, the test holes found little evidence of occupation and no indication of the course of the town ditch (Rogerson and Dallas 1984, 53-4). A more complete summary of work in the vicinity of the site is provided by (Jecock 2024).

The geology consists of Cretaceous Lewes Nodular Chalk bedrock with sedimentary superficial deposits of Quaternary River Terrace sand and gravel (Geological Survey of Great Britain 2010; British Geological Survey 2024). Soils within Thetford town are unrecorded but are provisionally listed on Soilscapes as loamy and sandy with naturally high groundwater with a peaty surface (Soil Survey of England and Wales 1983; Soilscapes 2024)

The weather was dry and overcast during the survey. The ground was flat and consisted of recently cut grass.

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 multi-element DXG1820 vehicle towed, 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 2. 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 GNSS correction network (OSNet) and gives a stated accuracy of 0.01 to 0.015m per point with vertical accuracy being half as precise.

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 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 full GPR survey data set are shown on Figure 4. 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 0.116m/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 0.15m intervals from the ground surface, shown as individual greyscale images in Figures 3, 5, 6 and 7. 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, [**gpr1-15**] discussed in the following text, superimposed on the base OS mapping data, is provided in Figure 8.

Two linear, high-amplitude anomalies [**gpr1**] have been identified in the north-east corner of the survey area that are most probably modern pipes, possibly associated with drainage grates located along the north and north-east border of the green. A scatter of discrete high-amplitude anomalies (not shown on Figure 8) is also found across the site in the near-surface data similar to the response recorded at other sites within the project area (see Clements and Linford 2024a, 2024b).

In the southern corner of the survey area are a number of segmented high-amplitude anomalies [**gpr2**] most clearly seen between 15.0 and 25.0ns (0.87 to 1.45m). The anomalies are, superficially, similar in form to the dipping edges of the defensive Saxon ditch identified in the Queensway Junior Academy area of the Thetford OCN Project (cf [gpr1] on Figure 8 in Clements and Linford 2024a). An area of diffuse high-amplitude response [**gpr3**] lies further to the north of [**gpr2**], separated by a low-amplitude band [**gpr4**]. While a definitive interpretation is difficult to make due to the limited area [**gpr2-4**] have been detected within, it is possible the GPR survey may have identified a section of the town's defensive ditch.

A semi-circular low-amplitude anomaly [**gpr5**] is present from 5.0ns (0.29m) and becomes more defined as a series of segmented responses until the signal attenuates at 22.5ns (1.31m). While difficult to determine an exact interpretation, an anthropogenic origin cannot be entirely discounted.

Several curvilinear high-amplitude and more diffuse anomalies [**gpr6**] have been identified from 17.5ns (1.02m) onwards in the data set and appear to be centred around the high [**gpr7**] and low [**gpr8**] amplitude responses. The large curvilinear low-amplitude band [**gpr9**] may also be related to [**gpr6**] due to their similar orientation. Within the same area but located deeper within the data set, are two parallel linear high-amplitude anomalies [**gpr10**]. While a geomorphological origin may be possible given the low-lying topography of the site and proximity to the Little Ouse River, the depth and form of [**gpr6-10**] do suggest the anomalies could have some archaeological significance.

In the centre of the survey area are two disjointed high-amplitude anomalies [**gpr11**] that may possibly be a response to buried masonry. Further high-amplitude responses [**gpr12**]

to the south-east of [**gpr11**] and within [**gpr3**], and the cluster of anomalies [**gpr13**] located just to the east of [**gpr11**], may also have been caused by buried masonry or rubble.

Three diffuse anomalies [**gpr14**] are found in the north-west corner of the survey area, although the isolated location makes it difficult to ascribe a confident interpretation. Further discrete and diffuse high-amplitude anomalies [**gpr15**] have been detected throughout the survey area and are of unknown origin, possibly due to the underlying fluvial geomorphology.

Conclusions

The Ground Penetrating Radar survey has successfully identified a short section of a shallow, wide ditch that may be associated with the defences of the Saxon town together with a number of anomalies that may indicate buried masonry or rubble. Modern pipes have also been detected within the data set.

List of Enclosed Figures

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Figure 1

THETFORD TOWN OCN PROJECT: NUNS' BRIDGE OPEN SPACE, THETFORD, NORFOLK

Location of current geophysical survey areas within the Thetford Town OCN Project

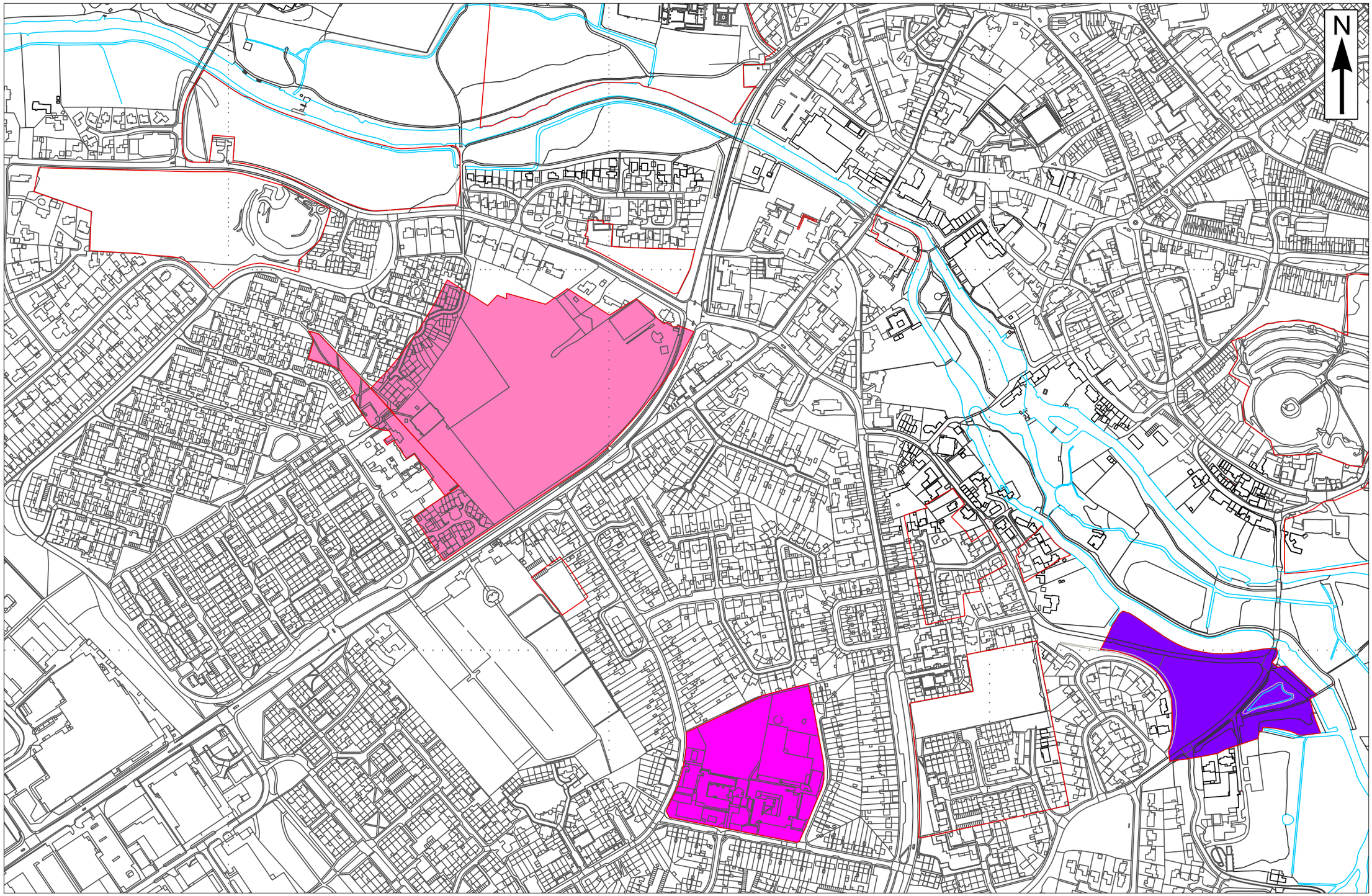

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Figure 2

THETFORD TOWN OCN PROJECT: NUNS' BRIDGE OPEN SPACE, THETFORD, NORFOLK

Location of GPR instrument survey swaths, July 2024

0 60m

1:750

Ground Penetrating Radar survey swaths

Extent of Scheduled Monument

2024-07-24-001 Location of selected GPR profiles shown on Figure 4

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Figure 3

THETFORD TOWN OCN PROJECT: NUNS' BRIDGES OPEN SPACE, THETFORD, NORFOLK

GPR amplitude time slice between 15.0 and 17.5ns (0.87 to 1.02m), July 2024

0 60m

1:750

Low *High*
relative reflector strength

Extent of Scheduled Monument

2024-07-24-001 Location of selected GPR profiles shown on Figure 4

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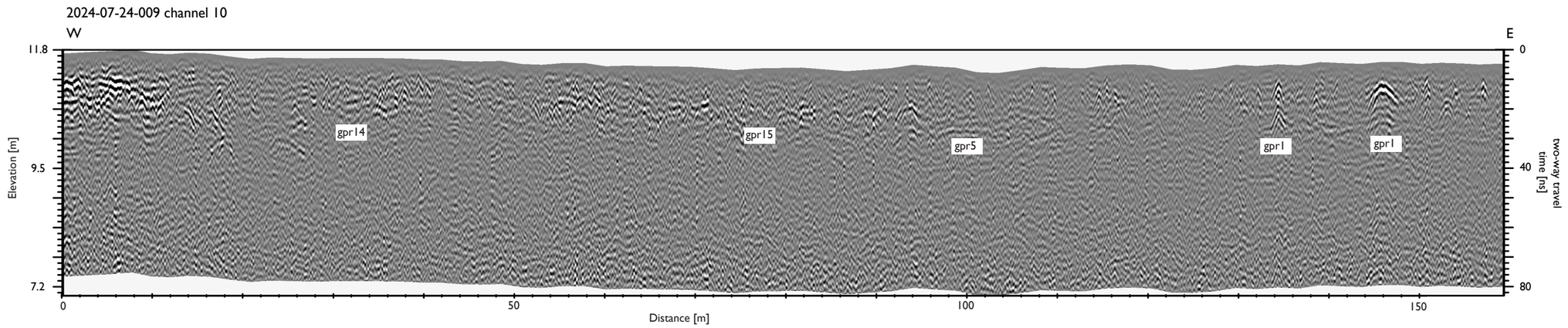
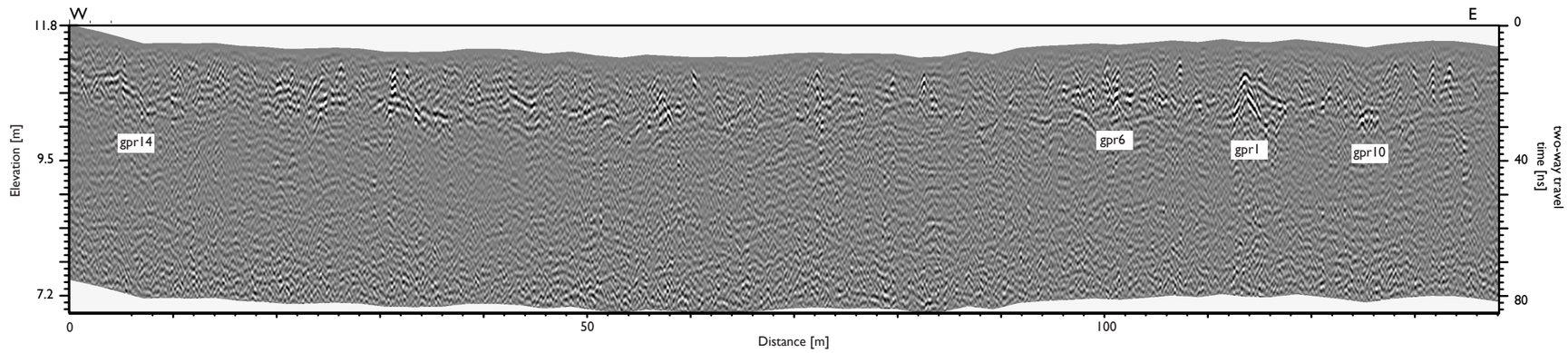
THETFORD TOWN OCN PROJECT: NUNS' BRIDGES, THETFORD, NORFOLK
Representative topographically corrected GPR profiles, July 2024

Figure 4





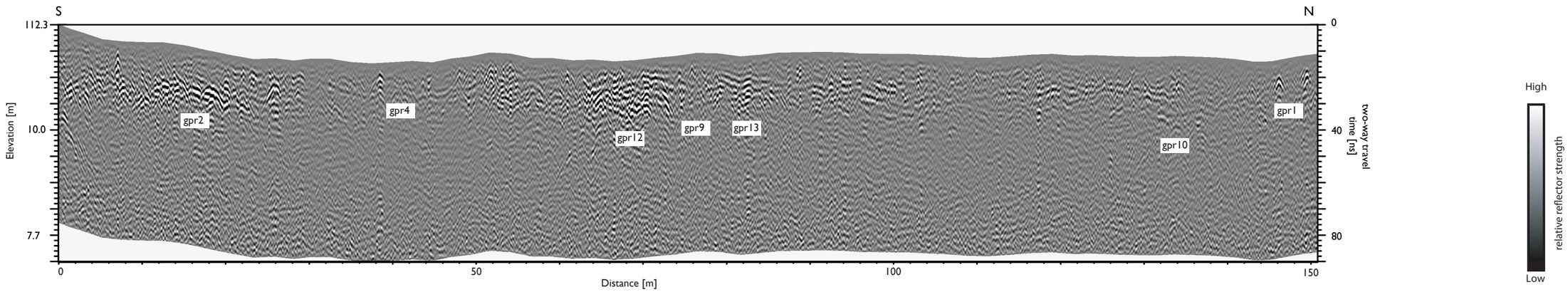


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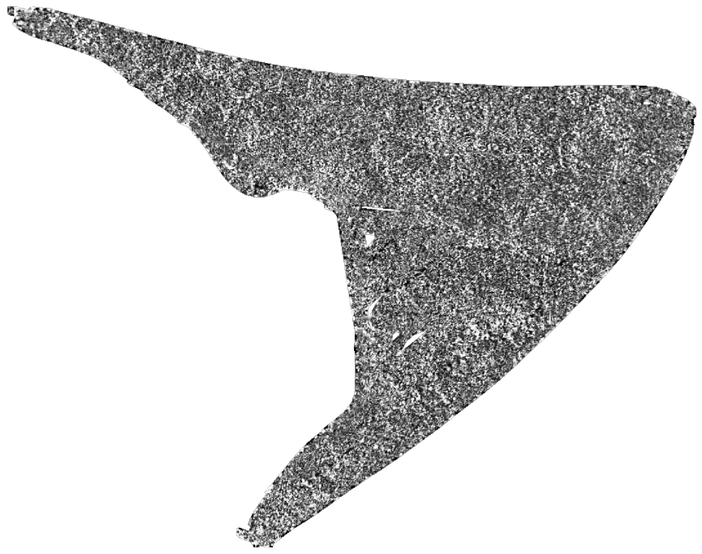
Figure 5

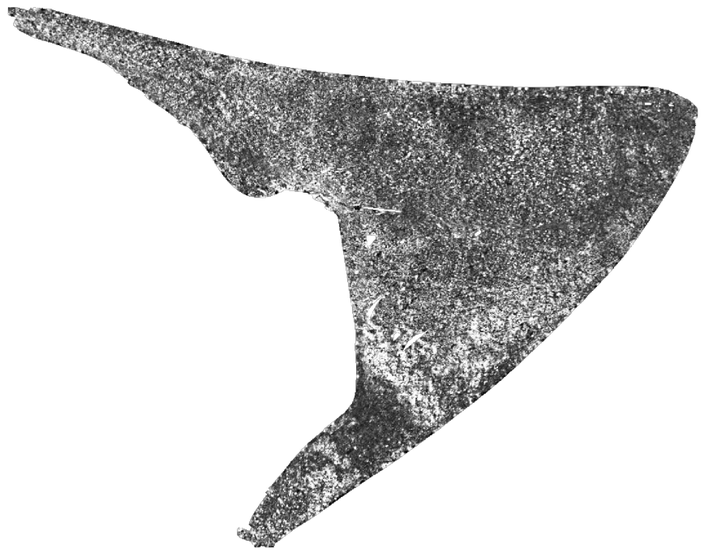
THETFORD TOWN OCN PROJECT: NUNS' BRIDGES OPEN SPACE, THETFORD, NORFOLK
GPR amplitude time slices between 0.0 and 15.0ns (0.0 to 0.87m), July 2024

N

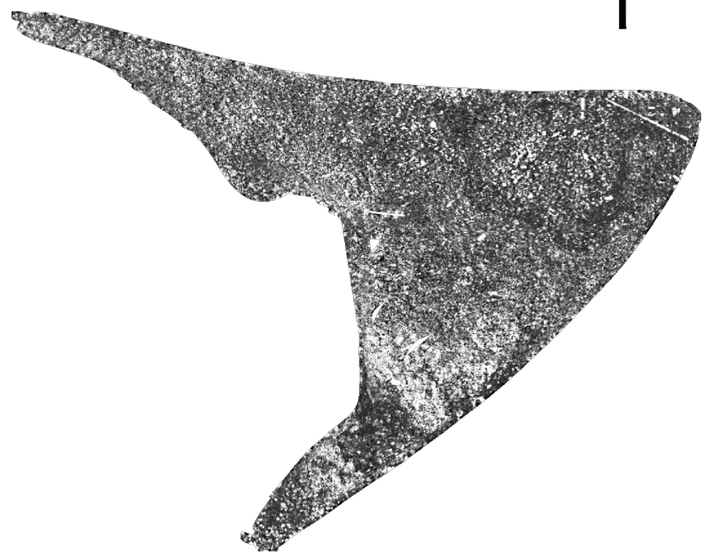
0.0 - 2.5ns (0.0 - 0.15m)



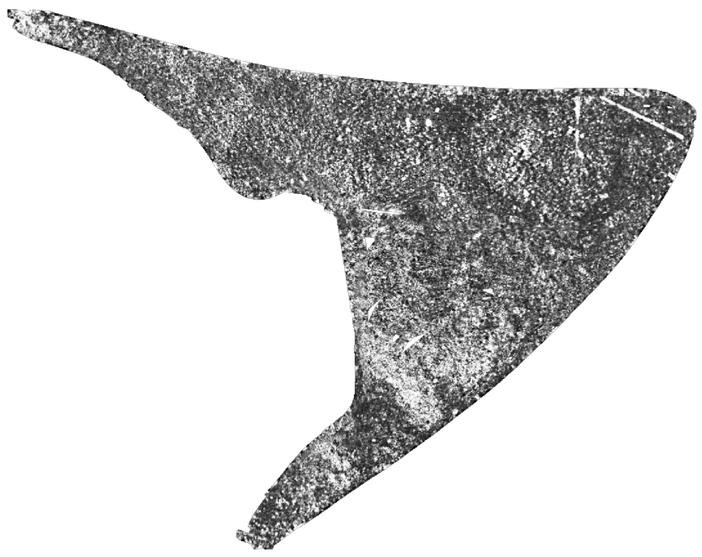
2.5 - 5.0ns (0.15 - 0.29m)



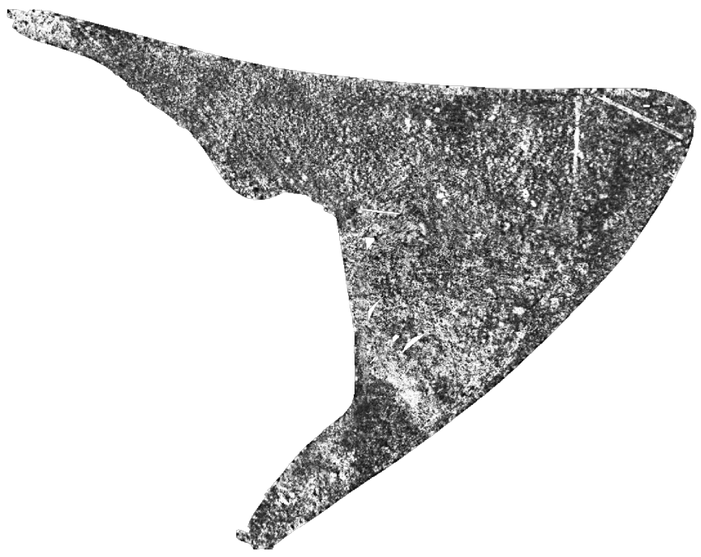
5.0 - 7.5ns (0.29 - 0.43m)



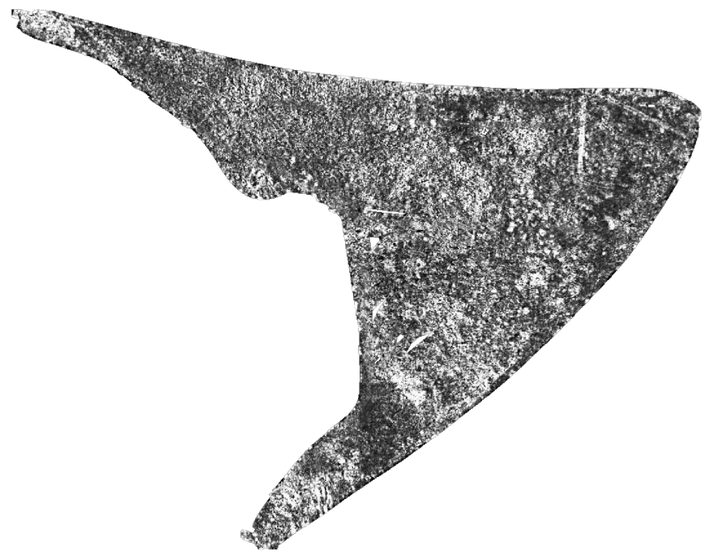
7.5 - 10.0ns (0.43 - 0.58m)



10.0 - 12.5ns (0.58 - 0.73m)



12.5 - 15.0ns (0.73 - 0.87m)



0 150m

1:1500

Low *High*
relative reflector strength

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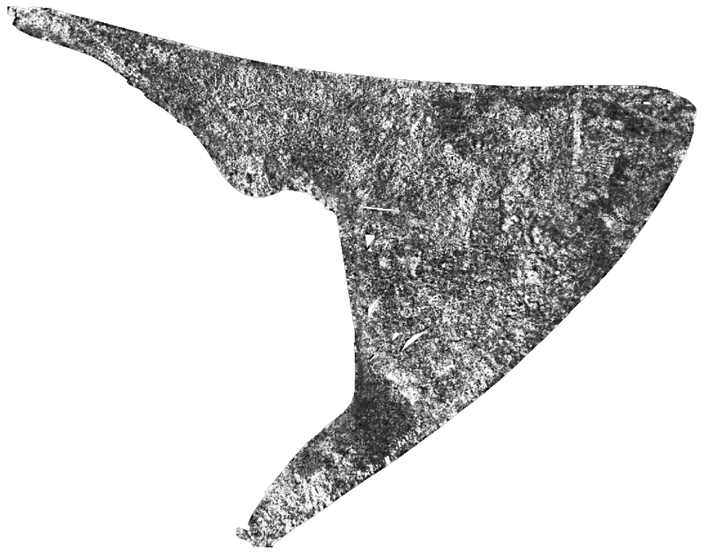
Figure 6

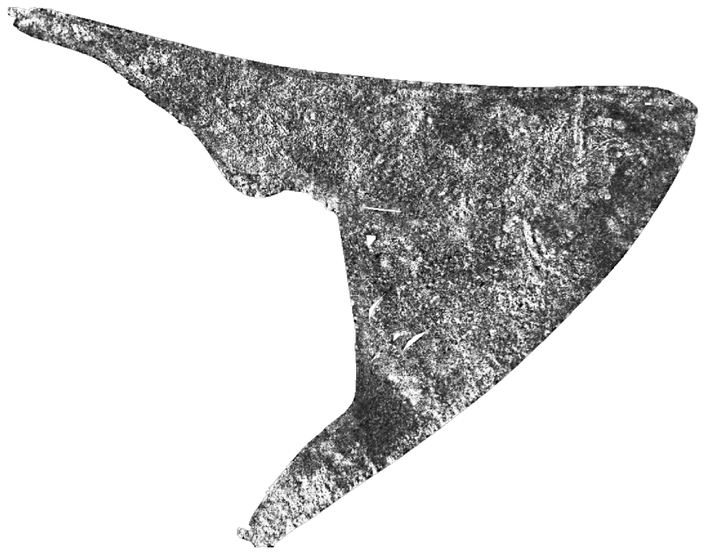
THETFORD TOWN OCN PROJECT: NUNS' BRIDGES OPEN SPACE, THETFORD, NORFOLK
GPR amplitude time slices between 15.0 and 30.0ns (0.87 to 1.74m), July 2024

N

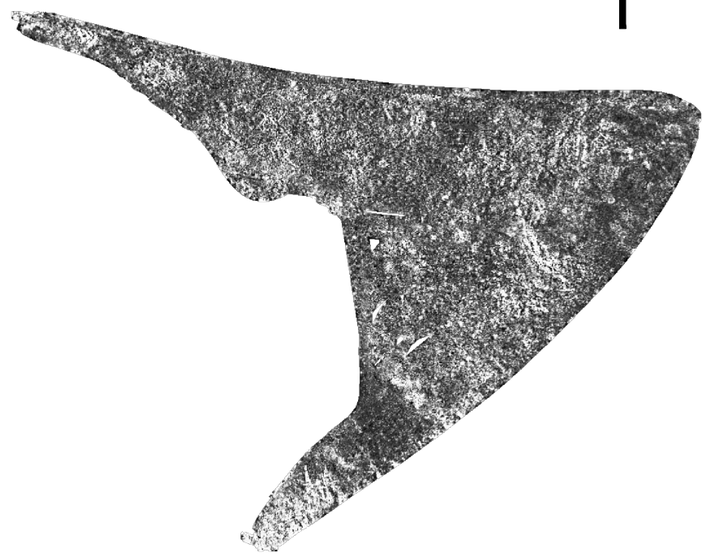
15.0 - 17.5ns (0.87 - 1.02m)



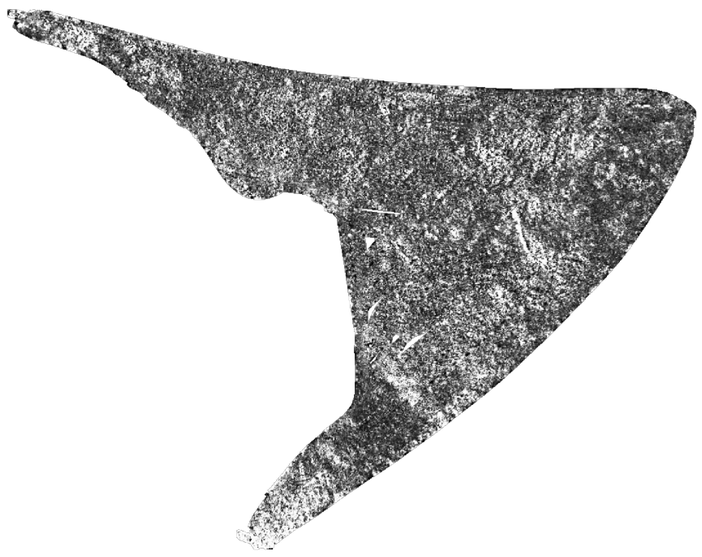
17.5 - 20.0ns (1.02 - 1.16m)



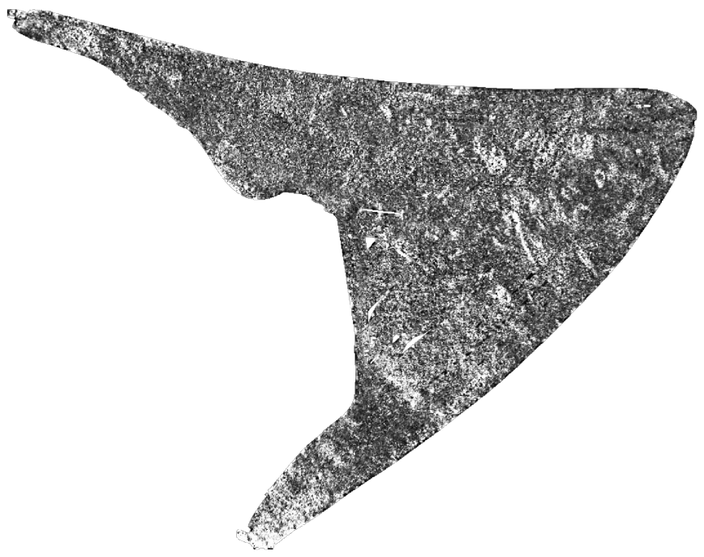
20.0 - 22.5ns (1.16 - 1.31m)



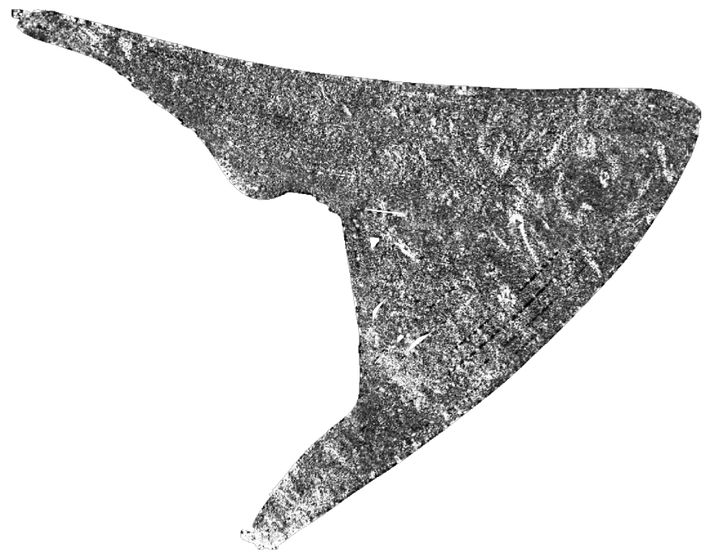
22.5 - 25.0ns (1.31 - 1.45m)



25.0 - 27.5ns (1.45 - 1.59m)



27.5 - 30.0ns (1.59 - 1.74m)



0 150m

1:1500

Low *High*
relative reflector strength

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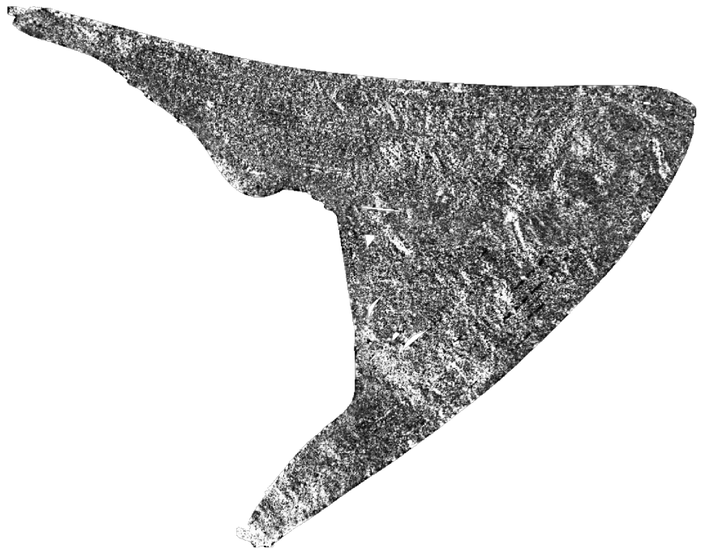
Figure 7

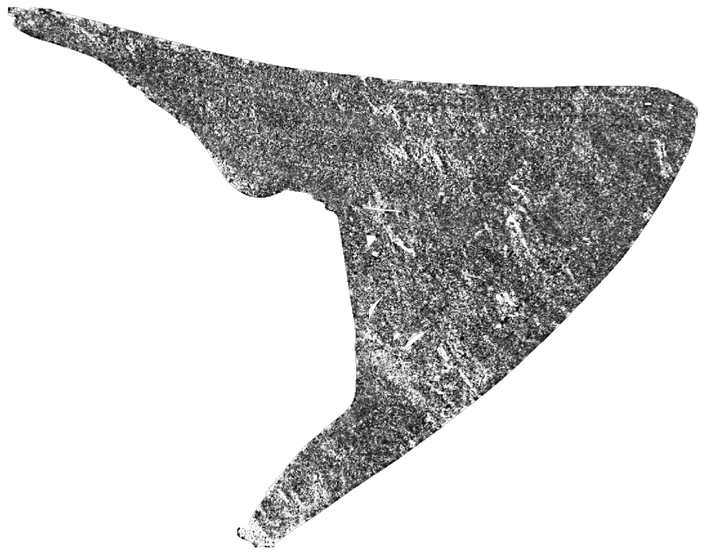
THETFORD TOWN OCN PROJECT: NUNS' BRIDGES OPEN SPACE, THETFORD, NORFOLK
GPR amplitude time slices between 30.0 and 45.0ns (1.74 to 2.61m), July 2024

N

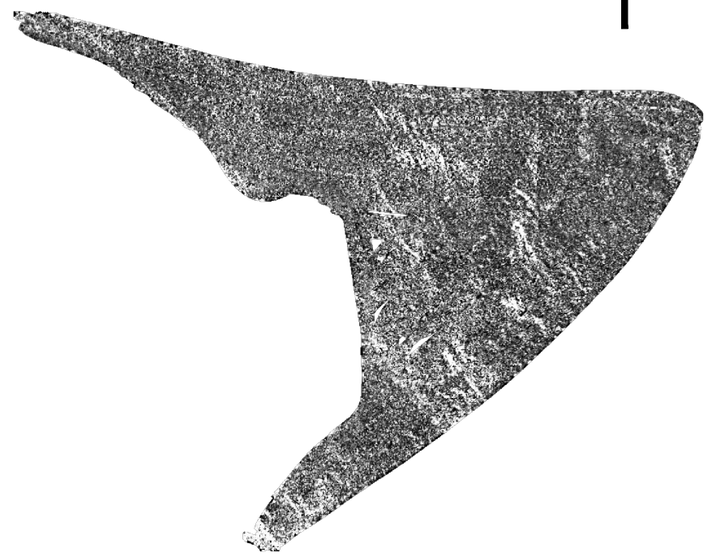
30.0 - 32.5ns (1.74 - 1.89m)



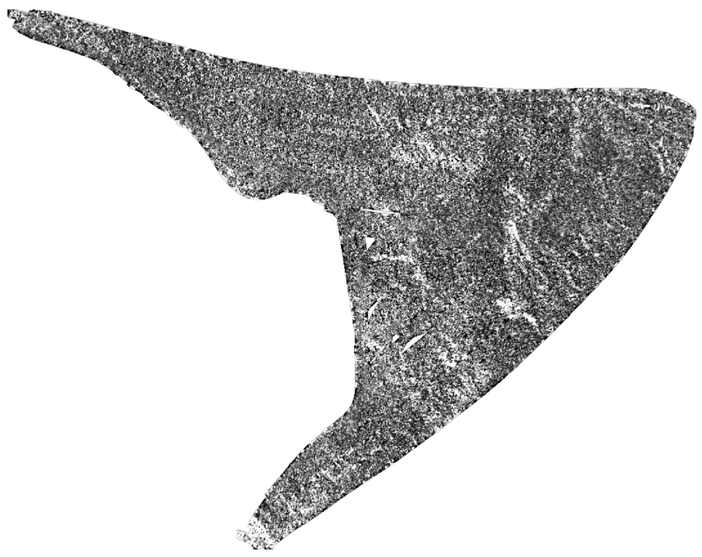
32.5 - 35.0ns (1.89 - 2.03m)



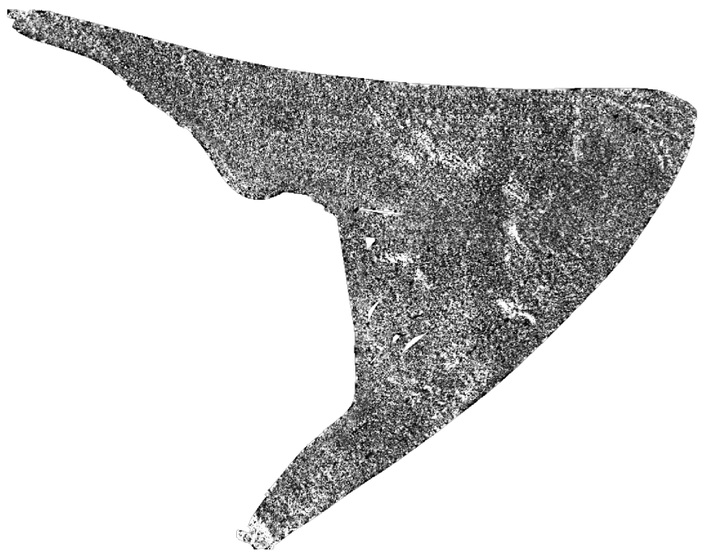
35.0 - 37.5ns (2.03 - 2.18m)



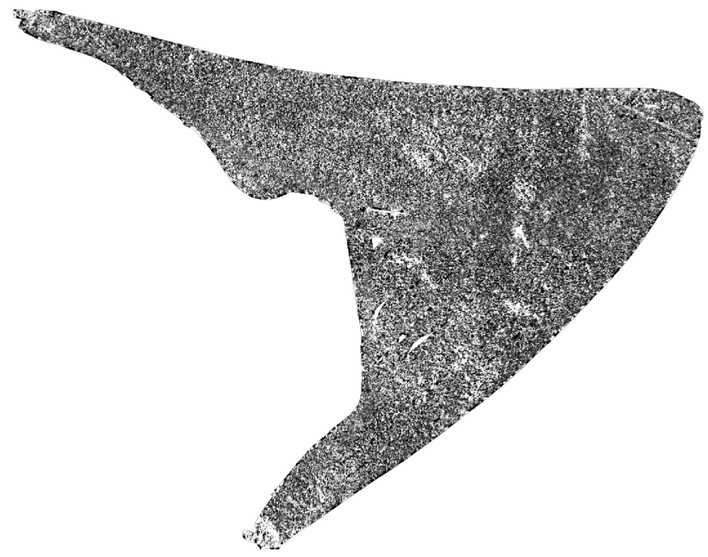
37.5 - 40.0ns (2.18 - 2.32m)



40.0 - 42.5ns (2.32 - 2.47m)



42.5 - 45.0ns (2.47 - 2.61m)



0 150m

1:1500

Low *High*
relative reflector strength

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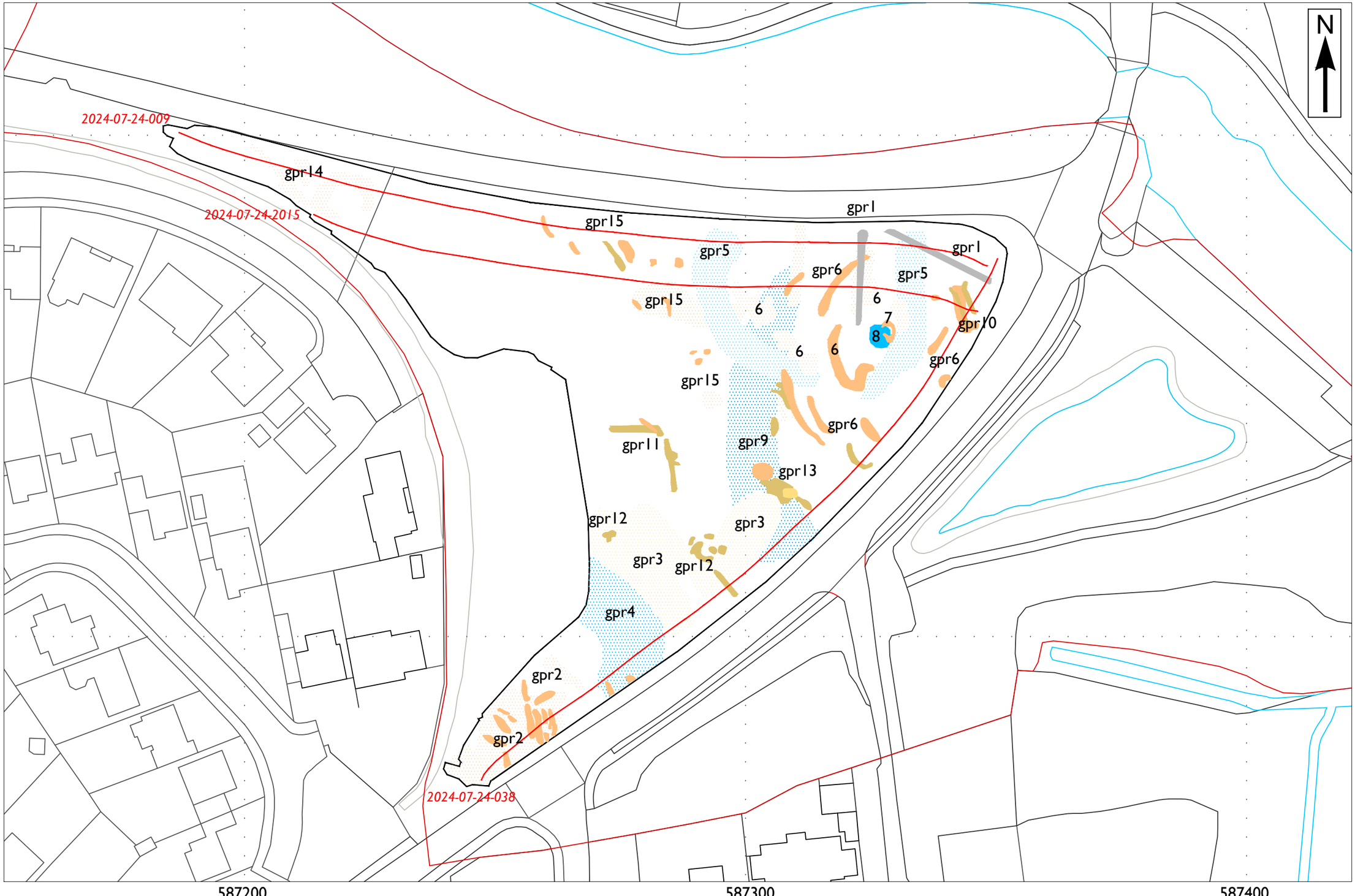
Figure 8

THETFORD TOWN OCN PROJECT: NUNS' BRIDGES OPEN SPACE, THETFORD, NORFOLK

Graphical summary of significant GPR anomalies, July 2024



0 60m

1:750

Low amplitude reflectors

High amplitude reflectors

Anomalies of known or recent origin

Extent of Scheduled Monument

2024-07-24-001 Location of selected GPR profiles shown on Figure 4

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