



# Thetford Town OCN Project: Thetford Grammar School

Report on Geophysical Survey, July 2024

Megan Clements and Neil Linford



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## Report on Geophysical Survey, July 2024

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Thetford Grammar School Playing Fields  
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# Summary

A vehicle-towed Ground Penetrating Radar (GPR) survey was conducted over an area of 4.3ha covering the playing fields of Thetford Grammar School, 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 designations within Thetford that will allow Historic England's East of England Regional Team to make decisions regarding the management of the sites. The survey successfully revealed evidence for structural remains across the site associated, in part, with the known location of St John's church and burial ground. More fragmented, possibly structural remains, corroborated results from an earlier GPR survey conducted in the vicinity of the current pavilion. However, extending the GPR survey over the entirety of the playing fields has revealed further significant building remains, possibly indicative of a small church or chapel, and a more complex group of anomalies associated with a substantial sub-circular structure approximately 20m in diameter. Linear anomalies found in the south-east of the site suggest the location of the Saxon town defensive ditch that potentially pre-dates some of the structural remains revealed by the survey. The field work was conducted in July 2024.

## 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 Thetford Grammar School for their permission to conduct the survey on their land. The cover image shows the school's playing field and the vehicle-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 23rd and 25th of July 2024. The report was completed on the 21<sup>st</sup> January 2025.

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# Contents

Introduction .....	1
Method .....	2
Ground Penetrating Radar.....	2
Results .....	4
Ground Penetrating Radar.....	4
Conclusions .....	10
List of Enclosed Figures.....	11
References.....	12



# Introduction

A Ground Penetrating Radar (GPR) survey was conducted over the playing fields of Thetford Grammar School, Thetford, Norfolk, as part of the wider Thetford Town OCN (Old County Number) Project. The project aims to investigate OCN scheduled sites south of the Little Ouse River to increase understanding of the monuments and assist the East of England Regional Team with their on-going management and any revisions to designation (Figure 1; Clements and Linford 2024b, 2024a). This report concerns the National Heritage List for England (NHLE) Scheduled Monument 1003936, 'Site of Saxon town including site of St John's churchyard on playing fields' (Historic England 2024) and covers the Thetford Grammar School and adjacent Redcastle Family School playing fields, and numerous private gardens.

Historic mapping and aerial photographs taken in 1945 (Ordnance Survey 1843-1893), show the location of St John's church and burial ground, although the position of the church is indicated further to the east on later mapping. Small-scale excavations were conducted by staff and students from the school in the 1950s, identifying features including metalled roads under the location of the current tennis courts, and four inhumation burials (Davison 1967, 192-3; Dallas 1993, 58-75, 221). The Ministry of Works conducted a magnetometer survey in 1966 in the area now used as a playing field by the Redcastle Family School, and identified pottery kilns, which were confirmed by later excavations (Norfolk HER: 5756, Dallas 1993). Norfolk Archaeological Unit (NAU) undertook GPR and borehole surveys together with an excavation in 2007 ahead of the construction of houses at Jubilee Close and Saxon Bank although this work remains unreported (Norfolk HER ENF141817 and ENF119466). A more recent GPR survey has also been conducted to the west of the tennis courts and identified anomalies interpreted as roads, post-holes, pits and the possible site of a church and a kiln (Wessex Archaeology 2020). A more complete summary of work in the vicinity of the site is provided by Jecock (2024).

The geology at the site consists of Cretaceous Lewes Nodular chalk overlain by Quaternary (post Hoxnian-Holocene) superficial sedimentary deposits of second 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 Soilscales as loamy and sandy with naturally high groundwater and a peaty surface (Soil Survey of England and Wales 1983; Soilscales 2024). The surface at the site consisted of well-kept grass with paint markings for a running track, football and rugby pitches with goal posts for both. The weather was dry and mild during 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 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 between 0.01 and 0.015m per point with vertical accuracy being half as precise. The Trimble VRS Now Network RTK delivery service was also used to adjust the roving GNSS receiver when operated without a base station.

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 topographically corrected 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 0.112m/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 0.14m 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).

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 8. The algorithm uses edge detection to identify bounded 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

## Ground Penetrating Radar

A graphical summary of the significant GPR anomalies, [gpr1-51] discussed in the following text, superimposed on the base OS mapping data, is provided in Figure 8.

Reflections have been recorded throughout the 75ns two-way travel time window, although there are few significant responses beyond approximately 50ns (2.83m) other than anomalies due to near-surface multiples and the underlying geology. The near-surface data between 0.0 and 7.5ns (0 to 0.39m) has been influenced by a response to the markings for the running track [gpr1], the central cricket square [gpr2], and three high-amplitude rectangular anomalies [gpr3-5] that seem also seem likely to be associated with the more recent use of sports field, perhaps the site of temporary marquees. A network of high-amplitude anomalies [gpr6] are found against the margins of the survey area and appear to be the associated with the roots of mature trees found here.

A linear anomaly [gpr7] extends into the survey area from the London Road and correlates with a boundary shown on historic mapping (OS Historic County Mapping Series: Suffolk 1843 to 1893 Epoch 1). Historic mapping also confirms the location of the original pavilion that was later destroyed by fire (OS Historic County Mapping Series: Suffolk 1904 to 1939 Epoch 3), replicated by a rectilinear anomaly [gpr8] together with a linear service [gpr9], most likely a drain, that falls away from the building and 'dog legs' around the cricket square [gpr2].

Numerous discrete high-amplitude anomalies [gpr10] found across the survey area between 2.5 and 12.5ns (0.15 to 0.75m). Similar anomalies were recorded at the two other sites within the project area and whilst a geomorphological origin is possible, they appear to overlie archaeological responses that may suggest an association with either more recent overburden or, perhaps, more significant destruction deposits.

An approximately 50m x 50m rectilinear walled enclosure [gpr11] corresponds with the site of St. John's chapel and burial ground shown on historic mapping to the north of the survey area (OS Historic County Mapping Series: Suffolk 1843 to 1939 Epochs 1 to 3). Extensions to the walled enclosure [gpr11] are found to the north-west [gpr12] and south-east [gpr13] together with evidence for internal structural detail, including possible building remains at [gpr14-16]. There is little evidence for the location of buildings shown on the historic mapping beyond a single later structure to the west that may correspond with [gpr16]. However, the radar data suggests [gpr14-16] represent well preserved building remains between 15.0 and 35.0ns (0.85 to 1.98m) with evidence for walls and floor layers.

While this area contains a number of discrete, high-amplitude anomalies [gpr17] it is difficult to confidently interpret these as possible inhumations, in part due to the prevalence of similar responses [gpr10] found across the site.

A high-amplitude linear anomaly [gpr18] immediately to the south of [gpr11] appears to represent a road or track-way within the near-surface between 5.0 and 10.0ns (0.28 to 0.57m) that continues into the main playing fields to the south-east. The track-way [gpr18] continues beyond the survey area towards the London Road and meets a cross-road with a north-south branch but is not recorded on historic mapping. The previous GPR survey also detected the track-way together with a series of fragmented high [gpr19] and low-amplitude anomalies [gpr20] sharing the same orientation immediately to the north of [gpr18]. While elements of [gpr19] and [gpr20] may be associated with significant structural remains or other occupation activity, particularly the rectilinear anomalies at [gpr21] that appear to suggest a building, the deeper data suggests a more geomorphological response following the boundary between the stepped river terrace deposits (Geological Survey of Great Britain 2010). There is a pattern of more diffuse, high-amplitude response evident in the data from approximately 22.5ns (1.27m) onwards that seems most likely to be associated with the underlying sand and gravel. Low-amplitude ditch-type anomalies either share same orientation [gpr22-25] or are orthogonal, [gpr26] and [gpr27], to [gpr18] and could, possibly, represent a contemporary phase of field divisions or enclosures.

More significant remains are found at [gpr28] towards the southern extent of [gpr18] in the form of a 16m by 7m building with the long axis orientated east-west. The wall foundations appear between 7.5 and 25.0ns (0.42 to 1.41m) with a deeper, approximately 8m square structure, with thicker walls to the east extending to a depth of 37.5ns (2.12m). A series of discrete high-amplitude anomalies [gpr29] are found surrounding [gpr28] with two similar internal responses within the building. A row of five discrete anomalies [gpr30] share the same orientation offset approximately 4m to the south. It seems likely that [gpr28] represents a former small church or chapel with the wider wall footings to the east possibly supporting a more substantial structure, and the discrete anomalies [gpr29] and [gpr30] could be associated with grave marker stones or, perhaps, post pads to support timber uprights. Similar small churches have been excavated in Thetford at Red Castle, approximately 500m to the north-west, and Nunsgate approximately 900m to the south-east (Plate 1; Knocker 1967; Dallas 1993)

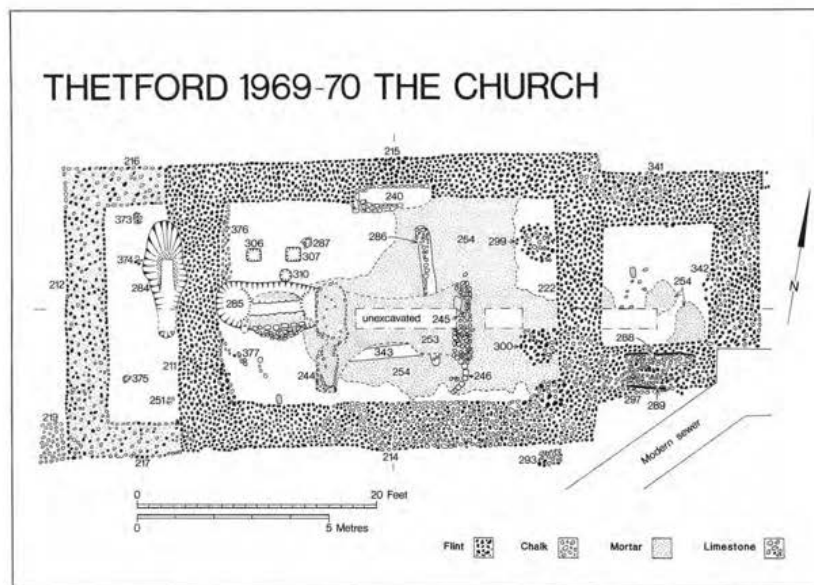


Figure 110 Site 5759, Trench 2 The church: plan of Period III-IV church, and Period V-VII features. Scale 1:100.

Plate 1: Plan of the small church with similar dimensions to [gpr28] excavated at Site 5759 to the south-west of Thetford (see Plate 2). Reproduced from Dallas (1993).

Further structural remains are evident from 2.5ns (0.14m) towards the southern extent of the survey area and boundary with the Redcastle Family School. A circular high-amplitude anomaly [gpr31] is found between 2.5 and 45.0ns (0.14 to 2.54m) with a wall thickness of approximately 2.0m. There is an octagonal structure within the centre of [gpr32], again with wide wall footings. A number of short, linear wall-type responses extend from [gpr31], including a well-defined apsidal anomaly [gpr33] to the east. While [gpr31] and [gpr32] could represent a building, for example a circular church, the thickness of the wall footings suggests little internal space within the structure. An alternative interpretation might be a large lime kiln that are known within the town, although there is no evidence from historic mapping of workings on this scale here.

A series of linear wall-type responses [gpr34], including a sub-circular anomaly [gpr35] extend to the north-east of [gpr31] towards a possible enclosure trapezoidal enclosure [gpr36]. An approximately 8m square rectilinear anomaly [gpr37] is found within [gpr36], that contains some more complex internal detail. The depth of both [gpr34] and [gpr36] appears shallow compared to [gpr31] and [gpr32], extending between 5.0 and 17.5ns (0.28 to 0.99m). There is also a discrete high-amplitude anomaly [gpr37] found immediately to the north of [gpr36]. Interpretation of [gpr34-37] and may suggest some association with [gpr31] and [gpr32], although the discrete sub-circular anomalies within



[gpr36] and at [gpr37] have similar dimensions to the late Saxon kilns known through excavation approximately 100m to the north (Plate 3; Dallas 1993).

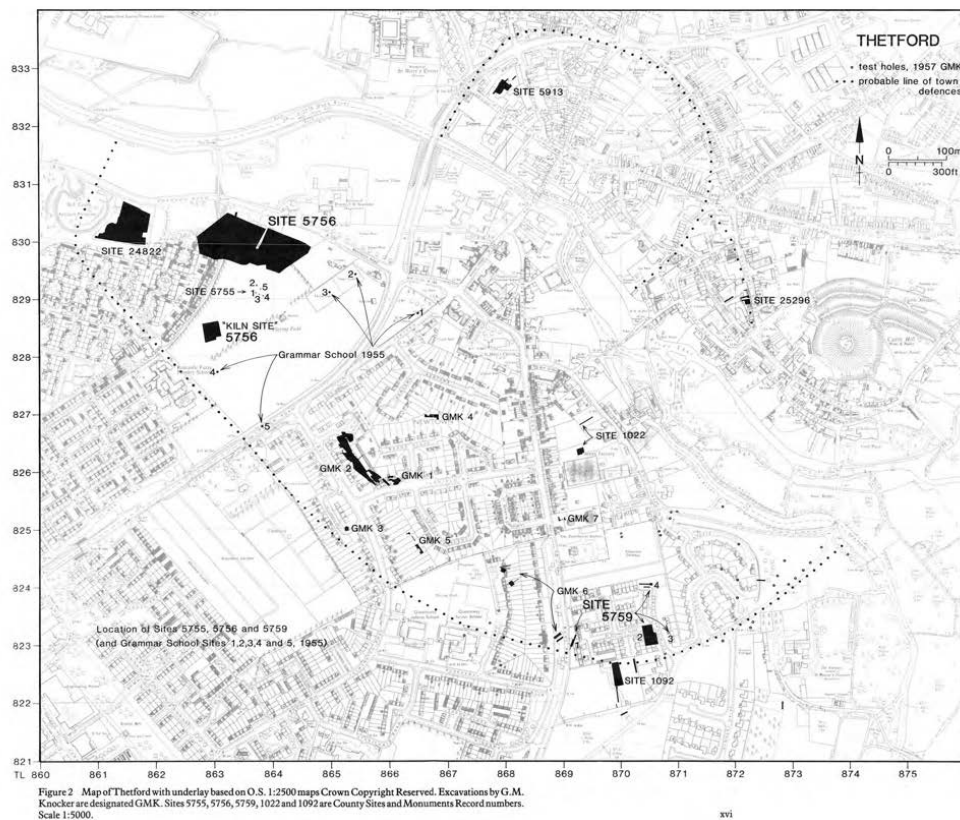


Plate 2: Plan of Thetford showing the location of the “kiln site” 5756 and excavated church found at site 5759. The dotted line indicates the presumed location of the town defences. Reproduced from Andrews and Penn (1999).

More fragmented linear anomalies [gpr38] are found immediately to the north on a similar orientation to [gpr34] together with tentative rectilinear arrangement of discrete responses [gpr39] that appear between 10.0 and 20.0ns (0.57 to 1.13m). Both [gpr38] and [gpr39] could represent a continuation of the occupation activity although the rectangular anomaly [gpr40] found between 2.5 and 12.5ns (0.14 to 0.71m) is perhaps more suggestive of a modern origin associated with the playing fields. A rectilinear low-amplitude anomaly [gpr41] immediately to the north of [gpr40] also appears to be modern although the interpretation here is complicated by the presence of tree roots [gpr6] extending from the field boundary.

Fragmented structural remains continue to the south and include a small rectilinear building [gpr42] and a more complex, broad linear anomaly [gpr43] found across the width of the survey area, that may represent a boundary or trackway. Parallel ditches, with

depths ranging between 0.61 and 0.91m containing both clay and sandy fills, were excavated immediately to the north of the Grammar School playing fields. These ditches were associated with the late Saxon kiln yard, with a location and alignment that may conceivably represent an extension of [gpr43] (Plates 2 and 3; Dallas 1993).

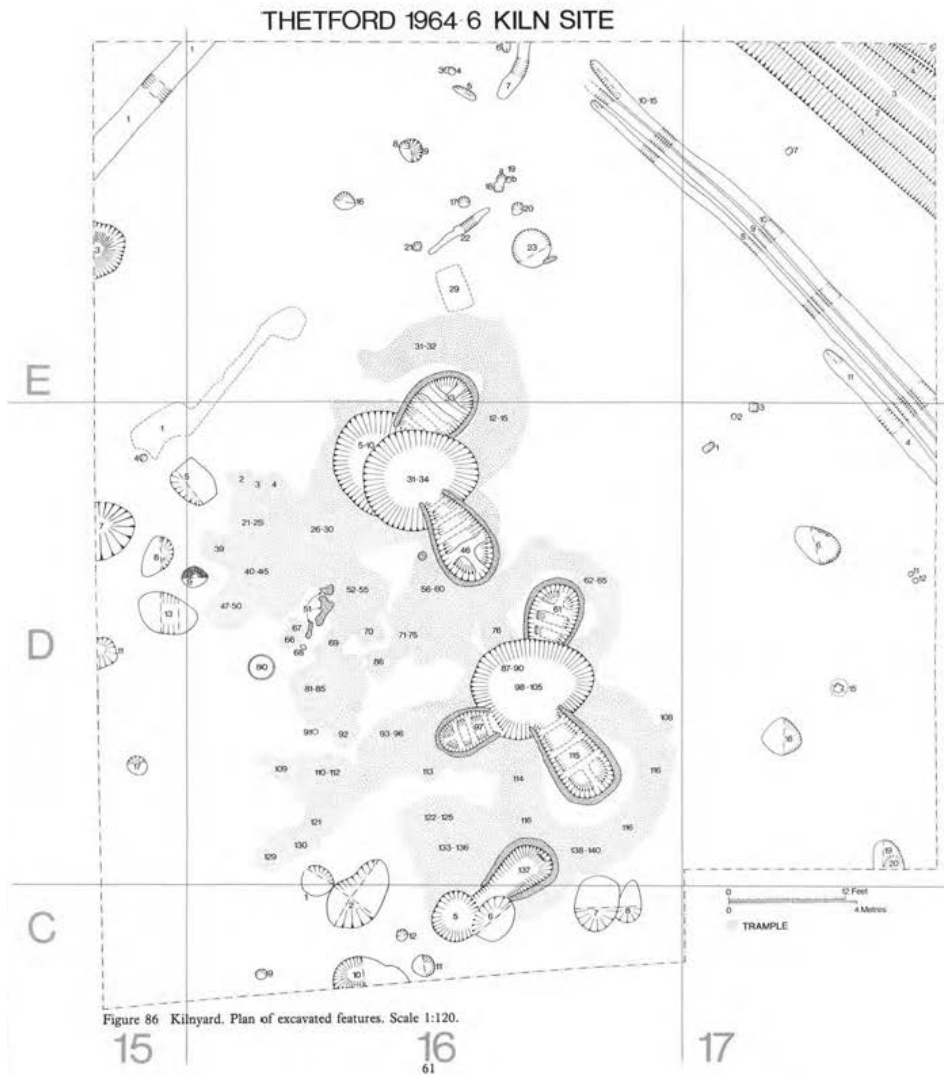


Plate 3: Plan of the excavated features from the “Kiln Site” Site 5756 (see Plate 2 and Figure 8 for location). Reproduced from Dallas (1993).

High-amplitude linear anomalies [gpr44] are found parallel to [gpr43] approximately 25m to the west with a low-amplitude ditch-type response [gpr45] in between the two that appears from approximately 20.0ns (1.13m) onwards. There is an additional rectilinear low-amplitude response orthogonal to [gpr44], that corroborates the presumably more recent near-surface response [gpr5] that appears to have attenuated the radar signal

here. Deeper lying anomalies between 22.5 and 50.0ns (1.27 to 2.83m) immediately to the west are more suggestive of a response to the underlying sand and gravel.

The near-surface data contains a prominent rectangular structure [gpr46] approximately 12m x 4m from 5.0ns (0.28m) onwards suggestive of an additional building on the boundary with the Redcastle Family School. There are some further discrete [gpr47] and linear anomalies [gpr48] in the vicinity of [gpr46], although these are difficult to fully interpret given the limited extent of the data. A more diffuse linear anomaly [gpr49] shares a similar orientation to [gpr43] and [gpr44], but gently dips towards the west reminiscent of the response from the Saxon town ditch suggested by the GPR survey at two other sites in the project area (Clements and Linford 2024b, 2024a). As the Saxon town ditch is believed to be located close to the boundary with the Redcastle Family School (Plate 2) this would be a reasonable interpretation for [gpr49] although it is unclear whether [gpr43-45] are associated with the defensive ditch, a different phase of occupation activity or geomorphological features that may have partly defined the boundary of the town.

The structural remains at [gpr46] appear to be built over the possible town ditch [gpr49], suggesting [gpr46] most likely post-dates the Saxon activity at the site. In addition, linear anomalies [gpr34] appear to overlie and partially cut-through the presumed late Saxon ditch [gpr43], that may suggest that [gpr31-37] also post-dates the Saxon activity. Two short parallel linear anomalies [gpr50] immediately to the north of [gpr43] are difficult to interpret as they are of limited extent on the periphery of the survey area. The linear alignment of discrete anomalies [gpr51], found between 10.0 and 30.0ns (0.57 to 1.7m) to the south of [gpr31], does not appear to be associated with the Saxon ditch but could, perhaps, be associated with the track-way [gpr18] as they share the same approximate orientation.

## Conclusions

The Ground Penetrating Radar (GPR) survey has successfully identified anomalies across the site of the Thetford Grammar School playing fields, extending previous coverage with the same technique. Recent activity from the use of the site as playing fields has been detected in the near-surface data, together with the known location of the former pavilion and the site of St. John's church and burial ground. More significant anomalies corroborate the results of the previous GPR survey and suggest a wider pattern of archaeological activity partially aligned with a former road network. The new survey data, extending over the entire area of the playing fields, has revealed a series of structural remains possibly including a small Saxon church and evidence for semi-industrial activity. A substantial, concentric sub-circular anomaly has been found in the south of the survey area. While it is difficult to suggest a definitive interpretation this may possibly represent either a building, for example a circular church perhaps, or a more recent industrial structure such as a lime kiln. A magnetic survey of the playing field may well help to determine the presence of thermoremanent anomalies, more likely to be associated with high-temperature industrial processes.

Evidence for the presumed location of the defensive ditch marking the extent of the Saxon town has also been suggested to the south-east of the site. A series of linear anomalies found broadly parallel to the main ditch may, potentially, correlate with similar late Saxon features excavated in association with pottery kilns immediately to the north of the site. This may well provide a *terminus post quem* for the structural remains apparently cut through the ditch network here.

## List of Enclosed Figures

- Figure 1: Location of current geophysical survey areas within the Thetford Town OCN Project (1:5000).
- Figure 2: Location of GPR instrument survey swaths superimposed over the base OS mapping data (1:1500).
- Figure 3: GPR amplitude time slice between 10.0 and 12.5ns (0.75 to 0.90m) superimposed over the base OS mapping data (1:1500).
- Figure 4: Representative topographically corrected GPR profiles shown as greyscale images with annotation denoting significant anomalies. The location of selected profiles can be found on Figures 2, 3 and 8.
- Figure 5: GPR amplitude time slices between 0.0 and 15.0ns (0.0 to 0.85m) (1:3000).
- Figure 6: GPR amplitude time slices between 15.0 and 30.0ns (0.85 to 1.70m) (1:3000).
- Figure 7: GPR amplitude time slices between 30.0 and 45.0ns (1.70 to 2.54m) (1:3000).
- Figure 8: Graphical summary of significant GPR anomalies superimposed over the base OS mapping data. The approximate location of the Kiln Site excavation plan is also shown. For clarity the 'gpr' prefix has been removed from some of the annotation identifying anomalies (1:1500).

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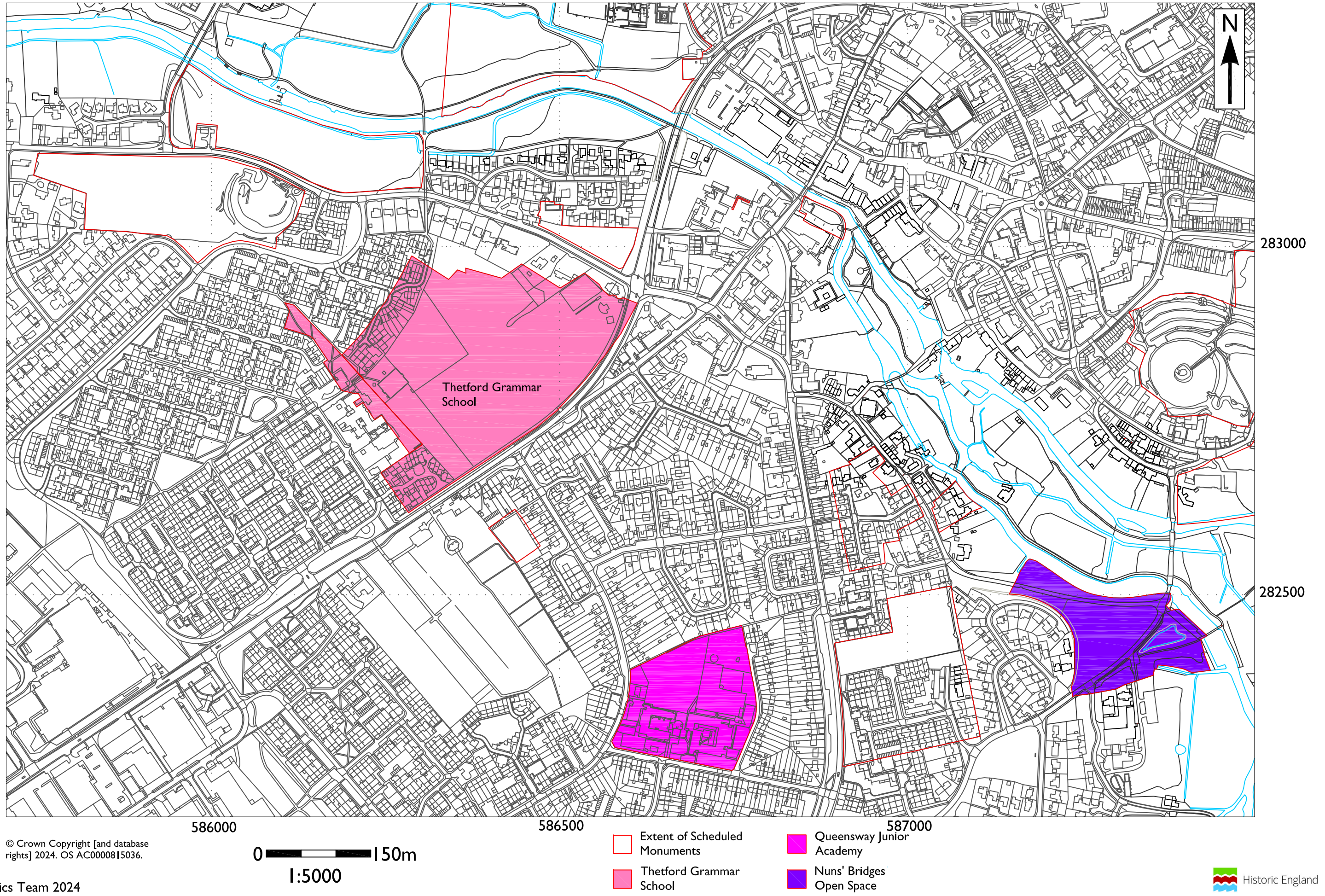


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# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

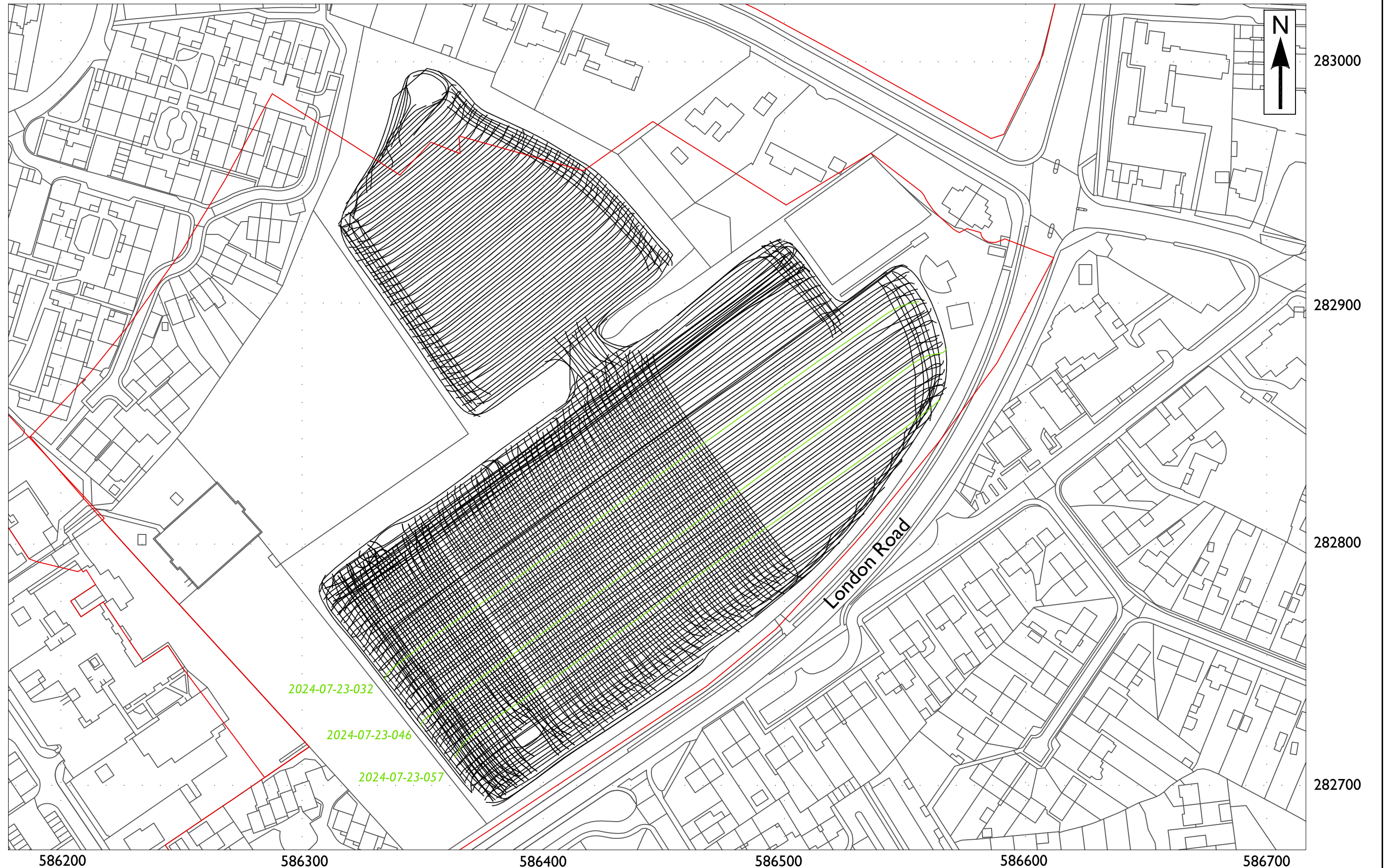
## Location of current geophysical survey areas within the Thetford Town OCN Project



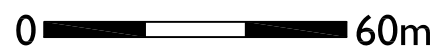



# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK


## Location of GPR instrument survey swaths, July 2024



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0  60m  
1:1500

 Ground Penetrating Radar survey swaths

 Extent of Scheduled Monument

 Location of selected GPR profiles shown on Figure 4  
2024-05-14-001



# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

GPR amplitude time slice between 10.0 and 12.5ns (0.57 to 0.71m), July 2024



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0 60m  
1:1500

Low High  
relative reflector strength

Extent of Scheduled Monument

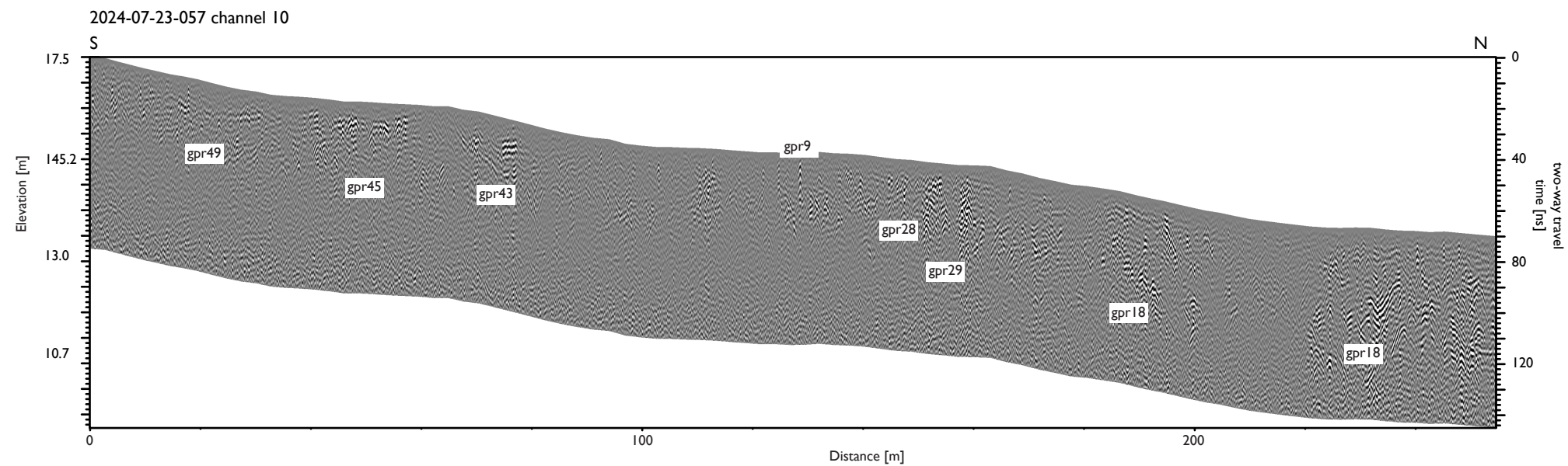
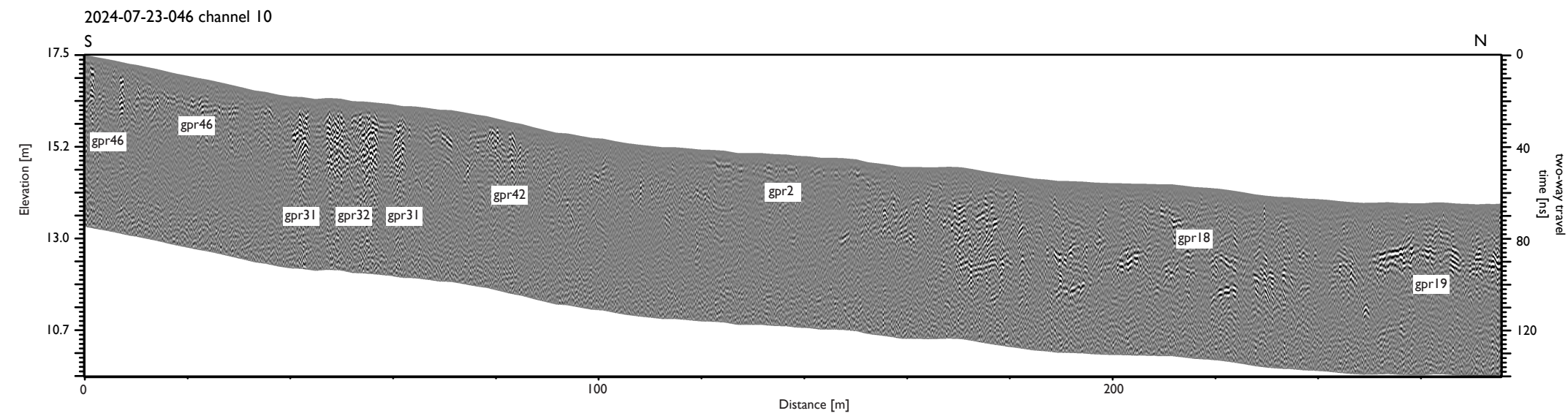
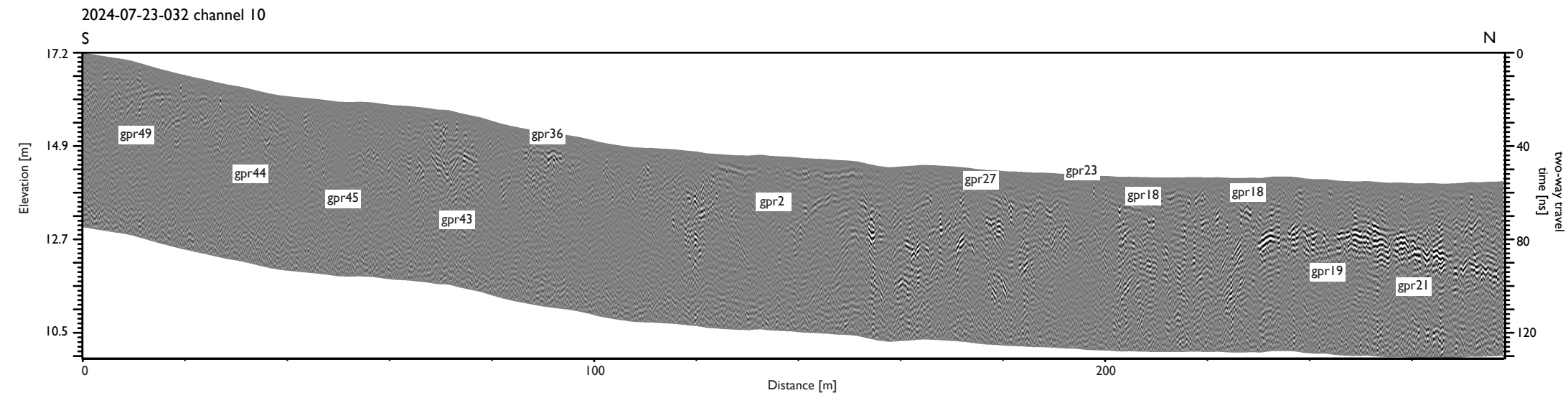
Location of selected GPR profiles shown on Figure 4  
2024-07-23-001



# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

## Representative topographically corrected GPR profiles, July 2024

Figure 4





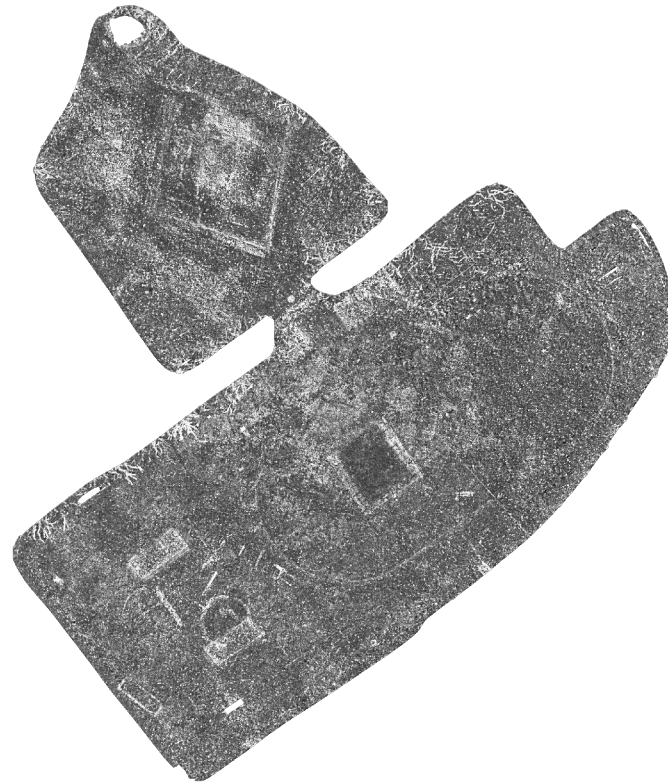
# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

## GPR amplitude time slices between 0.0 and 15.0ns (0.0 to 0.85m), July 2024

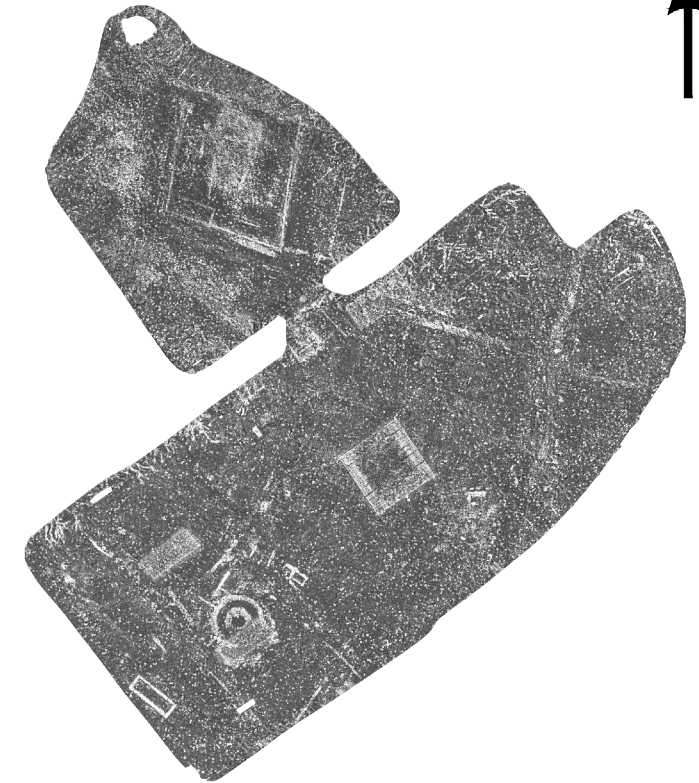
0.0 - 2.5ns (0.0 - 0.14m)



2.5 - 5.0ns (0.14 - 0.28m)



5.0 - 7.5ns (0.28 - 0.42m)



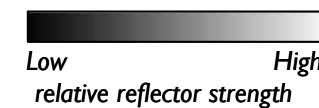
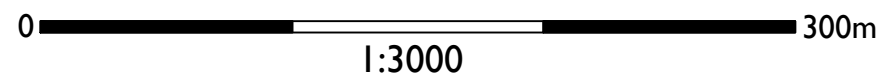
7.5 - 10.0ns (0.42 - 0.57m)



10.0 - 12.5ns (0.57 - 0.71m)



12.5 - 15.0ns (0.71 - 0.85m)





# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

GPR amplitude time slices between 15.0 and 30.0ns (0.85 to 1.70m), July 2024

15.0 - 17.5ns (0.85 - 0.99m)



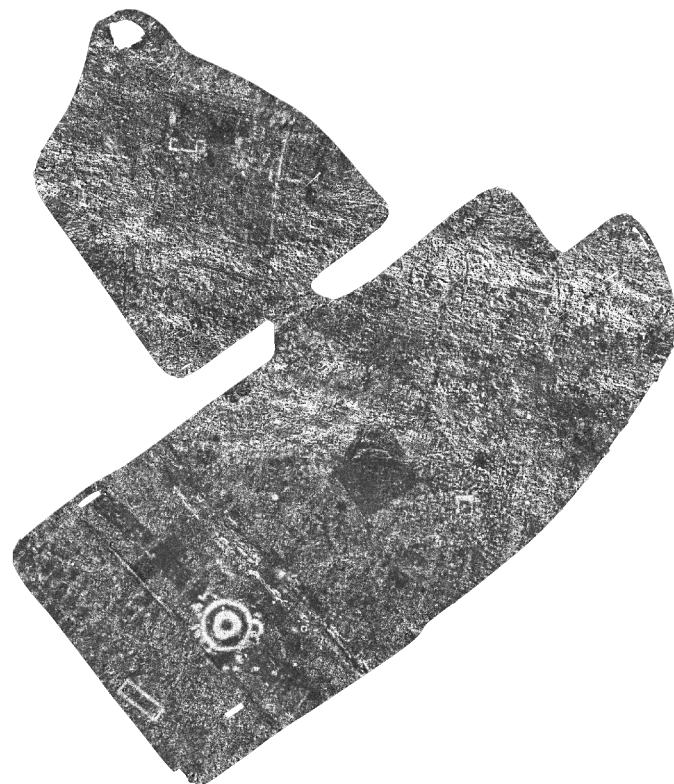
17.5 - 20.0ns (0.99 - 1.13m)



20.0 - 22.5ns (1.13 - 1.27m)



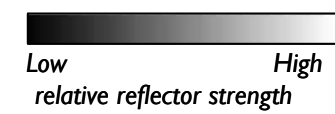
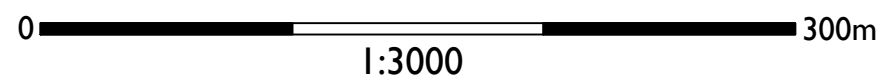
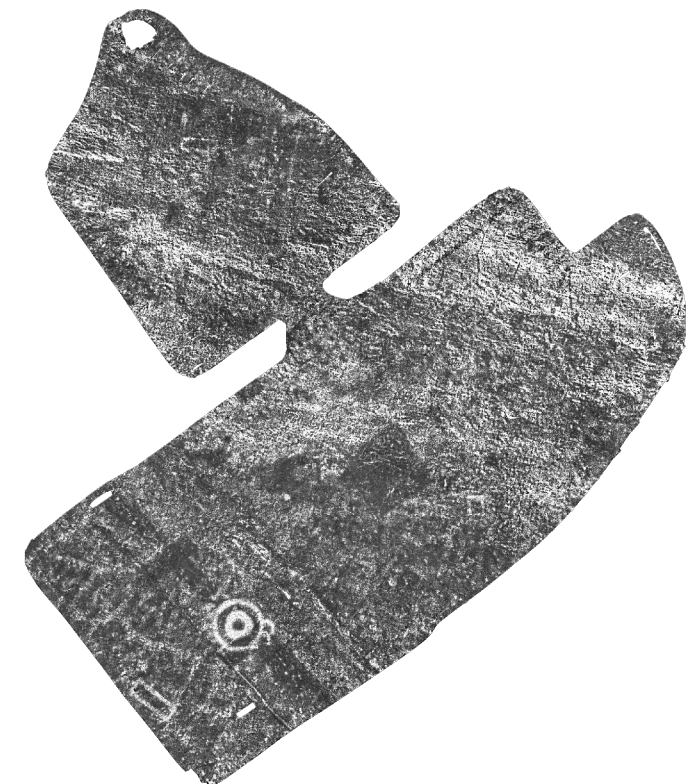
22.5 - 25.0ns (1.27 - 1.41m)



25.0 - 27.5ns (1.41 - 1.55m)



27.5 - 30.0ns (1.55 - 1.70m)

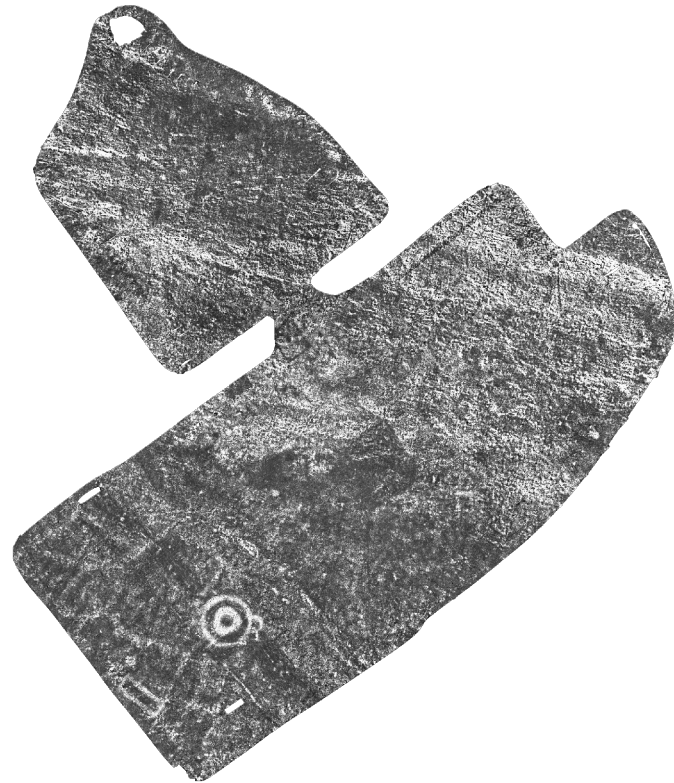




# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

## GPR amplitude time slices between 30.0 and 45.0ns (1.70 to 2.54m), July 2024

30.0 - 32.5ns (1.70 - 1.84m)



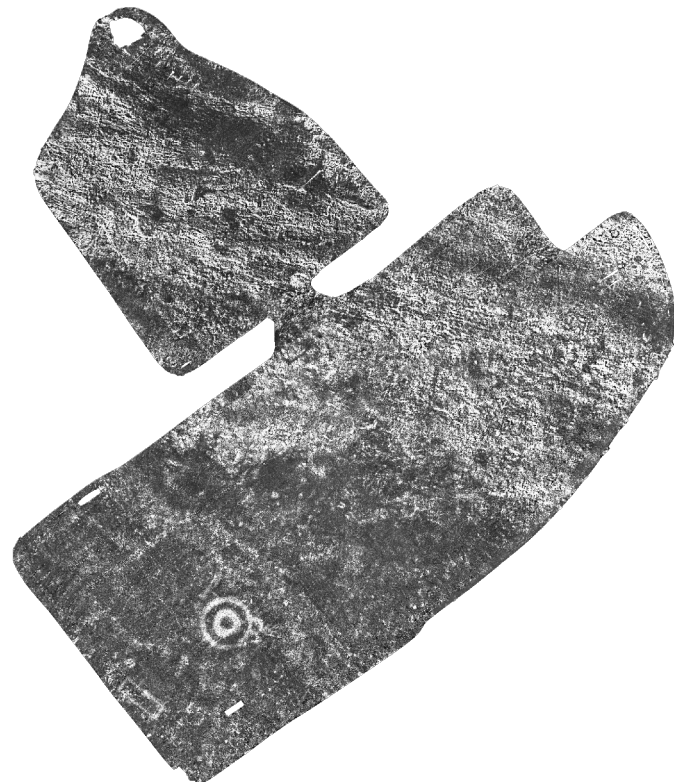
32.5 - 35.0ns (1.84 - 1.98m)



35.0 - 37.5ns (1.98 - 2.12m)



37.5 - 40.0ns (2.12 - 2.26m)

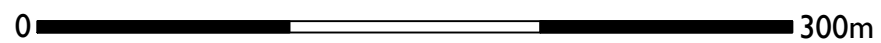



40.0 - 42.5ns (2.26 - 2.40m)



42.5 - 45.0ns (2.40 - 2.54m)



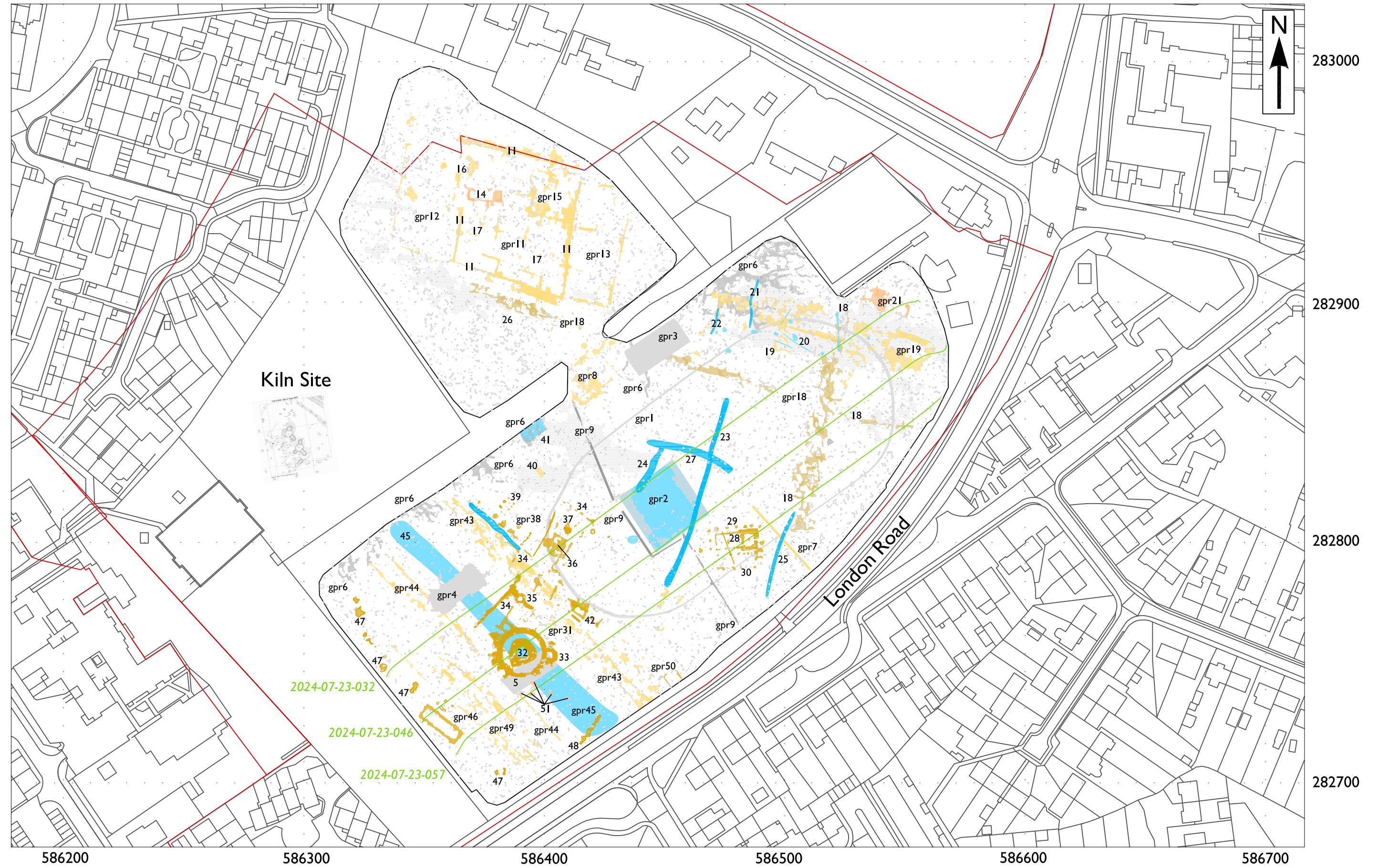
0  300m  
1:3000

Low  High  
relative reflector strength



# THETFORD TOWN OCN PROJECT: THETFORD GRAMMAR SCHOOL, THETFORD, NORFOLK

## Graphical summary of significant GPR anomalies, July 2024



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0 60m  
1:1500

Low amplitude anomalies	Anomalies of known or recent origin
High amplitude anomalies	Extent of Scheduled Monument

near-surface discrete anomalies [gpr10]

Location of selected GPR profiles shown on Figure 4  
2024-07-23-001



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