SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Abbey Farm, Ground Penetrating Radar Survey

Hoxne, Suffolk

Client:
Mr Wilf White

Date:
December 2017

HXN 004
Geophysical Survey Report
SACIC Report No. 2017/107
Author: Timothy Schofield HND BSc MCIfA

Abbey Farm, Ground Penetrating Radar Survey, Hoxne, Suffolk HXN 004

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Author: Timothy Schofield

Illustrator: Timothy Schofield

Editor: John Craven

Report Date: December 2017

HER Information

Site Code:	**HXN 004**
Site Name:	**Abbey Farm, Hoxne, Suffolk**
Report Number	**2017/107**
Date of Fieldwork:	**28th – 29th September 2017**
Grid Reference:	**TM 7640 1830**
OASIS Reference:	**301547**
Historic England Case No.	**SL00168349**
Section 42 License Reference:	**AA/044753/5**
Curatorial Officer:	**Will Fletcher, Historic England**
Project Officer:	**Timothy Schofield**
Client/Funding Body:	**Mr Wilfred White**

Digital report submitted to Archaeological Data Service:
http://ads.ahds.ac.uk/catalogue/library/greylit

Disclaimer

Any opinions expressed in this report about the need for further archaeological work are those of Suffolk Archaeology CIC. Ultimately the need for further work will be determined by the Local Planning Authority and its Archaeological Advisors when a planning application is registered. Suffolk Archaeology CIC cannot accept responsibility for inconvenience caused to the clients should the Planning Authority take a different view to that expressed in the report.

Prepared By: Timothy Schofield
Date: December 2017

Approved By: John Craven
Position: Project Manager
Date: December 2017
Signed: 

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Summary

In September 2017 Suffolk Archaeology Community Interest Company (SACIC) undertook a detailed ground penetrating radar survey within the grounds of Abbey Farm, Hoxne, Suffolk, which lies within the former boundary of the Benedictine Hoxne Priory, a Scheduled Monument. This followed on from preceding reconnaissance earth resistance meter and targeted detailed earth resistance meter surveys, both undertaken in April 2017.

The GPR survey was successful in recording anomalies of a structural derivation in greater detail than previously prospected by the earth resistance meter surveys. Anomalies indicative of walls and rubble spreads, likely to relate to the medieval Priory and the post-medieval farmhouse were present within the datasets.

Plate 1. View towards Abbey Farm, Area 2, facing east

1. Introduction

A detailed ground penetrating radar survey (GPR) covering an area of 0.18 hectares within the grounds of Abbey Farm, Hoxne, Suffolk (Fig. 1) was undertaken by Suffolk Archaeology Community Interest Company (SACIC) in September 2017.

Abbey Farm occupies the site of the former Hoxne Priory, a monument recorded on the Suffolk Historic Environment (HER No. HXN 004) and designated in part as a Scheduled Monument (National Heritage List for England (NHLE) No. 1020447). The project was commissioned by the owner of the property Mr Wilf White, as part of his personal research into the sites history, following a discussion with Dr Will Fletcher (Inspector of Ancient Monuments (Beds, Norfolk and Suffolk, Historic England) and Dr Abby Antrobus Suffolk County Council Archaeological Service).

Abbey Farm and its gardens form a rectangular enclosure of *c*. 1.5ha, bordered by Abbey Hill to the west and south where it is bounded by a curtilage wall. An associated complex of largely 19th century farm buildings are extant to the north and a series of linear ponds are present to the east. The farmhouse and gardens, ponds, farm complex and the 0.36ha property of Moatfield to the north, together occupy the western half of the grounds of the former Benedictine Priory that was established in the 12th to 13th centuries. Abbey Farm is believed to have contained various buildings associated with the monastic complex.

Although the general boundary of the Priory precinct is known and survives as a traceable feature in the modern landscape, with substantial survival of the ponds and fishponds within the Priory grounds, there are no surviving structures apart from a section of medieval wall present in the curtilage wall. The layout and location of Priory buildings has also been largely unknown. An earth resistance meter survey, commissioned by Mr White and undertaken by the SACIC geophysical survey team in April 2017 (Schofield, 2017) was therefore an important opportunity to investigate the site, comprising broad-ranging reconnaissance earth resistance survey followed by a more targeted detailed earth resistance meter survey on the southern lawn of the farmhouse. Anomalies indicative of building structures relating to the Priory, former wings of the 16th century farmhouse and pits and ditches of possible archaeological derivation were prospected.

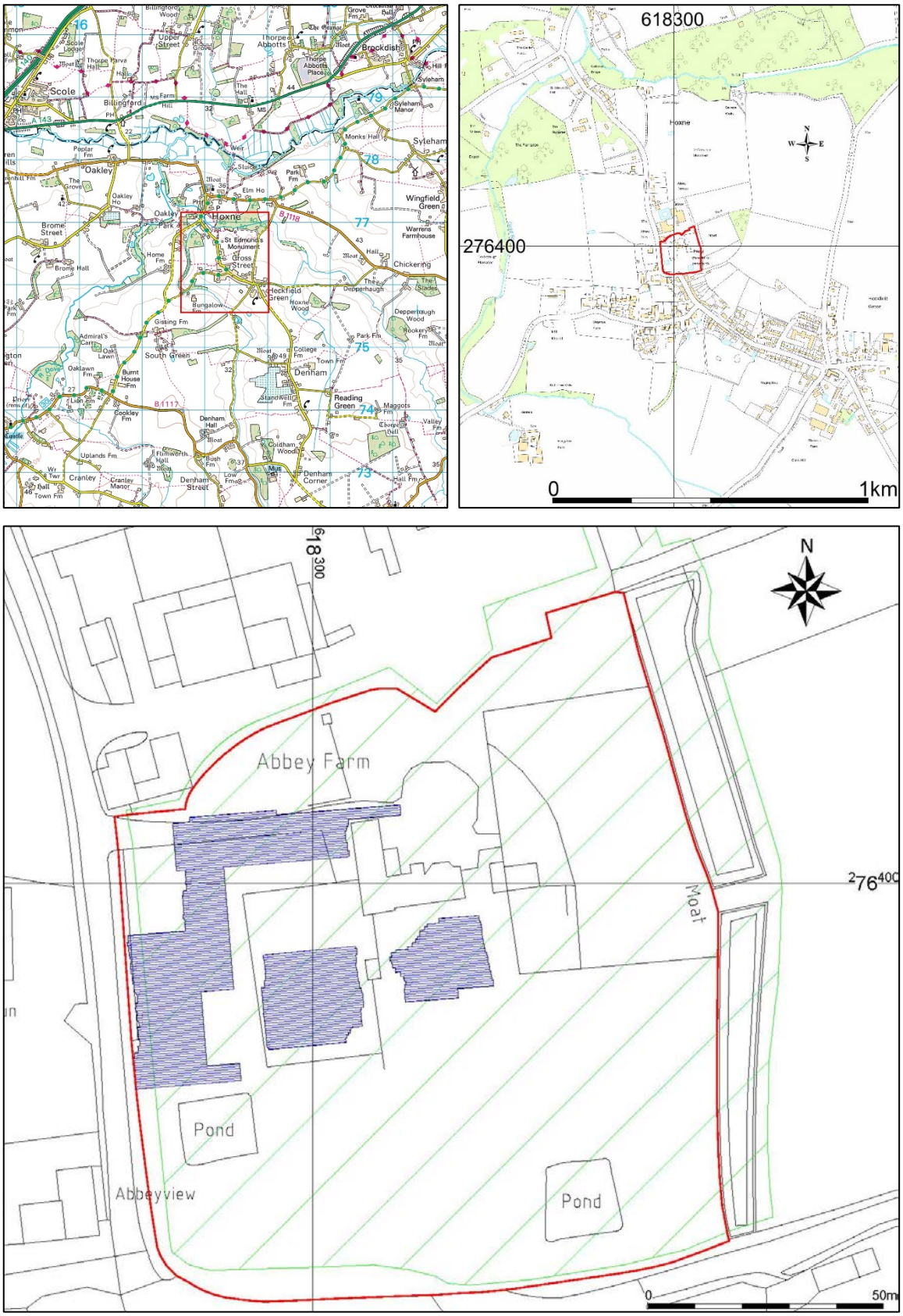

Figure 1. Site location plan (Site boundary in red, GPR transects in blue, Scheduled Monument in green)

This current phase of ground penetrating radar survey, funded by SACIC with a contribution from Mr White, has been carried out to supplement the earlier earth resistance survey, with a view to gaining further evidence relating to the medieval Priory and post-medieval layout employing non-intrusive means.

2. Geology and topography

The Farm lies at the northern end of a plateau of high ground, *c.* 40m above Ordnance Datum (AOD), which extends southeast through Cross Street to Heckfield Green. To the north, the natural topography descends towards the confluence of the Goldbrook and Chickering Beck and the settlement core of Low Street. The prevailing topography within the site (centred on NGR TM 7640 1830) slopes down from 42m in the south to 37

m AOD in the north.

Bedrock geology is described as Norwich Crag Formation Sand, deposited up to 5 million years ago in the Quaternary and Neogene Periods in shallow seas as mud, silt, sand and gravel. Superficial deposits are described as Lowestoft Formation Diamicton, deposited up to 2 million years ago in the Quaternary Period below glaciers as moraines of till with outwash sand and gravel from seasonal and post glacial meltwaters (BGS, 2017).

3. Archaeology and historical background

The following is a shortened summary of that provided in the previous earth resistance survey report (Schofield 2017).

Hoxne was an important parish for the early Christian church in the Late Anglo-Saxon and early medieval periods, by the later Anglo-Saxon period being established as a Bishopric. The parish also has a long association with the legend of the martyrdom of St Edmund in 870 AD and the Priory was centred on a Chapel of St Edmund which may have had pre-conquest origins, before being restored and rebuilt in the early 12th century. The Priory was founded by charter in 1130, with monks taking residence in the early 13th century. Rebuilding and enlargement continued into the 15th century.

The description of the Scheduled Monument in the NHLE states that *'Hoxne Priory was a small house of six or seven monks under a prior or warden who was appointed by the prior of Norwich. Shortly before the Dissolution of the Monasteries the last prior, William Castleton, conveyed the property of the cell to Sir Richard Gresham and the monks were recalled to Norwich…. Details of the priory buildings and precinct are recorded in account rolls of Norwich Priory dating chiefly from the 14th and 15th centuries. In addition to the chapel the buildings comprised a hall subdivided by a parclose (screen) where the monks would have taken their communal meals, a parlour, a dormitory with a chamber over it, and offices including a kitchen, bakehouse, dairy and brewery. In the surrounding precinct were a malthouse, dovecote and stables, closes for threshing and winnowing, fishponds, a garden in the southern part, and a cemetery enclosed by a wall. There was also a cistern, presumably to collect water for domestic use, and a well - known as St Edmund's Well.'*

Of the medieval buildings, the only structure that visibly survives today is a length of flint wall incorporated into the Grade II listed curtilage wall (NHLE No. 1374922), which extends south for 90m from the modern driveway, before cornering and running for 60m to the east along the southern edge of the former precinct. This is believed to be the surviving western wall of a building depicted on a map of the estates of Lord Maynard in Hoxne, Chickering, Denham, Eye and Wetheringsett in 1757 by Thomas Skynner (Fig. 2) and which subsequent mapping reveals was demolished by the mid-19th century. The earth resistance meter survey (Schofield 2017) appeared to confirm the presence of walled remains running parallel and perpendicular to the east of the upstanding flint wall, forming a long and narrow rectangular building (internal dimensions of 6.3m wide by 22.6m+ long).

Abbey Farm itself is a Grade II* Listed Building (NHLE No. 1032502) with the east wing being described in the listing as the surviving part of a larger house of *c.* 1540, said to be for Sir Richard Gresham who acquired the Priory site after the Dissolution, and an early 17th century cross-wing on the west side which extends north to form an L-shape plan. The farmhouse has more recently been described by Alston (2010) as *'a fine timber-framed structure of the late-16th century…entirely inconsistent with a date of circa 1540 and was probably built by its next owners (possibly the Thruston family) in the final quarter of the 16th century.'*

Structural remains, likely to be associated with the medieval Priory or former parts of the post-medieval house, were prospected on the lawn immediately to the south of the house, and to its northwest straddling the driveway, during the earth resistance meter survey (Schofield, 2017).

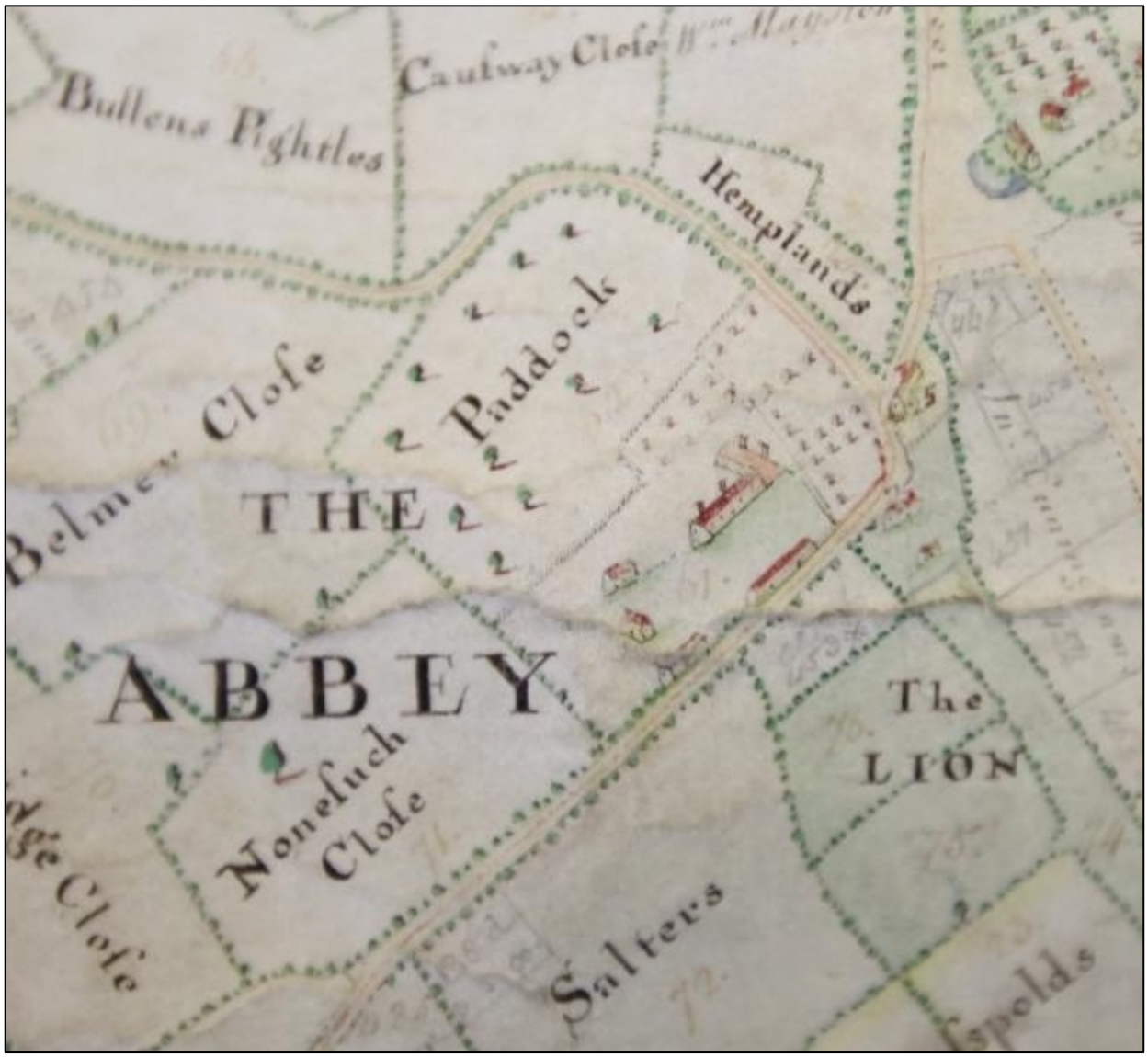

Figure 2. Extract from Skynner's estate map of 1757 depicting Abbey Farm, (north to bottom left).

4. Methodology

4.1. Introduction

The survey attempted, within the time available, to cover those areas to north, west and south of the farmhouse which had given positive results during the earth resistance meter survey, and to infill gaps in the data by including the driveway. The turning circle located to the northeast of the house was initially going to form part of the survey area but its shape proved too complex to survey.

An Utsi Electronics GroundVue 3_8 with a ground-coupled 400mHz central frequency antenna was employed. The antenna was strapped to a sled and pushed in front of a two-wheeled cart, which allowed good ground-coupling and the traverses to be recorded with ease. An on-board computer tablet with automated processing software controlled the system and recorded the data, producing amplitude time-slice representations of the survey traverse that could be viewed in real time, allowing data to be monitored for quality as it was acquired.

Data were recorded at 0.04m inline sample intervals by 0.50m traverse separation. The weather was overcast following a period of precipitation, however the ground conditions were found to be suitable.

4.2. Survey traverse layout

The radar traverses (Figs. 1 & 2 blue lines) were located on the same grid employed during the preceding earth resistance meter surveys, orientated east-northeast to west-southwest and geolocated employing a Leica Viva GS14 Smart Rover RTK GLONASS/GPS, allowing an accuracy of +/- 0.03m. Data were converted to National Grid Transformation OSTN15.

4.3. Data capture

Ground penetrating radar survey points were recorded on a tablet linked to a wheel-odometer trigger, data were recorded and checked for quality during the survey and further composited in the evenings, allowing traverses to be re-surveyed if required. A

proforma survey sheet detailing the number of traverses and fiducial marker locations was completed enabling the traverse composites to be created. Data were filed in unique project folders and backed up onto an external storage device and then a remote server in the evening.

4.4. Data software, processing and presentation

The ground conditions for the GPR were found to be suitable, allowing good quality data to be recorded. Data processing involved the conversion of raw data to time-domain through a time window of 0 – 60ns, using ReflexW 2D. Time zero was adjusted to the level of the true ground surface using starttime, and a background removal algorithm was run on the data. Suitable 'y' gain was employed to highlight late arrivals.

A 3D cube was created in ReflexW 3D, which enabled the production of timeslice data. The geometry file, raw files, processed files, cube files, timeslices and .mpg files will be stored and archived in this format. Detailed processing algorithm schedules are presented in Appendix 1.

Timeslice data was exported out of ReflexW 3D, into Terrasurveyor as raster images, these images were then imported into AutoCAD. An interpretation plan based on the combined timeslice results (Figs. 4a and 4b) has been produced (Fig. 5) with a plot comparing the GPR to earth resistance meter anomaly interpretations (Fig. 6).

5. Results

The ground penetrating radar survey was targeted in five areas to further investigate anomalies of high archaeological potential (Figs. 3 - 6) initially prospected during the preceding earth resistance meter survey. Four of the five areas were suitable for illustrating here. Due to a technical equipment error the data recorded in Area 1 proved to be too incomplete to be usable and has been discarded.

5.1. Area 2

Area 2 was located just to the north of the walled garden and lies partially over the tarmacadam drive to the south of Area 1; both these areas were targeted to further investigate structural anomalies recorded during the earth resistance meter survey.

A single linear anomaly (blue line) first recorded as a low amplitude response at 13.01ns (0.76m) that resolves into a high amplitude reflector at 15.60ns (0.90m) is indicative of a service pipe trench, containing a service pipe. This anomaly corresponds with the location of a scar in the tarmacadam drive.

A single rectangular anomaly (blue hatching) recorded initially as a high amplitude response at 0.11ns (0.01m) is indicative of an inspection chamber, however the cover was not witnessed during the survey, therefore it is likely to be buried below the gravelled drive. An associated service trench run was not prospected in the dataset.

High amplitude linear anomalies (red hatching) on northeast to southwest and perpendicular alignments are potentially indicative of structural remains, present from 4.5ns to 20ns (0.20m – 1.15m) in the dataset. These anomalies are interesting because they differ in orientation to the current boundary configuration and may provide evidence of a separate, previously unknown phase of construction on site.

The GPR survey data reveals a series of potential structures that were not recorded in the resistance meter data of Area 2. A single high resistance response recorded centre-north of the high amplitude anomalies however, may prove to be evidence for an associated building structure straddling the driveway.

5.2. Area 3

Area 3 is situated along the only extant remains of the Priory; this flint stone and lime mortar wall is now part of the more modern brick curtilage wall that surrounds the southern and western boundary. This area was chosen for GPR survey to further target structural anomalies recorded parallel and perpendicular to the upstanding remains, during the preceding earth resistance meter survey.

Plate 2. View towards the curtilage wall, Area 3, facing west

Narrow high amplitude linear anomalies (red hatching) were recorded from 12.50ns until 28ns (0.45m - 1.00m), running parallel and perpendicular to the remains of the extant Priory wall; the shorter perpendicular anomaly was prospected where the end of the extant Priory wall currently terminates, this rectangular building has internal dimensions of 6.3m wide, by 22.6m+ long. The two walls do not join, and there appears to be a clear gap (3.30m) in between, which may indicate an entrance way or could reveal that the building material has been completely removed from this section.

Six discrete high amplitude responses (orange hatching) were recorded within close proximity, and in some cases abutting the narrow high amplitude linear anomalies from 1.75 to 25ns (0.06m - 0.90m) in the dataset. It is likely that these high amplitude readings delineate the location of building rubble material associated with the former Priory walls.

Both survey instruments have recorded buried walls and demolition material with good correlation in Area 3, however the higher density sampling of the GPR reveals increased clarity of the structural anomalies prospected in its dataset. A low resistance anomaly present within the earth resistance meter dataset to the south and north of the structure was not prospected by the GPR, highlighting the advantages of undertaking multiple instrument surveys over the same area.

5.3. Area 4

Area 4 was positioned on the lawn to the south of Abbey Farm, targeting high resistance linear anomalies interpreted as walls and building rubble remains, previously prospected during the earth resistance meter survey.

The ground penetrating radar survey recorded six high amplitude linear anomalies (red hatching) aligned north-northwest to south-southeast and perpendicular, found between 5.5 and 25.5ns (0.23 - 1.10m). These responses are indicative of walls whose layout follows the current house and walled-garden configuration.

Plate 3. View towards Abbey Farm, Area 4, facing north

The combined geophysical survey datasets recorded in Area 4 reveal good correlation between anomalies prospected by the two instruments. Walled structures likely to be

associated with the post-medieval farmhouse and walled-garden, but possibly also the earlier Priory, were recorded by both instruments, but are presented in greatest clarity within the GPR dataset.

5.4. Area 5

Area 5 was located within the walled-garden, situated in-between Areas 3 and 4, and had anomalies of archaeological interest recorded near its eastern boundary during the preceding survey.

Two high amplitude linear reflectors (red hatching) orientated north-northwest to south-southeast and perpendicular were recorded in the centre of the dataset, found between 12 and 22.5ns (0.43 - 0.81m) that likely record the remains of adjoining walls. The anomaly running north-northwest to south-southeast abruptly stops, suggesting that the rest of its length has been removed for re-use elsewhere. These walls are most similarly aligned with the remains of the Priory to the west and are therefore perhaps more likely to be associated with the medieval phase rather than the post-medieval house and walled-garden structures.

Plate 4. View towards Abbey Farm, Area 5, facing northeast

A single discrete increased amplitude response (orange hatching) diffuse in character,

was found in the northwestern corner of the dataset, arriving at 10.3ns (0.37m) and departing at 25ns (0.90m). It is recorded abutting the edge of the wall located to its east and is consistent with building rubble remains.

Large broad areas of diffuse high amplitude readings (green hatching) were recorded where garden borders are extant. On similar orientations to these garden borders are narrow high amplitude reflectors (green lines) recorded in the near surface that are likely to be indicative of garden border edging.

The higher resolution GPR survey in Area 5 has recorded perpendicular abutting walls that were not prospected during the lower resolution earth resistance meter survey. However, the earth resistance meter could be operated in closer proximity to the extant walled-garden boundary where it recorded two broad linear anomalies on similar orientations that may prove to abut the high amplitude linear anomalies found in the GPR dataset.

6. Conclusions

The results of the ground penetrating radar survey have proven to both complement and, in the case of the structural remains, improve the clarity of anomalies recorded by the preceding earth resistance meter survey undertaken in April 2017. The main achievement of the two projects has been to demonstrate that substantial archaeological evidence for structures dating to the medieval and post-medieval periods appears to survive below the ground surface of the Scheduled Monument. The anomalies recorded with greatest clarity are those that have a well-defined surface, particularly apparent where structural remains were encountered.

The modern layout of the gardens caused the survey areas to be isolated, small and irregular with incomplete coverage, which has caused difficulties when interpreting the results and assigning dates and overall structure layout. The extent of the medieval building to the west has been well established, with a southern wall closely corresponding to the southern limit of the extant medieval flintwork in the curtilage wall (Area 3). In the walled garden (Area 5) further walls on a similar orientation may also be associated with medieval structures. The structural remains recorded to the north in Areas 1 and 2 are of an uncertain date, being on a separate orientation to both the known medieval building and the extant farmhouse. Prospected to the south of the farmhouse (Area 4) are a series of anomalies that could be associated with the Priory or former parts of the post-medieval Abbey Farm.

There is still good potential for future geophysical surveys, particularly if they are undertaken at higher resolutions and if above ground obstructions such as trees *etc*. are ever removed. Based on the current evidence it seems highly likely that further remains relating to the medieval Priory and the post-medieval farmhouse could eventually be identified, which may assist in developing a greater understanding of the Priory layout.

However geophysical survey has its limitations and it seems probable that there would be continuing uncertainty as to the extent and phasing of this structural evidence. The site has clear potential for archaeological investigation, that could now be targeted to within specific locations with a view to ‘ground-truthing’ the survey results, but the benefit of any such investigation would have to be weighed against the impact it would have upon the Scheduled Monument.

7. Archive deposition

The paper and digital archive will be held by SACIC in Needham Market, Suffolk. Digital and hard copies of the report and dataset will be deposited with the Suffolk Historic Environment Record in due course.

8. Acknowledgements

Suffolk Archaeology CIC would primarily like to thank Mr Wilf White for commissioning the project and, in keeping with our role as a Community Interest Company, are pleased to have been able to contribute by subsidising, in part, the costs of survey and reporting.

The project was managed by John Craven. The survey was directed by Tim Schofield and the fieldwork was carried out by Cameron Bate and Tim Schofield, with volunteer assistance from John Craven. The report and illustrations were created by Tim Schofield, with contributions and editing by John Craven.

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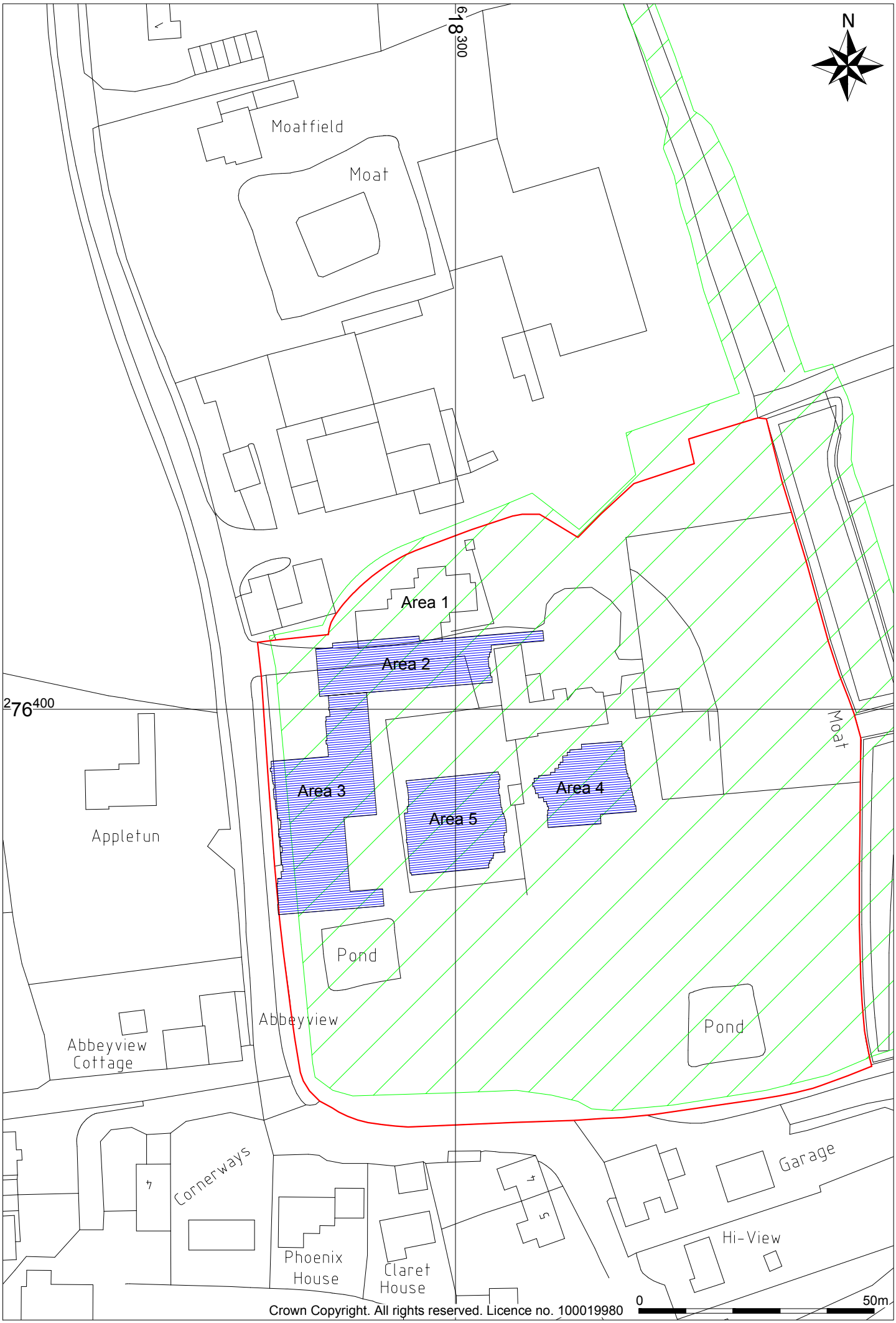

Fig. 3. Site, survey traverses and scheduled monument (green hatching) location

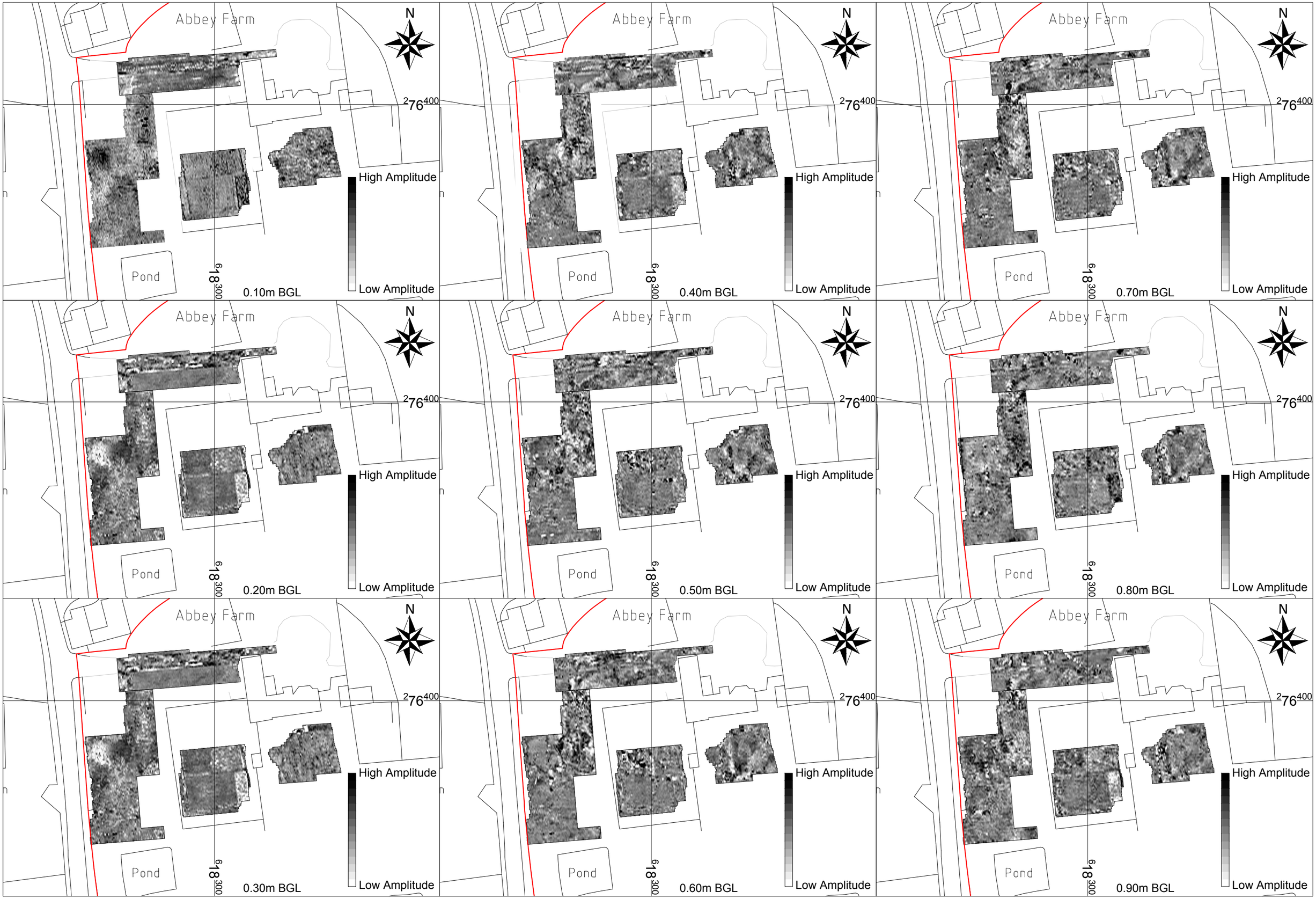

Fig. 4a. Ground penetrating radar, greyscale timeslice plots, 0.00 - 0.90m

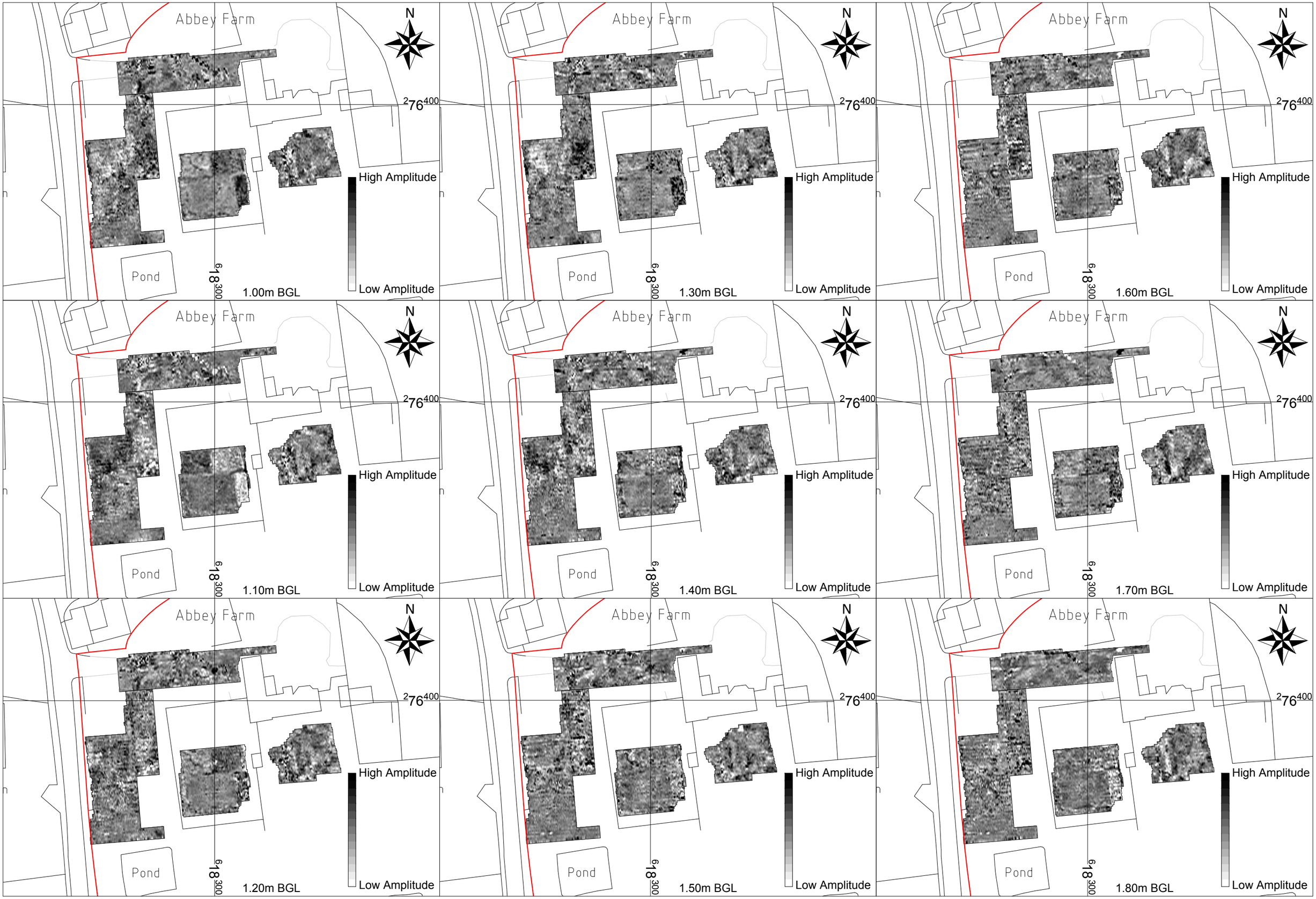

Fig. 4b. Ground penetrating radar, greyscale timeslice plots, 1.00 - 1.80m

Fig. 5. Interpretation plot of ground penetrating radar anomalies

High amplitude linear, structural remains	
Increased response, discrete anomaly, archaeology	
Narrow high amplitude linear anomaly, garden feature	
Area of disturbance, garden feature	
High amplitude response, modern Tarmacadam road	
Large high amplitude response, inspection chamber	
Linear response, service pipe and trench backfill deposit	
High resistance anomaly, building structure remains	
Low resistance anomaly, moisture rich material flanking structural remains	
High resistance discrete / increased response, archaeology?	
Low resistance discrete, archaeology?	
Low resistance anomaly, flower beds	
High resistance discrete / increased response, geology?	

Fig. 6. Combined interpretation plot of GPR and earth resistance meter anomalies

Appendix 1. Metadata sheets

Area1

Area 1 data was not suitable for reproduction in the report.

Area 2

Traverses

Traverses: 22
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DOCUMENTS121017_102_CH1.DAT
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DOCUMENTS121017_121_CH1.DAT
DOCUMENTS121017_122_CH1.DAT

Processed Data

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Collection Method	ZigZag
Sensors	1 x 400MHZ antenna
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	1251 x 25
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Grid Size	50 m x 12.5 m
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Y Interval	0.5 m
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Max	3365.07
Min	-4498.53
Std Dev	692.10
Mean	1.08
Median	0.00
Composite Area	0.06255 ha
Programs	
Name	ReflexW 2D/3D v.8.5.4
Name	TerraSurveyor v.3.0.33.6

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3. subtract-DC-shift / 0 / 60
4. bandpassfrequency / 50 / 200 / 800 / 1000
5. bandpassbutterworth / 200 / 800
6. background removal / 0 / 56.83594
7. manual gain (y)
8. Kirchhoff migration / 13 / 0.1163 / 0 / 56.83594

Area 3

Traverses

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DOCUMENTS121017_186_CH1.DAT
DOCUMENTS121017_187_CH1.DAT
DOCUMENTS121017_188_CH1.DAT
DOCUMENTS121017_189_CH1.DAT
DOCUMENTS121017_190_CH1.DAT
DOCUMENTS121017_191_CH1.DAT
DOCUMENTS121017_192_CH1.DAT

Processed Data

Description	
Instrument Type	Surfer ASCII
Units	MHz
Direction of 1st Traverse	0 deg
Collection Method	ZigZag
Sensors	1 x 400MHZ antenna
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	576 x 91
Survey Size (meters)	23 m x 45.5 m
Grid Size	23 m x 45.5 m
X Interval	0.04 m
Y Interval	0.5 m
Stats	
Max	3302.00
Min	-4222.00
Std Dev	882.43
Mean	0.97
Median	0.00
Composite Area	0.10483 ha
Programs	
Name	ReflexW 2D/3D v.8.5.4
Name	TerraSurveyor v.3.0.33.6

Processes

1. Move starttime / -3
2. subtract-mean(dewow) / 60
3. subtract-DC-shift / 0 / 60
4. bandpassfrequency / 50 / 200 / 800 / 1000
5. bandpassbutterworth / 200 / 800
6. background removal / 0 / 57.1875
7. manual gain (y)
8. Kirchhoff migration / 9 / 0.0717 / 0 / 57.1875

Area 4

Traverses

Traverses: 34
DOCUMENTS121017_100_CH1.DAT
DOCUMENTS121017_101_CH1.DAT
DOCUMENTS121017_102_CH1.DAT
DOCUMENTS121017_103_CH1.DAT
DOCUMENTS121017_104_CH1.DAT
DOCUMENTS121017_105_CH1.DAT
DOCUMENTS121017_106_CH1.DAT
DOCUMENTS121017_107_CH1.DAT
DOCUMENTS121017_108_CH1.DAT
DOCUMENTS121017_109_CH1.DAT
DOCUMENTS121017_110_CH1.DAT
DOCUMENTS121017_111_CH1.DAT
DOCUMENTS121017_112_CH1.DAT
DOCUMENTS121017_113_CH1.DAT
DOCUMENTS121017_114_CH1.DAT
DOCUMENTS121017_115_CH1.DAT
DOCUMENTS121017_116_CH1.DAT
DOCUMENTS121017_117_CH1.DAT
DOCUMENTS121017_118_CH1.DAT
DOCUMENTS121017_119_CH1.DAT
DOCUMENTS121017_120_CH1.DAT
DOCUMENTS121017_121_CH1.DAT
DOCUMENTS121017_122_CH1.DAT
DOCUMENTS121017_123_CH1.DAT
DOCUMENTS121017_124_CH1.DAT
DOCUMENTS121017_125_CH1.DAT
DOCUMENTS121017_126_CH1.DAT
DOCUMENTS121017_127_CH1.DAT
DOCUMENTS121017_128_CH1.DAT
DOCUMENTS121017_129_CH1.DAT
DOCUMENTS121017_130_CH1.DAT
DOCUMENTS121017_131_CH1.DAT
DOCUMENTS121017_132_CH1.DAT
DOCUMENTS121017_133_CH1.DAT

Processed Data

Description	
Instrument Type	Surfer ASCII
Units	MHz
Direction of 1st Traverse	0 deg
Collection Method	ZigZag
Sensors	1 x 400MHZ antenna
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	576 x 37
Survey Size (meters)	23 m x 18.5 m
Grid Size	23 m x 18.5 m
X Interval	0.04 m
Y Interval	0.5 m
Stats	
Max	3641.00
Min	-3352.00
Std Dev	594.59
Mean	0.16
Median	0.00
Composite Area	0.042624 ha
Programs	
Name	ReflexW 2D/3D v.8.5.4
Name	TerraSurveyor v.3.0.33.6

Processes

1. Move starttime / -3
2. subtract-mean(dewow) / 60
3. subtract-DC-shift / 0 / 60
4. bandpassfrequency / 50 / 200 / 800 / 1000
5. bandpassbutterworth / 200 / 800
6. background removal / 0 / 57.1875
7. manual gain (y)
8. Kirchhoff migration / 9 / 0.0717 / 0 / 57.1875

Area 5

Traverses

Traverses: 40
DOCUMENTS121017_100_CH1.DAT
DOCUMENTS121017_101_CH1.DAT
DOCUMENTS121017_102_CH1.DAT
DOCUMENTS121017_103_CH1.DAT
DOCUMENTS121017_104_CH1.DAT
DOCUMENTS121017_105_CH1.DAT
DOCUMENTS121017_106_CH1.DAT
DOCUMENTS121017_107_CH1.DAT
DOCUMENTS121017_108_CH1.DAT
DOCUMENTS121017_109_CH1.DAT
DOCUMENTS121017_110_CH1.DAT
DOCUMENTS121017_111_CH1.DAT
DOCUMENTS121017_112_CH1.DAT
DOCUMENTS121017_113_CH1.DAT
DOCUMENTS121017_114_CH1.DAT
DOCUMENTS121017_115_CH1.DAT
DOCUMENTS121017_116_CH1.DAT
DOCUMENTS121017_117_CH1.DAT
DOCUMENTS121017_118_CH1.DAT
DOCUMENTS121017_119_CH1.DAT
DOCUMENTS121017_120_CH1.DAT
DOCUMENTS121017_121_CH1.DAT
DOCUMENTS121017_122_CH1.DAT
DOCUMENTS121017_123_CH1.DAT
DOCUMENTS121017_124_CH1.DAT
DOCUMENTS121017_125_CH1.DAT
DOCUMENTS121017_126_CH1.DAT
DOCUMENTS121017_127_CH1.DAT
DOCUMENTS121017_128_CH1.DAT
DOCUMENTS121017_129_CH1.DAT
DOCUMENTS121017_130_CH1.DAT
DOCUMENTS121017_131_CH1.DAT
DOCUMENTS121017_132_CH1.DAT
DOCUMENTS121017_133_CH1.DAT
DOCUMENTS121017_134_CH1.DAT
DOCUMENTS121017_135_CH1.DAT
DOCUMENTS121017_136_CH1.DAT
DOCUMENTS121017_137_CH1.DAT
DOCUMENTS121017_138_CH1.DAT
DOCUMENTS121017_139_CH1.DAT

Processed Data

Description	
Instrument Type	Surfer ASCII
Units	MHz
Direction of 1st Traverse	0 deg
Collection Method	ZigZag
Sensors	1 x 400MHZ antenna
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	551 x 47
Survey Size (meters)	22 m x 23.5 m
Grid Size	22 m x 23.5 m
X Interval	0.04 m
Y Interval	0.5 m
Stats	
Max	5268.00
Min	-4317.00
Std Dev	574.39
Mean	0.09
Median	0.00
Composite Area	0.051794 ha
Programs	
Name	ReflexW 2D/3D v.8.5.4
Name	TerraSurveyor v.3.0.33.6

Processes

1. Move starttime / -3
2. subtract-mean(dewow) / 60
3. subtract-DC-shift / 0 / 60
4. bandpassfrequency / 50 / 200 / 800 / 1000
5. bandpassbutterworth / 200 / 800
6. background removal / 0 / 56.83594
7. manual gain (y)
8. Kirchhoff migration / 15 / 0.0797 / 0 / 56.83594

Appendix 2. Technical data

Ground penetrating radar

Ground penetrating radar instruments are particularly suited for prospecting for features that have well-defined surfaces, gradual changes are less likely to be prospected. Therefore, when a feature such as a wall or service pipe is traversed it will be recorded with good clarity, equally a void within a structure can be easily detected. It has relatively slow data collection speed, especially where high resolution surveys are required, it is therefore usually targeted where favourable anomalies are likely to be found, or where other geophysical survey techniques do not work. This instrument performs well on manmade surfaces, for example Tarmacadam or concrete, but also within fen environments and on sites with flat even ground.

Electro-magnetic radiation

Ground penetrating radar (GPR) uses radar pulses to image the subsurface with electromagnetic radiation in the very high frequency (VHF) microwave band of the radio spectrum, between 10 and 1000mhz. A transmitter is employed to emit an electromagnetic pulse into the ground, when a change in the boundary between materials or a buried object is encountered, the energy from the pulse is either reflected, refracted or scattered back to the receiving antenna that records these variations.

The best results from a ground penetrating radar survey are achieved where well defined changes in the electromagnetic properties of deposits are encountered, gradual change is more complicated to detect. Ground penetrating radar is therefore good at prospecting for service pipes, buried buildings and changes in stratigraphic soil horizons, it can also record voids within structures.

Depth measurement can also be estimated depending on the soil types encountered. Dry sandy soils or objects that contain low moisture content, for example building materials or stone bedrock, tend to be resistive rather than conductive and therefore a few meters of depth penetration can be gained. Conversely in moist and/or clayey soils and in materials that have high electrical conductivity, penetration can be as little as a few centimetres. The centre frequency transmitted by the antenna, and the radiated power may also limit the effective depth range of the GPR survey.

Higher frequencies do not penetrate the ground as deep as lower frequency antennas, however higher frequency antennas do provide better resolution compared with those of a lower frequency. Therefore, the operating frequency will always be a compromise between acquiring high enough resolution with the need for gaining sufficient depth penetration.

Utsi GroundVue ground penetrating radar

An UTSI GroundVue single frequency Ground Penetrating Radar (GPR) system can be deployed with a variety of antennas, for archaeological purposes a 400MHz central frequency antenna is commonly employed. The antenna is strapped to a two-wheeled cart and placed on a skid pad that allows traverses to be recorded with relative ease whilst maintain good ground coupling. An on-board computer tablet with automated processing software controls the system and records the data, producing amplitude time-slice representations of the survey traverse, that can be viewed in real time, allowing data to be monitored for quality as it is acquired.

Ground penetrating radar anomalies

High amplitude anomalies are strong and well defined, they can be caused by walls, foundations, culverts, vaults and service pipes, these anomalies can be discrete or linear trends.

Increased amplitude anomalies are usually weaker and less well defined but could be of potential archaeological derivation, for example rubble spreads, or anomalies that form good contrast patterns of potential archaeological derivation.

Low amplitude anomalies, offer little contrast and form incomplete patterns, they are of potential archaeological origin however a modern or natural derivation cannot be ruled out.

Earth resistance meter

The earth resistance meter is commonly deployed to investigate specific features. It is particularly suited in prospecting for targets with both high and low moisture content relative to the natural soil, for example highly resistive (moisture less) features like stone or brick built structures or compacted banks and low resistive (moisture rich) features like rubbish pits or ditches. It has relatively slow data collection speeds especially where high resolution surveys are required, therefore it is more widely used to investigate known or expected types of favourable targets or to further investigate anomalies recorded by another instrument.

Soil resistance

The earth's soil has an electrical property known as conductivity or low resistance, which can be exploited by geophysical surveyors when prospecting for archaeological features. Naturally occurring minerals within the soil can be broken down by rainwater forming electrolytes, which further break down into positive and negative ions. When a current is inserted into the ground these ions will either attract or repel the current, driving it through the matrix along the path of least resistance.

Two sets of probes are employed to measure the relative resistance of the soil matrix; the first are the current probes which inject an electrical signal into the soil that is measured by a second set of potential probes recording the current's density. Archaeological features contain varying amounts of soil moisture, for example a loose moisture-rich pit or ditch will allow an injected electrical current to pass through it with relative ease, increasing the current density whilst decreasing the potential gradient and recording a low resistance anomaly within the dataset. Conversely a wall or road that is structurally dense, will repel the current, driving it above and below the feature on its journey through the matrix, decreasing the current density and increasing the potential gradient recording a high resistance anomaly.

Earth Resistance Meters

A single twin (pole-pole) probe array was employed to undertake this survey, using one set of mobile probes that along with the instrument box are mounted to the frame, recording individual data points within the survey grid, and remote probes that are located at least 15m beyond the edge of the grid to avoid feedback. The remote probes act as a

static control station that the mobile probe readings are measured against. A 50m cable connects the remote probes to the instrument box; to progress the survey the static station will need to be moved. A control reading is taken before and after the remote probes are moved, to enable grid matching from one section to another. The mobile probes are mounted 0.5m apart on the frame, with the remote probes pushed into the ground approximately 3 – 4m apart. Once the mobile probes are placed onto the ground surface an electrical circuit is formed between the current electrodes of the remote and mobile probes; the potential gradient between the remote and mobile probes is then automatically recorded by the instrument. Removing the mobile probes from contact with the ground resets the instrument ready for the next point, as soon as the probes touch the ground a circuit is once again formed; this point is then auto-logged by the instrument.

Resistance anomalies

Discrete anomalies

Discrete anomalies can be recorded with both high and low resistance, those with low resistance are likely to be moisture-rich and those with high resistance are likely to have low moisture content compared with the surrounding matrix. Examples of low resistance anomalies include naturally occurring pockets of differing material within the geology, tree hollows or throws, glacial infilling of natural hollows, ponds, culturally excavated and backfilled storage or rubbish waste pits. High resistance anomalies are recorded where naturally occurring stone deposits, structural post pads, kilns, oven and hearth, furnace linings, rubble dumps and dried out hard or compacted fills are encountered.

Linear trends

Linear anomalies can also be either high or low resistance. Once again those with low resistance are likely to be moisture rich and conversely those with high resistance are likely have a low moisture content. Examples of low resistance linear trends include periglacial troughs, agricultural or settlement ditches, service run trenches. Examples of high resistance linear anomalies include geological rock formations, buried foundations, walls, metalled tracks or road surfaces, ditch banks.

Appendix 3. OASIS form

OASIS ID: suffolka1-301547

Project details	
Project name	Abbey Farm, Hoxne, Suffolk, Ground Penetrating Radar Survey
Short description of the project	In September 2017 Suffolk Archaeology Community Interest Company (SACIC) undertook a detailed ground penetrating radar survey within the grounds of Abbey Farm, Hoxne, Suffolk, which lies within the former boundary of the Benedictine Hoxne Priory, a Scheduled Monument. This followed on from a preceding reconnaissance earth resistance meter and targeted detailed earth resistance meter surveys, both undertaken in April 2017. The GPR survey was successful in recording anomalies of a structural derivation in greater detail than previously prospected by the earth resistance meter surveys. Anomalies indicative of walls and rubble spreads, likely to relate to the medieval Priory and the post-medieval farmhouse were present within the datasets.
Project dates	Start: 12-10-2017 End: 13-10-2017
Previous/future work	Yes / Not known
Any associated project reference codes	HXN 004 - Sitecode
Type of project	Field evaluation
Site status	Scheduled Monument (SM)
Current Land use	Residential 1 - General Residential
Monument type	ANOMALIES INDICATIVE OF A PRIORY Medieval
Monument type	ANOMALIES INDICATIVE OF BUILDING RUBBLE Medieval
Monument type	ANOMALIES INDICATIVE OF WALLS ASSOCIATED WITH A POST-MEDIEVAL HOUSE Post Medieval
Monument type	ANOMALIES INDICATIVE OF DEMOLITION RUBBLE LAYERS Post Medieval
Significant Finds	NONE None
Methods & techniques	"'Geophysical Survey"'
Development type	None
Development type	Not recorded
Prompt	Scheduled Monument Consent
Position in the planning process	Not known / Not recorded
Solid geology (other)	Norwich Crag Formation Sand
Drift geology (other)	Lowestoft Formation Diamicton
Techniques	Ground penetrating radar
Project location	
Country	England
Site location	SUFFOLK MID SUFFOLK HOXNE Abbey Farm, Hoxne, Suffolk
Study area	0.18 Hectares
Site coordinates	TM 7640 1830 51.794153463516 2.009017017335 51 47 38 N 002 00 32 E Point
Height OD / Depth	Min: 37m Max: 42m

Project creators	
Name of Organisation	Suffolk Archaeology CIC
Project brief originator	Historic England
Project design originator	Tim Schofield
Project director/manager	John Craven
Project supervisor	Timothy Schofield
Type of sponsor/funding body	Landowner
Name of sponsor/funding body	Mr Wilfred White

Project archives	
Physical Archive Exists?	No
Digital Archive recipient	Suffolk HER
Digital Contents	"Survey"
Digital Media available	"Database","GIS","Geophysics","Images raster / digital photography","Images vector","Moving image","Survey","Text"
Paper Archive recipient	Suffolk HER
Paper Contents	"Survey"
Paper Media available	"Report","Survey ","Unpublished Text"

Project bibliography	
Publication type	Grey literature (unpublished document/manuscript)
Title	Abbey Farm, Ground Penetrating Radar Survey Hoxne, Suffolk
Author(s)/Editor(s)	Schofield, T. P.
Other bibliographic details	2017/107
Date	2017
Issuer or publisher	Suffolk Archaeology CIC
Place of issue or publication	Needham Market
Description	A4 bound report with A3 fold-out figures

Appendix 4

Historic England Geophysical Survey Summary Questionnaire

Survey Details

Name of Site: Abbey Farm, Hoxne

County: Suffolk

NGR Grid Reference (Centre of survey to nearest 100m): TM 7640 1830

Start Date: 28/09/2017 **End Date:** 29/09/2017

Geology at site (Drift and Solid):

Bedrock geology is described as Norwich Crag Formation Sand. Superficial deposits are described as Lowestoft Formation Diamicton. (BGS website, 2017).

Known archaeological Sites/Monuments covered by the survey
(Scheduled Monument No. or National Archaeological Record No. if known)

Remains of Hoxne Priory at Abbey Farm. NHLE No. 1020447.

Archaeological Sites/Monument types detected by survey
(Type and Period if known. "?" where any doubt).

Anomalies indicative of building structures related to the medieval Priory and former wings of the 16th century farmhouse, modern garden features and service runs were prospected.

Surveyor (Organisation, if applicable, otherwise individual responsible for the survey):

Tim Schofield, Suffolk Archaeology CIC

Name of Client, if any:

Mr Wilf White
Abbey Farm
Hoxne
Suffolk

Historic England

Purpose of Survey:

The survey was commissioned by the owner of Abbey Farm as a part of his personal research into the history of the site, the primary objective being to further investigate anomalies indicative of building structures relating to the former Benedictine Priory and/or demolished wings associated with the post-medieval Abbey Farmhouse.

Location of:

a) Primary archive, i.e. raw data, electronic archive etc:

Suffolk Archaeology CIC
Unit 5, Plot 11, Maitland Road
Lion Barn Industrial Estate
Needham Market, Suffolk, IP6 8NZ

A copy of the digital archive will be submitted to the Suffolk HER

b) Full Report:

Suffolk Archaeology CIC
Unit 5, Plot 11, Maitland Road
Lion Barn Industrial Estate
Needham Market, Suffolk, IP6 8NZ

A copy of the report archive will be submitted to the Suffolk HER

Historic England

Technical Details

(Please fill out a separate sheet for each survey technique used)

Type of Survey (Use term from attached list or specify other):

Ground Penetrating Radar

Area Surveyed, if applicable (In hectares to one decimal place):

0.18ha

Traverse Separation, if regular: 0.50m **Reading/Sample Interval:** 0.04m

Type, Make and model of Instrumentation:

Utsi Electronics GroundVue 3_8, with ground-coupled 400mHz central frequency antenna.

Land use at the time of the survey (Use term/terms from the attached list or specify other):

Garden lawn

Additional Remarks (Please mention any other technical aspects of the survey that have not been covered by the above questions such as sampling strategy, non standard technique, problems with equipment etc.):

Suffolk Archaeology CIC
Unit 5 | Plot 11 | Maitland Road | Lion Barn Industrial Estate
Needham Market | Suffolk | IP6 8NZ

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