PN 1529

Sarehole Mill:
Geophysical survey 2007

Checked by

Supervisor……………………………………... date…………………

Project Manager……………………….….. date…………………

Project No. 1529

Sarehole Mill:

Geophysical Survey 2007

By

Mark Kincey

For

Birmingham Tolkien Group (BTG)

For further information please contact:
Alex Jones (Director)
Birmingham Archaeology
The University of Birmingham
Edgbaston
Birmingham B15 2TT
Tel: 0121 414 5513
Fax: 0121 414 5516
E-Mail: bham-arch@bham.ac.uk
Web Address: http://www barch.bham.ac.uk/bufau

Sarehole Mill

Geophysical Survey 2007.

CONTENTS

FIGURES

SUMMARY

A geophysical survey was carried out in the car park area at Sarehole Mill, Birmingham (SP 0988 8182) on 30th May 2007. The survey was undertaken to determine whether remains of a mill predating the 18th century were on a different site to the existing mill and survive under the modern car park. The survey used a ground-penetrating radar system with a 400 MHz antenna and calibrated survey wheel. A number of features of possible archaeological origin were revealed, along with some which were clearly due to the modern land use of the site. A series of high amplitude linear features possibly indicate the presence of below ground structural remains, although further work is required to clarify these interpretations.

SAREHOLE MILL

GEOPHYSICAL SURVEY, 2007.

• INTRODUCTION

• Background to the project

Birmingham Archaeology was commissioned to undertake a programme of geophysical survey at Sarehole Mill (hereinafter referred to as the site). The work is being carried out as a research project on behalf of the Birmingham Tolkien Group (BTG).

This report outlines the results of a ground-penetrating radar (GPR) survey carried out on 30th May 2007, and has been prepared in accordance with the Institute of Field Archaeologists Standards and Guidance for Archaeological Evaluations (IFA 2001).

The survey conformed to a brief produced by Birmingham City Council (Appendix 1), and a Written Scheme of Investigation (Birmingham Archaeology 2007).

• LOCATION AND GEOLOGY

The site is located on the north side of Cole Bank Road, Hall Green, Birmingham, and is centred on NGR SP 0988 8182 (Figs. 1 and 2).

The underlying geology consists of glaciofluvial sands and gravels, bordered to the east of the site by alluvium (clay, silt, sand and gravel) (BGS sheet 168, Birmingham drift).

The present character of the site is as a rough gravel surface public car park for the Sarehole Mill visitor centre.

• ARCHAEOLOGICAL BACKGROUND

The first reference to a mill at Sarehole is in 1542, but it is not clear whether this refers to a new building or rebuilding of an existing mill. There was major rebuilding in the 18th and 19th centuries. The oldest surviving parts of the extant mill structure to the west of the survey area are likely to be of 18th century date.

• AIMS AND OBJECTIVES

The principle aim of the survey was to determine the presence or absence of archaeological deposits through a geophysical survey.

More specific aims were to:

- Establish whether remains of mill buildings were on a different site to the existing mill and survive under the modern car park.

- **METHODOLOGY**

- **Description of technique**

Ground-penetrating radar is an active geophysical technique involving the transmission of electromagnetic (radio) pulses from a transmitter antenna moved across the ground surface. When the pulse reaches an interface between different materials, some of the energy is reflected back to a receiving antenna whilst some travels further into the ground and is reflected from a deeper subsurface discontinuity (Gaffney and Gater 2004:47). The amplitude of the returned pulse is dependent on the velocity of the radar wave as it passes through a material. The relative dialectric permittivity (RDP) is a measure of the ability of a material to conduct the radar wave and will vary depending on the composition, porosity and moisture content of the material. The travel times of each pulse are recorded and allow an approximate depth measurement to be made by assuming a dialectric constant value, although these depths should only be considered as estimations unless accompanied by ground-truthing (David 1995:24).

- **Survey methodology**

The ground-penetrating radar survey focussed on an area measuring 21m x 30m within the Sarehole Mill car park (Fig. 2). The GPR data were collected with the SIR3000 GPR system manufactured by Geophysical Survey Systems Inc. (GSSI). The survey was carried out using a 400MHz antenna to provide a suitable combination of depth penetration and resolution of results. A calibrated survey wheel was employed for the data collection to ensure that the length of the transects was accurately recorded.

Radar scans were carried out along traverses 0.5m apart, using measuring tapes for guidance. The traverses were collected in a northwesterly unidirectional pattern to ensure that staggering between traverses did not occur. This also allowed the traverses to be extended as far as possible towards the mill stream, depending on the location of modern obstacles. The sample interval was set to record 512 samples per scan and 100 scans per metre. The range setting was set to 45 nanoseconds providing a maximum estimated depth of c. 2.10m, although it should be noted that this is an estimated depth based on an assumed dialectric value of 8.

The processing of the radar data was carried out in Radan 6.5 software. The raw traverse (.dzt) files were initially loaded into Radan for a preliminary examination prior to any processing or combining of files. The processing techniques to be applied to the datasets were first tested on several of the profiles individually until suitable parameters were obtained. A macro was created using these processing functions and applied to all of the files within the project. The processing included a time-zero correction, an FIR filter for horizontal background removal and a variable velocity migration. Following processing, the individual profiles were then combined together to form a single Radan 3D file which could subsequently be viewed as a 3-dimensional cube, allowing both plan (timeslice) and profile views of the data at varying depths. Certain timeslices were exported from Radan before being added to the GIS project and georeferenced.

The location of the survey grid was recorded on site using a Nikon Total Station. Features visible on a 1:2500 OS map were used to position the survey grid relative to its surroundings.

RESULTS

- **Introduction**

The results of the GPR survey are presented in Figs. 3-12, with a corresponding interpretation plot (Fig. 5) displaying the feature numbers referred to in the text. Anomalies highlighted on the plots have been labelled using the following classificatory scheme:

(i) **Modern features** – Anomalies which are probably the result of modern/surface features in the survey area.
(ii) **Strong discrete low amplitude responses** – Anomalies with low amplitude values and which have a clear form/outline. Low amplitude responses suggest areas of homogenous material, possible silting/dumping of material.
(iii) **Weak discrete low amplitude responses** – Anomalies with low amplitude values which are either tentatively identified or which demonstrate little clarity of form. Low amplitude responses suggest areas of homogenous material, possible silting/dumping of material (although poorly defined).
(iv) **Strong discrete high amplitude responses** – Anomalies with high amplitude values and which have a clear form/outline. Possible structural remains or compacted buried surfaces.
(v) **Weak discrete high amplitude responses** – Anomalies with high amplitude values which are either tentatively identified or which demonstrate little clarity of form. Possible structural remains, buried surface or rubble (although poorly defined).

- **Description and Interpretation**

The GPR survey has highlighted a series of anomalies within the study area, a number of which are of possible archaeological origin. The data is represented in plan form at depths of between 0.1 and 2.2 metres (Figs. 3 and 4). Ten features have been interpreted from the data (Fig. 5), with vertical radar profiles and 3D cubes also being included in the report to further illustrate these identified features (Figs 6-12). The survey area has also been overlain on the 1st Edition Ordnance Survey map of the site to aid the discussion and interpretation of the results of the survey (Fig 13).

Features 1 and 2 (Fig. 5) have been identified as relating to the modern car park. Feature 1 is a linear high amplitude response visible in the upper 0.10m of the radar cube (Fig. 3: 0.1m timeslice). The feature is located to the north of the survey area and measures 10.1m in length. This linear feature corresponds with the location of a low kerb wall defining the northern extent of the car park area and is clearly modern in origin. Feature 2 is an approximately circular anomaly exhibiting a high amplitude response around its perimeter and significant disturbance of the radar scan within the interior. The anomaly measures 6.05m in diameter and was again visible in the upper 0.10m of the radar cube (Fig. 3: 0.1m timeslice). Field observations made during the survey recorded a circular area in this location where the surface of the car park had been disturbed and numerous loose stones were present. This disturbed modern ground surface is most likely to be the cause of the response noted as feature 2.

When the vertical profiles through the GPR data were examined it was also apparent that there were a significant number of reflectors in the upper 0.3-0.5 metres below the present ground surface (Fig.6). These multiple reflectors are the result of numerous small but reflective features and are probably caused by a layer of rubble/hardcore used to level the ground immediately below the car park surface. They therefore appear to be modern in origin.

Feature 3 (Fig. 5) is a strong high amplitude response visible in the southeast corner of the survey area and between approximately 0.4 and 1.1 metres below the current ground surface (Fig. 3: 0.4m timeslice; Fig. 7). The feature has a definite linear form oriented north-south and measuring 9.25 x 2.70 metres (although the feature possibly also extends beyond the southern extent of the surveyed area). In profile this feature appears as a clearly defined reflective anomaly suggestive of buried masonry or compacted material (Figs. 8 and 9). Feature 4 (Fig. 5) is another linear high amplitude response located c.10 metres to the west of feature 3 and visible between approximately 0.4 and 1.4m below the modern ground surface (Figs. 3, 4, and 7). These two features are aligned on the same orientation and are of similar dimensions, with feature 4 measuring 11.5m in length and 2.80m in width. In profile, feature 4 is also visible as a strong reflective anomaly, again suggestive of buried masonry or a compacted surface (Figs. 10 and 11). The similarity in form, alignment, depth and dimensions between features 3 and 4 strongly suggests that they may be associated (Fig. 5). If the responses do relate to buried masonry then it is possible that they may represent two sides of a single building or enclosure.

Feature 5 is an irregular high amplitude anomaly located to the south of the survey area and measuring 4.9 x 2.3 metres (Fig. 5). Although the feature is situated at the southern extent of feature 4 it is located considerably deeper below ground, being visible between the approximate depths of 1.3 and 2.1 metres. In profile the feature appears as a very highly reflective anomaly suggesting a compacted surface such as masonry or possibly a rise in the underlying bedrock (Fig. 10 and 11). The irregular form of the anomaly and lack of associated features does not allow any further interpretative statements to be made without further fieldwork.

Feature 6 is an irregular high amplitude anomaly measuring c. 2.9 x 2.4 metres and located to the northwest of the survey area (Figs. 3 and 5). This feature is visible as a strongly reflective surface between the depths of 0.3 and 0.9 metres (Figs. 10 and 11). The feature is located at the western end of the modern kerb wall (feature 1) described above and is also close to the modern path leading down to the bridge across the mill stream. This association suggests that feature 6 may be modern in origin but it is located notably deeper in the GPR profile and so could also plausibly relate to an earlier feature.

Feature 7 is located to the west of the survey area and is visible as a high amplitude reflective surface oriented southeast-northwest measuring 8.1 x 2.3 metres (Figs. 5 and 7). The surface is first visible to the south at a depth of c.0.45 metres. It then dips considerably as it extends north, reaching a depth of c.1.45 metres at the northern extent of the survey area (Fig. 12). This feature is of potential archaeological significance, as it appears to be a compacted surface that is both oriented on, and dipping down to, the line of the mill stream. It also does not appear to be an earlier stream bank or natural ground surface as it does not extend any further east. The form and alignment of the feature is more suggestive of a metalled surface/structure. Further investigations would be required to clarify the nature and purpose of this feature.

Feature 8 (Figs. 5 and 7) is an irregular broad spread of high amplitude responses with little overall clarity of form. The feature is located to the east of the survey area and measures approximately 9.7 x 7.4 metres. In profile this feature appears as a series of irregularly spaced hyperbolae between 0.5 and 0.9 metres below the modern ground surface (Figs. 8 and 9), suggesting an area of disturbed reflective ground such as rubble. Although feature 8 is located at the northern end of feature 3 and is at a similar depth, the lack of clarity with the feature precludes any statement being made about whether the features could be associated.

Feature 9 extends from the southeastern corner of the survey area in a northerly direction, before turning northwest at the northern extent of feature 3 (Figs. 3, 4, 5 and 7). The feature is visible as a clearly defined area of low amplitude anomalies measuring over 17.2m in length and 5.1m in width. The feature first appears at a depth of 0.3m and extends down to over 2.1m, at least in a faint form. In profile (Figs. 8 and 9) feature 9 is visible as a break in the reflective layers to either side, suggesting a possible negative cut feature or area of vertically homogenous subsoil. The location of the feature running parallel and adjacent to the possible structural response at feature 3 possibly implies that the two are associated.

Feature 10 is another area of low amplitude responses, although noticeably less clearly defined than feature 9 (Figs 3, 4 and 5). The feature is located towards the centre of the survey area, between the linear high amplitude responses at features 3 and 4. The irregular concentration of low amplitude responses measures c. 5.7 metres in diameter and is visible from approximately 0.5m below the current ground surface down to at least 1.7 metres (Figs. 10 and 11). Although little more can be stated about the feature without further investigations, it is perhaps notable that the feature lies within the area bounded by the possible structural features 3 and 4 and could possibly be related to feature 9.

- **DISCUSSION**

The ground-penetrating radar survey has revealed a series of anomalies of possible archaeological origin about which tentative interpretations can be made. Perhaps the most significant features located in the survey area are the two linear features 3 and 4. The responses created by these parallel anomalies suggest the presence of clearly defined compacted features such as walls or metalled surfaces. Their similar alignment, dimensions and depth hint that they may well be associated, being part of a single structure or complex of structures. The 1884 1st Edition Ordnance Survey map of the area (Fig. 13) indicates the presence of a building to the southeast of the survey area which has since been demolished. The northwestern corner of the building appears to lie just within the survey area when the grid was overlain on the map in the GIS. The alignment and size of the building is similar to features 3 and 4 and feature 3 may represent the western side of the structure. It is therefore possible that these anomalies represent the remains of the structure visible on the 19th century map, with feature 4 possibly being part of an earlier phase of building or a structural element not recorded on the map. Further work is necessary to establish the nature of features 8 and 9, and how these relate to the linear anomalies 3 and 4.

The dipping compacted surface (feature 7) identified to the west of the survey area is also of potential archaeological significance. This feature is on a similar alignment to features 3 and 4 and appears to be sloping downwards towards the mill stream. It is possible that this feature represents an earlier path leading down to the stream crossing, or that it is the remains of part of an earlier structure. The similarity of alignment suggests that it may also relate to the building visible on the 1st Edition Ordnance Survey map.

Although the ground-penetrating radar survey has highlighted a number of features of possible archaeological significance, trial excavations would be necessary to confirm the exact nature of the geophysical anomalies and to test the hypothesis that an earlier mill existed on the site.

• ACKNOWLEDGEMENTS

Thanks are due to Councillor Michael Wilkes for his co-operation and assistance throughout the project. Thanks also go to Dr Mike Hodder, who monitored the project on behalf of Birmingham City Council. Work on site was undertaken by John Halsted and Mark Kincey. Mark Kincey produced the written report which was edited by John Halsted who also managed the project for Birmingham Archaeology. Thanks are also due to the Birmingham Tolkien Group for commissioning the project.

• REFERENCES

BGS Map Sheet 168: Birmingham Drift Geology.

David, A. 1995. *Geophysical Survey in Archaeological Field Evaluation*. English Heritage.

Gaffney, C. and Gater, J. 2004. *Revealing the Buried Past. Geophysics for Archaeologists*. Tempus, Stroud.

Institute of Field Archaeologists (IFA) 2001 *Standards and Guidance for Archaeological Evaluations*

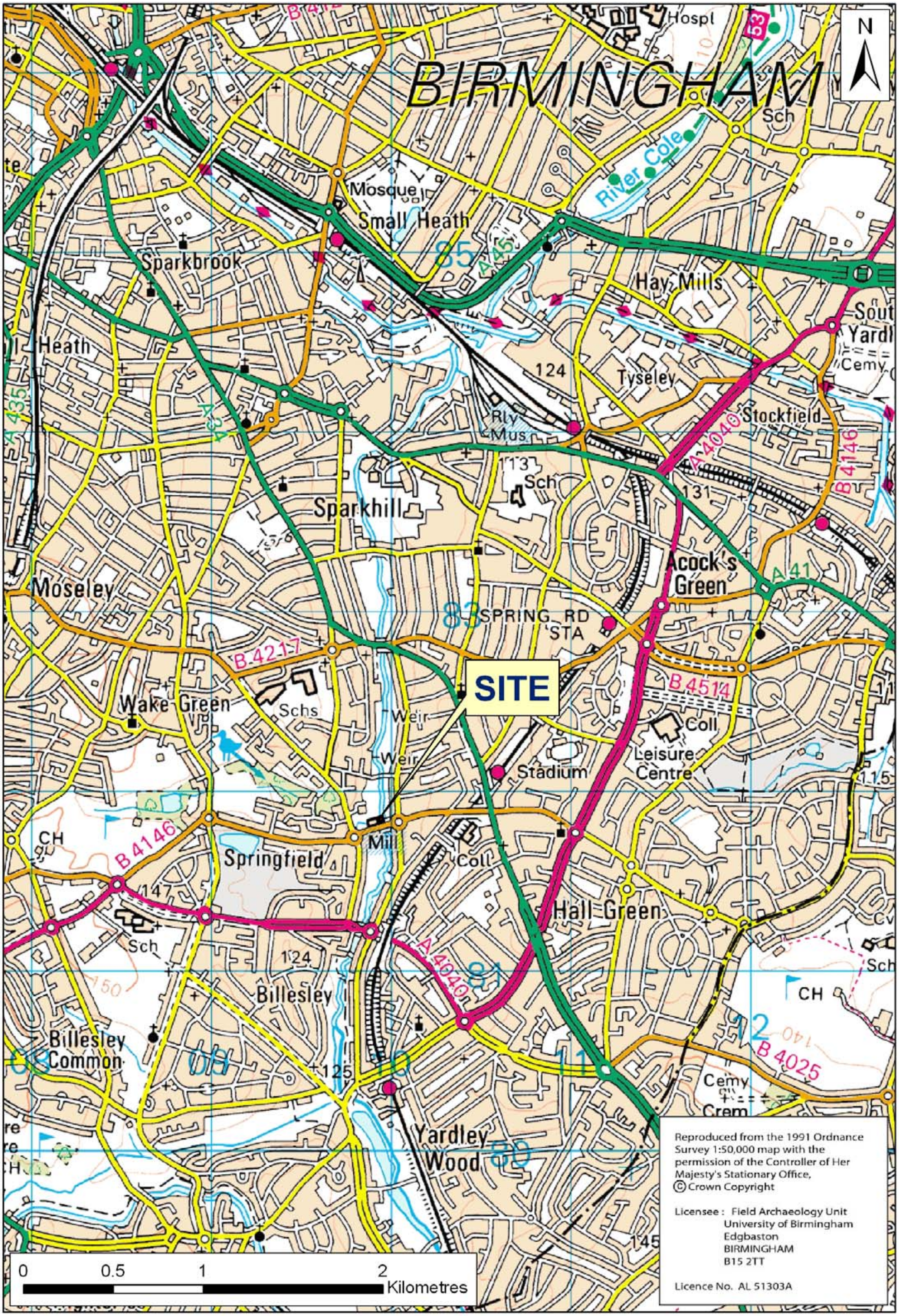


Fig. 1: Location of site

Fig. 2: Location of survey area

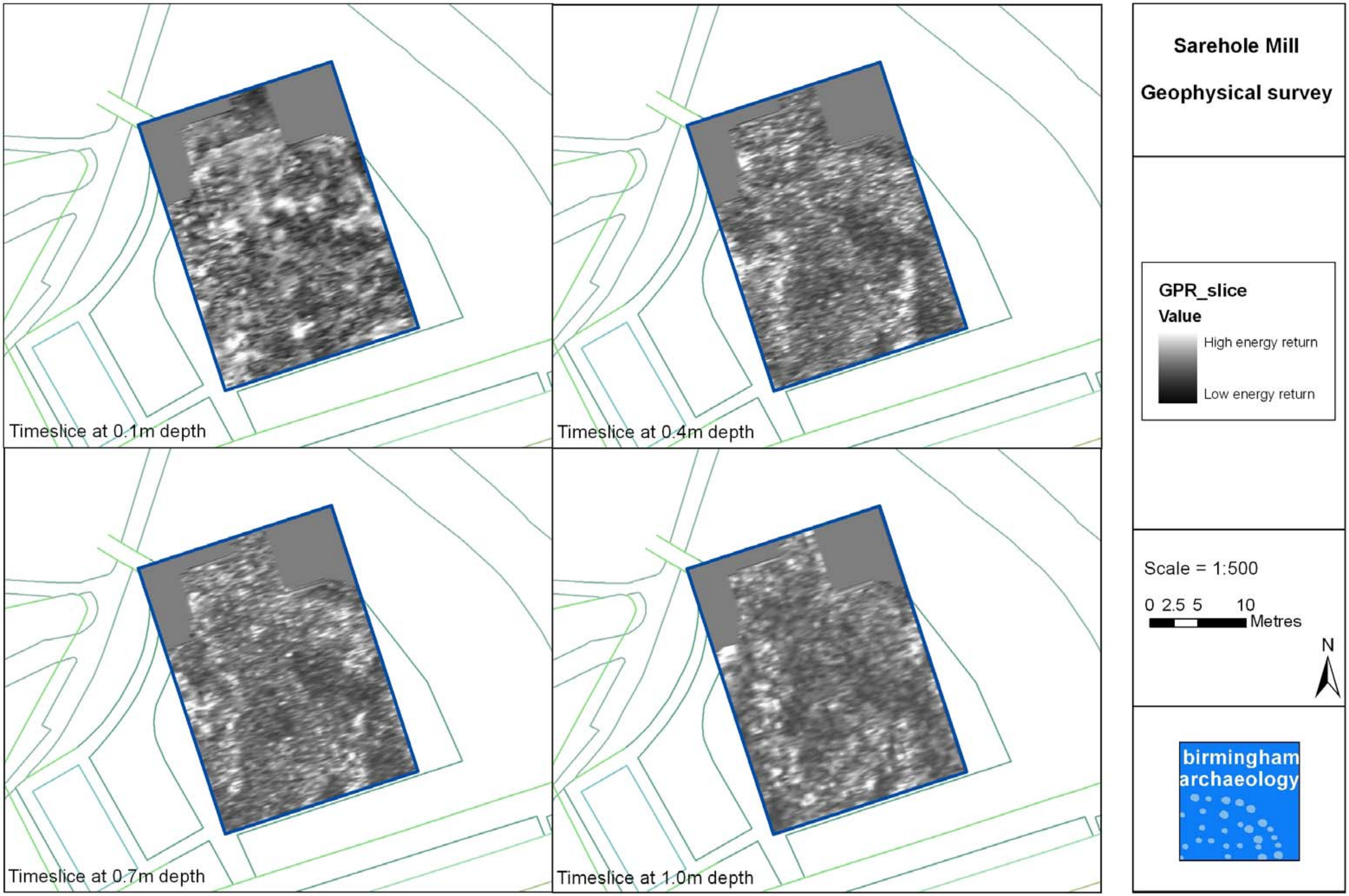


Figure 3: GPR timeslice plot at varying depths (0.1-1.0m). Slice thickness = 0.2m

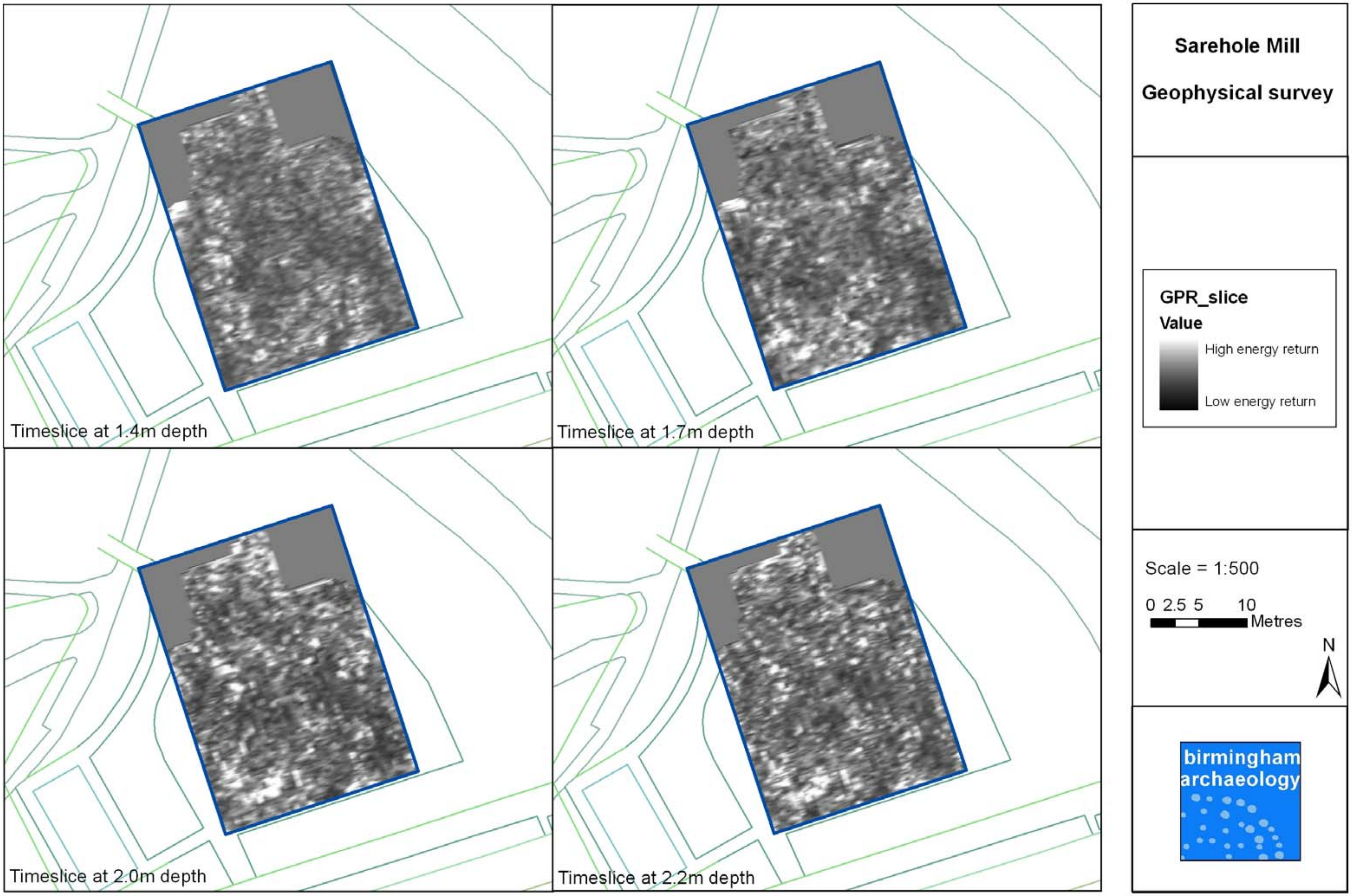


Figure 4: GPR timeslice plot at varying depths (1.4-2.2m). Slice thickness = 0.2m.

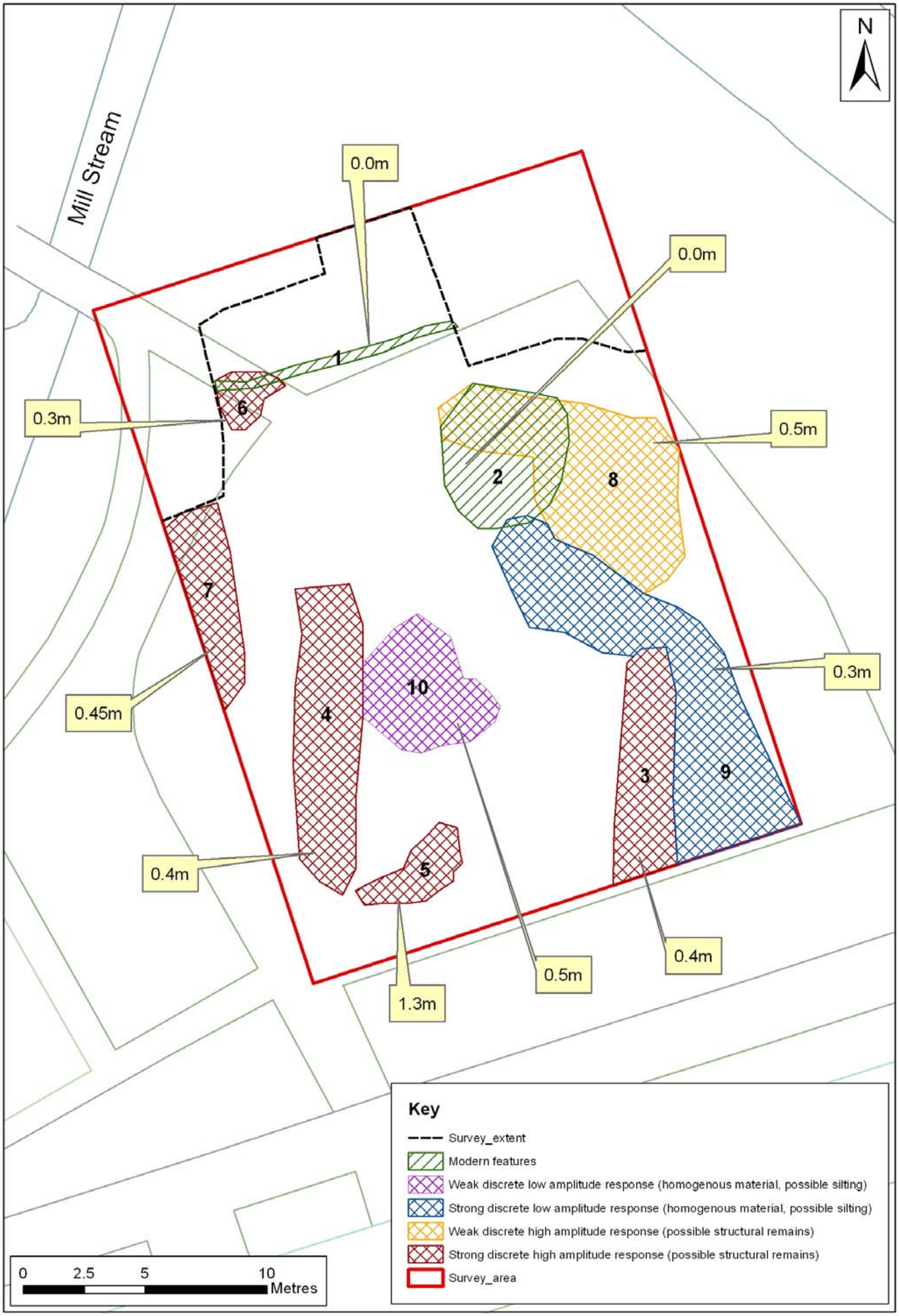


Fig. 5: Interpretation of GPR data
(measurements indicate approximate depth to top of each numbered anomaly)

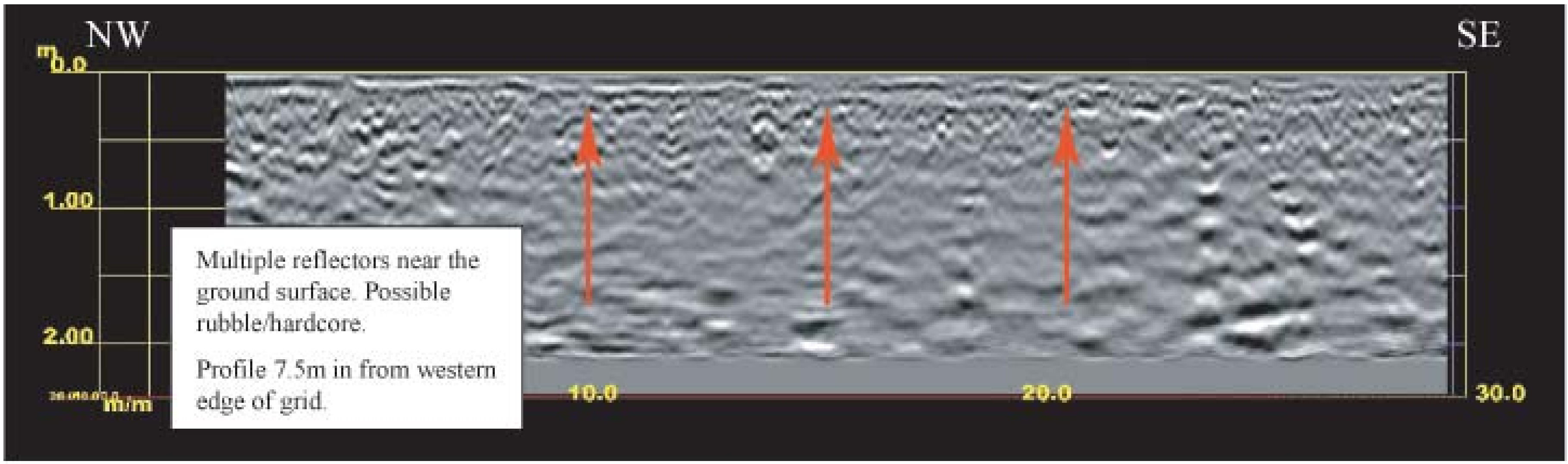


Fig. 6: GPR profile showing possible rubble/hardcore immediately below car park ground surface.

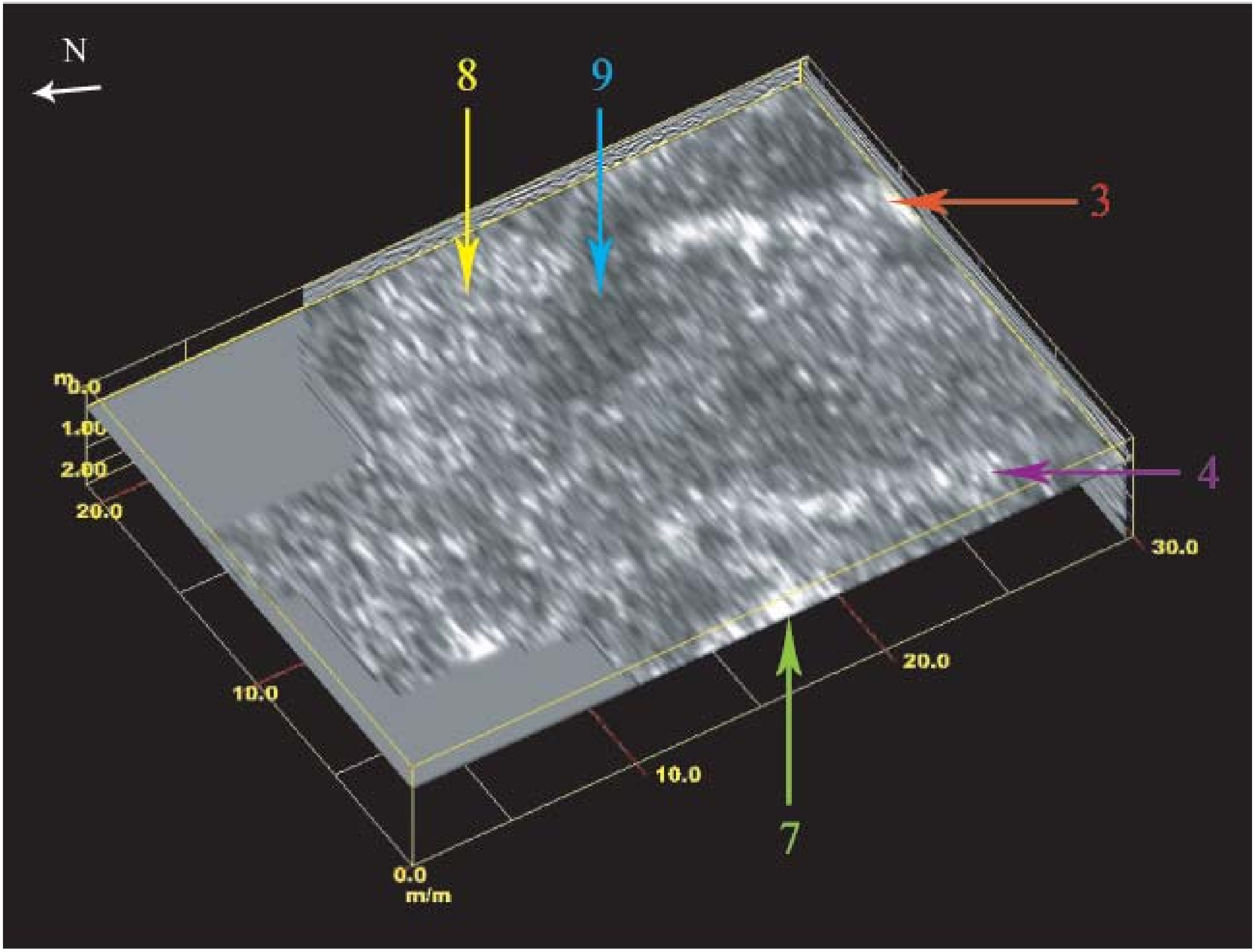


Fig. 7: 3D radar cube showing features visible on timeslice at 0.53m below ground surface
(feature numbers correspond to those shown on Fig. 5)

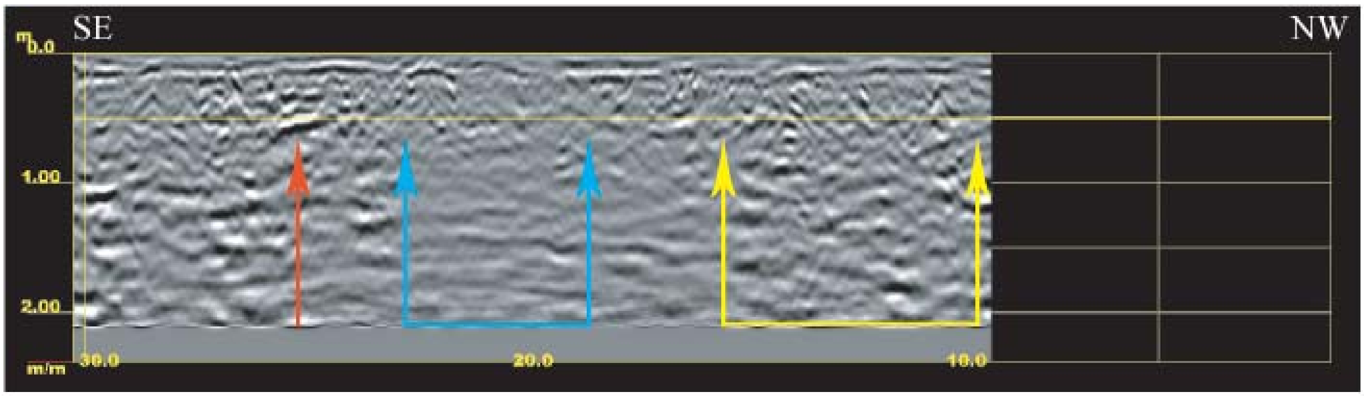


Fig. 8 (above): GPR profile showing features 3 (red), 8 (yellow) and 9 (blue). Profile is located 16m in from western edge of grid.

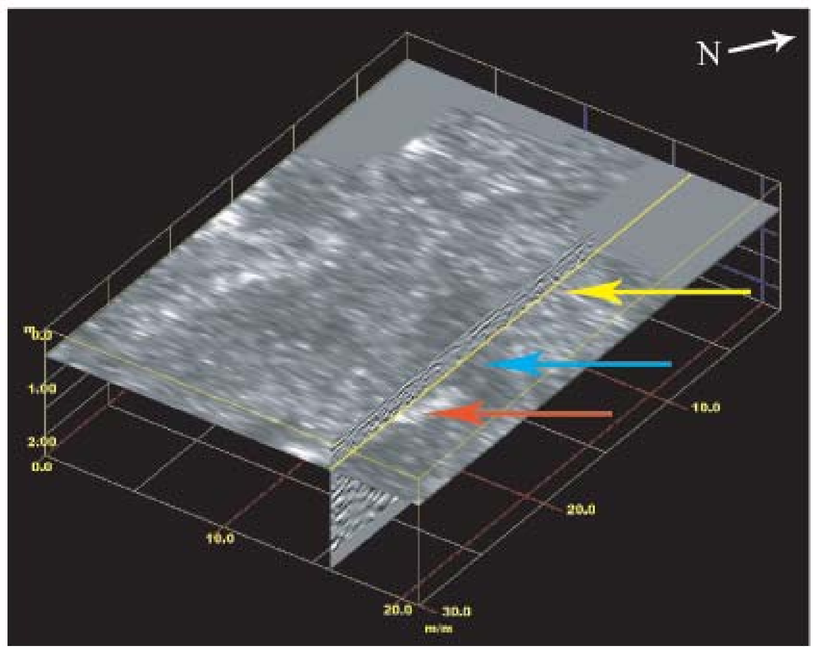


Fig. 9 (right): Three-dimensional radar cube showing location of Fig. 7 profile and features 3 (red), 8 (yellow) and 9 (blue). Timeslice is at 0.5m from ground surface.

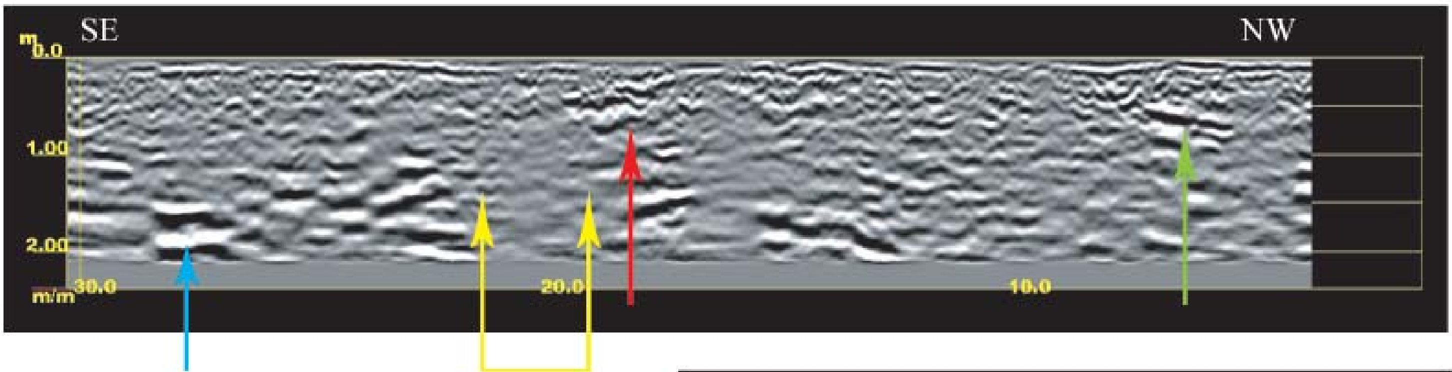


Fig. 10 (above): GPR profile showing features 4 (red), 5 (blue), 6 (green) and 10 (yellow). Profile is located 4.5m in from western edge of grid.

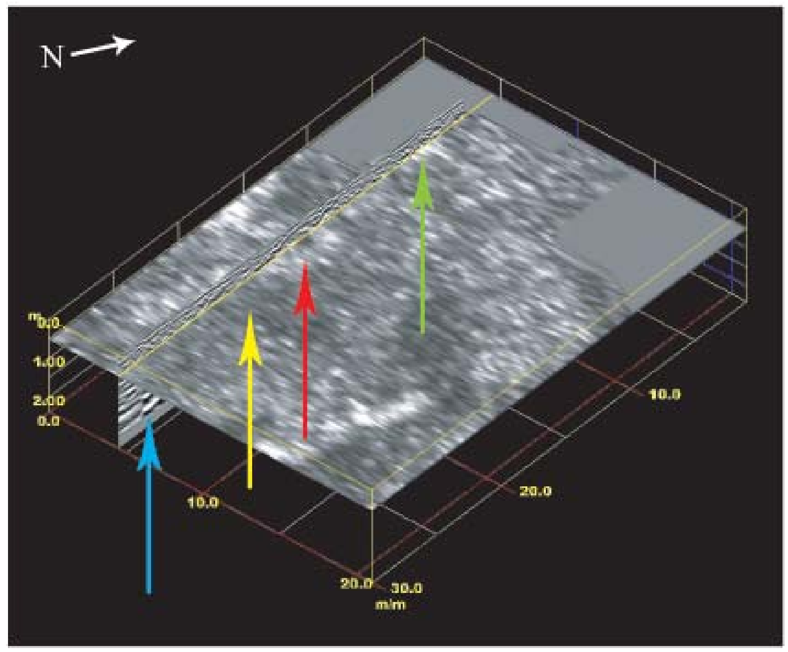


Fig. 11 (right): Three-dimensional radar cube showing location of Fig. 9 profile and features 4 (red), 5 (blue), 6 (green) and 10 (yellow). Timeslice is 0.5m from ground surface.

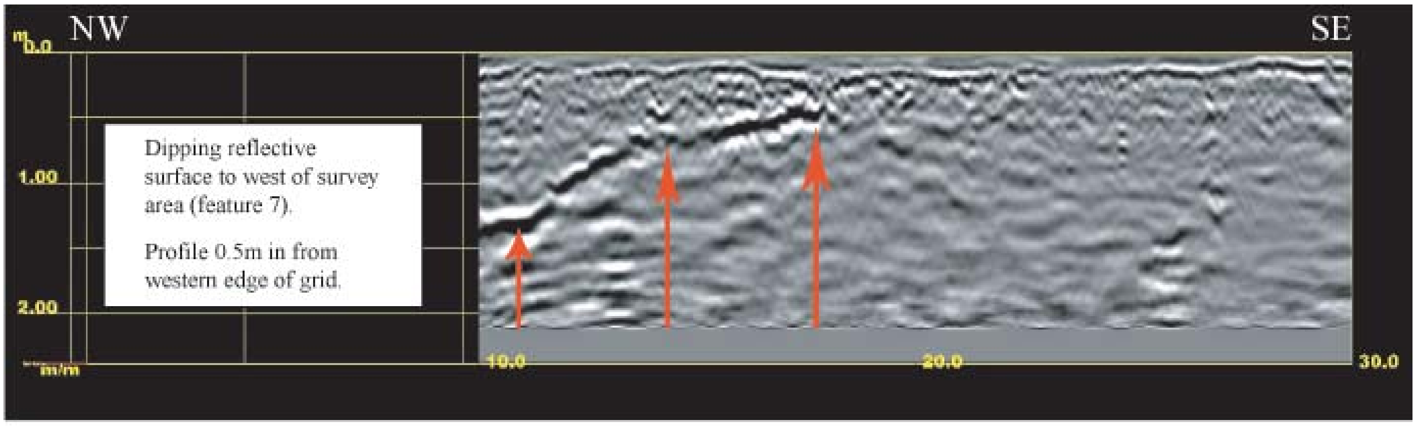
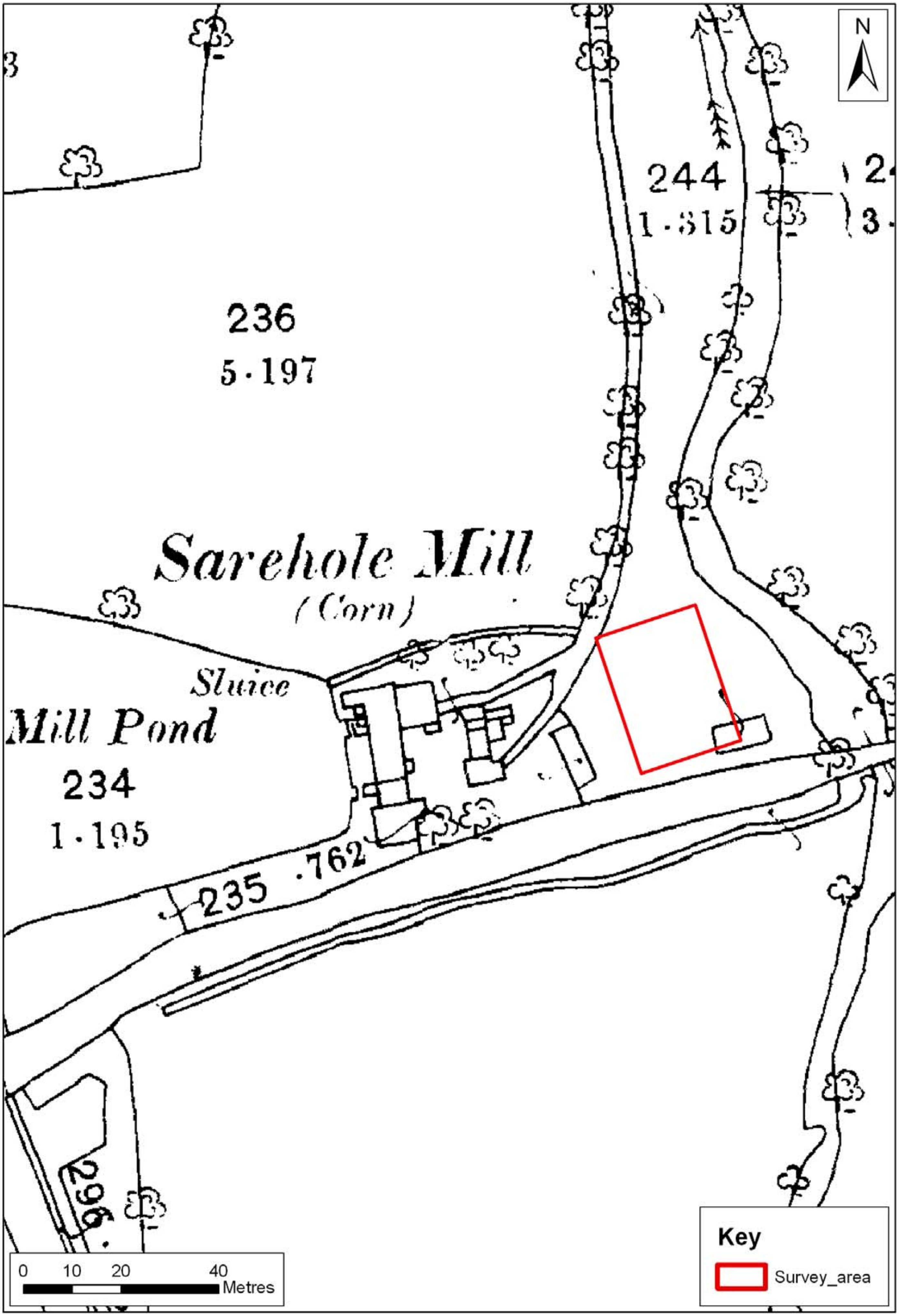


Fig. 12: GPR profile showing dipping reflective surface to west of survey area (feature 7).



N
244
1·315
24
3·
236
5·197
Sarehole Mill
(Corn)
Sluice
Mill Pond
234
1·195
235
·762
296·
0 10 20 40
Metres
Key
Survey_area

APPENDIX

BIRMINGHAM CITY COUNCIL

DEVELOPMENT DIRECTORATE

Sarehole Mill (SP 0988 8182; SMR 01201)

Brief for *Geophysical Survey*

1.Summary

This brief is for a geophysical survey to locate possible remains of an earlier watermill and other archaeological features adjacent to Sarehole Mill.

2.Site location and description

The site is on the north side of Cole Bank Road. The geophysical survey is to take place in the car park to the east of the mill buildings.

3.Existing archaeological information

The first reference to a mill at Sarehole is in 1542, but is not clear whether this refers to a new building or rebuilding an existing mill. There was major rebuilding in the 18th and 19th centuries. The oldest surviving parts of the mill are likely to be of 18th century date.

4.Purpose of work

The geophysical survey is required to establish whether remains of mill buildings predating the 18th century were on a different site to the existing mill and survive under the existing car park.

5.Stages of work

The geophysical survey is to use appropriate instruments and methods.

6.Standards and Staffing

The geophysical survey archaeological field evaluation is to be carried out in accordance with the Code of Conduct, Standards and Guidelines of the Institute of Field Archaeologists, and all staff are to be suitably qualified and experienced for their roles in the project. It is recommended that the project be under the direct supervision of a Member or Associate Member of the Institute of Field Archaeologists.

7.Written Scheme of Investigation

A brief methods statement should be produced.

8.Monitoring

The geophysical survey will be monitored by the City Council's Planning Archaeologist.

9.Reporting

The results of the geophysical survey are to be presented as a written report, containing the following:

(i)A description of methodology

(ii)A description, discussion and interpretation of the results

(iii)Raw data plots

(iv)Appropriate filtered data plots

(v)An interpreted plot

A bound hard copy of the report and an electronic copy in pdf format must be

sent to the Planning Archaeologist.

10.Publication

The written report will become publicly accessible, as part of the Birmingham Sites and Monuments Record, within six months of completion. The contractor must submit a short summary report for inclusion in *West Midlands Archaeology* and summary reports to appropriate national period journals. On completion of the project the contractor must complete the obligatory fields of the OASIS form and submit an electronic version of the report to OASIS (http://ads.ahds.ac.uk/oasis)

BIRMINGHAM CITY COUNCIL

Date prepared: 8 November 2006

Planning Archaeologist: Dr Michael Hodder 0121-464 7797 fax 0121-303 3193

Mike.hodder@birmingham.gov.uk

Birmingham City Council

Alpha Tower

PO Box 28

Suffolk Street Queensway

Birmingham B1 1TU

BRIEFSarehole.DOC