Archaeological Services
University of Durham

Kitchen Garden, Preston Park, Stockton-on-Tees, Teesside

geophysical surveys

on behalf of

Tees Archaeology

Report 2162
March 2009

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Sir William Gray House, Clarence Road, Hartlepool. TS24 8BT

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted in advance of the proposed restoration of the Kitchen Garden in Preston Park, Stockton-on-Tees. The works comprised geomagnetic and electrical resistance surveys.

1.2 The works were commissioned by Tees Archaeology and conducted by Archaeological Services Durham University.

Results

1.3 The original south boundary wall was almost certainly detected running along the top of the existing ditch next to the track in the south-west of the survey area.

1.4 Former garden paths and areas of rubble were identified across the area.

1.5 A possible former service was also detected.

2. Project background

Location (Figure 1)

2.1 The study area was located in the walled Kitchen Garden at Preston Park, Stockton-on-Tees (NGR centre: NZ 4300 1600). The works comprised both geomagnetic and electrical resistance survey of the available garden area, defined by brick walls to the north, east and west and to the south by a ditch and track. The north-eastern corner of the walled garden was separated from the survey area by a stone wall and brick-built raised flower beds.

Development proposal

2.2 The development proposal is for regeneration of the walled garden as a public attraction at Preston Park.

Objective

2.3 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological and historical significance within the survey area, principally the southern boundary wall and any paths or other features of the former garden, prior to trial trenching in advance of proposed regeneration of the walled garden.

Methods statement

2.4 The surveys have been undertaken in accordance with a brief provided by Tees Archaeology (Appendix) and a project design provided by Archaeological Services.

Dates

2.5 Fieldwork was undertaken on 16th March 2009. This report was prepared between 17th and 30th March 2009.

Personnel

2.6 Fieldwork was conducted by Edward Davies and Richie Villis (Supervisor). This report was prepared by Richie Villis with illustrations by Edward Davies and edited by Duncan Hale, the Project Manager.

Archive/OASIS

2.7 The site code is **SPP09**, for **S**tockton-on-Tees, **P**reston **P**ark 20**09**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (OASIS). The OASIS ID number for this project is **archaeol3-57024**.

Acknowledgements

2.8 Archaeological Services is grateful for the assistance of personnel from Preston Park Museum in facilitating this scheme of works.

3. Archaeological and historical background

3.1 Preston Hall was completed in 1825 and the landscaping of the gardens and park is believed to have been completed around the same time.

3.2 The walled garden has extant walls to the north, east and west and there is evidence that the northern wall was heated with glasshouses. The boiler house survives in use by the Teesside Small Gauge Railway Group.

4. Landuse, topography and geology

4.1 At the time of survey the proposed development area comprised a single field of grasses and scrub. The north-eastern corner of the area was not surveyed due to the presence of brick raised beds. The extreme north edge of the area was also not surveyed due to concrete and brick paving. The extreme south-west of the area was not surveyed due to thick undergrowth and dumped waste. The entire area was littered with brick and rubble. Brick and stone paved paths ran north-south and east-west through the garden.

4.2 The survey area occupied a gentle south-facing slope with an elevation of between 12-20m OD.

4.3 The underlying solid geology of the area comprises Permian and Triassic sandstones, which are overlain by boulder clay and morainic drift.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation, 2nd edition* (David, Linford & Linford 2008); the Institute for Archaeologists Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2002).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a variety of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, it was considered likely that cut features might be present on the site, and that other types of feature such as tracks, wall foundations and other garden structures might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

5.5 Given the likely presence of wall-footings and cobbled surfaces an electrical resistance survey was also considered appropriate. Earth electrical resistance survey can be particularly useful for mapping stone and brick features. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which retain more moisture, will provide relatively low resistance values.

Field methods

5.6 A 20m grid was established across the survey area and tied-in to known, mapped Ordnance Survey points using a Trimble Pathfinder Pro XRS global positioning system (GPS) with real-time correction providing sub-metre accuracy.

5.7 Measurements of vertical geomagnetic field gradient were determined using a Bartington Grad601-2 dual fluxgate gradiometer. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 1600 sample measurements per 20m grid unit.

5.8 Measurements of earth electrical resistance were determined using a Geoscan RM15D resistance meter with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1ohm, the sample interval to 0.5m and the traverse interval to 1.0m, thus providing 800 sample measurements per 20m grid unit.

5.9 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.10 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (unfiltered) data. The greyscale images and interpretations are presented in Figures 2-3; the trace plots are provided in Figure 4. In the greyscale images, positive magnetic and high resistance anomalies are displayed as dark grey and negative magnetic/low resistance anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla and ohm.

5.11 The following basic processing functions have been applied to the data:

clip	clips, or limits data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic.
zero mean traverse	sets the background mean of each geomagnetic traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities.
destagger	corrects for displacement of geomagnetic anomalies caused by alternate zig-zag traverses.
despike	locates and suppresses iron spikes in gradiometer data and and poor contact resistance spikes in resistance data.
interpolate	increases the number of data points in a survey to match sample and traverse intervals. In this instance the data have been interpolated to 0.25m x 0.25m intervals.

Interpretation: anomaly types

5.12 Colour-coded geophysical interpretation plans are provided. One type of geomagnetic anomaly has been distinguished in the data:

dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths.

5.13 Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble.
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches.

Interpretation: features

5.14 A colour-coded archaeological interpretation plan is provided.

5.15 Several large dipolar magnetic anomalies have been detected. These are likely to correspond to areas of fired brickwork, such as former and current paths. The concentration of dipolar anomalies along the south-western side of the area almost certainly reflects the large amount of brick rubble noted on the ground.

5.16 A rough line of discrete dipolar magnetic anomalies has been identified aligned broadly north-east/south-west across the area; these correspond to a relatively low resistance anomaly and could reflect materials in service trench, such as fittings along a water pipe.

5.17 The resistance survey detected a band of relatively high resistance running along the eastern edge and then curving around the southern edge of the

survey. This anomaly follows the top of the ditch that bounds the track on the southern side and could be the footing for the old south wall of the garden.

5.18 Narrow areas of relatively high resistance running north/south and east/west reflect garden paths that appear on old maps and some are apparent on the ground. One linear high resistance anomaly in the west of the area could reflect a former path, which is no longer visible.

5.19 Another narrow band of high resistance had been detected running north/south parallel to the central path. This could reflect another path, however there is no corresponding magnetic anomaly; this could reflect a series of anomalous readings or more stone rubble.

5.20 The large high resistance anomaly in the south-west of the area corresponds to the large dipolar magnetic anomaly and almost certainly reflects the large amount of brick and building rubble evident in the ground.

5.21 The area of high resistance detected in the extreme south-east corner reflects the existing track.

6. Conclusions

6.1 Both geomagnetic and electrical resistance surveys were undertaken in the Kitchen Garden at Preston Park prior to proposed reconstruction of the garden.

6.2 The original south boundary wall was almost certainly detected running along the top of the existing ditch next to the track in the south-west of the survey area.

6.3 Former garden paths and areas of rubble were identified across the area.

6.4 A possible former service was also detected.

7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical survey in archaeological field evaluation, 2nd edition,* English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*, Technical Paper **6**, Institute for Archaeologists

Schmidt, A, 2002 *Geophysical Data in Archaeology: A Guide to Good Practice*, Archaeology Data Service, Arts and Humanities Data Service

Appendix: Project brief

Brief for Geophysical Survey:
Walled Garden, Preston Park, Stockton-on-Tees.

1 Background

1.1 The site centered on NZ 4300 1600 is the overgrown remains of a mid 19th century walled garden.

1.2 It is proposed to re-instate the garden as part of enhancement works for the public park at Preston, Stockton-on-Tees.

1.3 Preston Hall and Park was created from 1820 onwards when the land was bought by David Burton Fowler, he proceeded to build the hall, although originally it faced across the river, and to landscape the grounds. The hall was finished in 1825 and it is presumed that the landscaping was finished at much the same time, as was the Stockton & Darlington Railway which runs through the park. The walled garden is shown on the first edition Ordnance Survey map of 1857.

1.4 The walled garden retains walls on the north, west and east, the southern wall has been demolished. Both maps and archaeological evidence indicate that the south face of the north wall was heated with glasshouses and the boiler house survives in use by the Teesside Small Gauge Railway group.

1.5 There are some indications of the position of the former south wall and the land fall s away sharply to the south. A previous re-generation scheme has resulted in the construction of a number of low brick walls in the north-eastern part of the site. The remainder of the site is heavily overgrown, but is accessible.

2 Aims of Geophysical Survey

2.1 The geophysical survey will cover an L shaped area of c.0.4 ha, excluding the north eastern section of low brick walls. Evidence should be particularly sought for the following: -

- the location, and nature of paths, path edgings, planting beds and any ancillary structures. In addition the exact position of the original south wall should be plotted.

2.2 The purpose of the survey is to inform plans for the re-establishment of the garden and it is proposed to carry out trial trenching as a public archaeology project to investigate and confirm the information provided by the Geophysical Survey.

3 Methodology

3.1 Geophysical Survey

3.1.1 The most likely remains to be encountered in this situation are cut and built features such as paths, walls, cobbled surfaces, and small brick structures.

3.1.2 It is recommended that both Electrical Resistance Survey and Magnetometer Survey should be deployed. The Electrical Resistance Survey should be carried out at 1m x 0.5m intervals.

3.1.3 A strategy for the Geophysical Survey should be provided and agreed with the Tees Archaeology Officer or his representative.

3.1.4. The geophysical survey should be conducted according to the standards set out in 'English Heritage. 1995. *Geophysical survey in Archaeological Field Evaluation*. Research and Professional Services Guideline No. 1. English Heritage'.

3.1.5 At least two permanent survey points should be established in the walled garden to which the survey can be tied and which can be used to locate features discovered in the survey.

4 Method Statement

4.1 The current brief should not be considered sufficient to enable the execution of the project. A method statement will be required to provide the basis for a measurable standard for monitoring. The method statement should be prepared in response to this brief in the format set out in Appendix 2 of English Heritage. 1991. *Management of Archaeological Projects*.

4.2 The method statement should particularly:-

- demonstrate the techniques, materials and recording systems to be employed
- provide a provisional programme for undertaking the fieldwork, processing of the data, report preparation and the deposition of the project archive
- identify the staff involved, their qualifications, and those who will be carrying out specialist assessments
- demonstrate that the work will be undertaken in accordance with all relevant health and safety legislation.

5 Monitoring

5.1 The proposal for the work should identify the staff involved. The Tees Archaeology Officer or his representative should be notified at least two weeks in advance of the work taking place and should be allowed on site to inspect and monitor the work at any reasonable time.

5.2 The archaeological contractor will be notified if standards contained in the brief are not being met. The report for the work and deposition of archive will be monitored and standards enforced where required.

6 Report and Recommendations

6.1 The information from the fieldwork should be brought together in a report.

6.2 X copies of the report should be provided to the client and two forwarded to the Tees Archaeology Sites and Monuments Record.

6.3 The archaeological contractor must complete the online OASIS form at http://ads.ahds.ac.uk/project/oasis/ within 3 months of completion of the work. Contractors are advised to ensure that adequate time and costings are built into their tenders to allow the forms to be filled in. Technical advice should be sought in the first instance from OASIS (oasis@ads.ahds.ac.uk) and not from Tees Archaeology. This will then be verified by Tees Archaeology.

7 Archive

7.1 An appendix (Appendix 1) is attached detailing the archival requirements. A copy of the documentary and photographic archive should be deposited with Tees Archaeology at Sir William Gray House, Clarence Road, Hartlepool. TS24 8BT.

7.2 The contractor should inform of the results of the work by forwarding three copies of the report to the HER and one copy to the NMR..

8 Health and Safety

8.1 Contractors are expected to abide by the 1974 Health and Safety Act and its subsequent amendments. Safe working practice should be adopted as described in the Standing Conference of Archaeological Unit Managers manual on archaeological health and safety. It is recommended that a risk assessment for the site is completed prior to the start of works.

Brief prepared by Robin Daniels, Archaeology Officer.
18th February 2009.

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University of Durham

Preston Park, Stockton-on-Tees

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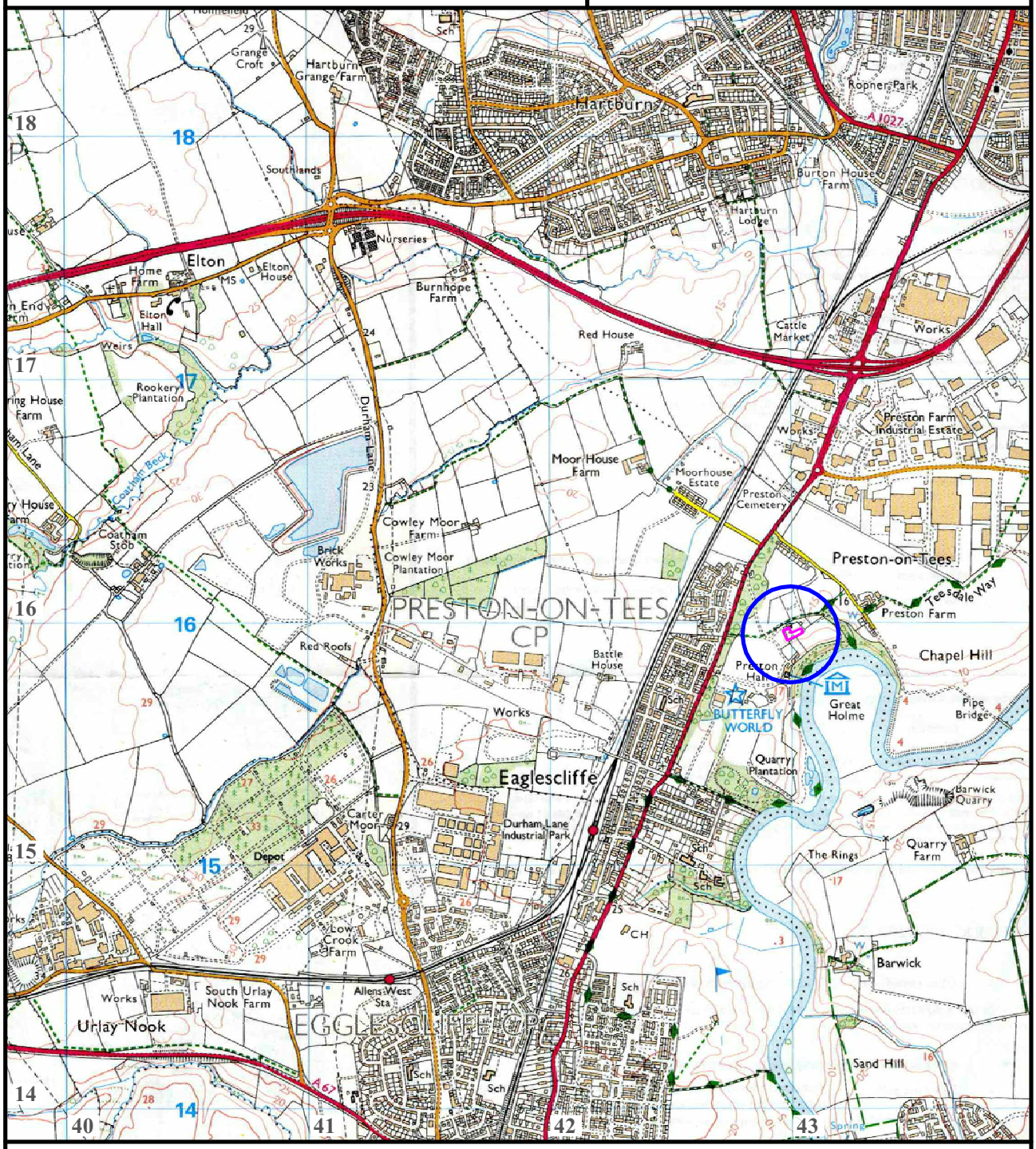
Figure 1
Location map

on behalf of
Tees Archaeology



survey location

0 1km

scale 1:25 000 - for A4 plot

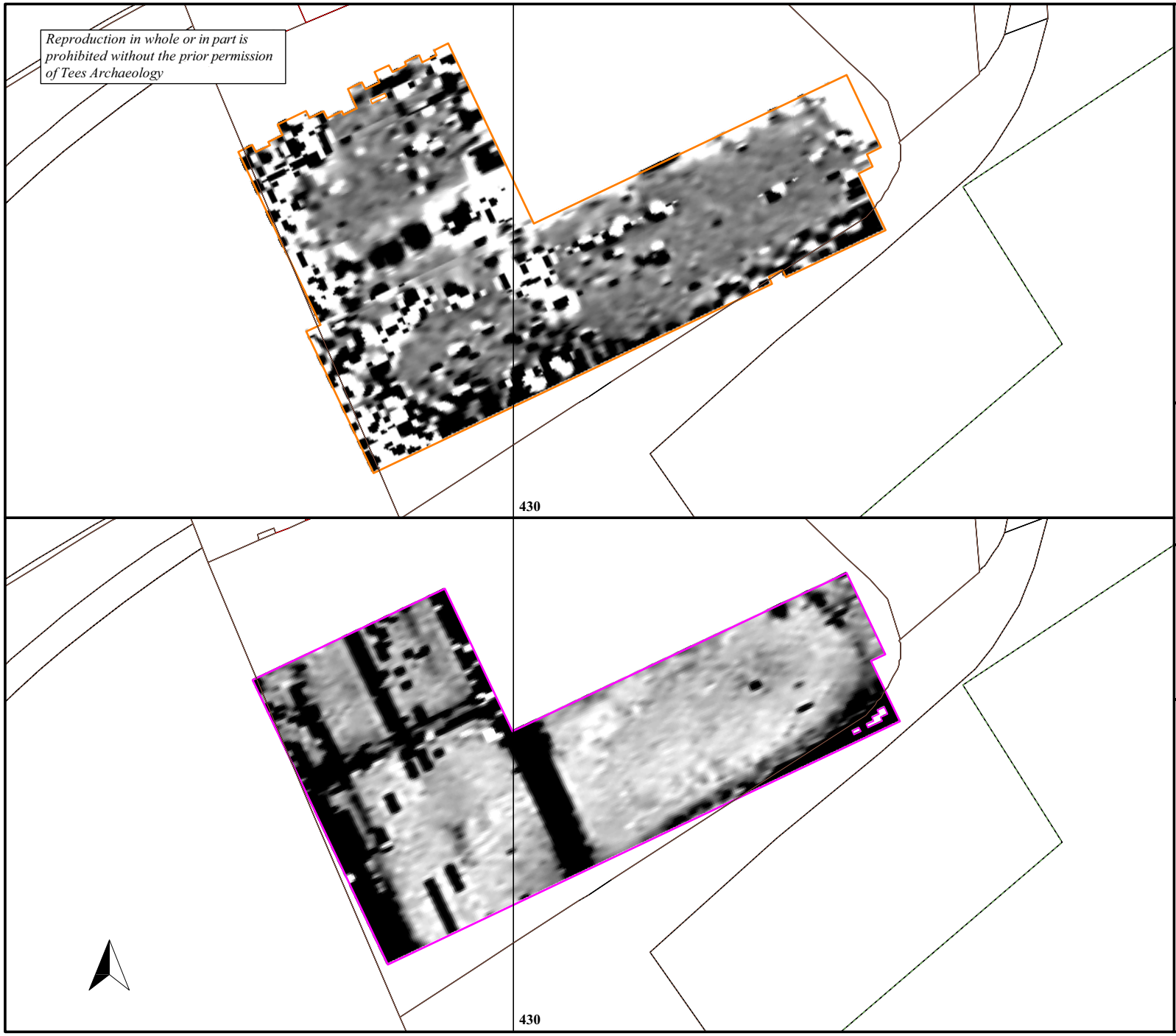


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Figure 2

Magnetic and resistance survey results

on behalf of
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0 25m
scale 1:500 - for A3 plot

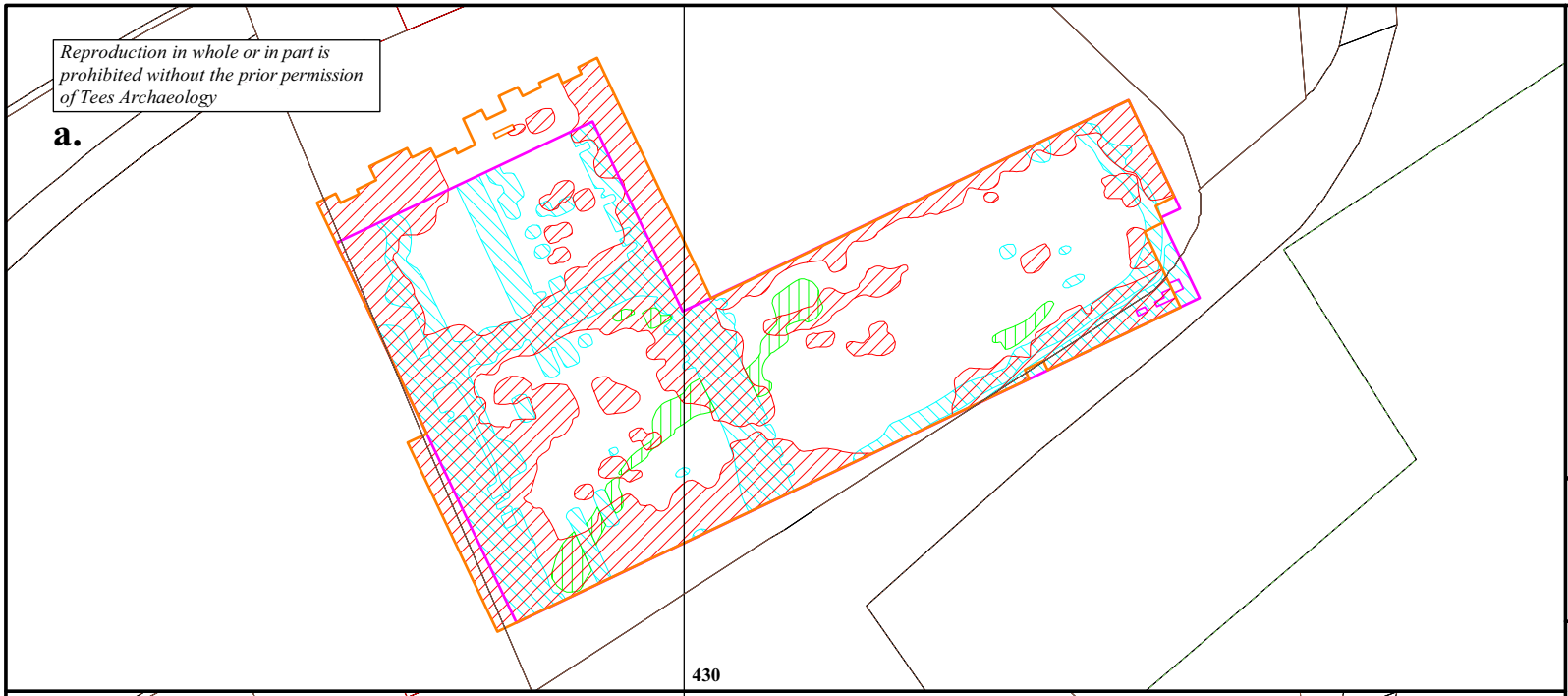
magnetic survey area

resistance survey area

15.00
12.5
10.00
7.5
5.00
2.5
0
-2.5
-5.00
-7.5
-10.00
-12.5
-15.00 nT

20.00
18.75
17.50
16.25
15.00
13.75
12.50
11.25
10.00
8.75
7.50
6.25
5.00 ohm

a.



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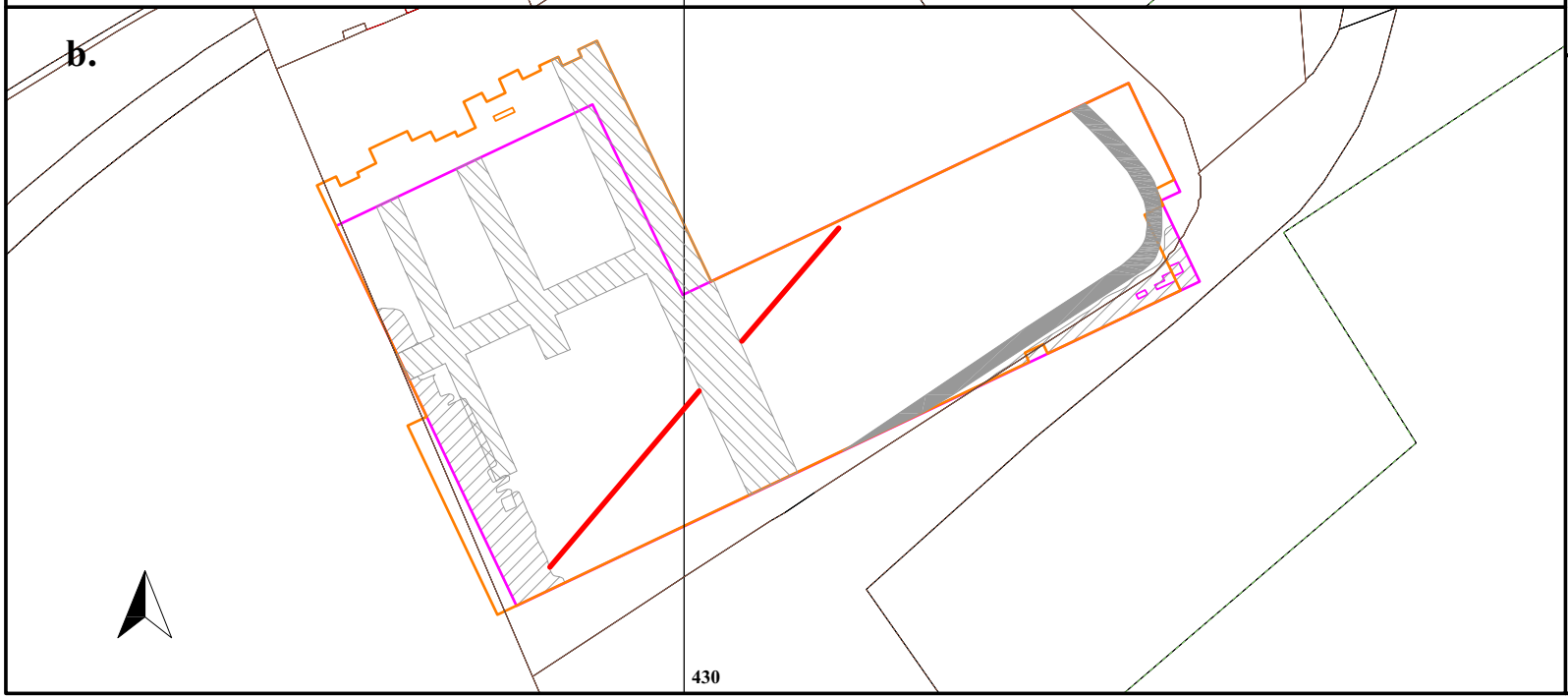

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Figure 3

Geophysical and archaeological interpretations

on behalf of
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0 25m
scale 1:500 - for A3 plot

outline of magnetic survey area

outline of resistance survey area

a.
- dipolar magnetic anomalies
- high resistance anomalies
- low resistance anomalies

b.
- wall
- rubble
- paths
- service pipes

Figure 4: Trace plots of geomagnetic and resistance data