ARCHAEOLOGICAL SERVICES WYAS

Peterborough Gas Compressor Station Site
Glinton
Peterborough

Geophysical Survey

Report no. 2754

May 2015

Client: Hyder Consulting (UK)

Peterborough Gas Compressor Station Site
Glinton
Peterborough

Geophysical Survey

Summary

A geophysical (magnetometer) survey, covering approximately 4.8 hectares, was carried out on agricultural land to the east of the Peterborough Gas Compressor Station, prior to the proposed development of the site. Anomalies indicative of possible archaeological activity have been identified in the survey. A boundary ditch and enclosure have been recorded in the north of the survey area and a possible field system or 'ladder' settlement in the south. Five isolated areas of magnetic enhancement have also been identified, two that are possibly evidence of extraction, and with the others perhaps being areas of intense heating, such as kilns. Other anomalies recorded in the survey include three gas pipes and recent agricultural activity.

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Report Information

Client:	Hyder Consulting (UK) Ltd.
Address:	The Mill, Brimscombe Port, Stroud, Gloucester GL5 2QG
Report Type:	Geophysical Survey
Location:	Glinton
County:	Peterborough
Grid Reference:	TF 153 046
Period(s) of activity:	Roman?/modern
Report Number:	2754
Project Number:	4382
Site Code:	PGC15
OASIS ID:	archaeol11- 210998
Planning Application No.:	
Museum Accession No.:	n/a
Date of fieldwork:	April 2015
Date of report:	May 2015
Project Management:	Sam Harrison BSc MSc MCIfA
Fieldwork:	David Harrison BA MSc MCIfA
	Sam Harrison
Report:	Sam Harrison
Illustrations:	Sam Harrison
Photography:	Sam Harrison
Research:	n/a

Authorisation for distribution: ----------

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Contents

List of Figures

List of Plates

1 Introduction

Archaeological Services WYAS (ASWYAS) was commissioned by Hyder Consulting (UK) Limited (the Client) on behalf of National Grid, to undertake a geophysical (magnetometer) survey of land to the east of the Peterborough Gas Compressor Station. The work was undertaken in order to inform a planning application for the proposed development of the site and in accordance with policy contained within the National Planning Policy Framework (DCLG 2012), in line with current best practice (CIfA 2014; David *et al.* 2008) and to a Project Design (Harrison 2015) approved by the Client. The survey was carried out on April 13th 2015 to provide additional information on the archaeological resource of the site.

Site location, topography and land-use

The proposed development area (PDA) comprises of the southern half of a field, 1km south of Glinton, centred at TF 153 046 (see Fig. 1), which had recently been sown at the time of survey (see plates). The survey area is constrained by the access track to the Gas Compressor Station and access tracks to the south, west and east. The northern site limit is unbound. The site is flat and situated at approximately 13m above Ordnance Datum (aOD).

Soils and geology

The underlying bedrock mainly comprises sandstone and siltstone of the Kellaways Sand Member in the west and mudstone of the Oxford Clay Formation in the east. Superficial deposits of sand and gravel are recorded in the east of the survey area (British Geological Survey 2015). The soils are classified in the Badsey 2 association in the east and the Denchworth association in the west. These are characterised as well drained calcareous and non-calcareous fine loams; and slowly permeable, seasonally waterlogged clays with fine loams respectively, (Soil Survey of England and Wales 1983).

2 Archaeological Background

A Cultural Heritage Assessment (Hyder 2014) concluded that the potential for unknown heritage assets to be present within the site is likely to be high based on the frequency of Roman remains identified in the local landscape. Whilst there are no previous archaeological investigations within the site, the focus of investigations have been to the north and east of the site.

3 Aims and Methodology

Magnetometer Survey

The aim of the geophysical survey as described in the Project Design (Harrison 2015) is to, as far as possible, identify the presence or absence, and extent and layout, of buried archaeological remains across the PDA, through the interpretation of magnetic anomalies identified following the processing of data gathered during the survey.

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. Features such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the Earth's magnetic field. In mapping these slight variations, detailed plans of sites can be obtained as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney and Gater 2003). Further information on types of anomaly is provided as Appendix 1.

On this site a Sensys Magneto®MXPDA cart-based magnetometer system (see Plate 3) was employed. This system has five FGM650 fluxgate gradiometers mounted at 0.5m intervals with readings of between ±0.1nT and ±10,000nT recorded at 20Hz. The gradiometers are linked to a Trimble R6 Real Time Kinetic (RTK) differential Global Positioning System (dGPS) allowing for the geo-referencing of all measurement points within ±1cm accuracy. The data is recorded by Sensys Magneto®MXPDA software on a Personal Data Assistant (PeDA) device and stored on a Secure Digital (SD) memory card within the PeDA.

The survey boundary was laid out using a Trimble VRS differential Global Positioning System (Trimble R6 model) providing an accuracy greater than 0.01m. The locations of the survey boundary and anomalies are available as a DXF file. The survey grids were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if co-ordinates are measured off hard copies of the mapping rather than using the digital co-ordinates.

Data Processing

The gradiometer data has been presented in this report in XY trace and greyscale formats. In the former format the data shown is 'raw' with no processing other than grid biasing having been done. An XY plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. The data in the greyscale images has been interpolated and selectively filtered, using Terrasurveyor (DW Consulting) software

to remove the effects of drift in instrument calibration and other artificial data constructs and to maximise the clarity and interpretability of the archaeological anomalies.

Presentation

A general site location plan, incorporating the 1:50000 Ordnance Survey (OS) mapping, is shown in Figure 1. Figure 2 shows the extent of the survey areas together with the processed data at a scale of 1:2500. Detailed data plots ('raw' and processed) and interpretative figures are presented at a scale of 1:1000 in Figures 3 to 5 inclusive.

Further information on magnetic survey and characterisation and interpretation of anomaly types are given in Appendix 1. Appendix 2 describes the composition and location of the site archive and Appendix 3 reproduces the OASIS entry.

The survey methodology, report and any recommendations comply with the Project Design (Harrison 2015) and guidelines outlined by English Heritage (David *et al.* 2008) and by the Chartered Institute for Archaeologists (CIfA 2014).

Disclaimers

The figures in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All figures are presented to most suitably display and interpret the data from this site based on the experience and knowledge of Archaeological Services staff.

The results and subsequent interpretation of data from geophysical surveys should not be treated as an absolute representation of the underlying archaeological and non-archaeological remains. Confirmation of the presence or absence of archaeological remains can only be achieved by direct investigation of sub-surface deposits.

Archaeological Services WYAS cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

4 Results and Discussion

Overview

The magnetic background is relatively uniform across the site with little variation throughout the survey area. Against this background a number of anomalies have been identified by the survey which are discussed below and cross-referenced to specific examples depicted on the interpretative figures, where appropriate.

Ferrous Anomalies

Ferrous anomalies, as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris or material is common on rural sites, often being present as a consequence of manuring or tipping/infilling. Magnetic disturbance around the perimeters of some of the fields is caused by ferrous material within, or forming part of the field boundary.

Three gas pipes have been identified within the dataset as high magnitude dipolar linear trends, anomalies **A**, **B** and **C**. These all appear to be heading to/from the Gas Compressor Station.

Geological Anomalies

As mentioned in the overview (see above) there is little variation in the magnetic background across the site. Throughout the survey area small discrete areas of magnetic enhancement have been identified, which are thought to be caused by variations in the soils and superficial geological deposits.

Agricultural Anomalies

Analysis of historical maps indicates that four former field boundaries are located within the survey area. Of these, only two have been identified in the survey, linear trends **D** and **E**. The reason for this lack of detection is uncertain. If the former boundary comprised of a ditch, it is possible that agricultural erosion has removed all trace of the feature. Alternatively, it is possible that there is insufficient magnetic contrast between the soil-fill of the ditch and the surrounding soils for the ditch to manifest as a magnetic anomaly. A potential third former field boundary has been identified, **F**, although this is not mapped on historical OS mapping.

A system of field drains have been recorded in the east of the survey area. These are arranged in a 'herring-bone' pattern which is typical of modern land improvement practices.

Possible Archaeological Anomalies

Two distinct areas of archaeological potential have been recorded by the survey. Towards the north of the survey area a curvilinear anomaly, **G**, possibly locating a soil-filled ditch, can be seen traversing the site in an east-west direction, 250m in length. Appended to the northern side of this anomaly is a possible enclosure, **H**.

In the south of the survey area two west, north-west/east, south-east aligned linear trends anomalies, **I** and **J**, have been identified. At right angles to these anomalies are a number of ditch like linear anomalies, **K**, **L**, **M** and **N** that may signify partitions between **I** and **J**, perhaps forming a field system or a 'ladder' settlement.

Elsewhere the survey has identified five distinct isolated areas of magnetic enhancement, **O**, **P**, **Q**, **R** and **S**. The northernmost two, **O** and **P**, may be associated with extraction, being low in magnitude. The southern three, **Q**, **R**, and **S**, are a lot higher in magnitude, possibly signifying high intensity burning such as a kiln.

5 Conclusions

The magnetometer survey has identified two areas of archaeological potential. In the north, anomalies indicative of a soil-filled ditch and appended enclosure have been recorded. To the south, linear anomalies forming a possible field system or 'ladder' settlement have been identified. Five isolated areas of magnetic enhancement are also evident, two that are possibly evidence of extraction, with the other three being of higher magnitude, perhaps being areas of intense heating, such as kilns. Other anomalies recorded in the survey include three gas pipes and recent agricultural activity.

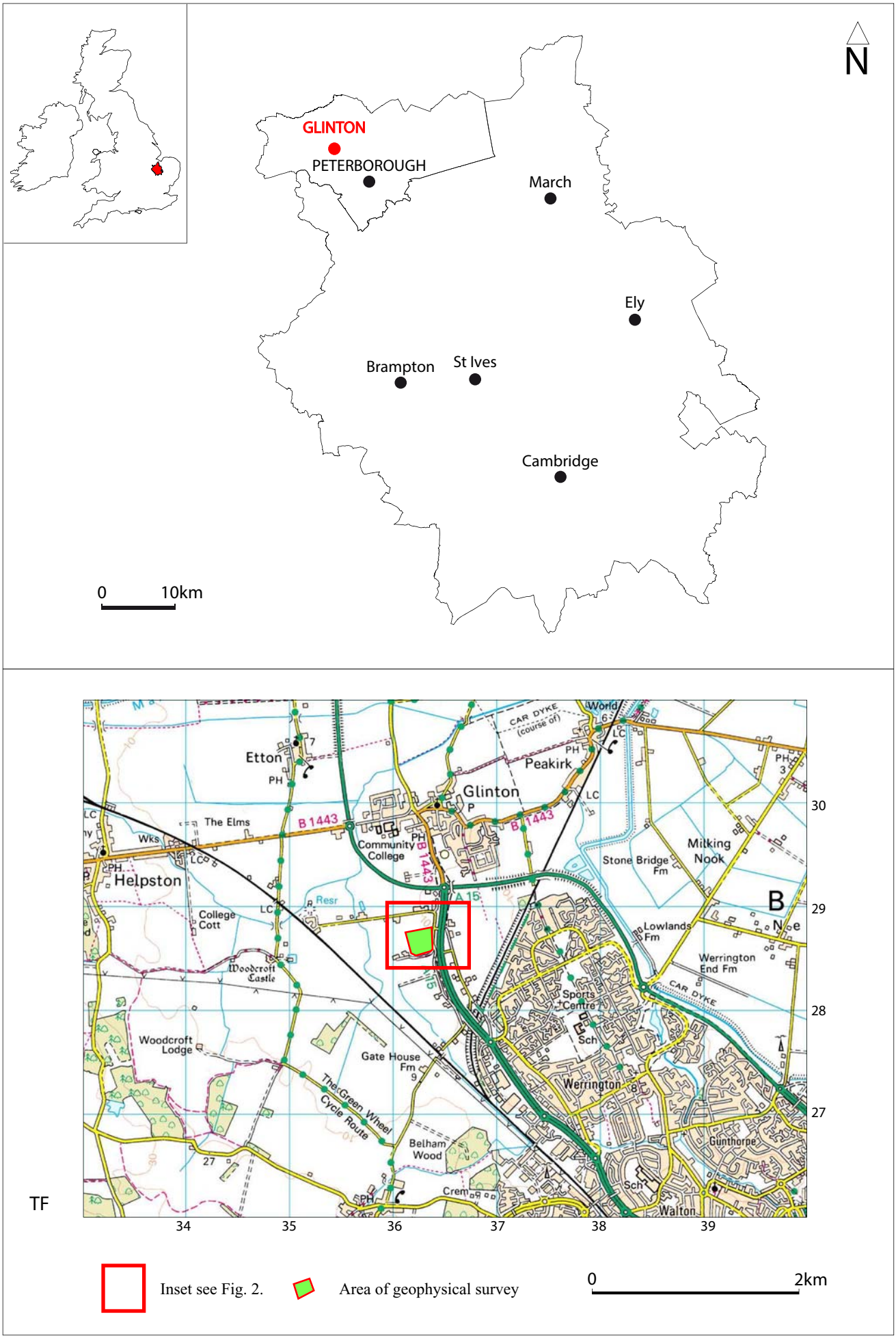

Fig. 1. Site location

PROPOSED DEVELOPMENT BOUNDARY

LOCATION AND DIRECTION OF PLATES

N

WATERWORKS LANE

GAS COMPRESSOR STATION

A15

LINCOLN ROAD

5.0

-5.0

nT

3050 00

3045 00

5150 00

5155 00

0 100m

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Fig. 2. Survey location showing greyscale magnetometer data (1:2500 @ A3)

N

3048 00

3046 00

5152 00

5.0

-5.0

nT

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0 30m

Fig. 3. Processed greyscale magnetometer data (1:1000 @ A3)

N

3048 00

3046 00

5152 00

20.0 nT/cm

0 30m

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Fig. 4. XY trace plot of minimally processed magnetometer data (1:1000 @ A3)

TYPE OF ANOMALY		INTERPRETATION
•	DIPOLAR ISOLATED	FERROUS MATERIAL
—	DIPOLAR LINEAR	SERVICE PIPE
	MAGNETIC DISTURBANCE	FERROUS MATERIAL
	LINEAR TREND	FIELD DRAIN
—	LINEAR TREND	FORMER FIELD BOUNDARY
- - -	LINEAR TREND	FORMER FIELD BOUNDARY?
	MAGNETIC ENHANCEMENT	GEOLOGY
	MAGNETIC ENHANCEMENT	ARCHAEOLOGY?

N

304800

304600

515200

A
B
C
D
E
F
G
H
I
I
J
K
L
M
N
O
P
Q
R
S

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Fig. 5. Interpretation of magnetometer data (1:1000 @ A3)

0 30m

Plate 1. The Sensys Magneto MXPDA five sensor cart-based magnetometer system

Plate 2. General view of survey area, looking north

Appendix 1: Magnetic survey - technical information

Magnetic Susceptibility and Soil Magnetism

Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms. Areas of human occupation or settlement can then be identified by measuring the magnetic susceptibility of the topsoil because of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. The magnetic susceptibility of a soil can also be enhanced by the application of heat and the fermentation and bacterial effects associated with rubbish decomposition. The area of enhancement is usually quite large, mainly due to the tendency of discard areas to extend beyond the limit of the occupation site itself, and spreading by the plough. An advantage of magnetic susceptibility over magnetometry is that a certain amount of occupational activity will cause the same proportional change in susceptibility, however weakly magnetic is the soil, and so does not depend on the magnetic contrast between the topsoil and deeper layers. Susceptibility survey is therefore able to detect areas of occupation even in the absence of cut features. On the other hand susceptibility survey is more vulnerable to the masking effects of layers of colluvium and alluvium as the technique, using the Bartington system, can generally only measure variation in the first 0.15m of ploughsoil.

Types of Magnetic Anomaly

In the majority of instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire fencing and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

Appendix 2: Geophysical archive

The geophysical archive comprises:-

- an archive disk containing compressed (WinZip 8) files of the raw data, report text (Microsoft Word 2000), and graphics files (Adobe Illustrator CS2 and AutoCAD 2008) files; and
- a full copy of the report.

At present the archive is held by Archaeological Services WYAS with copies supplied to Hyder Consulting.

Appendix 3: OASIS Form

OASIS DATA COLLECTION FORM: England

Printable version

OASIS ID: archaeol11-210998

Project details

Project name	Peterborough Gas Compressor Station Site
Short description of the project	A geophysical (magnetometer) survey, covering approximately 4.8 hectares, was carried out on agricultural land to the east of the Peterborough Gas Compressor Station, prior to the proposed development of the site. Anomalies indicative of possible archaeological activity have been identified in the survey. A boundary ditch and enclosure have been recorded in the north of the survey area and a possible field system or 'ladder' settlement in the south. Five isolated areas of magnetic enhancement have also been identified, two that are possibly evidence of extraction, and with the others perhaps being areas of intense heating, such as kilns. Other anomalies recorded in the survey include three gas pipes and recent agricultural activity. On the basis of the survey, the archaeological potential of the north and south of the site is considered to be high, with a moderate potential throughout the remainder of the site.
Project dates	Start: 13-04-2015 End: 13-04-2015
Previous/future work	Not known / Not known
Any associated project reference codes	PGC15 - Sitecode
Type of project	Field evaluation
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	ENCLOSURE Roman
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Not recorded
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	sandstone and siltstone of the Kellaways Sand Member in the west and mudstone of the Oxford Clay Formation in the east
Drift geology	SAND AND GRAVEL OF UNCERTAIN AGE OR ORIGIN
Techniques	Magnetometry

Project location

Country	England
Site location	CAMBRIDGESHIRE PETERBOROUGH GLINTON Peterborough Gas Compressor Station Site
Postcode	PE6 7HH
Study area	47784.00 Square metres
Site coordinates	TF 153 045 52.6256368508 -0.296400830794 52 37 32 N 000 17 47 W Point
Lat/Long Datum	Unknown
Height OD / Depth	Min: 13.00m Max: 13.00m

Project creators

Name of Organisation	Archaeological Services WYAS
Project brief originator	Hyder Consulting
Project design originator	Archaeological Services WYAS
Project director/manager	T. S. Harrison
Project supervisor	D. Harrison
Type of sponsor/funding body	Electricity Authority/Company
Name of sponsor/funding body	National Grid

Project archives

Physical Archive Exists?	No
Digital Archive recipient	N/A
Digital Contents	"none"
Digital Media available	"Geophysics","Images raster / digital photography","Images vector","Survey"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Peterborough Gas Compressor Station Site Glinton Peterborough Geophysical Survey
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