SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

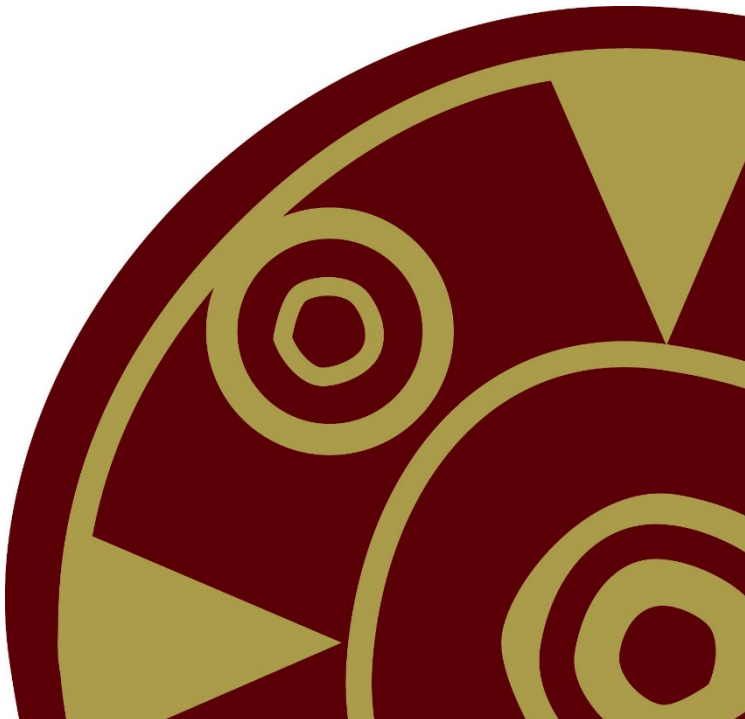
Land to the rear of St Margaret's Crescent, Leiston

Client:
Pigeon Investment Management Ltd and
Leiston Land Ltd

Date:
May 2016

LCS 220
Geophysical Survey Report
SACIC Report No. 2016/034
Author: Timothy Schofield HND BSc MCIfA

PIGEON



Land to the rear of St Margarets Crescent, Leiston LCS 220

Geophysical Survey Report

SACIC Report No. 2016/034

Author: Timothy Schofield

Illustrator: Timothy Schofield

Editor: Rhodri Gardner

Report Date: April 2016

HER Information

Site Code:	**LCS 220**
Site Name:	**Land to the rear of St Margarets Crescent**
Report Number	**2016/034**
Planning Application No:	**TBC**
Date of Fieldwork:	**March 30th – April 1st**
Grid Reference:	**TM 4377 6287**
Oasis Reference:	**245899**
Curatorial Officer:	**Rachael Abraham**
Project Officer:	**Timothy Schofield**
Client/Funding Body:	**Pigeon Investment Management Ltd and Leiston Land Ltd**
Client Reference:	**0066**

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

Prepared By: Timothy Schofield
Date: April 2016

Approved By: Rhodri Gardner
Position: Director
Date: 17/05/2016
Signed: R.V.Gardner.

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Summary

In March and April 2016 Suffolk Archaeology Community Interest Company undertook a detailed fluxgate gradiometer survey on land outlined for a proposed housing development on land to the rear of St Margaret's Crescent, Leiston, Suffolk.

The detailed fluxgate gradiometer survey prospected a range of geophysical anomalies comprising fourteen positive linear trends indicative of former field boundaries, four areas of magnetic disturbance logged where marl pits or ponds and a field boundary/ trackway are depicted on maps from 1841, seven positive discrete anomalies indicative of backfilled pits, ten further areas of magnetic disturbance and a plethora of isolated dipolar responses record a fair degree of modern fly-tipping across the site.

1. Introduction

In March 2016 detailed fluxgate gradiometer survey covering an area of c.3.3 hectares of land for a proposed residential development on land to the rear of St Margaret's Crescent, Leiston, Suffolk (Fig.1) was undertaken by Suffolk Archaeology Community Interest Company (SACIC).

Detailed geophysical survey was required by Suffolk County Council Archaeology Service/Conservation Team (SCCAS/CT) prior to consideration of the proposal. The scope of the project was originally detailed in a Brief (dated 20/01/2016) produced by the archaeological advisor to the LPA, Rachael Abraham (of SCCAS/CT) and then addressed by a SACIC Written Scheme of Investigation (WSI) Schofield, 2016, Appendix 2).

Suffolk Archaeology CIC were commissioned to undertake the work by Archaeological Risk Management on behalf of Pigeon Investment Management Ltd and Leiston Land Ltd.

Figure 1. Location plan

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2. Geology and topography

The site is located on the northwestern edge of Leiston (TM 4377 6287) in two adjoining sub-rectangular parcels comprising an area of *c.*3.3ha, bounded to the north by railway tracks of the former Great Eastern Railway, to the south by a modern residential development, to the west by a playing field and to the east by the Masterlord Industrial Estate. Located on a low-lying plateau that slopes gently from 21m AOD in the northwest to 19m in the southeast.

The fields are believed to have been under intermittent agricultural use over the last few centuries for both grazing and crop production, today the fields have a covering of light scrub with felled and standing trees and intermittent hedgerows.

The bedrock geology is described as Crag Group Sand, formed approximately 0 to 5 million years ago in the Quaternary and Neogene Periods, deposited as mud, silt, sand and gravel in shallow seas. Superficial deposits are described as Lowestoft Formation Diamicton, formed up to 2 million years ago in the Quaternary Period, deposited by glaciers as till with outwash sand and gravel (BGS, 2016).

3. Archaeology and historical background

The site lies within an area of archaeological interest defined by information held within the Suffolk Historic Environment Record and in a brief issued by SCCAS/CT (Abraham, 2016), a geophysical survey followed by a subsequent targeted trial trench evaluation (separate WSI) was requested to be undertaken, prior to consideration of the planning application.

The following archaeological background has been summarised from the desk-based assessment undertaken by Archaeological Risk Management (Hopkins, 2016).

No intrusive archaeological investigations have been carried out on the site, however evidence of prehistoric, Roman and medieval activity has been recorded within a 1km search radius. Two Middle/Late Bronze Age cinerary urns (LCS 004) were found 700m to the east, close to the cropmark of a possible c.30m diameter ring ditch (LCS 020), while 720m to the northeast a Late Bronze Age sword fragment was found during metal detecting (LCS 135). This is close to the location of a Roman kiln (LCS 142), a scatter of pottery, a few Roman coins (LCS 135) and a third century coin (LCS Misc). Two first century bronze sestertii were found 900m to the northeast (LCS 013). In the town, 770m to the southeast, late first to second century pottery was found during groundworks (LCS 149).

A large sub-rectangular enclosure of unknown date, approximately 400m to the north of the site, surrounds a semi-circular ring ditch enclosing a dark circular patch (LCS 025).

The site is 300m to the northeast of the medieval core of Leiston (LCS 143) and 180m to the north of the St Margaret's parish church, which was rebuilt in the nineteenth century with only the late medieval tower remaining.

Post medieval brickworks, kilns, a pug mill and drying sheds are recorded 450m to the east northeast (LCS 153). Masterlord Industrial Estate occupies part of the former Garret Ironworks site, a major influence on Leiston in the late eighteenth and nineteenth centuries.

4. Methodology

Instrument type

A Bartington DualGRAD 601-2 fluxgate gradiometer was employed to undertake the detailed geophysical survey.

Instrument calibration and settings

The magnetic susceptibility of the soil was found to be relatively high across the site due to the proximity of the surrounding housing estate combined with localised fly-tipping, this caused a degree of difficulty in locating a suitable zero station (to correct diurnal drift). One hour was allowed for the instruments sensors to reach optimum operating temperature before the survey commenced. The weather was overcast with interspersed sunny periods. Sampling intervals were set at 0.25m along 1m traverses (four readings per metre).

Survey grid layout

The survey was undertaken within 20m grids, orientated east to west and geolocated employing a Leica Viva GS08+ Smart Rover RTK GLONASS/GPS, allowing an accuracy of +/- 0.01m. Data were converted to National Grid Transformation OSTN02.

Data capture

Data points were recorded on an internal data logger that were downloaded and checked for quality at midday and in the evening, allowing grids to be re-surveyed if necessary. A pro-forma survey sheet was completed to allow data 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.

Data software, processing and presentation

Despite uneven and rough terrain in places high quality raw survey data was collected that enabled only minimal data processing to be required. Datasets were composited and processed using DW Consulting's Terrasurveyor v.3.0.27, the raw grid files will be stored and archived in this format. Minimal processing algorithms were undertaken on

the raw (Figure 3) and processed (Figure 4) datasets, which are presented in Appendix 3.

The data composites were exported as raster images into AutoCAD. An interpretation plan based on the combined interpretations of the raw, processed and xy trace plots (Figures 3, 4 & 5) has been produced in Figure 6. Relevant features recorded on the 1882 – 84 Ordnance Survey Map have further been digitised and are presented in Figure 6.

Survey grid restoration

No permanent survey grid stations were left in the fields, however the local survey grid and geophysical anomalies can be relocated employing the virtual survey stations that have been recorded along the baselines and are presented in Figure 2.

5. Results and discussion

Isolated dipolar responses (yellow spots) were most common within the datasets (Figures 3 – 6) and were evenly spaced throughout the site. These 'iron spike' readings are likely to have been caused by the introduction of ferrous material into the topsoil horizon by manuring, plough action and from fly-tipping and loss.

Areas of magnetic disturbance (yellow hatching) were also numerous, those located on the periphery were strong, dipolar and linear in character and predominantly caused by the presence of ferrous fencing and fly-tipping debris along the boundaries. Fourteen discrete areas of magnetic disturbance recorded towards the centre of the site are likely to identify the buried remains of large modern magnetic targets. To the north, east and west of the extant field boundary dividing the fields, are four areas of magnetic disturbance that correlate well with the digitised cartographic features (green lines) of the backfilled field boundary/former trackway and two possible ponds or marl pits that are first recorded on the Tithe Award Map of 1841 (Hopkins, 2016).

Five weak negative linear anomalies (cyan lines) record the presence of an extant pathway that traverses both fields.

Seven positive discrete anomalies (orange hatching) indicative of pit type features were recorded within the site with no apparent clustering, a geological derivation cannot be completely ruled out.

Three positive linear anomalies indicative of backfilled relic field boundaries were recorded, orientated *c*.northeast to southwest and perpendicular. None of which are recorded on the cartographic sources, however their orientation is largely consistent with the existing field boundary layout and therefore they are likely to be of a similar post-medieval origin.

A positive and negative curvilinear anomaly enclosing an area of magnetic disturbance on the western boundary of the eastern-most field, records the partial remains of a

backfilled pond or marl pit depicted on the digitised 1882-84 Ordnance Survey and 1841 Tithe Award maps (Hopkins, 2016).

6. Conclusions

The detailed fluxgate gradiometer survey recorded a range of geophysical anomalies comprising positive linear trends indicative of relic field boundaries, areas of magnetic disturbance recorded where marl pits or ponds and a field boundary/ trackway are depicted on maps from 1841, positive discrete anomalies indicative of backfilled pits, and areas of magnetic disturbance and isolated dipolar responses that attest to a fair degree of modern fly-tipping.

7. Archive deposition

The paper, and digital archive will be kept at the SACIC office in Needham Market, before deposition in the Suffolk County Council Stores.

8. Acknowledgements

The fieldwork was carried out by Tim Schofield and Ed Palka and directed by Tim Schofield.

Project management was undertaken by Rhodri Gardner.

The report illustrations were created by Tim Schofield and the report was edited by Rhodri Gardner.

9. Bibliography

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Survey Station	Easting	Northing
STN 01	643900.000	262786.781
STN 02	643900.000	262926.781
STN 03	643760.000	262926.781

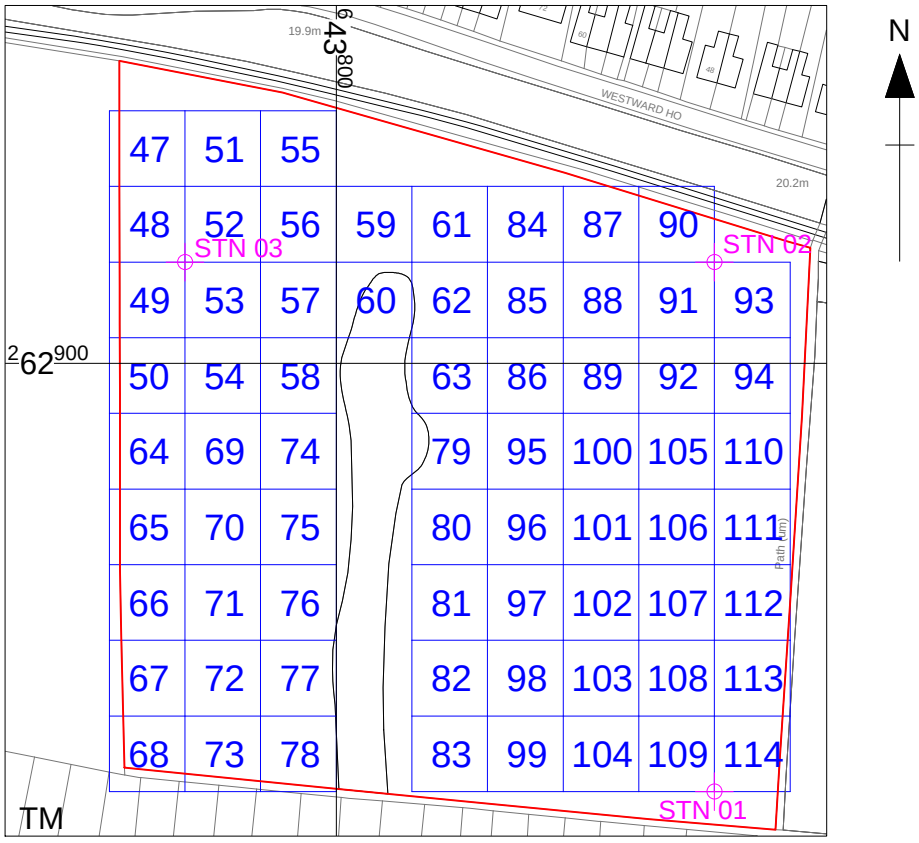


Figure 2. Survey grid & station location

0 100m

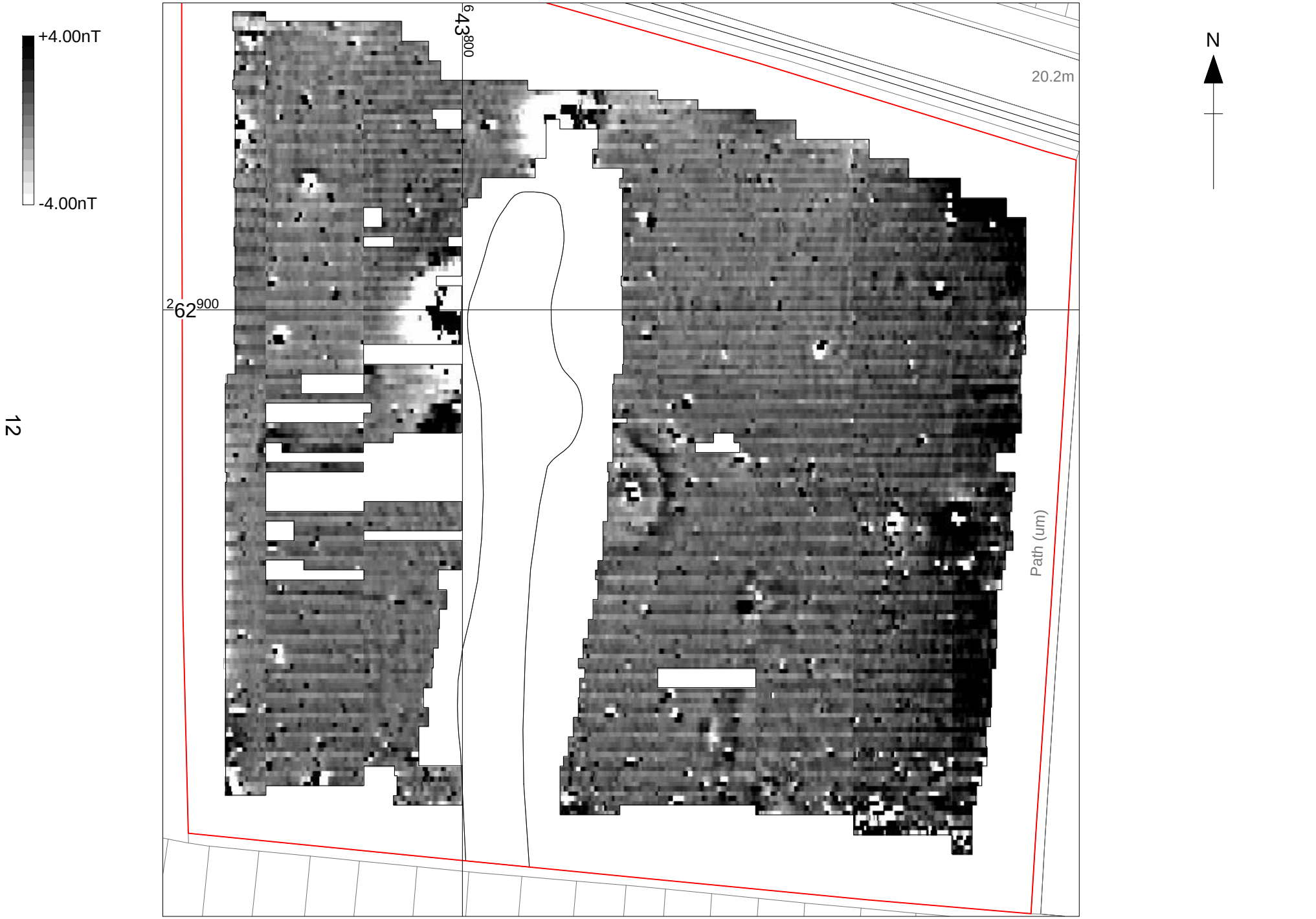


Fig.3 Raw magnetometer greyscale plot

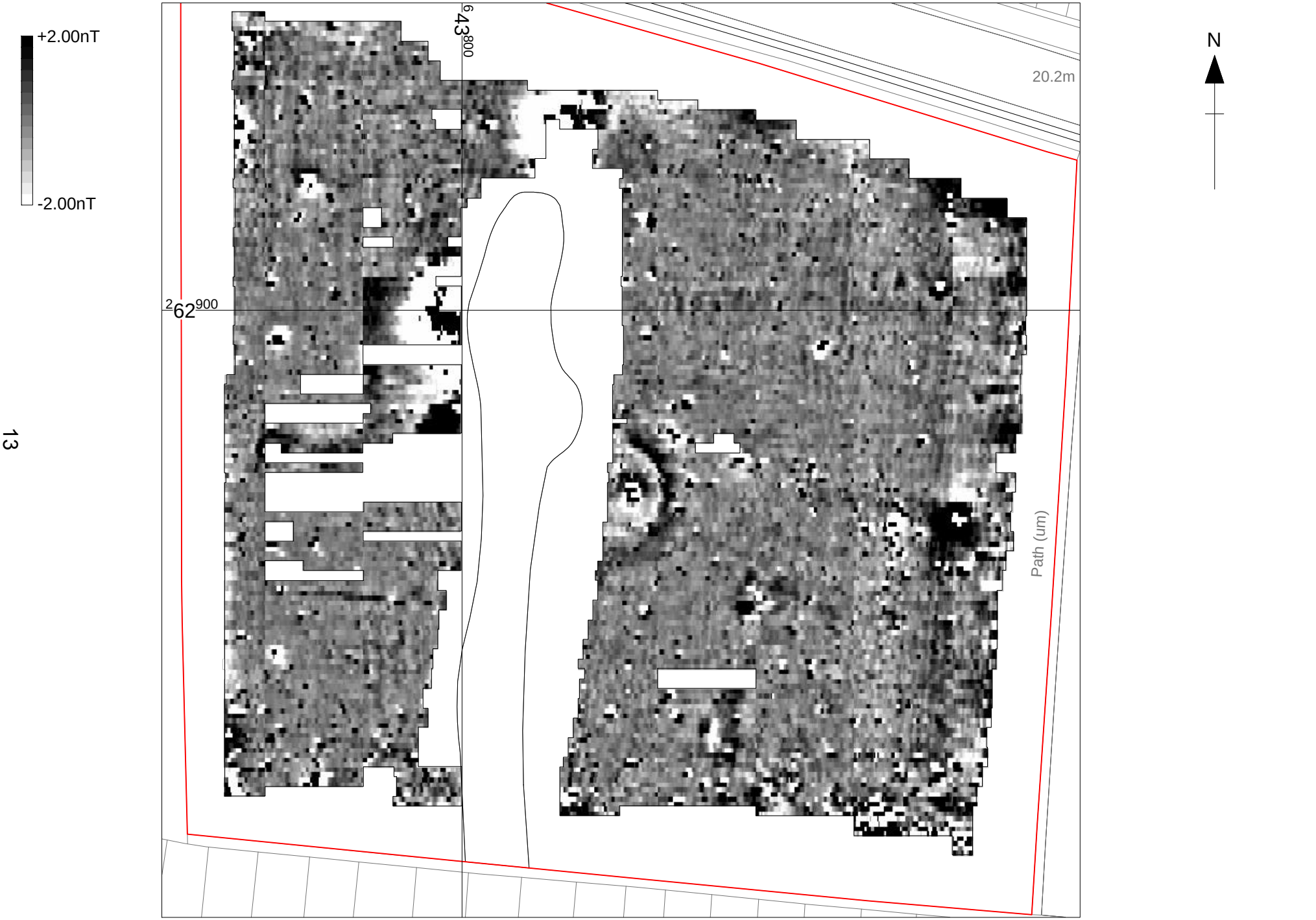


Fig.4 Processed magnetometer greyscale plot

Scale Interval	20nT/cm

N

Fig.5 Processed magnetometer xy trace plot

0 50m

Positive linear	
Negative linear	
Positive discrete, rubbish pit	
Magnetic disturbance, ferrous material	
Isolated dipolar, ferrous spike	
Areas unsuitable for survey	
Digitised 1882-84 Ordnance Survey Map features	

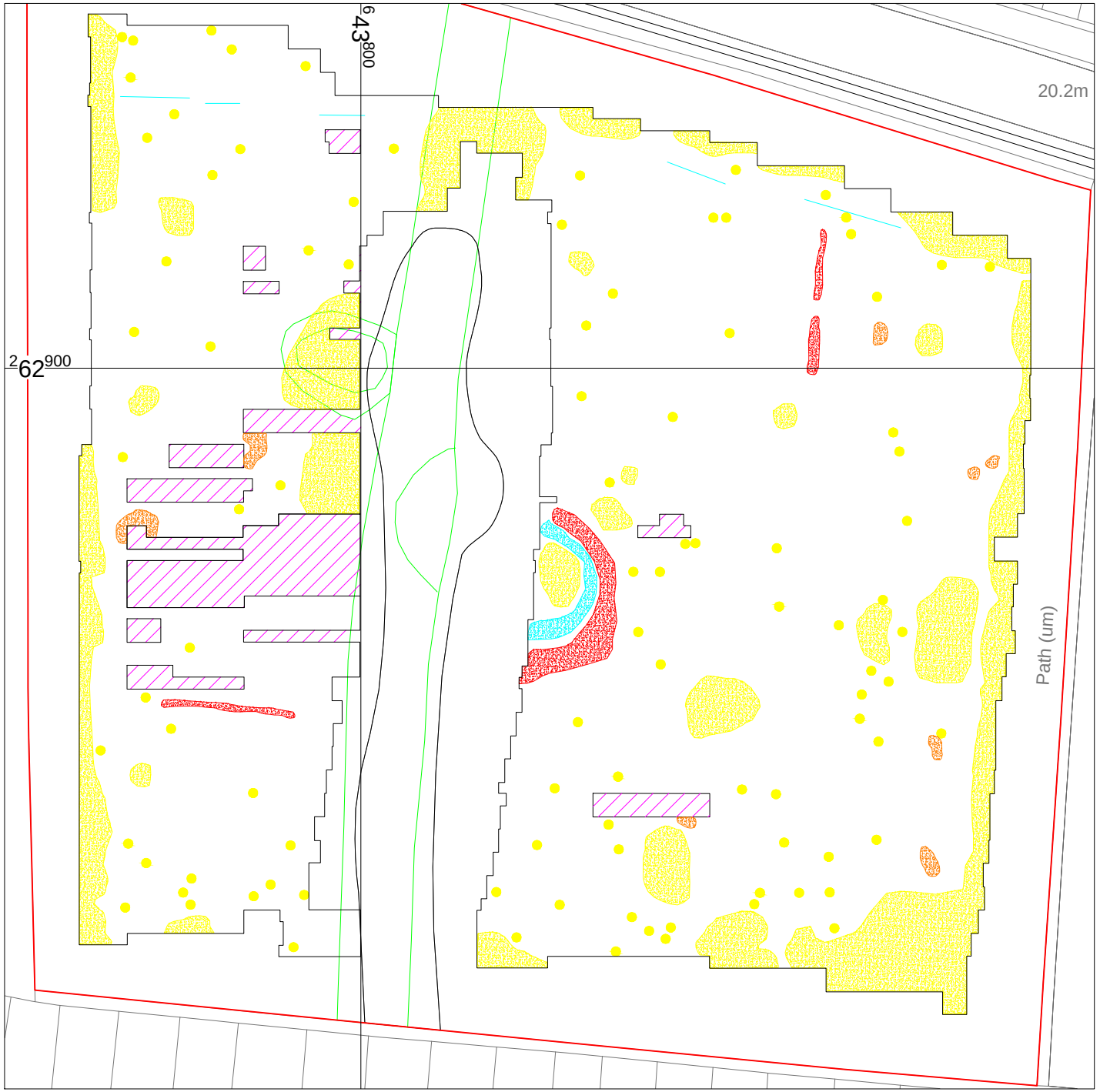


Fig.6 Interpretation plot of magnetometer anomalies

Appendix 1. Brief and specification

Suffolk County Council

The Archaeological Service
Conservation Team

Economy, Skills and Environment
9–10 The Churchyard, Shire Hall
Bury St Edmunds
Suffolk
IP33 1RX

Brief for an Archaeological Evaluation

AT

ST MARGARET'S CRESCENT, LEISTON

PLANNING AUTHORITY:	Suffolk Coastal District Council
PLANNING APPLICATION NUMBER:	To be confirmed
HER NO. FOR THIS PROJECT:	To be arranged/confirmed with the Suffolk HER Officer (james.rolfe@suffolk.gov.uk)
GRID REFERENCE:	TM 438 628
DEVELOPMENT PROPOSAL:	Housing
AREA:	5ha
THIS BRIEF ISSUED BY:	Rachael Abraham Senior Archaeological Officer Conservation Team Tel. : 01284 741232 E-mail: Rachael.abraham@suffolk.gov.uk
Date:	20 January 2016

Summary

1.1 The applicant and Local Planning Authority (LPA) have been advised that the location of the proposed development could affect important archaeological deposits.

1.2 The applicant is required to undertake an archaeological field evaluation prior to consideration of the proposal, in accordance with a Written Scheme of Investigation. This information should be incorporated in the design and access statement, in accordance with paragraphs 128 and 129 of the National Planning Policy Framework, in order for the LPA to be able to take into account the particular nature and the significance of any below-ground heritage assets at this location.

1.3 The archaeological contractor must submit a copy of their Written Scheme of Investigation (WSI) or Method Statement, based upon this brief of minimum requirements (and in conjunction with our standard Requirements for Geophysical Survey 2011 Ver. 1.1 and Trenched Archaeological Evaluation 2011 Ver 1.3), to the Conservation Team of Suffolk County Council's Archaeological Service (SCCAS/CT) for scrutiny; SCCAS/CT is the advisory body to the LPA on archaeological issues.

1.4 The WSI should be approved before costs are agreed with the commissioning client, in line with Institute for Archaeologists' guidance. Failure to do so could result in additional and unanticipated costs.

1.5 Following acceptance, SCCAS/CT will advise the LPA that an appropriate scheme of work is in place.

1.6 The WSI will *provide the basis for measurable standards* and will be used to establish whether the requirements of the brief will be met. If the approved WSI is not carried through in its entirety (particularly in the instance of trenching being incomplete) the evaluation report may be rejected.

Archaeological Background

2.1 Whilst no archaeological remains are recorded within the parcel of land itself, the site lies within an area of archaeological interest as defined by information held by the County Historic Environment Record (HER). To the south of the site is the medieval church (LCS 018) and an undated enclosure is recorded to the north (LCS 025). As a result of this potential, the large scale of the proposal and the fact that the site has been the subject of systematic archaeological investigation, there is a high probability of encountering archaeological remains at this location.

Fieldwork Requirements for Archaeological Investigation

3.1 A geophysical survey and trial trenched evaluation is required of the development area to enable the archaeological resource, both in quality and extent, to be assessed.

3.2 A magnetometry survey is required over the entire application site. Where appropriate (where ground conditions permit), it is recommended that magnetometer surveys be conducted using cart mounted sensors. A scale plan showing the proposed survey grid should be included in the WSI for approval by SCCAS/CT.

3.3 Trial Trenching is required to:

- 'Ground-truth' the geophysical results.
- Identify the date, approximate form and purpose of any archaeological deposit, together with its likely extent, localised depth and quality of preservation.
- Evaluate the likely impact of past land uses, and the possible presence of masking colluvial/alluvial deposits.
- Establish the potential for the survival of environmental evidence.
- Establish the suitability of the area for development.

3.4 Trial trenches are to be excavated to cover 3.5% by area, which is 1750m^2. Linear trenches are thought to be the most appropriate sampling method, using, where possible, a systematic grid array. Trenches are to be a minimum of 1.80m wide unless special circumstances can be demonstrated; this will result in *c*. 970m of trenching at 1.80m in width. Provision for a trenching contingency of up to 0.5% (250m$^{2)}$ should be made, to enable further clarification of areas of archaeology defined during the evaluation if required.

3.5 A scale plan showing the proposed location of the trial trenches should be prepared on the basis of the geophysical survey and metal detecting results. This plan must be submitted to the SCCAS/CT for approval before trenching begins.

3.6 Decisions on the need for any further archaeological investigation (e.g. excavation) will be made by SCCAS/CT, in a further brief, based on the results presented in the evaluation report. Any further investigation must be the subject of a further WSI, submitted to SCCAS/CT for scrutiny and formally approved by the LPA.

Arrangements for Archaeological Investigation

4.1 The composition of the archaeological contractor's staff must be detailed and agreed by SCCAS/CT, including any subcontractors/specialists. Ceramic specialists, in particular, must have relevant experience from this region, including knowledge of local ceramic sequences.

4.2 All arrangements for the evaluation of the site, the timing of the work and access to the site, are to be defined and negotiated by the archaeological contractor with the commissioning body.

4.3 The project manager must also carry out a risk assessment and ensure that all potential risks are minimised, before commencing the fieldwork. The responsibility for identifying any constraints on fieldwork (e.g. designated status, public utilities or other services, tree preservation orders, SSSIs, wildlife sites and other ecological considerations rests with the commissioning body and its archaeological contractor.

Reporting and Archival Requirements

5.1 The project manager must consult the Suffolk HER Officer to obtain an event number for the work. This number will be unique for each project or site and must be clearly marked on all documentation relating to the work.

5.2 An archive of all records and finds is to be prepared and must be adequate to perform the function of a final archive for deposition in the Archaeological Service's Store or in a suitable museum in Suffolk.

5.3 It is expected that the landowner will deposit the full site archive, and transfer title to, the Archaeological Service or the designated Suffolk museum, and this should be agreed before the fieldwork commences. The intended depository should be stated in the WSI, for approval.

5.4 The project manager should consult the intended archive depository before the archive is prepared regarding the specific requirements for the archive deposition and curation (including the digital archive), and regarding any specific cost implications of deposition.

5.5 A report on the fieldwork and archive must be provided. Its conclusions must include a clear statement of the archaeological value of the results, and their significance. The results should be related to the relevant known archaeological information held in the Suffolk HER, and an HER search should be commissioned. In any instances where it is felt that an HER search is unnecessary, this must be discussed and agreed with the relevant Case Officer. **ANY REPORTS WHICH DO NOT INCLUDE AN UP TO DATE HER SEARCH WILL NOT BE APPROVED. ALL REPORTS MUST CLEARLY DISPLAY THE INVOICE NUMBER FOR THE HER SEARCH, OTHERWISE THEY WILL BE RETURNED.**

5.6 An opinion as to the necessity for further evaluation and its scope may be given, although the final decision lies with SCCAS/CT. No further site work should be embarked upon until the evaluation results are assessed and the need for further work is established.

5.7 Following approval of the report by SCCAS/CT, a single copy of the report should be presented to the Suffolk HER as well as a digital copy of the approved report.

5.8 All parts of the OASIS online form http://ads.ahds.ac.uk/project/oasis/ must be completed and a copy must be included in the final report and also with the site archive. A digital copy of the report should be uploaded to the OASIS website.

5.9 Where positive results are drawn from a project, a summary report must be prepared for the *Proceedings of the Suffolk Institute of Archaeology and History*.

5.10 This brief remains valid for 12 months. If work is not carried out in full within that time this document will lapse; the brief may need to be revised and re-issued to take account of new discoveries, changes in policy and techniques.

Standards and Guidance

Further detailed requirements are to be found in our Requirements for Trenched Archaeological Evaluation 2011 Ver 1.2.

Standards, information and advice to supplement this brief are to be found in *Standards for Field Archaeology in the East of England*, East Anglian Archaeology Occasional Papers 14, 2003.

The Institute for Archaeologists' *Standard and Guidance for archaeological field evaluation* (revised 2001) should be used for additional guidance in the execution of the project and in drawing up the report.

Notes

The Institute for Archaeologists maintains a list of registered archaeological contractors (www.archaeologists.net or 0118 378 6446). There are a number of archaeological contractors that regularly undertake work in the County and SCCAS will provide advice on request. SCCAS/CT does not give advice on the costs of archaeological projects.

The Historic Environment Records Data available on the Heritage Gateway and Suffolk Heritage Explorer is **NOT** suitable to be used for planning purposes and will not be accepted in lieu of a full HER search.

Appendix 2. WSI

SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

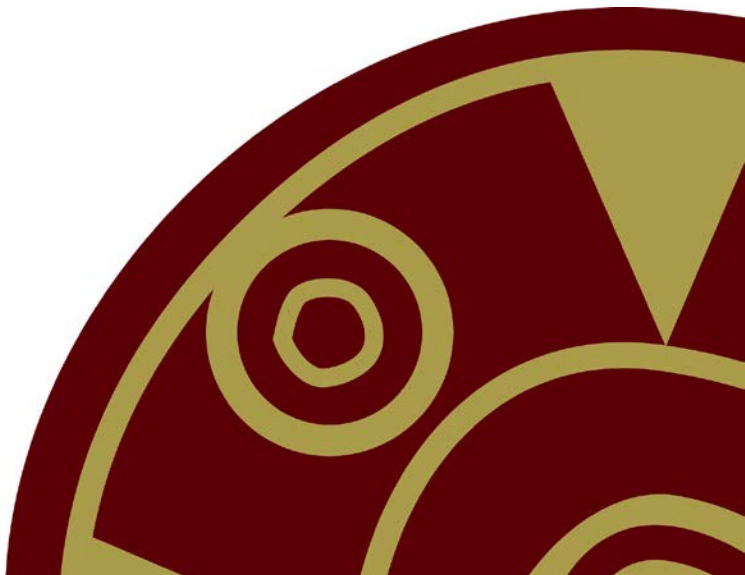
Land at St Margaret's Crescent

Leiston, Suffolk

Client:
Pigeon Investment Management Ltd and Leiston Land Ltd

Date:
March 2016

LCS 220
Written Scheme of Investigation and Risk Assessment – Geophysical Survey
Author: Simon Picard



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Project details

Planning Application No:	TBC
Curatorial Officer:	Rachael Abraham
Grid Reference:	TM 4377 6287
Area:	*c*.5ha
HER Event No/Site Code:	ESF23703/LCS 220
Oasis Reference:	245899
Project Start date:	30th March 2016
Project Fieldwork Duration:	3 Days
Client/Funding Body:	Pigeon Investment Management Ltd and Leiston Land Ltd
SACIC Project Manager:	Rhod Gardner
SACIC Project Officer:	Tim Schofield
SACIC Job Code:	TBC

1. Introduction

A geophysical survey is required on land for a proposed housing development at St Margaret's Crescent, Leiston, Suffolk (Fig. 1) in accordance with paragraph 128, 129 and 141 of the National Planning Policy Framework.

The Brief (dated 20/01/2016) produced by the archaeological adviser to the Local Planning Authority (LPA), Rachael Abraham of Suffolk County Council Archaeological Service/Conservation Team (SCCAS/CT) specifies for a geophysical survey over an area of *c*.5 hectares.

Suffolk Archaeology (SACIC) has been contracted to carry out the project. This document details how the requirements of the Brief and general SCCAS/CT guidelines (SCCAS 2011) will be met, and has been submitted to SCCAS/CT for approval on behalf of the LPA. It provides the basis for measurable standards and will be adhered to in full, unless otherwise agreed with SCCAS/CT.

2. The Site

The site, centred on grid reference TM 4377 6287, in two adjoining fields on the northwest edge of Leiston, both of which are sub-rectangular; the field to the west is *c*.2ha while the field to the east covers *c*.3ha. Sloping slightly from the northwest to the southeast, the site is located on a low-lying plateau that ranges in height from between 19m and 21m AOD. It is bounded by a modern residential development to the south and west, the Masterlord Industrial Estate to the east with hedgerows giving way to a railway line to the north.

The fields are believed to have been under intermittent agricultural use over the last few centuries for both grazing and crop production, today the eastern field has light scrub covering with trees and intermittent hedgerows while the western field is currently in use as a playing field.

The bedrock geology is described as Crag Group Sand, formed approximately 0 to 5 million years ago in the Quaternary and Neogene Periods, deposited as mud, silt, sand and gravel in shallow seas. Superficial deposits are described as Lowestoft Formation Diamicton, formed up to 2 million years ago in the Quaternary Period, deposited by glaciers as till with outwash sand and gravel (BGS, 2016).

3. Archaeological and historical background

The site lies within an area of archaeological interest defined by information held within the Suffolk Historic Environment Record and in a brief issued by SCCAS/CT (Abraham, 2016), a geophysical survey followed by a subsequent targeted trial trench evaluation (separate WSI) was requested to be undertaken, prior to consideration of the planning application.

The following archaeological background has been summarised from the desk-based assessment undertaken by Archaeological Risk Management (Hopkins, 2016).

No intrusive archaeological investigations have been carried out on the site, however evidence of prehistoric, Roman and medieval activity has been recorded within a 1km

radius of the site. Two Middle/Late Bronze Age cinerary urns (LCS 004) were found 700m to the east, close to the cropmark of part of a possible *c*.30m diameter ring ditch (LCS 020), while 720m to the northeast of the site a Late Bronze Age sword fragment was found by metal detecting (LCS 135). This is close to the location of a Roman kiln (LCS 142), a scatter of pottery and a few Roman coins (LCS 135) and a third century coin (LCS Misc). Two first century bronze *sestertii* were found 900m to the northeast of the site (LCS 013). In the town, 770m to the southeast, late first to second century pottery was found during groundworks (LCS 149).

A large sub-rectangular enclosure of unknown date, approximately 400m to the north of the site, surrounds a semi-circular ring ditch enclosing a dark circular patch (LCS 025).

The site is 300m to the northeast of the medieval core of Leiston (LCS 143) and 180m to the north of the St Margaret's parish church, rebuilt in the nineteenth century with only the late medieval tower remaining.

Post medieval brickworks, kilns, pug mill and drying sheds are recorded 450m to the east northeast of the site (LCS 153) and Masterlord Industrial Estate occupies part of the former Garret Ironworks site, a major influence on Leiston in the late eighteenth and nineteenth centuries.

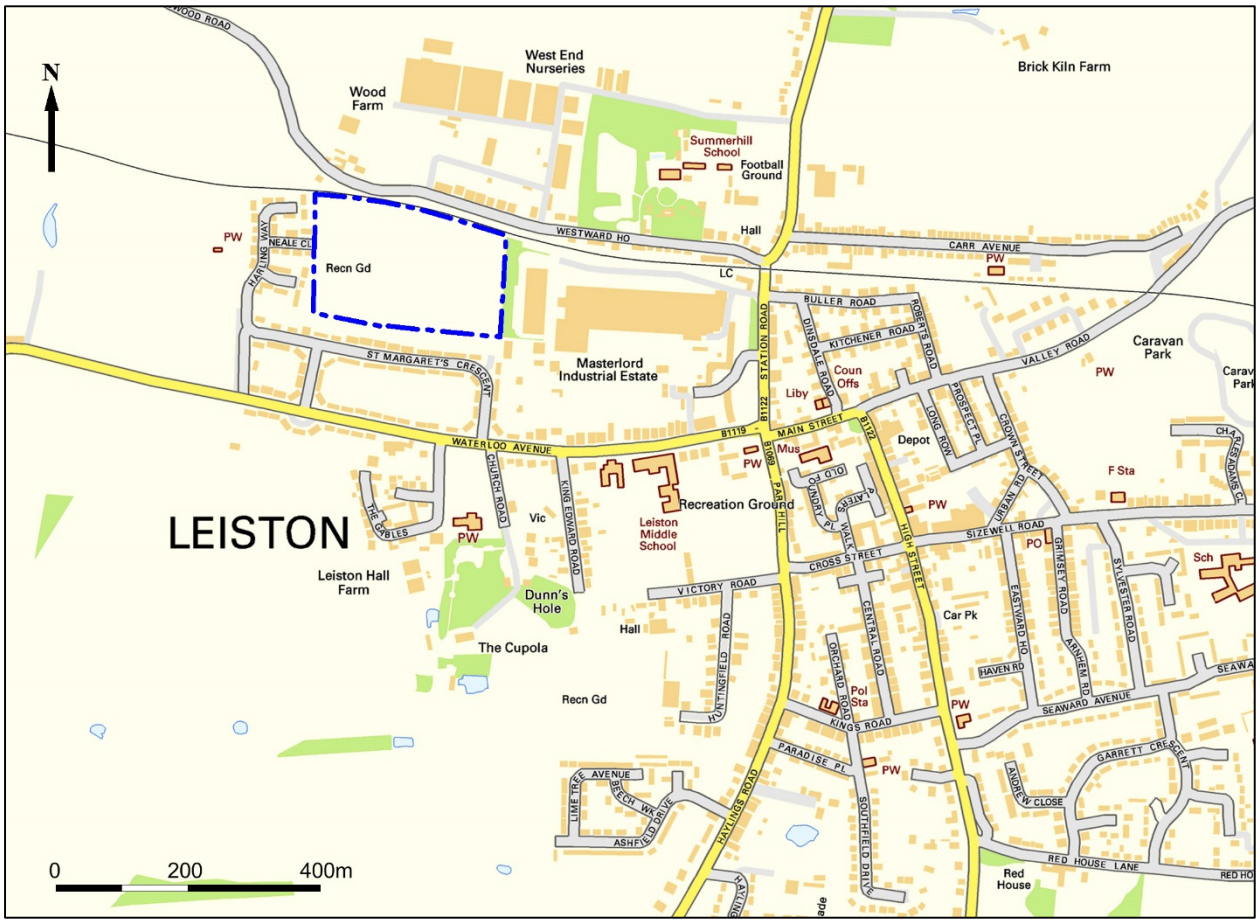

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Figure 1. Location map

4. Project Objectives

A non-intrusive geophysical survey is required of the development, followed by targeted trial trench evaluation to enable the archaeological resource, both in quality and extent, to be accurately quantified.

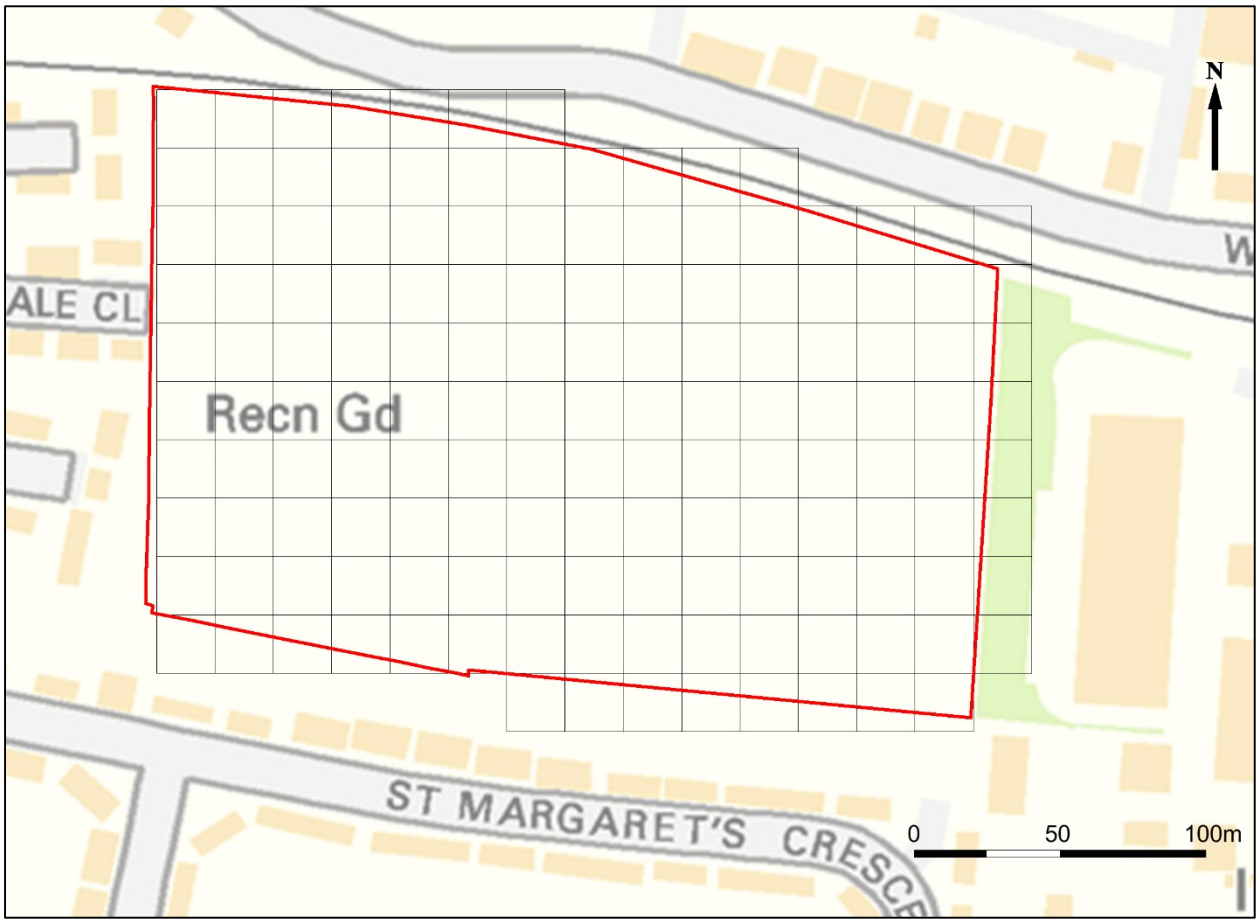

Figure 2. Survey grid location

5. Geophysical Survey method statement

5.1. Management

The project will be managed by SACIC Project Officer Tim Schofield in accordance with the principles of *Management of Research Projects in the Historic Environment* (MoRPHE, Historic England 2015).

SCCAS/CT will be given ten days' notice of the commencement of the fieldwork and arrangements made for SCCAS/CT site visit if required.

Full details of project staff are given in section 6 below.

5.2. Project preparation

An event number has been obtained from the SCCAS HER Officer and will be included on all future project documentation.

An OASIS online record has been initiated and key fields in details, location and creator forms have been completed.

A pre-site inspection and Risk Assessment for the project have been completed.

5.3. Fieldwork

Fieldwork standards will be guided by 'Standards for Field Archaeology in the East of England', EAA Occasional Papers 14, and the Chartered Institute for Archaeology's (CIfA) paper 'Standard and Guidance for archaeological geophysical survey', December 2014.

The fieldwork will be carried out by members of SACIC led by Project Officer Tim

Schofield. The fieldwork team will be drawn from a pool of suitable staff at SACIC.

The project Brief requires the survey of *c*.5 hectares over the development area (Fig. 2). Minor modifications to the survey area may be made onsite to respect any areas of disturbance/contamination or other obstacles.

A 5m exclusion zone around the sites periphery will be kept to minimise the amount of magnetic disturbance associated with the hedge boundaries.

Instrument type and set-up

The site will be surveyed using a Bartington Dual-Grad 601-2 which has high sensor sensitivity combined with rapid ground coverage. Good contrast between the magnetic susceptibility of a feature's fill (charcoal rich or humic deposits providing the best soil medium) and the local magnetic background signature of the superficial deposits will be important in achieving successful survey results.

Best practice dictates that sensors will be secured on the same side of the instrument until the completion of the survey, and sensor heights equalised to achieve a consistent elevation across the area. The instrument will be switched on and left for at least 20 minutes before the survey of the first grid to allow the sensors to reach a suitable operating temperature.

A zero station with low magnetic susceptibility shall be prospected on site to allow the correction of sensor diurnal drift. This unique station will be employed throughout the survey providing a common calibration location.

Sampling interval and grid size

The 20m survey grid will be set-out using a Leica Viva Glonass Smart Rover GS08+ to the Ordnance Survey OSGB36, converted to the National Grid Transformation OSTN02 datum that has an accuracy of +/- 0.01m. Regular testing of the instruments accuracy will

be undertaken employing stations with known ETRS89 coordinates. All raw data recorded by the GPS will be uploaded to the project folder, suitably labelled and kept as part of the project archive.

A 1m traverse interval and 0.25m sample interval will be utilised.

Data capture and archiving

A pro-forma survey sheet will be completed each day, unique grid numbers will be allocated to enable a data composite to be created. Instrument readings will be recorded on the internal data logger and downloaded to a laptop at midday and also in the evening, this will allow the data to be checked for quality on site and for grids to be re-surveyed if required.

Data will be filed in project specific folders separated into daily datasets. The daily datasets will be combined into a single composite on completion of the fieldwork.

Data will be stored in project specific folders that will be downloaded onto a laptop and then backed-up onto an external server on the evening of each day.

Metadata sheets will be completed and inserted into the report as an appendix.

All on-site derived site data will be entered onto a digital (Microsoft Access) SACIC database compatible with the Suffolk HER.

Data processing and presentation

Raw survey data will collected to a high standard to enable only minimal processing of the datasets to be required. Typically these algorithms may comprise de-spike and zero mean sensor. The data will also be clipped at a suitable level to enable the anomalies to be presented with best clarity.

Raw and processed greyscale plots and xy trace plots of the datasets shall be exported from Terrasurveyor into AutoCAD.

An interpretation plan based on the combined interpretations of the raw, processed and xy trace plots will be produced using AutoCAD. All figures shall be georeferenced within the National Grid and printed at an appropriate scale.

Software

The software used to process the data will be DW Consulting's Terrasurveyor v3.0.27.0. Images will be exported from Terrasurveyor into a geo-referenced grid within an AutoCAD drawing. Interpretation plans of the anomalies will then be digitised in AutoCAD.

Outreach

Due to the small size and likely short duration of the project outreach activities such as an open day or tours for the general public, local schools, councillors, societies *etc.* are unlikely to be viable. If warranted, and the site is not deemed too archaeologically sensitive, a press release will be issued to local media and information boards will placed on the site perimeter.

5.4. Report

The report will be commensurate with the results of the fieldwork and will be consistent with the principles of Management of Research Projects in the Historic Environment (MoRPHE, Historic England, 2015), Geophysical survey in Field Evaluation (English Heritage now Historic England, 2008) and the Standard and Guidance for Archaeological Geophysical Survey (Chartered Institute for Archaeologists, 2014), containing the following:

The report will contain a summary, description of the project background, site location, survey methodology, detailed description of the nature, location and extent of anomalies,

discussion of the anomalies, impact assessment, site potential and possible further work. Scaled raw, processed, xy data plans and an interpretation plan will also be included.

The report will include a summary in the established format for inclusion in the annual *'Archaeology in Suffolk'* section of the Proceedings of the Suffolk Institute of Archaeology and History.

A copy of this Written Scheme of Investigation will be included as an appendix in the report.

Metadata sheet tables will form one of the appendices within the report.

A technical data sheet will be included as an appendix.

The report will include a copy of the completed project OASIS form as an appendix.

An unbound draft copy of the report will be submitted to SCCAS/CT for approval within 6 months of completion of fieldwork.

5.5. Project archive

On approval of the report a printed and bound copy will be lodged with the Suffolk HER. A digital .pdf file will also be supplied, together with a digital and fully georeferenced vector plan showing the application area and survey location, compatible with MapInfo software.

The online OASIS form for the project will be completed and a .pdf version of the report uploaded to the OASIS website for online publication by the Archaeological Data Service. A paper copy of the form will be included in the project archive.

A second bound copy of the report will be included with the project archive.

A digital .pdf copy of the approved report will be supplied to the client, together with our final invoice for outstanding fees. Printed and bound copies will be supplied to the client on request.

The project archive, consisting of all paper and digital records, will be deposited in the SCCAS Archaeological Store at Bury St Edmunds within 6 months of completion of fieldwork. The project archive will be consistent with MoRPHE (Historic England, 2015) and ICON guidelines. The project archive will also meet the requirements of SCCAS (SCCAS 2010).

All physical site records and paperwork will be labelled and filed appropriately. Digital files will be stored in the relevant SCCAS archive parish folder on the SCC network site.

The project costing includes a sum to meet SCCAS archive charges. A form transferring ownership of the archive to SCCAS will be completed and included in the project archive.

If the client, on completion of the project, does not agree to deposit the archive with, and transfer to, SCCAS, they will be expected to either nominate another suitable depository approved by SCCAS.

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British Geological Survey, 2016

http://mapapps.bgs.ac.uk/geologyofbritain/home.html

6. Project Staffing

6.1. Management

SACIC Manager	Dr Rhodri Gardner
SACIC Project Manager	Dr Rhodri Gardner
SACIC Finds Dept	Richenda Goffin

6.2. Fieldwork

The fieldwork team will be derived from the following pool of SACIC staff.

Name	Job Title	First Aid	Other skills/qualifications
Tim Schofield	Project Officer	Yes	Surveyor
Robert Brooks	Project Officer	Yes	Surveyor
Simon Cass	Project Officer	Yes	Surveyor
Michael Green	Project Officer	Yes	Surveyor
Laszlo Lichenstein	Project Officer	Yes	Surveyor
Simon Picard	Project Officer		Surveyor
Preston Boyle	Project Supervisor	Yes	Surveyor
Tim Carter	Project Assistant	Yes	Metal detectorist
Sam Thomas	Project Assistant		Surveyor
Edmund Palka	Project Assistant		Surveyor

6.3. Report production

The production of the site report, graphics and submission of the project archive will be carried out by Tim Schofield.

Appendix 1. Health and Safety

1. Introduction

The project will be carried out following the SACIC Health and Safety Management System at all times. The SACIC Health and Safety Policy Statement reads as follows:

Suffolk Archaeology Community Interest Company is committed to ensuring the health, safety and welfare of its employees, and it will, so far as is reasonably practicable, establish procedures and systems necessary to implement this commitment and to comply with its statutory obligations on health and safety. Our Personnel are informed of their responsibilities to ensure they take all reasonable precautions, to ensure the safety, health and welfare of those that are likely to be affected by the acts and emissions of our organisations undertakings.

Suffolk Archaeology Community Interest Company understands our duty to identify the significant hazards that may be created by our undertakings and to risk assess these accordingly to ensure that suitable and effective controls are implemented to minimise risk to a suitable level as far as is reasonably practicable.

We also acknowledge our duty, so far as is reasonably practicable:

- *To provide a safe working environment for our workforce, fulfil our statutory commitments and actively manage and supervise health and safety at work;*
- *To identify the risks associated with our business activities and ensure suitable and sufficient control measures are in place.*
- *Ensure regular consultation with our employees on matters which affect their health and Safety.*
- *To ensure that all plant and equipment used by our employees is fit for purpose and adequately maintained.*
- *To provide suitable storage and ensure safe handling of Hazardous substances.*
- *To ensure that all workers are competent to undertake their daily work activities by providing all relevant information and training, consideration will also be given to any employees who do not have English as a first language.*
- *To prevent accidents and cases of work related ill health by ensuring a robust reporting and investigation system is in place.*
- *To liaise and communicate effectively regarding health and safety matters when working on other persons premises.*
- *To ensure that there is an effective system of induction, training, communication and supervision to other persons visiting or working on our premises.*
- *To have access to competent advice, this will be provided by Agility UK (Training and Consultancy) Ltd. Who will assists us in the continuous improvement in our health and safety performance and management through regular review and revision of this policy; and to provide suitable resources required to make this policy and our Health and Safety arrangements effective.*

2. Specific project issues

Introduction

All SACIC staff will be aware that they have a responsibility to:

- Take care of their own health and safety and that of others who may be affected by what they do, or fail to do, at work.
- Follow safe systems of work and other precautions identified in the project risk assessments.
- Report any changes to personal circumstances that may affect their ability to work safely.
- Report potential hazards, incidents and near misses to the Project Officer/supervisor.

A pre-site inspection has been made of the site and applicable SACIC Risk Assessments for the project are included below.

All SACIC staff are experienced in working on a variety of archaeological sites and permanent staff all hold a CSCS (Construction Skills Certification Scheme) card. All staff have been shown the SACIC Health and Safety Manual, copies of which are held at the SACIC office in Needham Market. All staff will read the site WSI and Risk Assessments and receive a site safety induction from the Project Officer prior to starting work. All staff will be issued with appropriate PPE.

From time to time it may be necessary for site visits by other SACIC staff, external specialists, SCCAS/CT staff or other members of the public. All such staff and visitors will be issued with the appropriate PPE and will undergo the required inductions.

Site staff, official visitors and volunteers are all covered by SACIC insurance policies. SACIC also has professional negligence insurance. Copies of these policies are available on request.

Welfare facilities

Due to the limited nature of the project, it is proposed that SACIC staff will work from their vehicle and use client welfare facilities if available. If not staff will be able to travel to public facilities. Additional facilities, toilet, site accommodation etc, will be provided if the project

is extended. Fresh, clean water for drinking and hand washing is carried in SACIC vehicles. A vehicle will be on site at all times.

First Aid

A member of staff with the First Aiders at Work qualification will be on site at all times. A First Aid kit and a fully charged mobile will also be in vehicle/on site at all times.

Working within School Grounds

SACIC staff and sub-contractors will follow any requirements made by the school, such as sign in procedures.

All SACIC staff have passed The Disclosure and Barring Service check.

Other than for access to welfare facilities staff will be working solely within the site and will have limited interaction with the school and pupils. Staff will be informed that they are not to go elsewhere on the school grounds unless authorized.

Site access and security

Access to the site is off High Road and has been agreed with the client and/or landowner. The site is bounded by hedgerows and not open to public access.

Contaminated ground

Details of any ground contamination have/have not been provided by the client. If any such is identified then groundworks will cease until adequate safety and environmental precautions are in place.

Advice will be sought from HSE and relevant authorities if required concerning any of these issues.

Hazardous Substances

No hazardous substances are specifically required in order to undertake the archaeological works.

Underground services

Details of known services have not been provided by the client.

Overhead Powerlines

No overhead powerlines cross the site.

Personal Protective Equipment (PPE)

The following PPE is issued to all site staff as a matter of course. Additional PPE will be provided if deemed necessary.

- Hard Hat (to EN397).
- High Visibility Clothing (EN471 Class 2 or greater).
- Safety Footwear (EN345/EN ISO 20346 or greater – to include additional penetration-resistant midsole).
- Gloves (to EN388).
- Eye Protection (safety glasses to at least EN 166 1F).

SACIC Environment Policy

Suffolk Archaeology is committed to the sustainable management of the local and global environment to support local communities and growth in our local economy. We will strive to reduce our carbon emissions, to protect and enhance the natural and historic environment and to tackle the issues of a changing climate. In delivering our services, we are committed to meeting all relevant regulatory, legislative and other requirements, and to the continual improvement of our environmental performance.

We will endeavour to:

- Prevent environmental pollution and minimise waste.
- Reduce our carbon emissions.
- Continually improve our energy efficiency and reduce our use of resources.
- Reduce the impact of vehicle travel by our employees
- Implement sustainable procurement practices where possible.
- Enhance biodiversity, conserve distinctive landscapes and protect the historic environment.

All existing and new SACIC subcontractors are issued annually with an Environmental Guidance Note For Contractors.

On site the SACIC Project Officer will monitor environmental issues and will alert staff to possible environmental concerns. In the event of spillage or contamination, e.g. from plant or fuel stores, EMS reporting and procedures will be carried out in consultation with the

SACIC EMS Officer.

The client and/or landowner has not informed SACIC of any environmental constraints upon the development area.

All rubbish will be bagged and removed either to areas designated by the client or returned to SACIC for disposal.

3. Project Contacts

SACIC

SACIC Manager	Dr Rhodri Gardner	01449 900120
SACIC Project Manager	Dr Rhodri Gardner	01449 900120
SACIC Finds Dept	Richenda Goffin	01449 900129
SACIC H&S	Stuart Boulter	01449 900122
SACIC EMS	Jezz Meredith	01449 900124
SACIC Outreach Officer	Duncan Allan	01449 900126

Emergency services

Local Police	Leiston Police Station, 34 Kings Road, Leiston, IP16 4DA	101, 01473 613500
Local GP	The Leiston Surgery, Main St, Leiston, IP16 4ES	01728 830526
Location of nearest A&E	Heath Road, Ipswich, IP4 5PD	01473 712233
Environment Agency	Customer Services Line (8am to 6pm)	03708 506506
	24 hour Emergency Hotline	0800 807060
Essex and Suffolk Water	24 hour Emergency Hotline	08457 820999
National Gas Emergency Service	Gas emergency hotline	0800 111999
UK Power Networks	East England electricity emergency hotline	08007 838838
Anglian Water	24 hour Emergency Hotline	08457 145145

Client contacts

Client	Pigeon Investment Management Ltd and Leiston Land Ltd	01284 766200
Client Agent	Adrian Tindall, ARM	01284 767681
Site landowner		

Archaeological contacts

Curator	Rachael Abraham	01284 741230
Consultant		
EH Regional Science Advisor	Dr Zoe Outram	01223 582707

Sub-contractors

Plant hire
Misc. Equipment hire
Toilet/facilities hire

4. Geophysical Technical Information

Detailed magnetometer survey

Detailed magnetometer survey is the most commonly employed archaeological geophysical prospection method in Britain, sensitive sensors can cost-effectively cover large areas of ground, rapidly recording anomalies that are indicative of cultural settlement activity. These anomalies can then be further investigated by field archaeologists to quantify a form and function. The magnetometer is a passive instrument that detects both permanent thermoremanent and temporary magnetic responses.

Thermoremanent Magnetism

When a material containing iron oxides, for example clay, is heated above the Curie point, weakly magnetic compounds transform in to highly magnetic oxides that can be detected by the sensors of a magnetometer (Clark). For instance the iron oxide haematite has a Curie temperature of 675 Celsius and magnetite 565 Celsius. Once these temperatures are reached, the oxides become demagnetised, on cooling their magnetic properties become permanently re-magnetised and align in the direction of the Earth's magnetic field (Gaffney and Gater). Over time the direction of the Earth's magnetic field changes allowing these directional differences to be detected by the magnetometer.

Strongly heated features such as hearths, kilns or furnaces frequently reach the materials Curie temperature and become permanently magnetised. These permanent magnetic responses are some of the strongest cultural features that can be recorded.

Temporary Magnetism

Magnetic susceptibility is the ease with which a magnetic field can pass through a material, therefore the higher the materials magnetic susceptibility, the stronger the induced magnetic field will be. Temporary magnetisation occurs within material that is magnetically susceptible, this material acquires its own local magnetic field that combine with the Earth's magnetic field causing an anomaly to stand out from the background noise (Clark). These anomalies are more subtle in nature, being derived from material that has been magnetically enhanced by cultural activity and become concentrated into features over time. Anomalies that have temporary magnetisation include backfilled pits,

ditches, field systems, occupation areas, land drains, remnant and existing field boundaries (David, 2011).

The key to a successful survey is having good contrast between the magnetic susceptibility of an archaeological feature with the surrounding superficial deposits. If there is no discernible difference between the two mediums it may be unlikely that the magnetometer will successfully prospect the feature. Archaeological features can also be masked by high magnetically susceptible topsoil, or deep overlying subsoil and colluvial deposits.

Ferrous anomalies

Ferrous objects are a common source of permanent magnetism, usually isolated with a strong dipolar signature. Some of these responses may have an archaeological derivation, however they are probably more indicative of modern iron objects introduced through manuring or lost within the topsoil.

Bartington DualGRAD 601-2 Fluxgate Gradiometers

Fluxgate gradiometers are the most commonly employed class of instrument in the UK. Two 1m sensitive sensors are affixed to a frame mounted 1m apart in a vertical plane and harnessed to the trunk of a geophysical surveyor or attached two a pulled cart. Each sensor contains two fluxgate magnetometers with 1m vertical separation. The sensor above records the Earth's magnetic field (magnetic background) while the sensor below records the local magnetic field. The two sensors need aligning before recording can begin, a zero station is located in an area with low magnetic variation for this purpose. After the sensors have been aligned, the survey can begin. When differences in the magnetic field strength occur between the two vertical magnetometers within each sensor, a positive or negative reading is recorded that is relative to the magnetic background of the zero station. Positive anomalies include pits, ditches and agricultural

furrows. Negative anomalies commonly prospected include earthwork embankments, land drains and geological features.

Sensors are normally mounted to a height of 0.30m above the surface, and can detect to a depth of between one and two metres below the ground. The first survey traverse is commonly undertaken in an east to west direction.

Magnetic Anomalies

Isolated dipolar responses

Isolated dipolar responses are commonly recorded throughout a dataset and are usually indicative of modern ferrous material deposited within the topsoil horizon. In some instances the anomalies may be of an archaeological derivation. They are isolated, strong and dipolar in character.

Areas of magnetic disturbance

These anomalies are usually caused by building demolition rubble, ferrous boundaries, slag waste dumps, modern buried rubbish, pylons and services. Strong and dipolar in character, they are commonly recorded over a wide area.

Linear trends

Linear trends can be either positive or negative magnetic responses depending on the nature of the material present within the feature. If the anomaly is broad and weak, it is more likely to be of geological origin. Stronger positive linear trends are more likely to be of archaeological derivation, caused by settlement activity infilling rich humic, charcoal and fired deposits into a feature. Negative linear trends are more commonly associated with bank deposits or land drains, with the less magnetically susceptible superficial

deposits deposited at the top of the feature. Curvilinear trends are usually of archaeological origin, commonly interpreted as ring ditches or drip-gullies.

Discrete anomalies

Discrete anomalies can either be positive or negative in nature recorded within a localised area. Those that are positive are more likely to be of an archaeological origin, with negative discrete anomalies more commonly interpreted as natural geological variations.

Thermoremanent responses

These responses are caused by the heating of material containing iron to above the Curie temperature, they are strong and discrete in nature, in Britain high positive readings are recorded to the south of the feature, and conversely high negative readings are recorded to the north.

SUFFOLK ARCHAEOLOGY

• A HISTORY OF EXPERTISE •

Geophysical Survey Risk Assessments

A pre-site inspection and assessment has been made of the site and the following SACIC Risk Assessments apply to the project and are included below.

SACIC GSRA1	Manual handling and outdoor working
SACIC GSRA2	Use of hand tools and instrumentation

Geophysical Survey Risk Assessment 1 Manual handling and outdoor working

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Manual handling of survey instruments and working outdoors.	Various.	Extremes of heat, cold and wet weather. Trip hazards.	Hypothermia, heat stroke, sunburn. Minor injuries. Carrying heavy equipment for prolonged periods.	All field staff.	9	All staff provided with appropriate clothing for weather conditions. No staff to work alone in extreme conditions. Regular sweep for trip hazards.	2	T Schofield	21/03/16	First Aid if required. Call emergency services if necessary.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

Geophysical Survey Risk Assessment 2 Use of hand tools and survey instruments

Activity	Location	Hazard	Risks	Persons affected	Initial risk	Control measures	Residual risk	Name	Date	Rescue procedures
Surveying, setting out and use of small hand tools and marker canes.	Various.	Splinters from poorly maintained equipment, trip hazards from unused equipment, trip hazards from uneven ground, some heavy lifting, tape winding.	Minor injuries.	All field staff.	8	Ensure all tools in serviceable condition. Careful policing of temporarily unused equipment (e.g. no discarded hand tools, hand tapes pegged down). Ensure all tools and instrumentation carried appropriately.	4	T Schofield	21/03/16	First Aid if required. Call emergency services if necessary.

	Likelihood				
Severity	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

Initial Risk
Residual Risk

Likelihood	Severity	Risk (likelihood x severity)
1. Highly unlikely	1. Slight inconvenience	1-5 Low
2. May occur but very rarely	2. Minor injury requiring first aid	
3. Does occur but only rarely	3. Medical attention required	6-12 Medium
4. Occurs from time to time	4. Major injury leading to hospitalisation	
5. Likely to occur often	5. Fatality or serious injury leading to disablement	13-25 High

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Appendix 3. Metadata Sheets

Source Grids: 67*

*grid numbers 01 – 46 not used

47 Col:5 Row:1 grids\47.xgd
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49 Col:5 Row:3 grids\49.xgd
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107 Col:12 Row:9 grids\109.xgd
108 Col:13 Row:3 grids\93.xgd
109 Col:13 Row:4 grids\94.xgd
110 Col:13 Row:5 grids\110.xgd
111 Col:13 Row:6 grids\111.xgd
112 Col:13 Row:7 grids\112.xgd
113 Col:13 Row:8 grids\113.xgd
114 Col:13 Row:9 grids\114.xgd

Raw data

Filename	Leiston R.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	720 x 180
Survey Size (meters)	180 m x 180 m
Grid Size	20 m x 20 m
X Interval	0.25 m
Y Interval	1 m
Stats	
Max	4.00
Min	-4.00
Std Dev	1.60
Mean	0.66
Median	0.66
Composite Area	3.24ha
Surveyed Area	2.3584 ha
Program	
Name	TerraSurveyor
Version	3.0.27.0

Raw data presentation

Clip from -4.00 to + 4.00 nT.

No processing.

Processed data

Filename	Leiston P.xcp
Description	
Instrument Type	Grad 601-2 (Gradiometer)
Units	nT
Direction of 1st Traverse	90 deg
Collection Method	ZigZag
Sensors	2 @ 1.00 m spacing.
Dummy Value	2047.5
Dimensions	
Composite Size (readings)	720 x 180
Survey Size (meters)	180 m x 180 m
Grid Size	20 m x 20 m
X Interval	0.25 m
Y Interval	1 m
Stats	
Max	2.00
Min	-2.00
Std Dev	0.95
Mean	0.01
Median	0.00
Composite Area	3.24 ha
Surveyed Area	2.3584 ha
Program	
Name	TerraSurveyor
Version	3.0.27.0

Processed data presentation

Destripe median sensors all

Clip from -2.00 to +2.00 nT

4. Geophysical Technical Information

Detailed magnetometer survey

Detailed magnetometer survey is the most commonly employed archaeological geophysical prospection method in Britain, sensitive sensors can cost-effectively cover large areas of ground, rapidly recording anomalies that are indicative of cultural settlement activity. These anomalies can then be further investigated by field archaeologists to quantify a form and function. The magnetometer is a passive instrument that detects both permanent thermoremanent and temporary magnetic responses.

Thermoremanent Magnetism

When a material containing iron oxides, for example clay, is heated above the Curie point, weakly magnetic compounds transform in to highly magnetic oxides that can be detected by the sensors of a magnetometer (Clark). For instance the iron oxide haematite has a Curie temperature of 675 Celsius and magnetite 565 Celsius. Once these temperatures are reached, the oxides become demagnetised, on cooling their magnetic properties become permanently re-magnetised and align in the direction of the Earth's magnetic field (Gaffney and Gater). Over time the direction of the Earth's magnetic field changes allowing these directional differences to be detected by the magnetometer.

Strongly heated features such as hearths, kilns or furnaces frequently reach the materials Curie temperature and become permanently magnetised. These permanent magnetic responses are some of the strongest cultural features that can be recorded.

Temporary Magnetism

Magnetic susceptibility is the ease with which a magnetic field can pass through a material, therefore the higher the materials magnetic susceptibility, the stronger the induced magnetic field will be. Temporary magnetisation occurs within material that is magnetically susceptible, this material acquires its own local magnetic field that combine with the Earth's magnetic field causing an anomaly to stand out from the background noise (Clark). These anomalies are more subtle in nature, being derived from material that has been magnetically enhanced by cultural activity and become concentrated into features over time. Anomalies that have temporary magnetisation include backfilled pits,

ditches, field systems, occupation areas, land drains, remnant and existing field boundaries (David, 2011).

The key to a successful survey is having good contrast between the magnetic susceptibility of an archaeological feature with the surrounding superficial deposits. If there is no discernible difference between the two mediums it may be unlikely that the magnetometer will successfully prospect the feature. Archaeological features can also be masked by high magnetically susceptible topsoil, or deep overlying subsoil and colluvial deposits.

Ferrous anomalies

Ferrous objects are a common source of permanent magnetism, usually isolated with a strong dipolar signature. Some of these responses may have an archaeological derivation, however they are probably more indicative of modern iron objects introduced through manuring or lost within the topsoil.

Bartington DualGRAD 601-2 Fluxgate Gradiometers

Fluxgate gradiometers are the most commonly employed class of instrument in the UK. Two 1m sensitive sensors are affixed to a frame mounted 1m apart in a vertical plane and harnessed to the trunk of a geophysical surveyor or attached two a pulled cart. Each sensor contains two fluxgate magnetometers with 1m vertical separation. The sensor above records the Earth's magnetic field (magnetic background) while the sensor below records the local magnetic field. The two sensors need aligning before recording can begin, a zero station is located in an area with low magnetic variation for this purpose. After the sensors have been aligned, the survey can begin. When differences in the magnetic field strength occur between the two vertical magnetometers within each sensor, a positive or negative reading is recorded that is relative to the magnetic background of the zero station. Positive anomalies include pits, ditches and agricultural

furrows. Negative anomalies commonly prospected include earthwork embankments, land drains and geological features.

Sensors are normally mounted to a height of 0.30m above the surface, and can detect to a depth of between one and two metres below the ground. The first survey traverse is commonly undertaken in an east to west direction.

Magnetic Anomalies

Isolated dipolar responses

Isolated dipolar responses are commonly recorded throughout a dataset and are usually indicative of modern ferrous material deposited within the topsoil horizon. In some instances the anomalies may be of an archaeological derivation. They are isolated, strong and dipolar in character.

Areas of magnetic disturbance

These anomalies are usually caused by building demolition rubble, ferrous boundaries, slag waste dumps, modern buried rubbish, pylons and services. Strong and dipolar in character, they are commonly recorded over a wide area.

Linear trends

Linear trends can be either positive or negative magnetic responses depending on the nature of the material present within the feature. If the anomaly is broad and weak, it is more likely to be of geological origin. Stronger positive linear trends are more likely to be of archaeological derivation, caused by settlement activity infilling rich humic, charcoal and fired deposits into a feature. Negative linear trends are more commonly associated with bank deposits or land drains, with the less magnetically susceptible superficial

deposits deposited at the top of the feature. Curvilinear trends are usually of archaeological origin, commonly interpreted as ring ditches or drip-gullies.

Discrete anomalies

Discrete anomalies can either be positive or negative in nature recorded within a localised area. Those that are positive are more likely to be of an archaeological origin, with negative discrete anomalies more commonly interpreted as natural geological variations.

Thermoremanent responses

These responses are caused by the heating of material containing iron to above the Curie temperature, they are strong and discrete in nature, in Britain high positive readings are recorded to the south of the feature, and conversely high negative readings are recorded to the north.

Appendix 5. OASIS Form

OASIS DATA COLLECTION FORM: England

OASIS ID: suffolka1-245899

Project details

Project name	St Margaret's Crescent, Leiston. Geophysical survey.
Short description of the project	In March and April 2016 Suffolk Archaeology Community Interest Company undertook a detailed fluxgate gradiometer survey on land outlined for a proposed housing development on land to the rear of St Margaret's Crescent, Leiston, Suffolk. The detailed fluxgate gradiometer survey prospected a range of geophysical anomalies comprising fourteen positive linear trends indicative of former field boundaries, four areas of magnetic disturbance logged where marl pits or ponds and a field boundary/trackway are depicted on maps from 1841, seven positive discrete anomalies indicative of backfilled pits, ten further areas of magnetic disturbance and a plethora of isolated dipolar responses record a fair degree of modern fly-tipping across the site.
Project dates	Start: 30-03-2016 End: 01-04-2016
Previous/future work	Yes / Yes
Any associated project reference codes	LCS 220 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	MARL PITS Post Medieval
Monument type	PONDS Post Medieval
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Landowner pre-sale planning application (outline)
Prompt	Direction from Local Planning Authority - Direction 4
Position in the planning process	Pre-application
Solid geology (other)	Crag Group Sand
Drift geology	GLACIAL SAND AND GRAVEL
Techniques	Magnetometry

Project location

Country	England
Site location	SUFFOLK SUFFOLK COASTAL LEISTON St Margaret's Crescent
Study area	3.3 Hectares

Site coordinates	TM 4377 6287 52.209431537374 1.568490750506 52 12 33 N 001 34 06 E Point
Height OD / Depth	Min: 19m Max: 21m

Project creators

Name of Organisation	Suffolk Archaeology CIC
Project brief originator	Local Planning Authority (with/without advice from County/District Archaeologist)
Project design originator	Rachael Abraham
Project director/manager	Rhodri Gardner
Project supervisor	Timothy Schofield
Type of sponsor/funding body	Client
Name of sponsor/funding body	Pigeon Investment Management Ltd and Leiston Land Ltd

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","Spreadsheets","Survey","Text"
Paper Archive recipient	Suffolk HER
Paper Contents	"Survey"
Paper Media available	"Report","Survey ","Unpublished Text"

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Land to the rear of St Margaret's Crescent, Leiston
Author(s)/Editor(s)	Schofield, T, P.
Other bibliographic details	2016/034
Date	2016
Issuer or publisher	Suffolk Archaeology CIC
Place of issue or publication	Needham Market
Description	A4 bound report with A3 fold-out figures
URL	www.suffolkarchaeology.co.uk

Entered by	Tim Schofield (tim.schofield@suffolkarchaeology.co.uk)

Entered on 13 September 2016

OASIS:

Please e-mail Historic England for OASIS help and advice

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