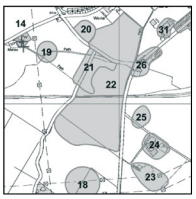
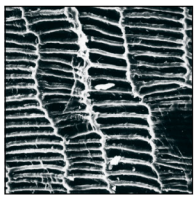
RRSG/02










RIDGE FARM, STURTON GRANGE, LEEDS

GEOPHYSICAL SURVEY

commissioned by GAS CORP

December 2015

HEADLAND ARCHAEOLOGY

REGISTERED ORGANISATION CIfA

RIDGE FARM, STURTON GRANGE, LEEDS

GEOPHYSICAL SURVEY

commissioned by GAS CORP

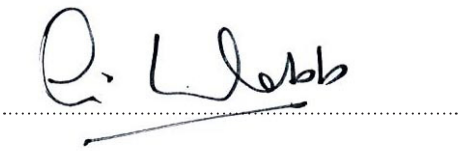
December 2015

project info

HA JOB NO.	RRSG/02
NGR	SE 42872 34178
PARISH	Sturton Grange
LOCAL AUTHORITY	Leeds City Council
OASIS REF.	headland5-233673

project team

PROJECT MANAGER	Sam Harrison
AUTHOR	David Harrison
FIELDWORK	Jake Freeman, Ross Bishop
GRAPHICS	Mano Kapazoglou
APPROVED BY	Alistair Webb



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north@headlandarchaeology.com

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PROJECT SUMMARY

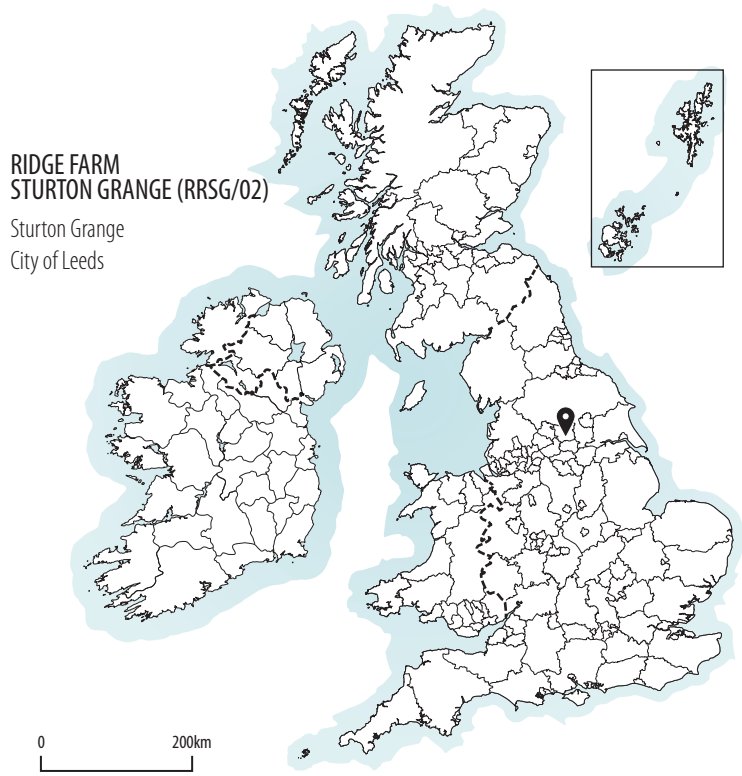
Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering approximately one hectare, along the route of a proposed biomethane connection pipeline. The survey has not identified any anomalies of definite archaeological potential with the majority of the identified anomalies being due to agriculture. A concentration of discrete anomalies at the western end of the corridor has been ascribed some archaeological potential since they cannot easily be attributed to any other origin, although it is possible that these may be geological in nature. The narrow corridor width makes confident interpretation of these, and other, anomalies difficult. However, there is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the subsurface conditions within the proposed pipeline corridor and therefore, based solely on the results and interpretation of the data, the archaeological potential of the route is considered to be low.

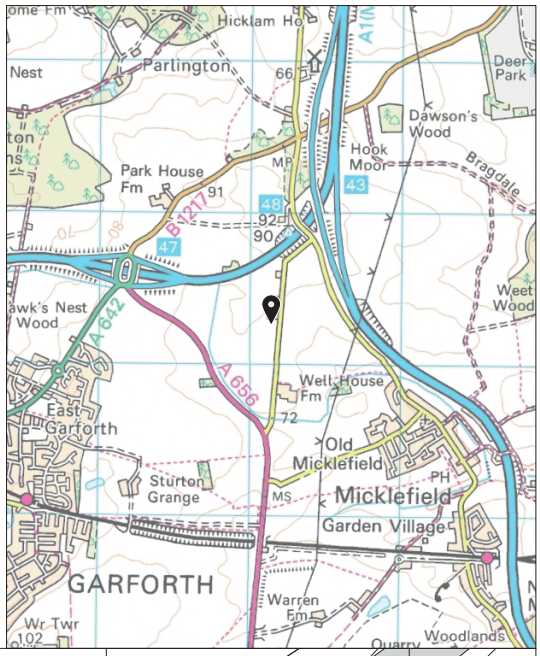
CONTENTS

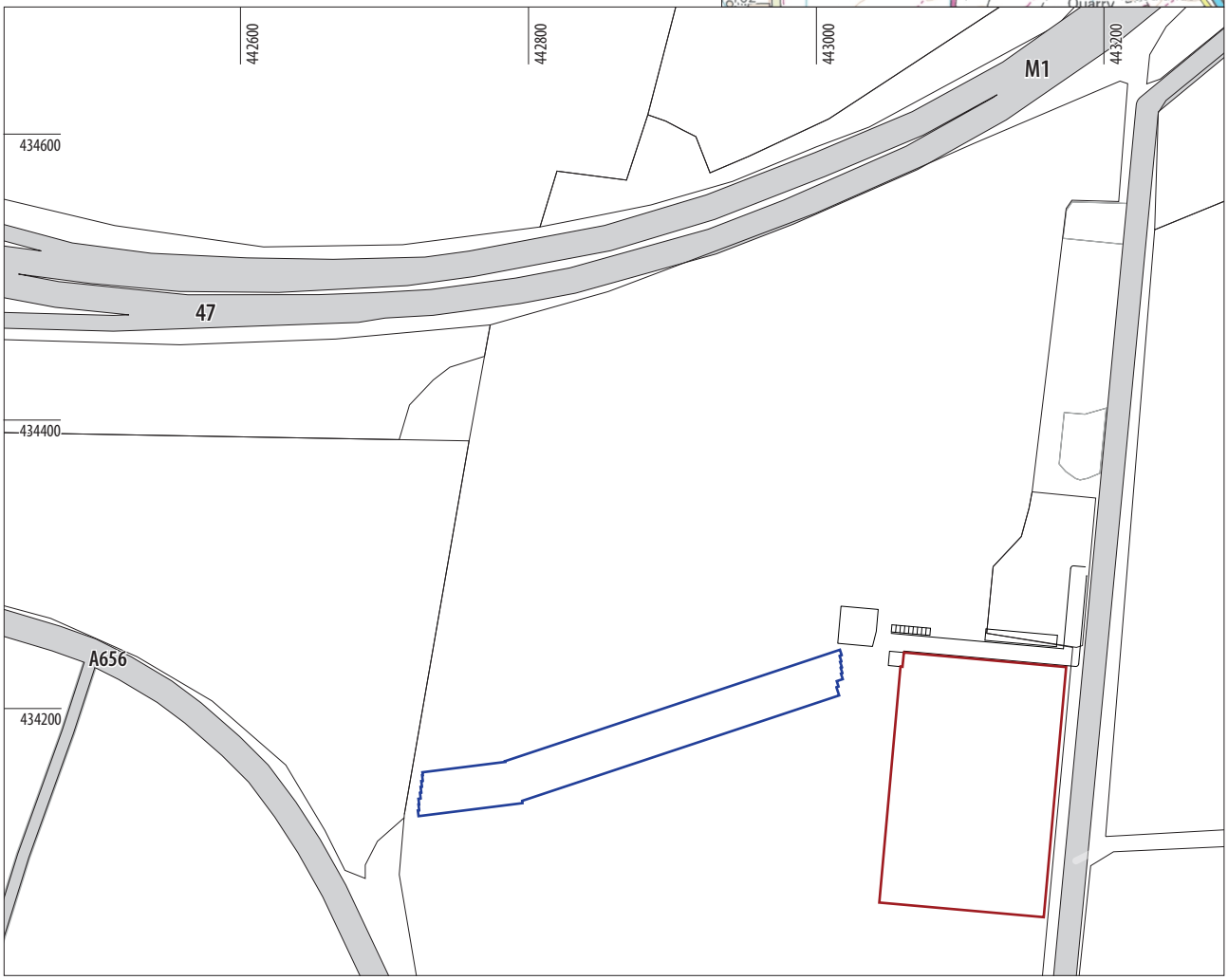
LIST OF ILLUSTRATIONS

RIDGE FARM
STURTON GRANGE (RRSG/02)

Sturton Grange
City of Leeds







KEY

- biomass digester development boundary
- geophysical survey area

N

0 250m

scale 1:5,000 @ A4

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ILLUS 1

Site location

RIDGE FARM, STURTON GRANGE, LEEDS

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Northern Gas Networks, on behalf of Gas Corp, to undertake a geophysical (magnetometer) survey along the route of a proposed biomethane connection pipe at Ridge Farm, Sturton Grange. The work was undertaken in accordance with guidance within the National Planning Policy Framework (DCLG 2012) and in line with current best practice (David et al. 2008). The survey was carried out on October 6th 2015 in order to provide additional information on the archaeological potential of the pipeline corridor.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The proposed development area (PDA) comprises a linear corridor extending from a biomass digester plant located to the immediate south of Ridge Farm, Sturton Grange, to a gas main 360m to the south-west (see **ILLUS 3**). The proposed pipeline passes through a single field which was under a young wheat crop at the time of the survey (see **ILLUS 2**). The site is largely flat at 79m above Ordnance Datum (aOD) but slopes slightly towards Sturton Dyke at the western end of the corridor.

1.2 GEOLOGY AND SOILS

The underlying bedrock comprises Cadeby Formation – dolostone which is largely overlain by Harrogate till (British Geological Survey 2015). No superficial deposits are recorded within the far west of the corridor (see **ILLUS 3**). The soils are mainly classified in the Soilscape 5 association, characterised as freely-draining lime-rich loams (Landis 2015).

2 ARCHAEOLOGICAL BACKGROUND

The route of a Roman Road passes by the east of the site (Roman Road 28b, West Yorkshire HER 3098) and is thought to be overlain by the modern Ridge Road (see **ILLUS 3**). The surrounding landscape is rich in cropmarks suggestive of field systems and quarry pits which are thought to be Iron Age/Roman in origin, although none are recorded within the pipe corridor or its immediate vicinity.

3 AIMS, METHODOLOGY AND PRESENTATION

The main aim of the geophysical survey was to provide sufficient information to enable an assessment to be made of the impact of the proposed pipeline on any potential subsurface archaeological remains and for further evaluation or mitigation proposals, if appropriate, to be recommended.

The general archaeological objectives of the geophysical survey were:

- to provide information about the nature and interpretation of any magnetic anomalies identified;
- to therefore model the presence/absence and extent of any buried archaeological features, either known or previously unknown; and
- to prepare a report summarising the results of the survey.

3.1 MAGNETOMETER 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 soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

Bartington Grad601 magnetic gradiometers were used during the survey, taking readings at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3,600 readings were recorded in each grid. These readings were stored in the memory of the instrument and later downloaded to computer for processing and interpretation. Geoplot 3 (Geoscan Research) software was used to process and present the data.

ILLUS 2

Ground conditions at the time of the survey

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble GeoXR model).

3.2 REPORTING

A general site location plan is shown in **ILLUS 1** at a scale of 1:5,000. **ILLUS 2** is a photograph showing ground conditions at the time of the survey. **ILLUS 3** is a large scale (1:2,500) survey location plans displaying the processed greyscale magnetometer. Detailed data plots ('raw' and processed) and interpretative illustrations are presented at a scale of 1:1,000 in **ILLUS 4**, **ILLUS 5** and **ILLUS 6**.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive.

The survey methodology, report and any recommendations comply with guidelines outlined by English Heritage (David et al. 2008) and by the Chartered Institute for Archaeologists (CIfA 2014). All illustrations reproduced from Ordnance Survey mapping are with the permission of the controller of Her Majesty's Stationery Office (© Crown copyright).

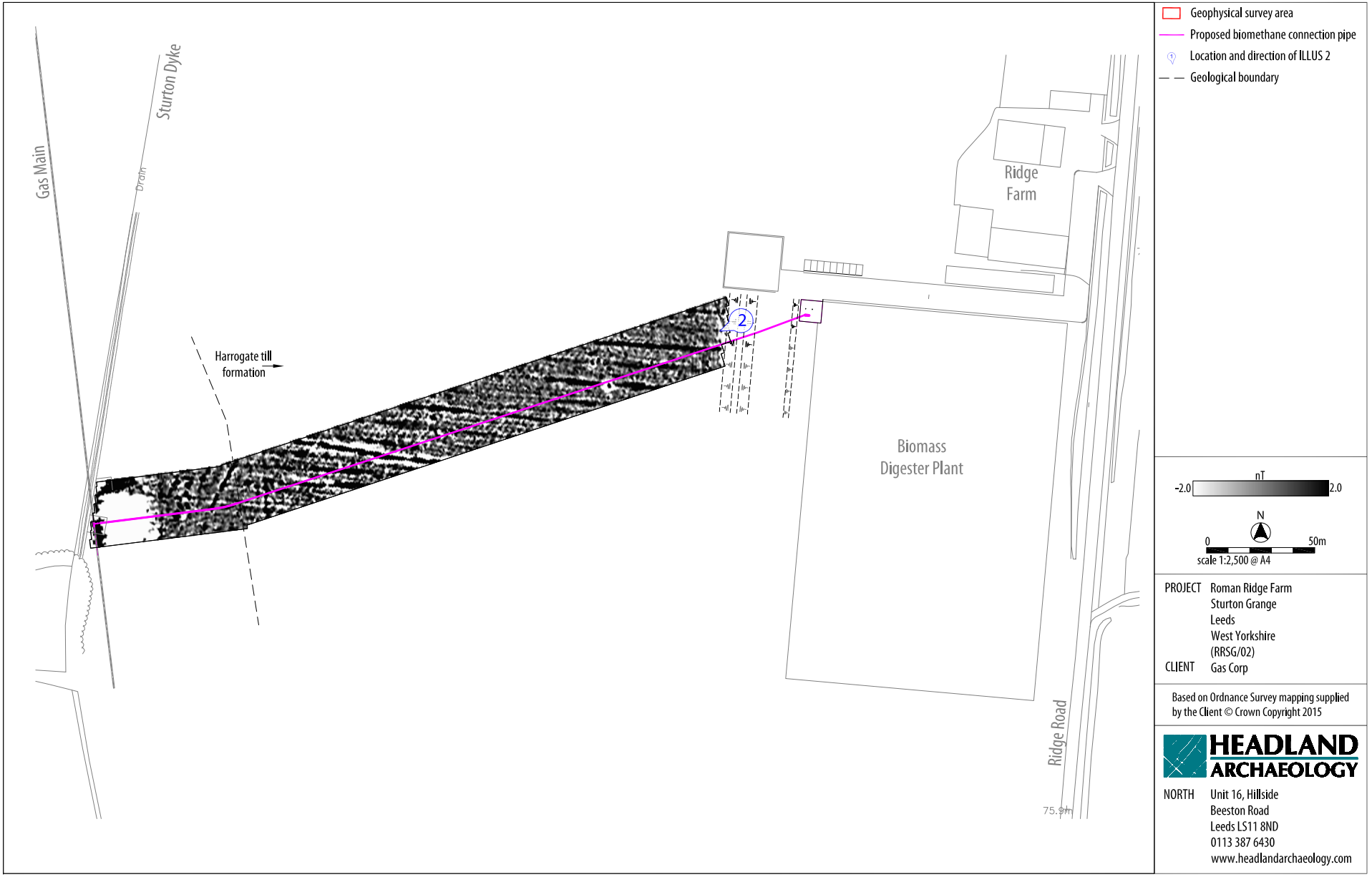
The illustrations in this report have been produced following analysis of the data in 'raw' and processed formats and over a range of different display levels. All illustrations are presented to most suitably display and interpret the data from this site based on the experience and knowledge of management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

4 RESULTS AND DISCUSSION

Generally, the survey has recorded a variable magnetic background throughout the corridor, with a less-elevated background at the western end. This change is thought to be due to the absence of superficial deposits within the west of the corridor. Against this variable background numerous anomalies have been identified and cross-referenced to specific examples depicted on the interpretative figure.

Ferrous anomalies

Ferrous anomalies, characterised 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 most sites, often being present as a consequence of manuring or tipping/infilling.



ILLUS 3

Survey location showing processed greyscale magnetometer data

Within the far west of the pipeline corridor a high magnitude linear dipolar anomaly, A, is caused by the north-south aligned gas main, whereas magnetic disturbance at the eastern end of the corridor is caused by ferrous material within an earthen bund.

Agricultural anomalies

Analysis of historical OS mapping indicates that one former field boundary has been removed from within the PDA since the publication of the first edition Ordnance Survey maps in 1849. The anomaly manifests in the data as a fragmented north/south aligned linear anomaly, B, in the west of the survey area. The anomaly is caused by the contrast between the soil-fill of a ditch and the surrounding soils.

Elsewhere, high magnitude parallel linear anomalies, indicative of ploughing, have been detected on an east/west orientation throughout the survey area. The anomalies appear at right angles to the existing pattern of land division and are likely to be post-medieval/modern in origin.

Towards the centre of the dataset a notably high-magnitude linear anomaly, C, may indicate another soil-filled ditch, perhaps an unmapped boundary, or a soil-filled plough-furrow containing a particularly enhanced fill. In either case, the anomaly runs parallel with the surrounding east/west-aligned agricultural anomalies and is likely to be agricultural in nature.

Geological anomalies

As noted above, the magnetic background is particularly variable across the majority of the corridor with a relatively low level of background variation within the west. The interface, D, between these two backgrounds corresponds closely to the extent of a superficial deposit of Harrogate till which covers most of the corridor (see **ILLUS 3**). The elevated background is due to sands and gravels within the soils and superficial deposits which manifest as discrete anomalies throughout the survey corridor.

Possible archaeological anomalies

Two linear anomalies, E and F, have been identified on a north-east/south-west orientation within the west of the survey corridor. The anomalies do not correspond to any features depicted on historical mapping and therefore an archaeological origin should be considered. However, it is difficult to provide a confident interpretation of anomalies within such a narrow survey corridor and it is possible that the anomalies are due to field drains. Immediately west of the linear anomalies a cluster of positive anomalies, G, is also ascribed a possible archaeological origin, perhaps being due to a concentration of soil-filled features. However, no clear archaeological pattern is visible in the data and it is possible that the anomalies are due to geological features (soil-filled cracks or solution hollows) within the dolostone bedrock – the anomalies being visible in this western end of the corridor due to the absence of the till superficial deposits.

5 CONCLUSION

The confident interpretation of anomalies on linear corridors is often problematic, primarily due to the often narrow width of the survey corridor, and this survey is no exception. However, soil-filled features have been identified across the survey area and it is likely that had there been major settlement activity within the pipeline corridor that this would have manifested in the data.

Anomalies of possible archaeological potential have been suggested within the west of the pipeline corridor but due to the narrow width of the survey area, interpretation of these anomalies is tentative. It is possible that the anomalies are caused by naturally-formed soil-filled geological features.

There is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the subsurface conditions within the proposed pipeline corridor. Therefore, based solely on the results and interpretation of the data, the archaeological potential of the survey areas is route is considered to be low.

6 REFERENCES

British Geological Survey 2015 (Website) Available: www.bgs.ac.uk/discoveringGeology/geology OfBritain/viewer.html Accessed: October 26th 2015.

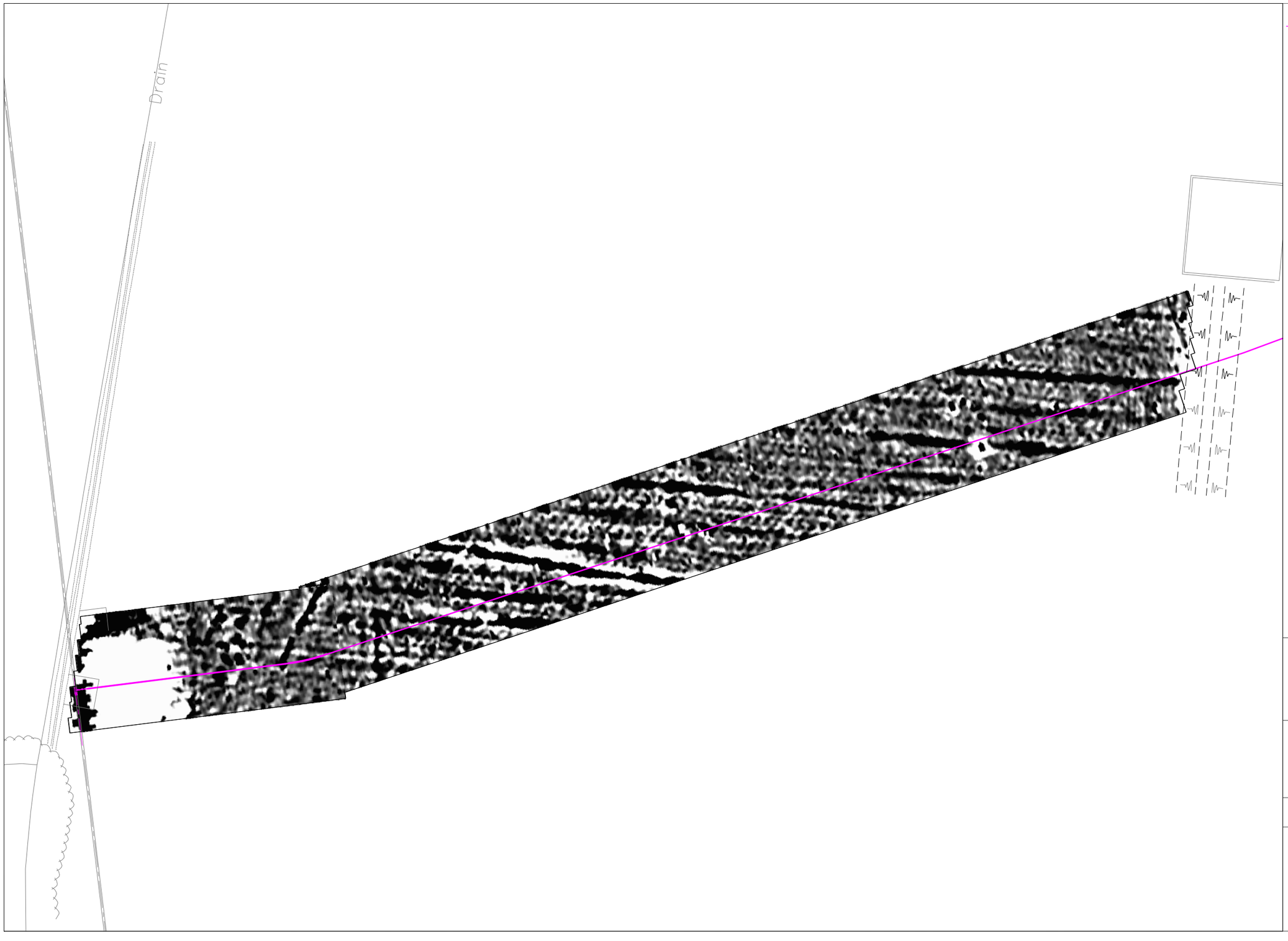
Chartered Institute for Archaeologists 2014 ***Standard and Guidance for archaeological geophysical survey*** CIfA.

David, A, Linford, N, Linford, P & Martin, L 2008 ***Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edition)*** English Heritage.

DCLG 2012 ***National Planning Policy Framework*** Department of Communities and Local Government.

Gaffney, C & Gater, J 2003 ***Revealing the Buried Past*** Tempus Publishing.

LandIS 2015 (Website) Available: www.landis.org.uk/soilscapes/ Accessed: October 26th 2015.



Proposed biomethane connection pipe

nT
-2.0
2.0

N

0
25m

scale 1:1,000 @ A3

PROJECT Roman Ridge Farm
Sturton Grange
Leeds
West Yorkshire
(RRSG/02)

CLIENT Gas Corp

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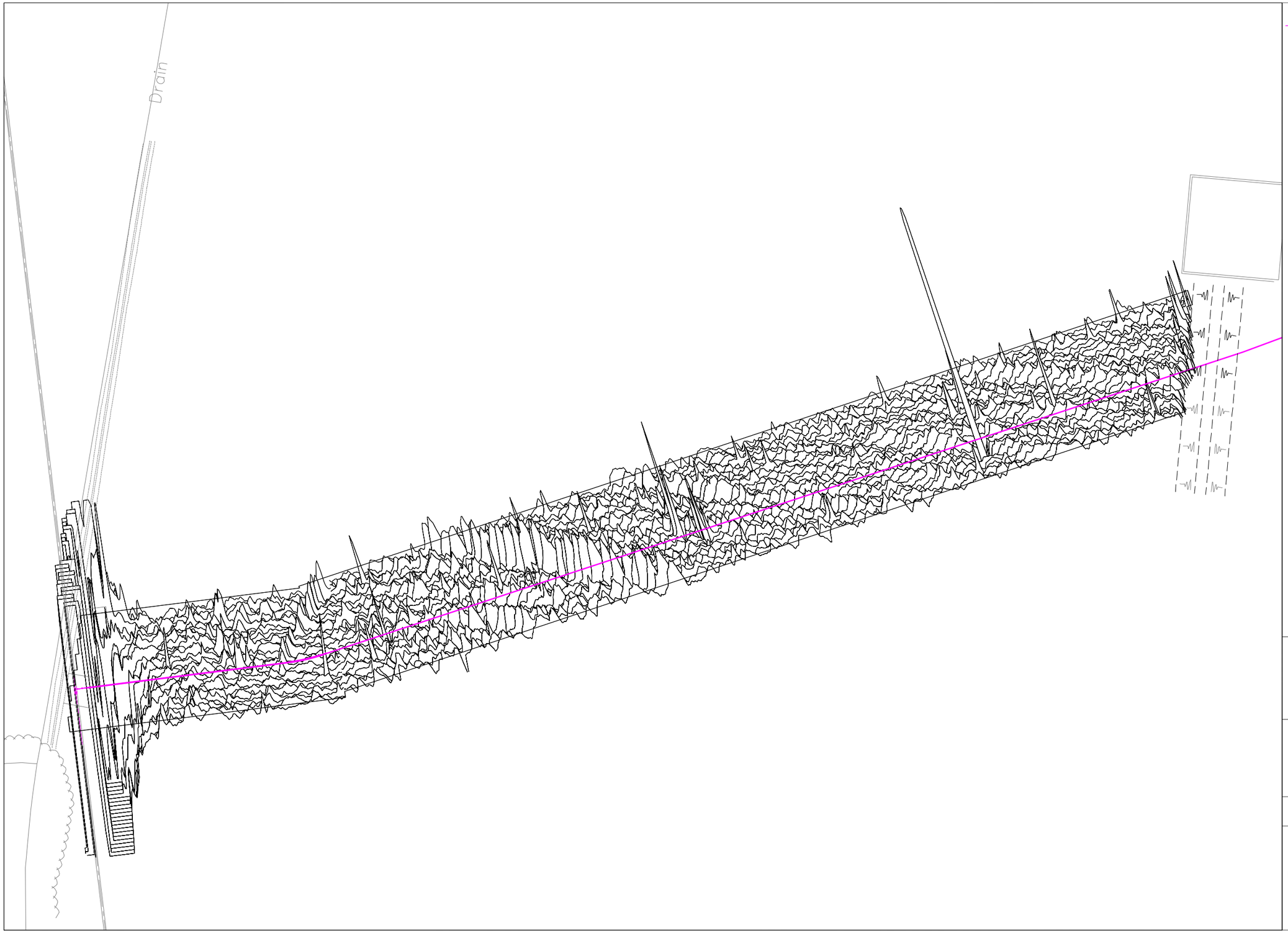
ILLUS 4

Processed greyscale magnetometer data



Proposed biomethane connection pipe

15.0nT/cm

N

0 25m

scale 1:1,000 @ A3

PROJECT Roman Ridge Farm
Sturton Grange
Leeds
West Yorkshire
(RRSG/02)

CLIENT Gas Corp

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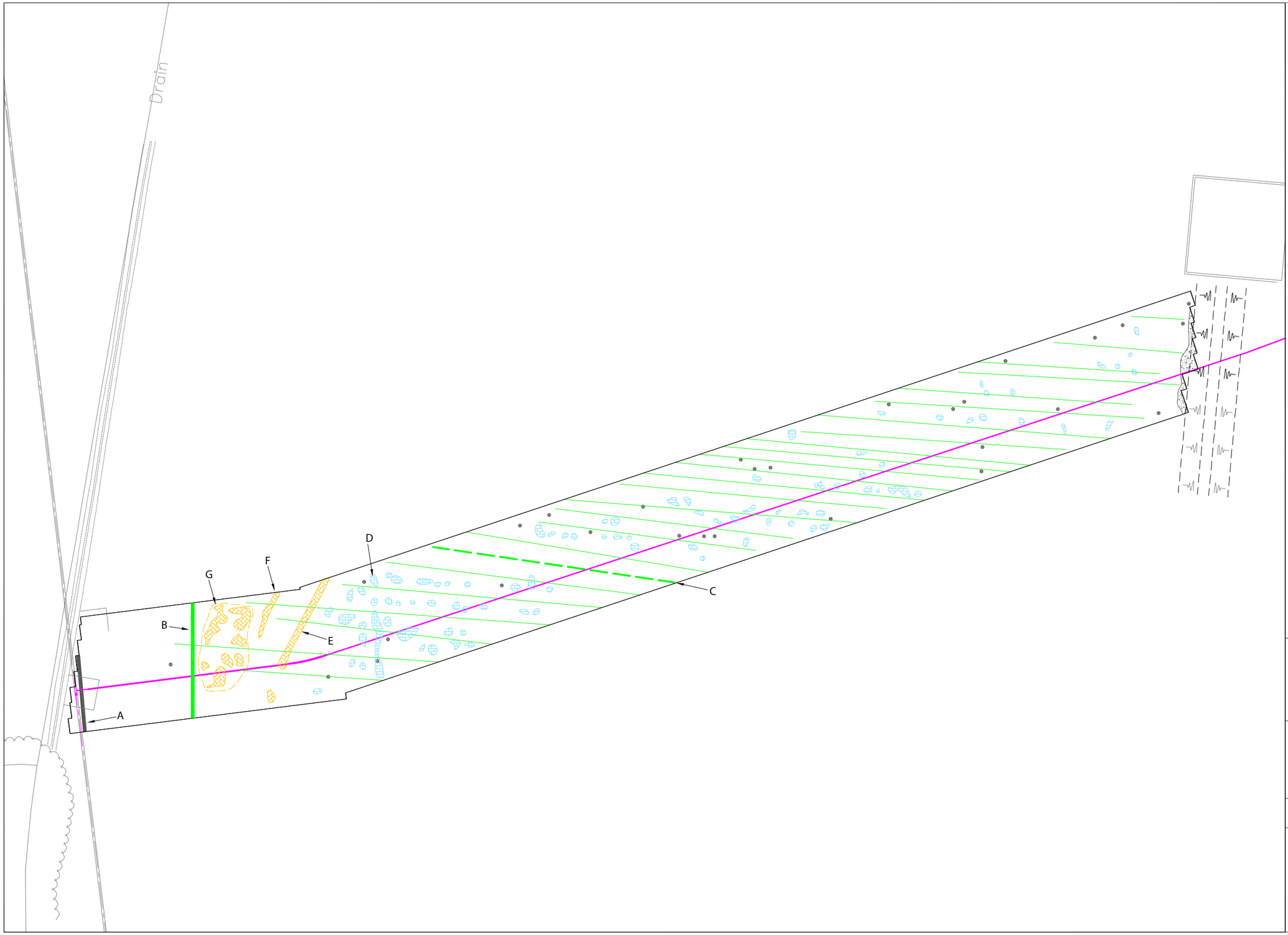
ILLUS 5

XY trace plot of minimally processed magnetometer data



Proposed biomethane connection pipe

TYPE OF ANOMALY	INTERPRETATION
Dipolar Isolated	Ferrous Material
Magnetic Disturbance	Ferrous Material
Dipolar Linear	Service
Linear Trend	Agricultural
Linear	Former Field Boundary
Linear	Former Field Boundary?
Magnetic Enhancement	Geology
Magnetic Enhancement	Archaeology?

N

0 25m

scale 1:1,000 @ A3

PROJECT Roman Ridge Farm
Sturton Grange
Leeds
West Yorkshire
(RRSG/02)

CLIENT Gas Corp

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ILLUS 6

Interpretation of magnetometer data

7 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Appendix 1.1 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 so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue 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. This effect can lead to the detection of features such as hearths, kilns or areas of burning.

Appendix 1.2 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 SURVEY LOCATION INFORMATION

The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble GeoXR model). The accuracy of this equipment is better than 0.01m. 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 coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology (UK) Ltd cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises:-

- an archive disk containing the raw data in XYZ format, a raster image of each greyscale plot with associate world file, and a PDF of the report

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 OASIS DATA COLLECTION FORM: ENGLAND

OASIS ID: headland5-233673

PROJECT DETAILS	
Project name	Ridge Farm, Sturton Grange, Leeds
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey covering approximately one hectare, along the route of a proposed biomethane connection pipeline. The survey has not identified any anomalies of definite archaeological potential with the majority of the identified anomalies being due to agriculture. A concentration of discrete anomalies at the western end of the corridor has been ascribed some archaeological potential since they cannot easily be attributed to any other origin, although it is possible that these may be geological in nature. The narrow corridor width makes confident interpretation of these, and other, anomalies difficult. However, there is no indication from any other source to suggest that the magnetic data provides anything other than an accurate representation of the sub-surface conditions within the proposed pipeline corridor and therefore, based solely on the results and interpretation of the data, the archaeological potential of the route is considered to be low.
Project dates	Start: 06-10-2015 End: 06-10-2015
Previous/future work	Not known / Not known
Any associated project reference codes	RRSG - Sitecode
Any associated project reference codes	
Type of project	002 - Contracting Unit No.
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	N/A None
Monument type	N/A None
Significant Finds	N/A None
Significant Finds	N/A None
Methods & Techniques	"Geophysical Survey"
Development type	Pipelines/cables (e.g. gas, electric, telephone, TV cable, water, sewage, drainage etc.)
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Not known / Not recorded
Solid geology (other)	Cadeby Formation - Dolostone
Drift geology (other)	Harrogate till
Techniques	Magnetometry

PROJECT LOCATION	
Country	England
Site location	WEST YORKSHIRE LEEDS STURTON GRANGE Ridge Farm, Sturton Grange, Leeds
Study area	LS25 3DL
Site coordinates	SE 442872 434178 53.884850717976 -1.32615887139 53 53 05 N 001 19 34 W Point

PROJECT CREATORS	
Name of organisation	Headland Archaeology
Project brief originator	Gas Corp
Project design originator	Headland Archaeology

PROJECT CREATORS	
Project director/manager	Harrison, S
Project supervisor	Bishop, R
Type of sponsoring/funding body	Developer

PROJECT ARCHIVES	
Physical Archive Exists?	No
Digital Archive Exists?	No
Digital Media available	"Geophysics"
Paper Archive Exists?	No
Paper Media available	"Report"

PROJECT BIBLIOGRAPHY 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Ridge Farm, Sturton Grange, Leeds: Geophysical Survey
Author(s)/Editor(s)	Harrison, D.
Date	2015
Issuer or publisher	Headland Archaeology
Place of issue or publication	Leeds
Description	A4 bound report

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ENTERED ON	9 December 2015

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