

TRENT VALLEY CREMATORIUM, SOUTH DERBYSHIRE

GEOPHYSICAL SURVEY

commissioned by Dignity UK Plc

9/2014/1040

November 2016





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project info

HA JOB NO. TVCM/01 NGR SK 41107 31070 PARISH Thulston LOCAL AUTHORITY South Derbyshire District Council OASIS REF. headland5-258430

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PROJECT SUMMARY

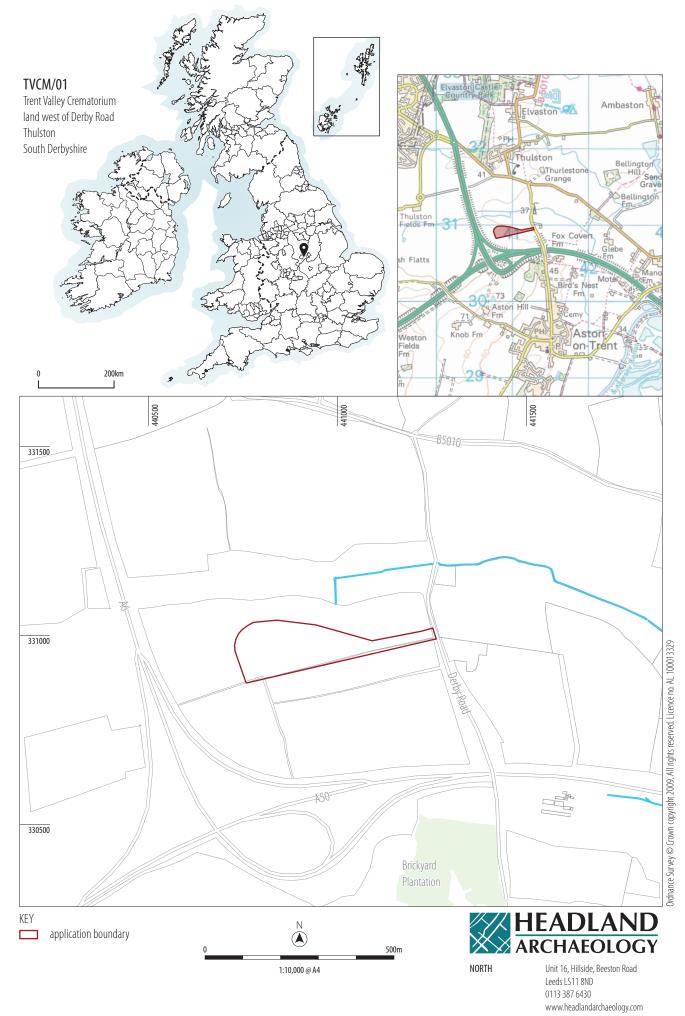
Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 4.7 hectares on land west of Derby Road, Thulston where it is proposed to site Trent Valley Crematorium. Linear ditch type anomalies defining part of two rectangular enclosures of unknown date have been identified in the centre of the site. Discrete anomalies within the main enclosure may also be of archaeological potential. Ridge and furrow ploughing anomalies are recorded on a north/south alignment across the western half of the survey area. A higher magnitude anomaly on the same alignment as the ploughing, possibly a boundary ditch, encloses a former pond identified as a rectangular area of high magnetic response and recorded on historic mapping. No anomalies of archaeological potential are recorded in the eastern half of the survey area. Based on the results of the geophysical survey the archaeological potential of the eastern and western parts of the site is assessed as low. In the centre of the site the potential is assessed as moderate to high.

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TRENT VALLEY CREMATORIUM, SOUTH DERBYSHIRE

GEOPHYSICAL SURVEY

1 INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Dignity UK Plc to undertake a geophysical (magnetometer) survey on agricultural land off Derby Road, Thulston, South Derbyshire. The survey forms part of an archaeological evaluation (also including trial trenching) being carried out by the Client in order to assess the archaeological potential of the site prior to the determination of a planning application for the development of a crematorium (Trent Valley Crematorium) on the site.

The work was undertaken in accordance with a Written Scheme of Investigation (Headland Archaeology 2016), provided to the Client and approved by Steve Baker, Development Control Archaeologist for Derby and Derbyshire, with guidance contained within the National Planning Policy Framework (DCLG 2012) and in line with current best practice (English Heritage. 2008).

The survey was carried out on May 4th and May 5th 2016 in order to provide information on the archaeological potential of the site.

1.1 SITE LOCATION, TOPOGRAPHY AND LAND-USE

The site covers an irregularly shaped area of approximately 4.7 hectares (centred at NGR 441107, 331070), part of a single field currently in agricultural use – a crop of oil seed rape was cleared from the site to facilitate survey (Illus 2 and Illus 3). It is situated to the north of Ashton-on-Trent and south of Thulston just to the north of the intersection of the A6 and A50, south-east of Derby.

The survey area comprises a narrow corridor of land leading west from Derby Road (which will provide access into the main site) and the main body of the site where the crematorium will be constructed. The site is flat at approximately 40m above Ordnance Datum currently situated within open agricultural land which borders the site to all sides.

1.2 GEOLOGY AND SOILS

The underlying bedrock geology comprises Mudstone of the Branscombe Mudstone Formation. The mudstone is overlain by superficial Allenton Terrace Deposits - sands and gravels (NERC 2016).

In the west of the site the soils are classified in the Soilscape 8 association. These are characterised as slightly acid loams and clays with impeded drainage. In the east of the site the soils are classified in Soilscape 6. Here they are characterised as freely draining slightly acid loams (Cranfield University 2016).

2 ARCHAEOLOGICAL BACKGROUND

There are no known heritage assets recorded within the application area on Derbyshire Historic Environment Record with the exception of a large area of ridge and furrow earthworks (HER 16611).

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 any proposed development on any potential sub-surface archaeological remains.

The general archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- > to therefore model the presence/absence and extent of any buried archaeological features; 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



ILLUS 2 General view of survey area, looking south-west

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.

Standard dual sensor Bartington Grad601 instruments were used to survey the site. Data collected with this system was processed using Geoplot V4 software. Readings were taken at 0.25m intervals on zig-zag traverses 1m apart within 30m by 30m grids, so that 3600 readings were recorded in each grid. The site grid was laid out using a Trimble VRS differential Global Positioning System (Trimble GeoXR model).

3.2 3.2 REPORTING

A general site location plan is shown in Illus 1 at a scale of 1:10,000. Illus 2 and Illus 3 are general site condition photographs. A survey location plan (1:3,000) showing the processed greyscale magnetometer data is presented in Illus 4. Illus 5 is an overall interpretation of the data at the same scale.

Detailed data plots (greyscale and XY trace) and interpretative illustrations are presented at a scale of 1:1,000 in Illus 6 to Illus 11 inclusive.

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. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 4.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Headland Archaeology 2016) and guidelines outlined by English Heritage (English Heritage 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

It is noticeable from the greyscale plot (Illus 4) that the magnetic background is much more uniform in the eastern half of the site as indicated by the uniform grey tone of the data and the very flat X-Y trace plot (Illus 9 and Illus 11). To the west there is much greater variation. This variation reflects changes in the superficial deposits and almost certainly explains why the soils are classified differently in the eastern and western parts of the site (see above). Against this background the types of



ILLUS 3 View of western part of survey area showing area unsuitable for survey, looking north-east

anomalies and their origins are discussed below and cross-referenced to specific examples on the interpretive figures, where appropriate.

4.1 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.

High magnitude dipolar linear anomaly, (Illus 5 and Illus 8–A), aligned south-west/north-east across the centre of the site is caused by a sub-surface pipe.

A rectangular area of high magnitude responses, (Illus 5 and Illus 8–B), locates a pond recorded on historic mapping which has been infilled with highly magnetic material.

High magnitude discrete anomaly, Illus 5 and Illus 11–C), is caused by the proximity of an electricity pole (Illus 2) whilst similar anomalies, (Illus 5 and Illus 8–D, E and F), locate groundwater level capped boreholes.

Other areas of disturbance around the perimeter of the survey area and individual field edges is due to the proximity of post and wire fencing and/or other ferrous material within the boundaries and around a gateway.

4.2 AGRICULTURAL ANOMALIES

A single linear anomaly, (Illus 5 and Illus 8–G), aligned north/south towards the western edge of the site locates a former field boundary recorded on historic mapping.

A series of slightly curving parallel linear trend anomalies recorded to the east of this former boundary are indicative of the former practice of ridge and furrow cultivation. The characteristic striped appearance is due to the magnetic contrast between the former ridges and infilled furrows.

4.3 GEOLOGICAL ANOMALIES

As discussed above the magnetic background is more variable to the west of the site with numerous discrete anomalies recorded. These anomalies are due to minor variations in the superficial deposits and soils, probably the presence of small pockets of magnetic gravels.

4.4 ARCHAEOLOGICAL AND POSSIBLE ARCHAEOLOGICAL ANOMALIES

An L-shaped anomaly, (Illus 5 and Illus 8–H), is identified in the centre of the site. The former pond, B, clearly respects the alignment of this anomaly but it is not clear whether the anomaly is caused by an infilled ditch or whether it is merely the continuation of the ridge and furrow ploughing and a headland.

On a different alignment to the ridge and furrow ploughing and the pond/enclosure is a linear ditch type anomaly, (Illus 5 and Illus 8–I), which defines part of a rectangular enclosure, aligned on a north-north-east/south-south-west axis. Several discrete anomalies within the enclosure have been ascribed possible archaeological potential. However, these anomalies could equally plausibly be interpreted as geological and their archaeological potential is inferred on the basis of their location and spatial arrangement. Anomaly J (Illus 5 and Illus 8), to the immediate east of I, locates part of a second enclosure on the same alignment. Short linear anomaly K Illus 5 and Illus 8), to the north of I, hints at the presence of a third enclosure extending outside the application area. A discrete anomaly, (Illus 5 and Illus 8–L), just to the west of the enclosure may be caused by a large pit or area of burning.

5 CONCLUSION

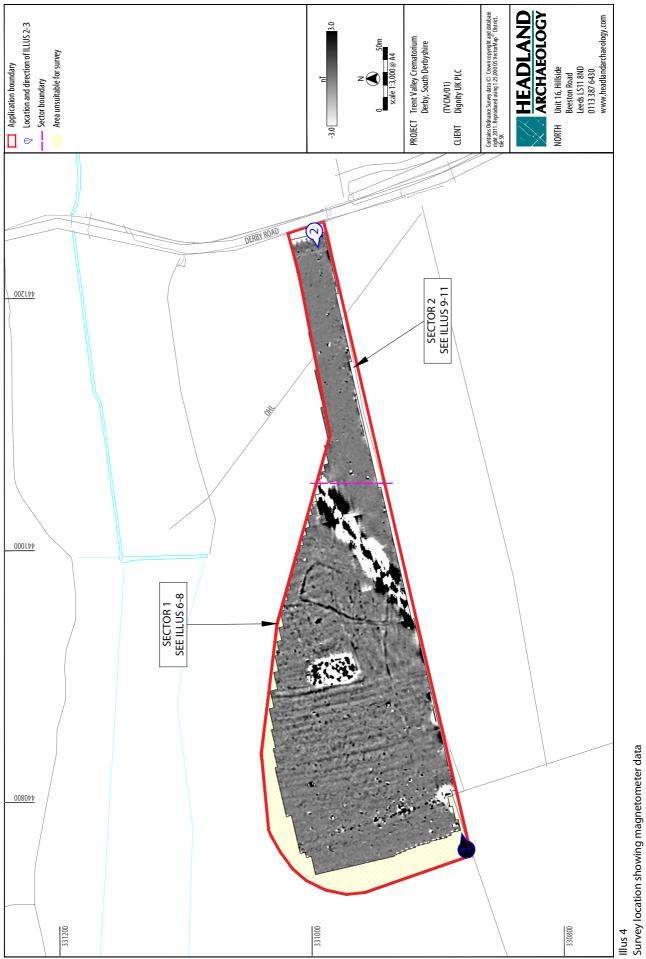
The survey has identified anomalies that suggest the presence of at least two enclosures of unknown date or function in the centre of the site. Discrete anomalies both within and just outside the main enclosure might possibly be indicative of human occupation although this interpretation is tentative.

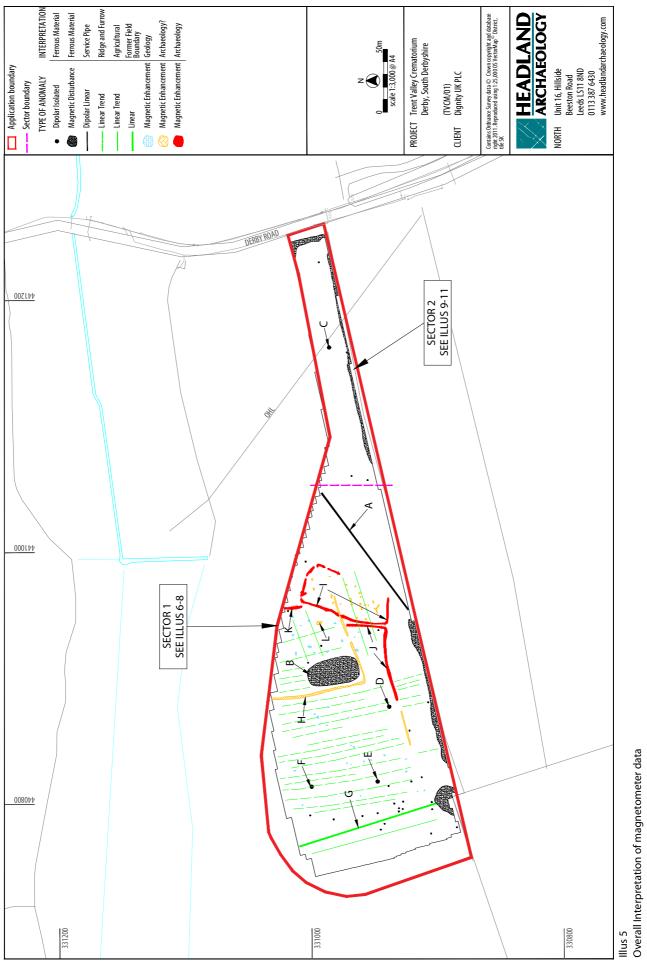
Other anomalies locate a former boundary and pond, the latter feature perhaps also enclosed within a ditched boundary. Anomalies confirm that the western part of the site has been subject to ridge and furrow cultivation in the post-medieval period.

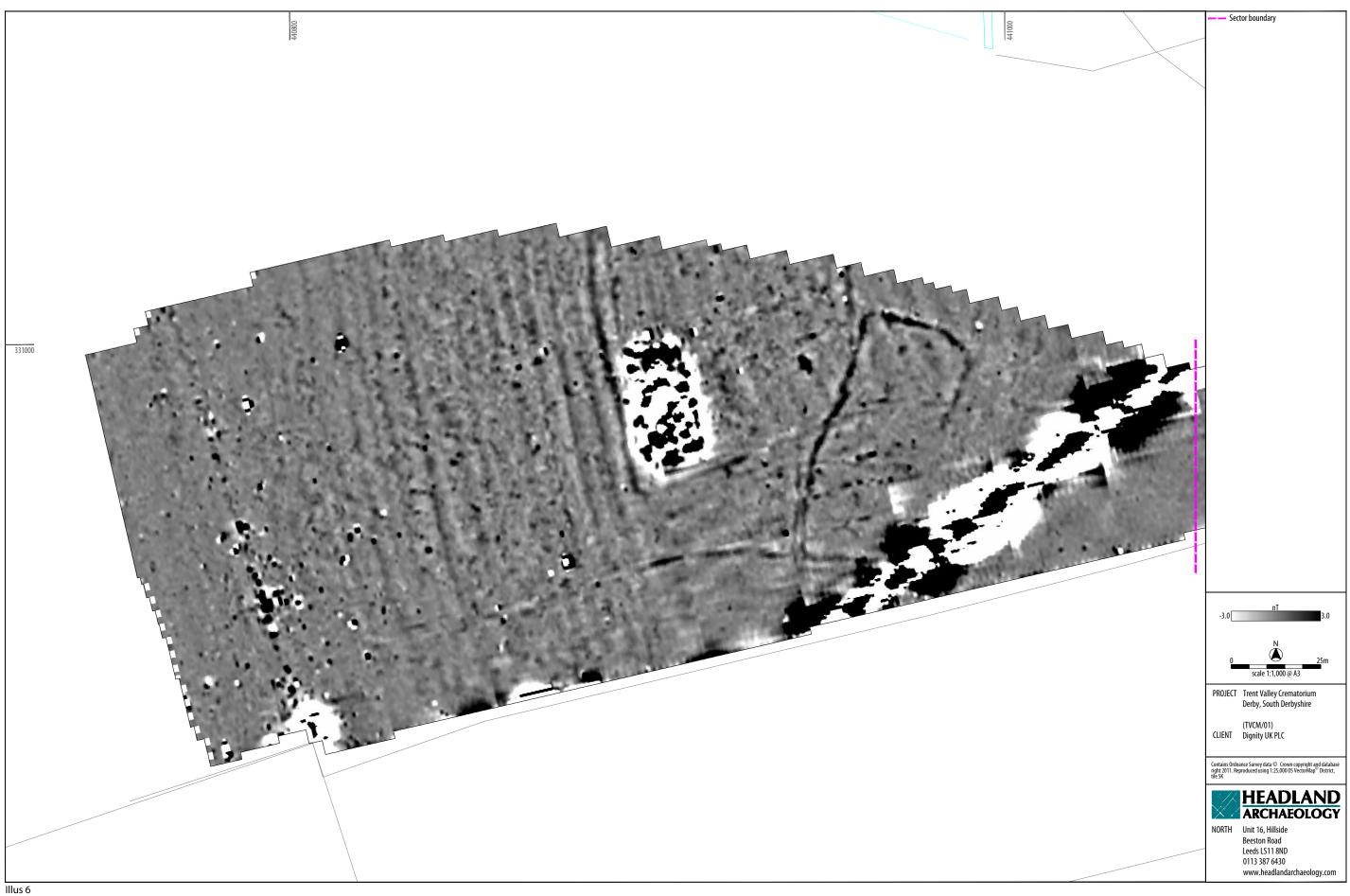
On the basis of the geophysical survey the eastern and western sides of the site are assessed as having low archaeological potential. In the central part of the site the potential is assessed as moderate to high.

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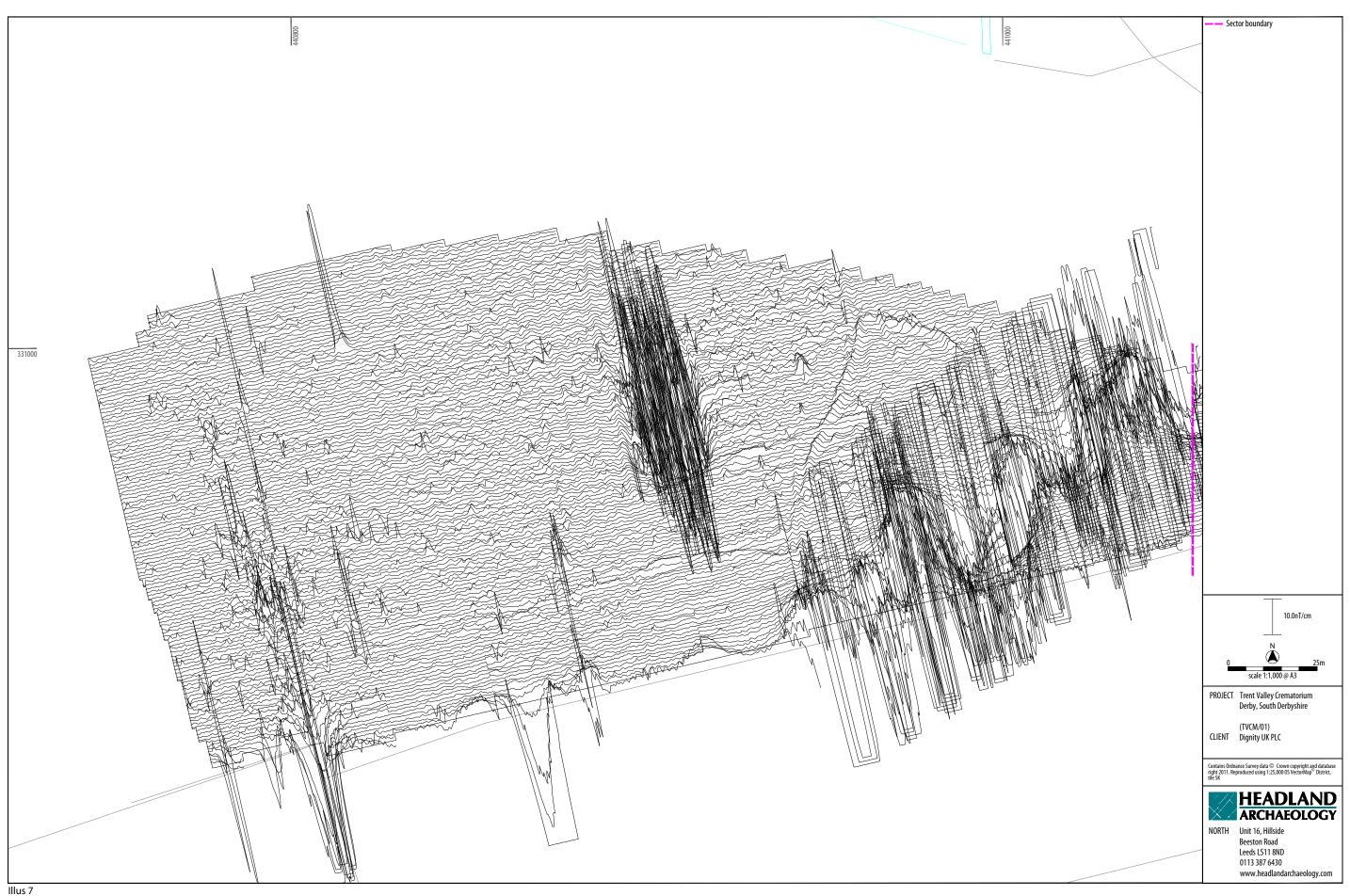
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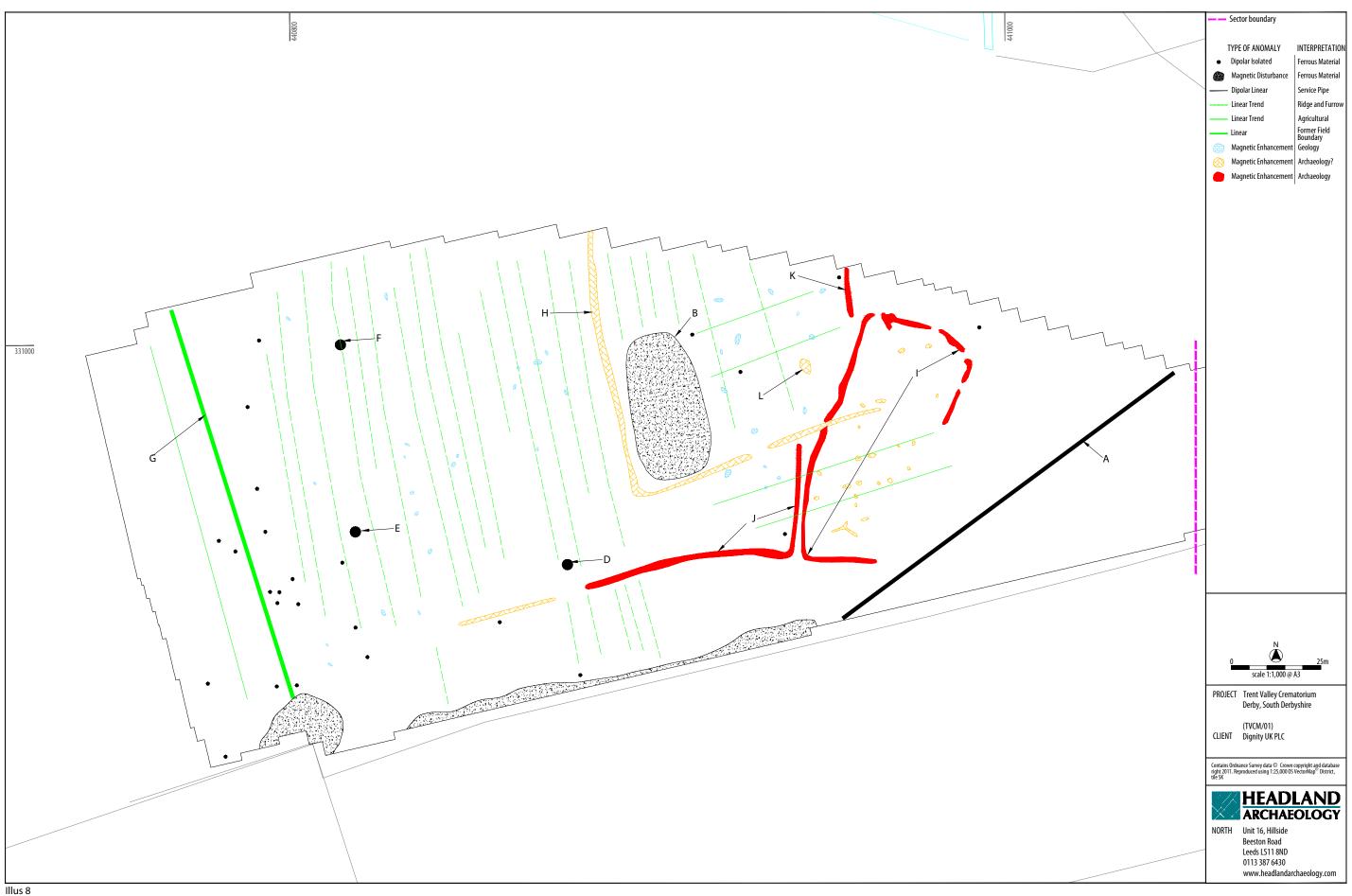




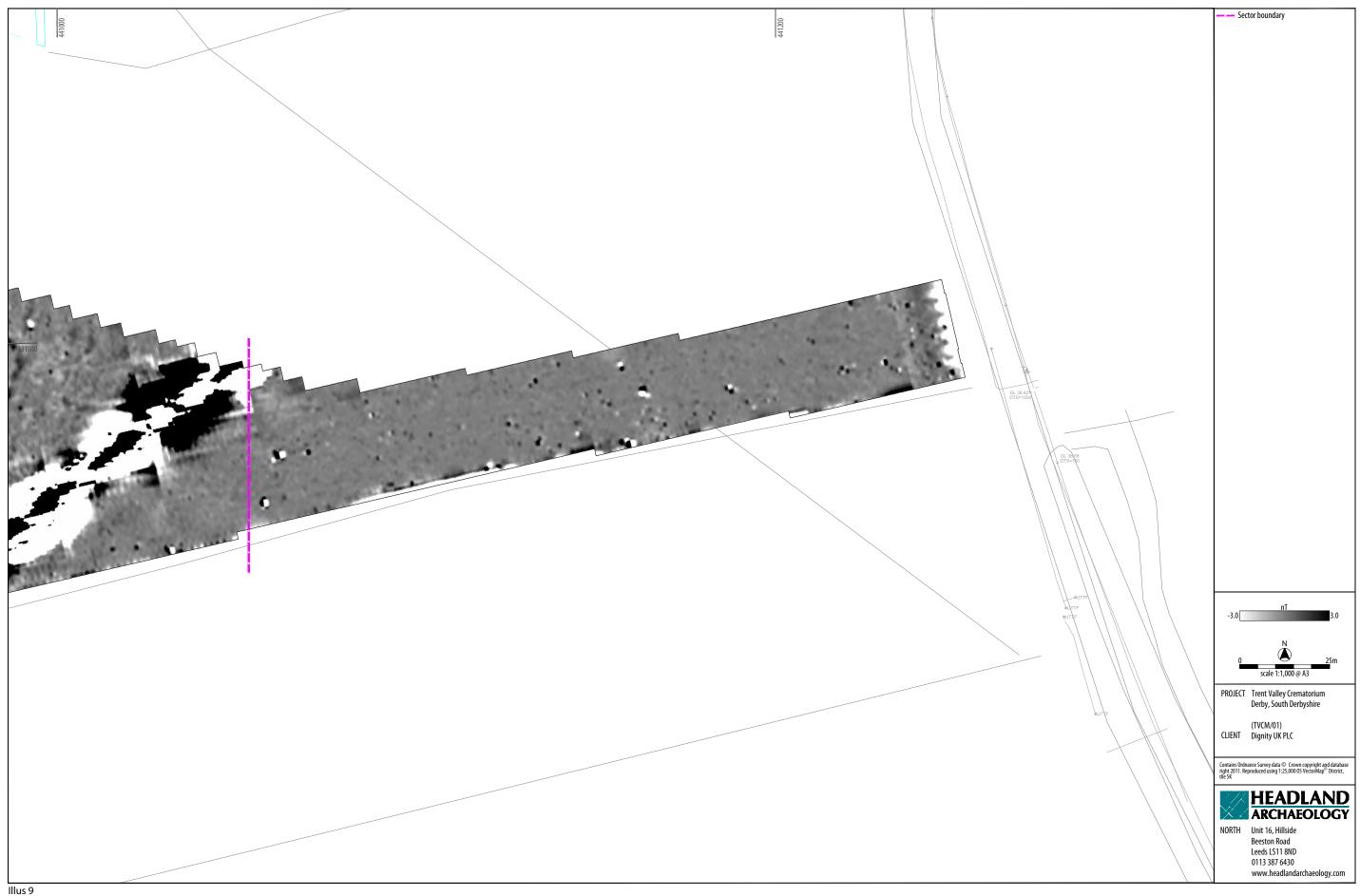
Processed greyscale magnetometer data; Sector 1



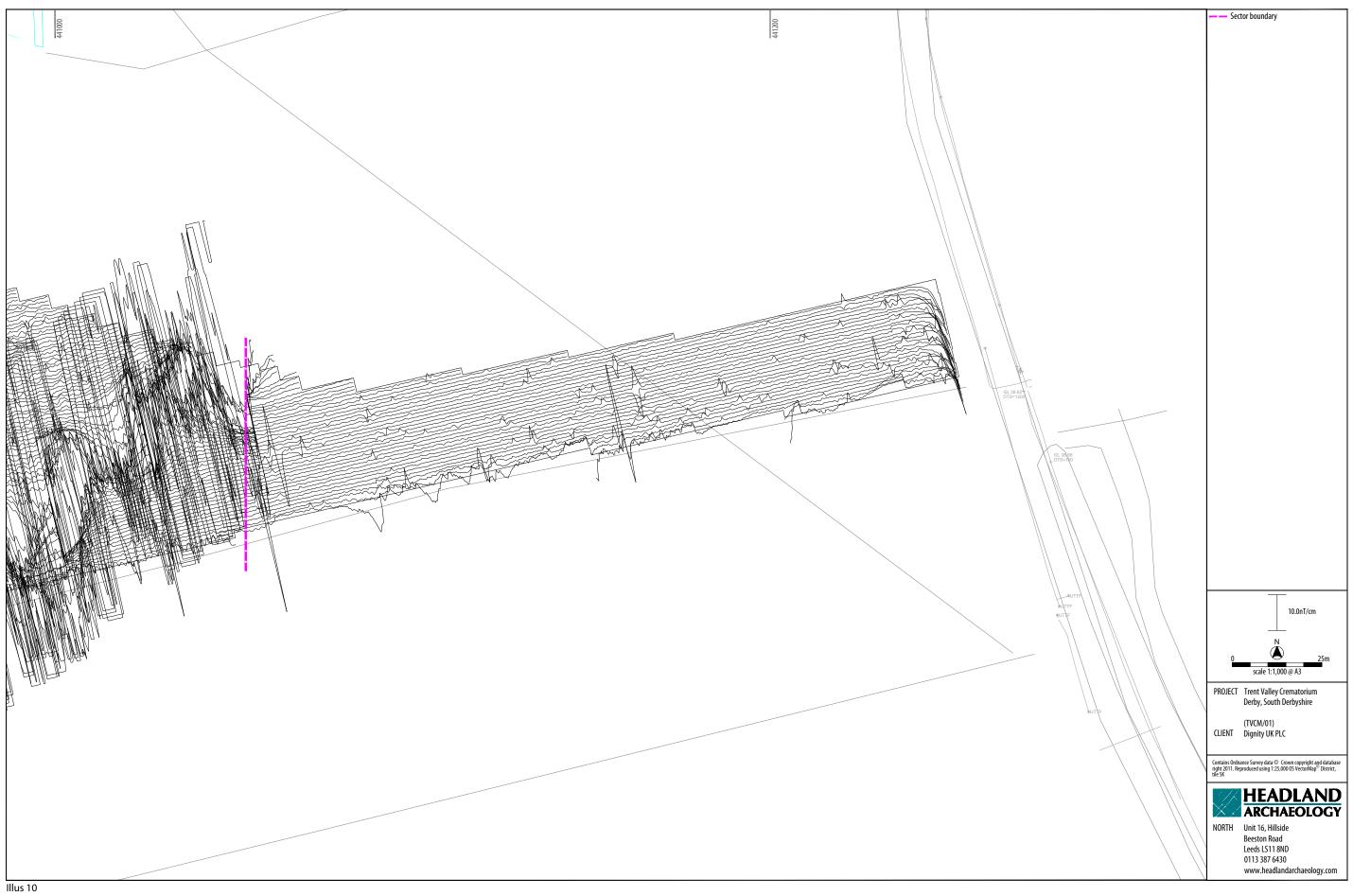
XY trace plot of magnetometer data; Sector 1



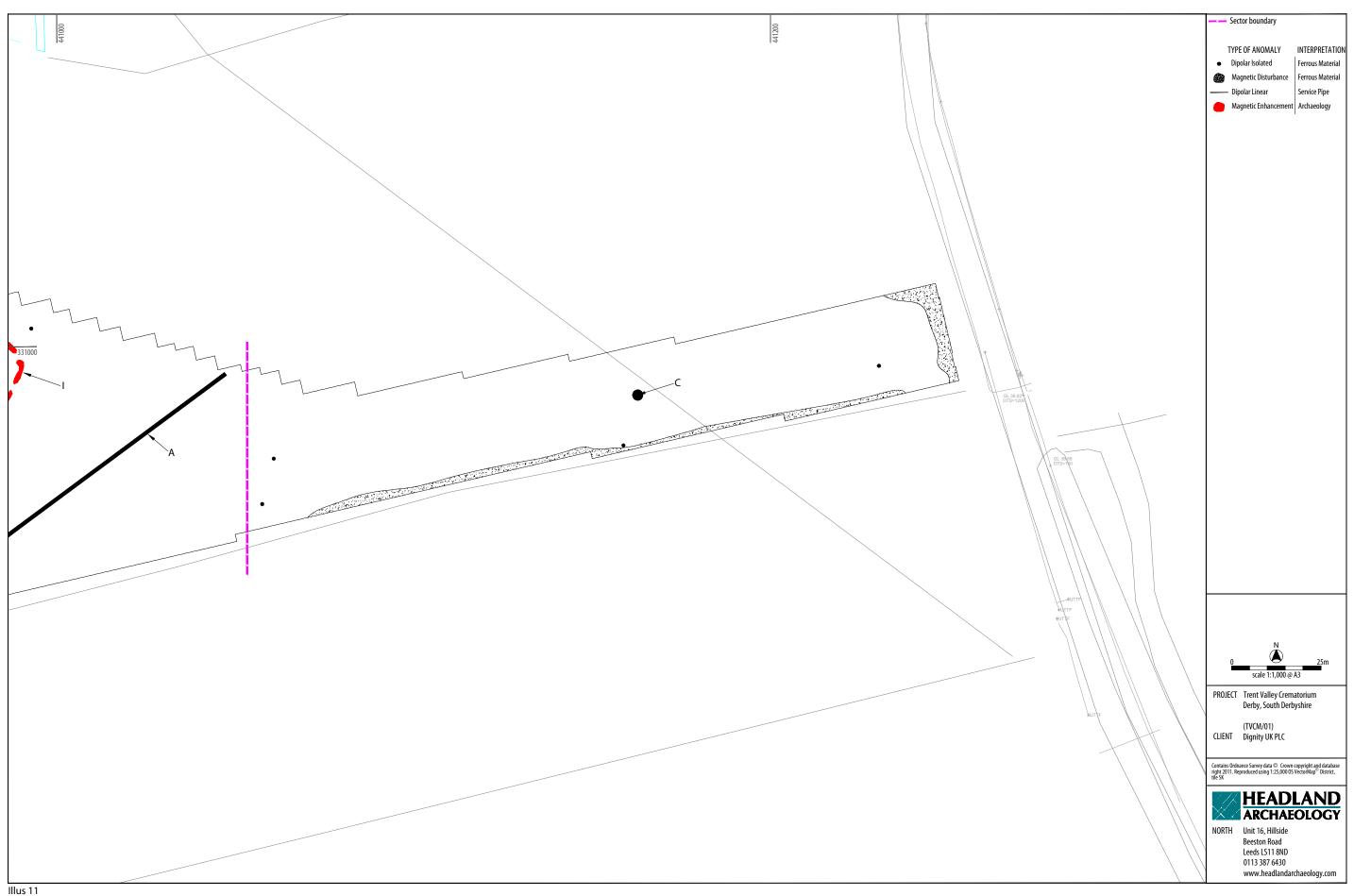
Interpretation of magnetometer data; Sector 1



Processed greyscale magnetometer data; Sector 2



XY trace plot of magnetometer data; Sector 2



Interpretation of magnetometer data; Sector 2

6 APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

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 haematite. 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.

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 5800 model). The accuracy of this equipment is better than 0.01m. The survey grids were then superimposed 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 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 (<u>http://guides.archaeologydataservice</u>. <u>ac.uk/g2gp/Geophysics</u>). 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: headland5-258430

PROJECT DETAILS		
Project name	Trent Valley Crematorium, South Derbyshire	
Short description of the project	Headland Archaeology (UK) Ltd undertook a geophysical (magnetometer) survey, covering approximately 4.7 hectares on land west of Derby Road, Thulston where it is proposed to site Trent Valley Crematorium. Linear ditch type anomalies defining part of two rectangular enclosures of unknown date have been identified in the centre of the site. Discrete anomalies within the main enclosure may also be of archaeological potential. Ridge and furrow ploughing anomalies are recorded on a north/south alignment across the westem half of the survey area. A higher magnitude anomaly on the same alignment as the ploughing, possibly a boundary ditch, encloses a former pond identified as a rectangular area of high magnetic response and recorded on historic mapping. No anomalies of archaeological potential are recorded in the eastem half of the survey area. Based on the results of the geophysical survey the archaeological potential of the eastern and western parts of the site is assessed as low. In the centre of the site the potential is assessed as moderate to high.	
Project dates	Start: 04-05-2016 End: 05-05-2016	
Previous/future work	Not known / Not known	
Any associated project reference codes	TVCM/01 - Contracting Unit No.	
Type of project	Field evaluation	
Site status	None	
Current Land use	Cultivated Land 3 - Operations to a depth more than 0.25m	
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	Crematorium	
Prompt	National Planning Policy Framework - NPPF	
Position in the planning process	Pre-application	
Solid geology (other)	Branscombe Mudstone	
Drift geology (other)	Allenton Terrace Deposits	
Techniques	Magnetometry	
PROJECT LOCATION		
Country	England	
Site location	DERBYSHIRE SOUTH DERBYSHIRE ELVASTON Land off Derby Road, Thulston, South Derbyshire	
Postcode	DE72 3FE	
Study area	4.7 Hectares	
Site coordinates	SK 441107 331070 52.893279080437 -1.344262664152 52 53 35 N 001 20 39 W Point	
Height OD / Depth	Min: 40m Max: 40m	
PROJECT CREATORS		
Name of Organisation	Headland Archaeology	
Project brief originator	Consultant	

TRENT VALLEY CREMATORIUM, SOUTH DERBYSHIRE TVCM/01

Project design originator	Headland Archaeology
Project director/manager	Harrison, S
Project supervisor	Harrison, D
Type of sponsor/funding body	Developer
Name of sponsor/funding body	Dignity UK Plc

PROJECT ARCHIVES

Physical Archive Exists?	No
Digital Archive recipient	In house
Digital Contents	"other"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

PROJECT BIBLIOGRAPHY 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Trent Valley Crematorium, South Derbyshire
Author(s)/Editor(s)	Webb, A
Other bibliographic details	TVCM/01
Date	2016
Issuer or publisher	Headland Archaeology
Place of issue or publication	Edinburgh
Description	A4 glue bound report
Entered by	Sam Harrison (sam.harrison@headlandarchaeology.com)
Entered on	22 July 2016





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