

2EE02 EEW - HS2 Phase 2a Early Environmental Works

Site 041 – Geophysics Survey Report Heritage Non-intrusive Survey Reports Group 003

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C01	Matt Berry	Sam Harrison	Alistair Webb	31/10/22	1 st Issue for acceptance

Methodology	Project Plan Site Code
Gradiometer (Magnetometer) Survey	2a20UZZNMG

Security classification: OFFICIAL

HS2 Ltd - Code 1 - Accepted

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1 Executive Summary

- 1.1.1 This document comprises a Final Report for a non-intrusive geophysical survey on the route of the proposed Phase 2a of High Speed Two (HS2) covering land proposed for development or likely to be impacted during the scheme as part of the Early Environmental Works (EEW) package. This report contains the results of a magnetometer survey undertaken on 19th April 2022 at Site 41 within Group 003.
- 1.1.2 The aim of the survey is to establish the presence/absence, extent and character of detectable archaeological remains within the proposed route of HS2 Phase 2a. The scope of the surveys is dependent upon securing access to the land and for the areas to be suitable for survey.
- 1.1.3 Site 41 lies within two Recognised Archaeological Zones. The southern area is defined as being an area between Rileyhill and Kings Bromley continuing westwards to the south side of the Trent, contains a major concentration of cropmarks. The northern is within a small outlier of this concentration of cropmarks, characterised by pit alignments of likely Iron Age date, indicating a remnant prehistoric field system to the east of Kings Bromley. The archaeological records from the HER within and immediately adjacent to the site correlate to this, identifying cropmarks of potential prehistoric or medieval date. A former post-medieval water meadow is also recorded as being upon the site.
- 1.2 The survey has not identified any anomalies of definite archaeological cause which may relate to nearby archaeological assets relating to an Iron Age pit alignment, cropmarks of possible Neolithic, Bronze Age, Iron Age and Medieval date or post Medieval water meadow. Magnetic disturbance is widespread in areas around the farm, field boundaries and former greyhound/horse track. The only findings of note are several discreet low magnitude responses in the westernmost parcel which are most likely natural in origin but for which an archaeological cause cannot be entirely dismissed. Linear trend anomalies parallel to the present boundaries identify agricultural patterns.

2 Introduction

2.1 Project Background

- 2.1.1 HS2 is a new railway network proposed by the Government to provide a new link between London, the West Midlands, the East Midlands, South Yorkshire, Leeds and Manchester. HS2 Phase 2a comprises approximately 36 miles of railway starting at Fradley at its southern end and connects with the West Coast Main Line (WCML), south of Crewe, to allow HS2 services to join the existing network and call at Crewe Station.
- 2.1.2 The overall framework within which archaeological work will be undertaken is set out in the draft Environmental Minimum Requirements (EMR) for HS2 Phase 2a. Accordingly, the nominated undertaker or any contractors will be required to implement certain control measures in relation to archaeology before construction work begins.
- 2.1.3 The works have been undertaken in accordance with Written Scheme of Investigation (WSI, HS2 2019a) and conform with current best practice and guidance for geophysical surveys as outlined in the Chartered Institute for Archaeologists' (CIfA) Standard and Guidance for archaeological geophysical survey (CIfA 2014) and European Archaeologiae Consilium Guidelines for the use of Geophysics in Archaeology (EAC 2016).
- 2.1.4 The selection of areas required for geophysical survey included as part of this Early Environmental Works (EEW) package are set out in location specific Written Scheme of Investigations (WSIs) based on Groups containing individual sites. HS2 Ltd has provided each EEW site along the Phase 2a route with a unique identifier Site Code.
- 2.1.5 Within EEW Group 003 (HS2 2020) the Site Code for geophysical survey is:
• Site 41: 2a20DBLFM

2.2 Scope of Document

- 2.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

2.3 The Site

- 2.3.1 A detailed gradiometer survey was carried out at Site 41, situated immediately north of the A513, between Handsacre and King's Bromley, Staffordshire, centred on NGR 409829, 317101(Figure 1).
- 2.3.2 The area required for magnetometer survey at Site 41, approximately 6.3ha, is broadly rectangular in shape, spread across multiple adjacent parcels along the A513 surrounding Bromley Lane Farm to the east, west and north. An oval former greyhound track associated with Bromley Lane Farm lies within the central area of the site which was largely rough pasture at the

time of survey (Figure 1). The River Trent lies approximately 400m to the north.

- 2.3.3 The survey area is flat at 63m above Ordnance Datum (aOD).
- 2.3.4 The solid geology across the survey area is recorded as Gunthrope Member mudstone, overlain by alluvial clay, silt, sand and gravel deposits (BGS 2021).
- 2.3.5 The soils underlying this survey area classified in Soilscape 22 Association, being described as loamy with naturally high groundwater (Cranfield University 2020).
- 2.3.6 Average responses of magnetometer surveys over mudstones and alluvial deposits are generally poor but results can be very variable depending on the nature and depth of overlying deposits (English Heritage 2008; Table 4). It remains that magnetometry was the most appropriate geophysical technique for evaluating the Site taking account of the limitations noted in Section 4.3 below.

3 Archaeological Background

3.1 Summary of the archaeological resource

- 3.1.1 The following archaeological background summarises details from the Location Specific Written Scheme of Investigation (LSWSI) together with information from publicly available online resources and other in-house resources.
- 3.1.2 The assessment and determination of the significance of archaeological assets is defined by Chapter 10 of the HS2 Ltd EIA Scope and Methodology Report (HS2 2017a).
- 3.1.3 The Recognised Archaeological Zones (RAZ) represent a high-level indication of likely concentrations of archaeological remains across the Phase 2a route. The location and spatial extent of RAZs has been determined using HS2 Environmental Statement (ES) Cultural Heritage information (HS2 2017b) and subsequent survey data.
- 3.1.4 The HS2 Ltd Phase 2a GWSI: HERDS document identifies Site 41 as falling within a Recognised Archaeological Zones (RAZ) RAZ 1 and RAZ 2. The south of the site is within RAZ 1, defined as being an area between Rileyhill and Kings Bromley continuing westwards to the south side of the Trent, containing a major concentration of cropmarks. There is a particularly intensive area of funerary monuments and potential ritual enclosures of later Neolithic to Early Bronze Age date either side of the A513, to the west of the Kings Bromley Manor gravel pits.
- 3.1.5 The north of the site (possibly outside the geophysical survey area) is within RAZ 2 which covers a small outlier of this concentration of cropmarks, characterised by pit alignments of likely Iron Age date, indicating a remnant prehistoric field system to the east of Kings Bromley.
- 3.1.6 The Staffordshire Historic Environment Record (HER) and the HS2 ES (HS2 2017b) identifies three known archaeological assets which are immediately adjacent to, or partially within sites in the EEW Group 003. They comprise:
- MST13455 / FRC042 – an Iron Age pit alignment of moderate significance, recorded as running east to west and identified from cropmarks on aerial photographs. This feature is situated within the south-east area of Site 41, approximately 23m east of the present-day horse track.
 - MST1556 / FRC044 – A complex of cropmarks visible on aerial photographs, believed to date to the Neolithic, Bronze Age, Iron Age and medieval periods, as assessed as being of moderate value. Features include an oval enclosure defined by a single ditch circuit with multiple ditch segments separated by causeways, which has been interpreted as a possible Neolithic causewayed enclosure. A second enclosure of similar size and shape, but defined by a continuous ditch, lies approximately 150m to the west. A north-south

oriented pit alignment, approximately 270m in length, of probable Iron Age date, runs across the causeway enclosure, and one of the pits can be seen to cut one of the ditch segments of the oval enclosure. Also identified within the complex are two double and four single ring ditches and a possible Iron Age square barrow and a rectangular enclosure that would appear to contain a post-hole building. The enclosure and building are of possible medieval date. A section of a possible enclosure ditch is recorded along the south-western border of Site 41. If extant these remains would be of moderate significance.

- MST1556 / FRC072 – The remains of a former water meadow, dating to the post-medieval period, assessed as being of low significance. It is now only partially surviving as earthworks and extant linear features, which are possible field boundaries or drains. Also present is an irregular U-shaped ditch to the south of the River Trent, which is not depicted on historic maps and is of uncertain date and function. An indicative area of post-medieval water meadow occupies the northmost field system of Site 41.

3.1.7 Heritage Asset data supplied from the British Museum Portable Antiquities Scheme (PAS) identified four archaeological assets in the proximity of the oval track located in the south-east of Site 41. They comprise:

- Object ID 544669: An incomplete cast copper alloy brooch of Colchester derivative Polden Hill of Roman dating, around AD 43 to AD 150.
- Object ID 619676: An incomplete copper alloy headstud brooch of Roman date, around AD 75 - AD 200.
- Object ID 619708: An incomplete copper alloy brooch of the Colchester derivative Polden Hill of Roman dating, around AD 80 to AD 175.
- Object ID 621063: An incomplete struck / hammered silver farthing of Edward I dating to the period AD 1300 to AD 1310.

3.1.8 Heritage Asset data supplied from the HS2 CA1 Aerial Photograph Survey (APS) database identified four archaeological features within EEW Group 003. They comprise:

- Feature ID 16: The indicative area of a Bronze Age funerary landscape comprised of eleven distinct ring ditches, representing likely barrow features, and multiple pit alignments. These features were identified from oblique aerial photography from the Cambridge University Collection of Aerial Photography (CUCAP). The western limits of this indicative area are located along the south-east boundary of Site 41.
- Feature ID 29: The indicative area of a possible crop-marked trackway thought to be of Iron Age or Roman date. The feature was identified from oblique aerial photography from the CUCAP and the Historic England National Mapping Programme (NMP). This feature is located within the south-west extent of Site 41.

- Feature ID 30: The indicative area of ridge and furrow earthworks thought to be of post-medieval date. The feature was identified from Royal Air Force vertical aerial photographs from the Historic England NMP. The feature is located in the south-west area of Site 41.
- Feature ID 31: The indicative area of ridge and furrow earthworks thought to be of post-medieval date. The feature was identified from Royal Air Force vertical aerial photographs from the Historic England NMP. The feature is located in the north-west area of Site 41.

3.1.9 Site 41 is partially depicted on the Kings Bromley Estate Map of 1771, with two fields, Mill Field Piece and New Close, depicted within the site. The Armitage and Handscare Estate map of 1850 shows more detail of the site. The northern end falls within Handscare Meadow, a possible water meadow. The remainder of the site is divided into fields, with two broadly east-west aligned paths also crossing through the site. The Ordnance Survey (OS) six inch: mile map of 1902 details a sinuous drain feature that ran through the south-east area of the site. This feature is also detailed in the OS 1:10,000 map of 1979. No other features of possible archaeological interest were recorded in available historic mapping.

3.1.10 The Supplementary Environmental Statement 2 and Additional Provision 2 Environmental Statement (HS2 2019b) noted that geophysical survey work has been undertaken within part of the LS-WSI Group.

Geophysical Survey Area 2: Pipe Ridware covered the north of Site 41. It did not identify any anomalies that could be definitively identified as archaeology. However, a number of positive pit-like anomalies were tentatively considered to be evidence of extraction activity or refuse pits. It is possible that some of these are associated with the extensive Bronze Age activity identified to the south of the area from cropmarks. However, these could equally be geological in origin.

- A number of sub-linear trends were also identified within the variable geological response that could possibly pertain to archaeological activity. However, it is also possible these anomalies are evidence of geological variation or agricultural activity.
- An increased magnetic response identified throughout the north-west of the survey area was interpreted as indicative of a former trackway.

3.1.11 LiDAR/ Remote sensing survey data did not identify any features or anomalies within the EEW Group area (HS2 2017c).

4 Methodology

4.1 Magnetometry

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature 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 Annex 1 and Annex 2 respectively.

4.2 Aims and Objectives

4.2.1 The aims of the survey comprise the following:

- To determine, as far as is reasonably possible, the nature of the detectable archaeological resource within a specified area using appropriate methods and practices; and
- To inform either the scope and nature of any further archaeological work that may be required; or the formation of a mitigation strategy (to offset the impact of the development on the archaeological resource); or a management strategy.

4.2.2 In order to achieve the above aims, the objectives of the geophysical survey are:

- To conduct a geophysical survey covering as much of the specified area as possible, allowing for on-site obstructions;
- To clarify the presence/absence of anomalies of archaeological potential; and
- Where possible, to determine the general nature of any anomalies of archaeological potential.

4.3 Assumptions and limitations

Magnetometry is the most widely used geophysical survey technique in archaeology as it can quickly evaluate large areas and, under favourable conditions, identify a wide range of archaeological features including infilled cut features such as large pits, gullies and ditches, hearths, and areas of burning and kilns and brick structures. It is therefore good at locating settlements of all periods, prehistoric field systems and enclosures and areas of industrial or

modern activity, amongst others. It is less successful in identifying smaller features such as post-holes and small pits (except when using a non-standard sampling interval), unenclosed (prehistoric) settlement sites and graves/burial grounds. Magnetometry has the potential to rapidly confirm the presence/absence of a wide range of potential archaeological remains within the site and was thus chosen as the most appropriate technique in this instance.

4.4 Fieldwork Methodology

4.4.1 The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses (swaths) 4m apart (Figure 1). These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point, in accordance with EAC guidelines (EAC 2016).

4.4.2 Unenclosed areas were surveyed using the co-ordinates of the pre-determined Site boundary visible as an outline on the MLGrad601 software during data collection.

4.4.3 MLGrad601 (Geomar Software Inc.) software was used to collect the data.

4.5 Data processing

4.5.1 Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

4.5.2 A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) to maximise the clarity and interpretability of the archaeological anomalies.

4.5.3 The data has also been clipped to remove extreme values and to improve data contrast.

4.5.4 MultiGrad601 (Geomar Software Inc.) software was used to export the survey data files.

4.5.5 Terrasurveyor V3.0.37.0 (DWConsulting) software was used to process and export graphical plots the data.

5 Geophysical Survey Results and Interpretation

5.1 Gradiometer survey results and interpretation

- 5.1.1 The detailed gradiometer survey was carried out on the 19th April 2022 and covered an area of 5.2ha.
- 5.1.2 Fully processed (greyscale) data, minimally processed data (XY trace plot) and interpretative plans are presented at a scale of 1:1,500 in Figures 2 – 4 inclusive.
- 5.1.3 The magnetic background was broadly homogenous across the Site but contained a large number of sporadic discreet low magnitude anomalies likely a result of the underlying mudstone geology and superficial alluvial clay, silt, sand and gravel deposits.
- 5.1.4 All areas surveyed within Site 41 contain some degree of magnetic disturbance of non-archaeological origin. Areas of magnetic disturbance are widespread at the field boundaries and surrounding Bromley Lane Farm and the former greyhound/horse oval track. Discreet ferrous 'spike' anomalies are prevalent across the Site and are also caused by modern magnetic debris.
- 5.1.5 A high magnitude linear anomaly (41-001) located immediately north of the farm identifies a service pipe. The line of this service is visible as a boundary on successive Google Earth satellite images.
- 5.1.6 Linear trends (41-002 – 41-005 inclusive) oriented parallel and perpendicular to the present field boundaries in each of the three largest parcels of the site may identify possible former boundaries pre-dating the first edition OS map and/or agricultural trends.
- 5.1.7 Several discrete, low magnitude strength anomalies of uncertain origin (41-006) but distinguishable from ferrous spike anomalies are tentatively identified in the square field immediately west of the farm as of possible archaeological origin but may simply reflect the natural geological background of the area.
- 5.1.8 Linear trends parallel to the present boundary in the easternmost parcel are caused by modern cultivation.

- 5.1.9 The survey has not identified any conclusive responses which may relate to nearby archaeological assets relating to an Iron Age pit alignment (MST13455 / FRC042), complex of cropmarks of possible Neolithic, Bronze Age, Iron Age and Medieval date (MST1556 / FRC044) or post Medieval water meadow (MST1556 / FRC072).

6 Discussion

- 6.1.1 The survey has not identified any anomalies of definite archaeological cause which may relate to nearby archaeological assets relating to an Iron Age pit alignment, cropmarks of possible Neolithic, Bronze Age, Iron Age and Medieval date or post Medieval water meadow.
- 6.1.2 Magnetic disturbance is widespread in areas around the farm, field boundaries and former greyhound/horse track. The only findings of note are several discreet low magnitude responses in the westernmost parcel which are most likely natural in origin but for which an archaeological cause cannot be entirely dismissed. Linear trend anomalies parallel to the present boundaries identify agricultural patterns.

References

Bibliography

British Geological Survey (BGS) 2022 Geology of Britain 3D <http://www.bgs.ac.uk/> accessed 18th July 2022

Chartered Institute for Archaeologists (CIfA) 2014 Standard and guidance for archaeological geophysical survey (Reading)
https://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_3.pdf accessed 18th July 2022

Cranfield University 2020 Cranfield Soil and Agrifood Institute Soilscales
<http://www.landis.org.uk/soilscales/> accessed 18th July 2022

English Heritage 2008 Geophysical Survey in Archaeological Field Evaluation

Europae Archaeologia Consillium (EAC) 2016 EAC Guidelines for the Use of Geophysics in Archaeology: Question to Ask and Points to Consider (Namur, Belgium) <https://www.europae-archaeologiae-consilium.org/eac-guidlines> accessed 18th July 2022

Gaffney C & Gater J 2003 Revealing the Buried Past: Geophysics for Archaeologists Stroud

HS2 Ltd, 2017a High Speed Rail (West Midlands-Crewe). Environmental Statement. Volume 5: Technical appendices. Environment Impact Assessment Scope and Methodology Report (CT-001-001). Available at: <https://www.gov.uk/government/publications/scope-and-methodology-report-for-hs2-phase-2a>

HS2 Ltd, 2017b High Speed Rail (West Midlands-Crewe). Environmental Statement. Volume 5: Technical appendices. CA1: Fradley to Colton. Gazetteer of heritage assets. (CH-002-001). Available at: <https://www.gov.uk/government/collections/hs2-phase-2a-environmental-statement#volume-5:-environmental-reports-and-maps-by-community-area>

HS2 Ltd, 2017c High Speed Two Phase 2a (West Midlands-Crewe). Background Information and Data. CA1: Fradley to Colton. Cultural heritage survey reports. (BID-CH-004-001). Available at: <https://www.gov.uk/government/collections/hs2-phase-2a-environmental-statement#volume-5:-environmental-reports-and-maps-by-community-area>

HS2 2019a HS2 Phase 2a Written Scheme of Investigation for EI-711 Surveys Package 1: Magnetometry (HS2-HS2-EV-MST-A000001)

HS2 Ltd, 2019b High Speed Two Phase 2a (West Midlands-Crewe). Background Information and Data. Cultural heritage survey data used in the Supplementary Environmental Statement 2 and Additional Provision 2 Environmental Statement. (BID-CH-004-000). Available at: <https://www.gov.uk/government/publications/hs2-phase-2a-background-information-and-data-cultural-heritage-february-2019>

HS2, 2020, Phase 2a LS-WSI: EEW Group 003, EEW Site 41 (HS2 Document no: 2EE01-BAF-EV-PRO-

A000-000032

Annex 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 the topsoil, subsoil and rock, 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.

Annex 2: Geophysical Interpretation

Most 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 introduced into the soil during 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.

Lightning-induced remnant magnetisation (LIRM)

LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical current associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

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

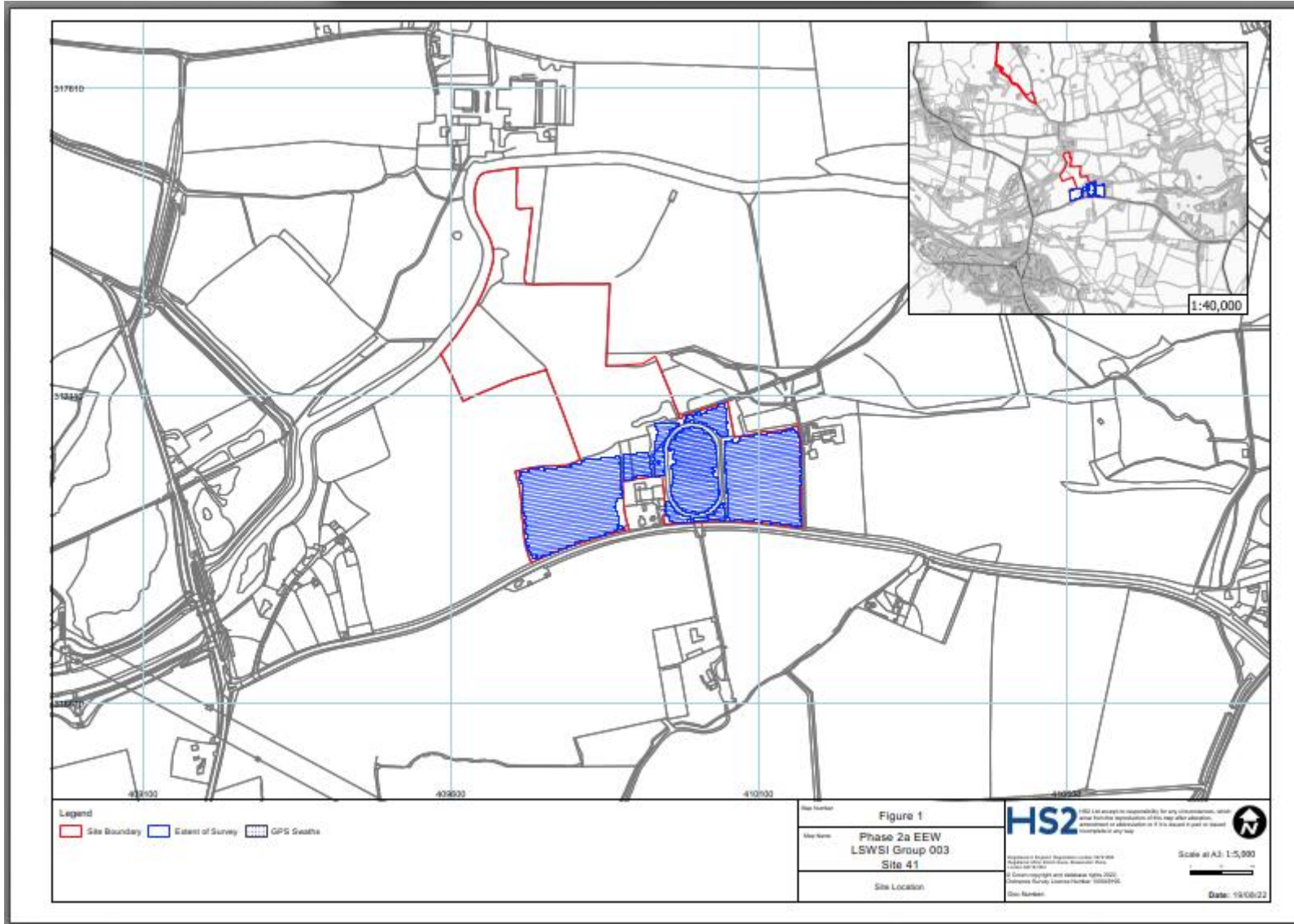
Areas of enhanced response are characterised by a general increase in the magnetic background over a

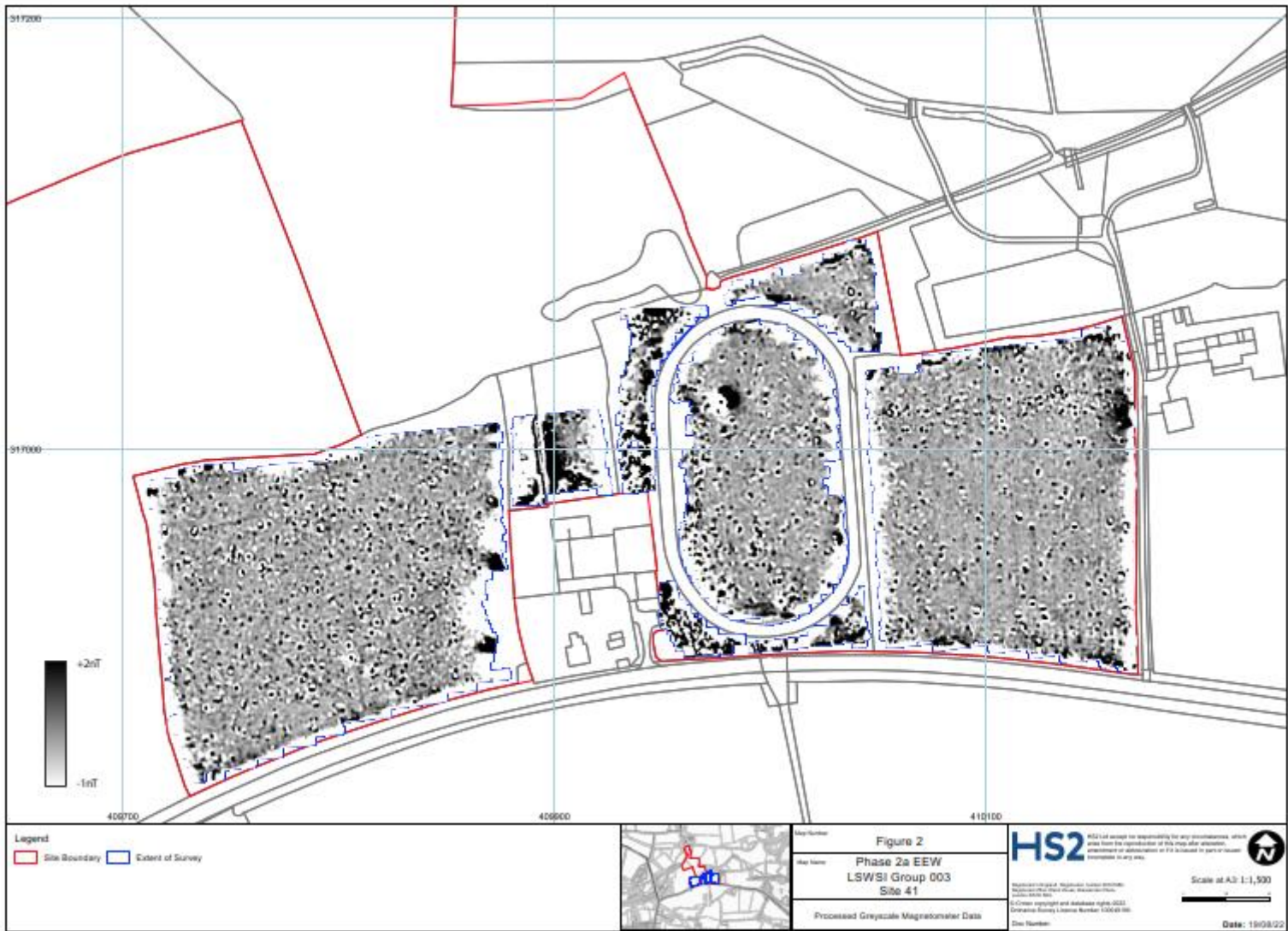
localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on an XY trace plot) on two or three successive traces. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (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

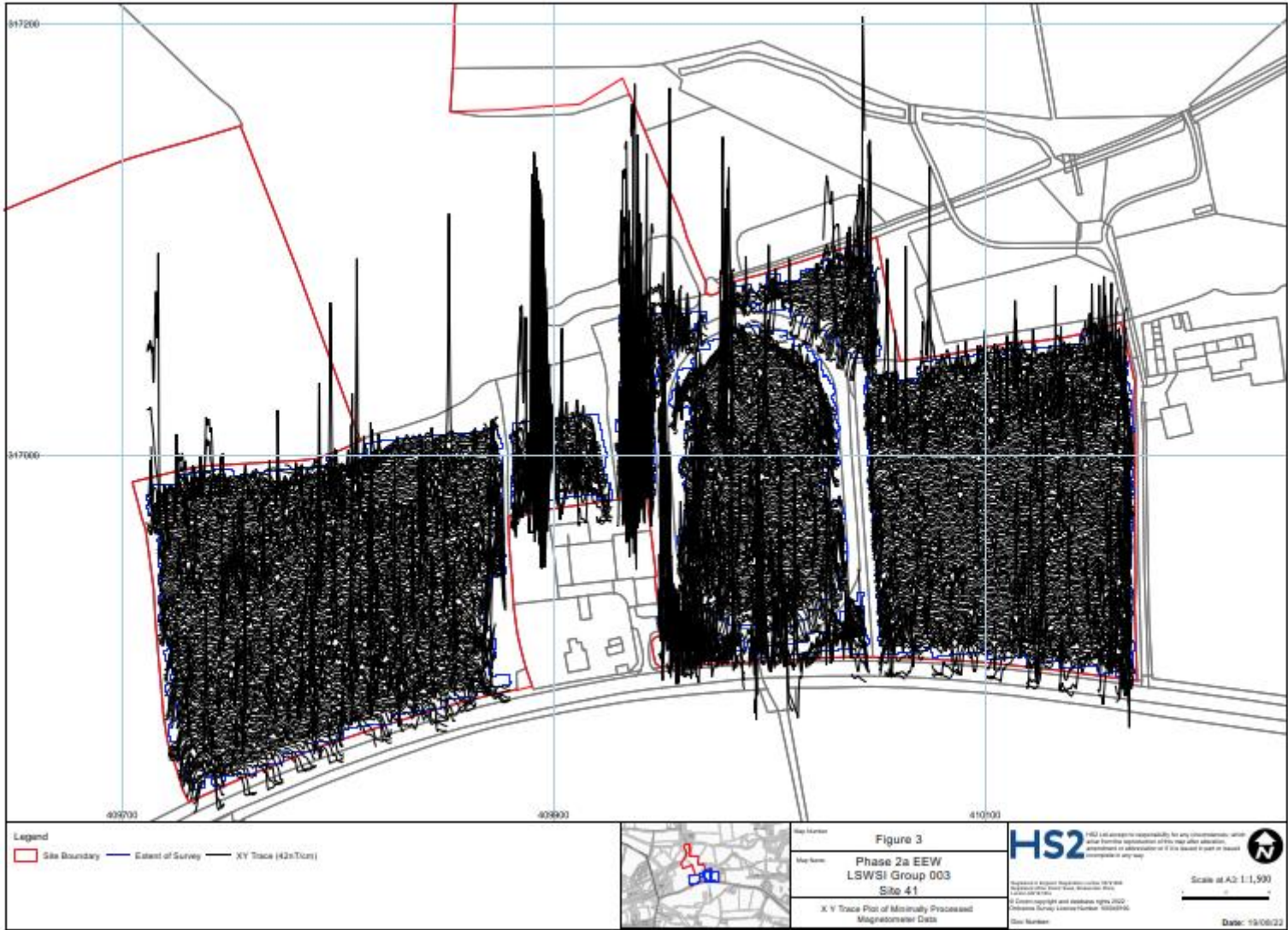
Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

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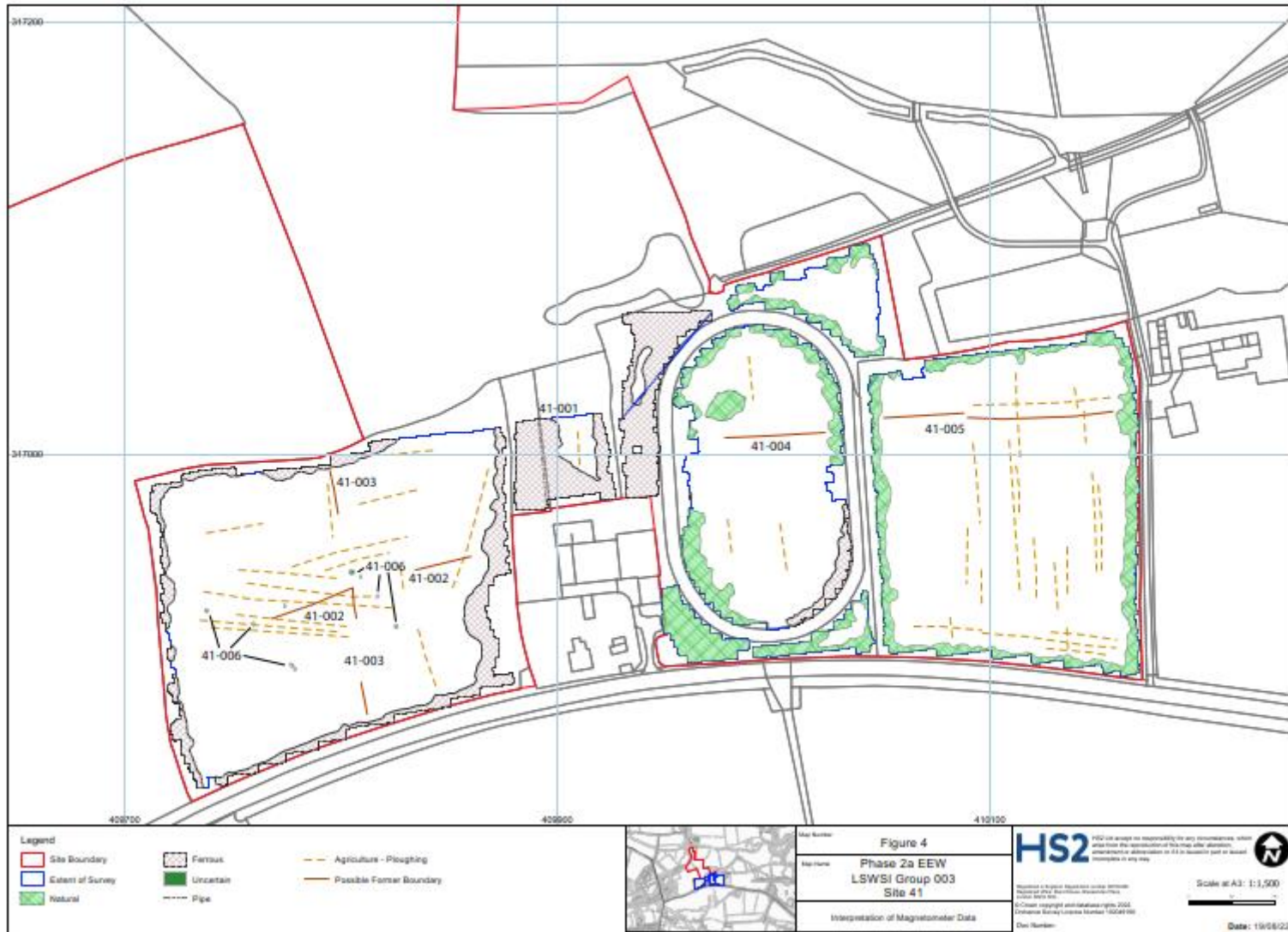




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Annex 3: OASIS Form

Project Details:

Project name	Geophysical Survey at Group 003 Site 41	
Type of project	Geophysical Survey, MAGNETOMETRY SURVEY	
Project description	<p>The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid carrying frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses (swaths) 4m apart. These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point, in accordance with EAC guidelines (EAC 2016).</p> <p>The survey has not identified any anomalies of definite archaeological cause which may relate to nearby archaeological assets relating to an Iron Age pit alignment, cropmarks of possible Neolithic, Bronze Age, Iron Age and Medieval date or post Medieval water meadow. Magnetic disturbance is widespread in areas around the farm, field boundaries and former greyhound/horse track. The only findings of note are several discreet low magnitude responses in the westernmost parcel which are most likely natural in origin but for which an archaeological cause cannot be entirely dismissed. Linear trend anomalies parallel to the present boundaries identify agricultural patterns.</p>	
Project dates	Start: 19-Apr-2022	End: 19-Apr-2022

Previous work		N/A			
Future work		N/A			
Project Code:	Group 003 Site 41	HER event no.			

		NMR no.	N/A	OASIS form ID:	hs2headl1-509386
		SM no.			
Planning Application Ref.					
Site Status		None			
Land use		ARABLE AND PASTURE			
Monument type		N/A	Period	N/A	

Project Location:

Site Address	situated immediately north of the A513, between Handsacre and King's Bromley			Postcode	
County	Staffordshire	District	Lichfield	Parish	Armitage with Handsacre
Study Area	6.3ha	Height OD	63m above Ordnance Datum	NGR	SK 09853 17092

Project Creators:

Name of Organisation	HS2 Headland Archaeology (UK) Ltd		
Project brief originator	HS2	Project design originator	HS2
Project Manager	Alistair Webb	Project Supervisor	Matt Berry
Sponsor or funding body	Balfour Beatty	Type of Sponsor	Client

Project Archive and Bibliography:

Physical archive	N/A	Digital Archive	Geophysical survey and report	Paper Archive	N/A
Report title	Phase 2a Heritage Non-intrusive Surveys Report: Group 003 Site 41 Geophysics survey report			Date	31/10/22
Author	Headland Archaeology	Description	PDF/A	Report ref.	

