ES VOLUME 2
Technical Appendices

H - Archaeology and Cultural Heritage

H.1 Archaeological Desk-based Assessment

H.2 Written Scheme of Investigation

KEDD Limited

Written Scheme of Investigation

Strip, Map and Sample Excavation: Lea Castle Farm Quarry, Wolverley, Worcestershire

Worcestershire Archaeology

for NRS Aggregates Ltd

September 2019

Find out more online:
www.explorethepast.co.uk

REGISTERED ORGANISATION CIfA

worcestershire county council

LEA CASTLE FARM QUARRY

Written Scheme of Investigation
Strip, Map and Sample Excavation

Worcestershire Archaeology
Worcestershire Archive & Archaeology Service
The Hive
Sawmill Walk
The Butts
Worcester
WR1 3PD

SITE INFORMATION	
Site name	Lea Castle Farm Quarry
WA project number	P5373
HER number	-
Planning reference	18/000023/SCO
Central NGR	SO 8407 7902
Contacts	
WA Contact	Robin Jackson: Senior Project Manager Tel: 01905 844866/765908 Email: rjackson@worcestershire.gov.uk
Client	NRS Aggregates Limited Unit 1 White Gate Farm Mythe Lane Witherley CV9 3NU
Consultant	Contact: Robin Smithyman, Director Tel: 07496 154504 Email; robin@keddltd.co.uk Kedd Limited, Fox Studio, King Street, Much Wenlock, Shropshire TF13 6BL
Planning Authority	Worcestershire County Council Contact: Emma Hancox Tel: 01386 565397; 07854 498585 Email: EHancox@worcestershire.gov.uk

Document control panel

Version	Date	Description	Author
1	09/05/2019	Draft for Consultant	Robin Jackson
2	11/09/2019	Revision of red line boundary	Robin Jackson

CONTENTS

Written Scheme of Investigation

Archaeological Strip, Map and Sample Excavation at Lea Castle Farm Quarry, Wolverley, Worcestershire

1 Introduction

1.1 Project background

Worcestershire Archaeology (WA) has been requested to prepare a Written Scheme of Investigation (WSI) for the undertaking of programme of archaeological mitigation comprising an archaeological Strip, Map and Sample Excavation at Lea Castle Farm Quarry, nr Wolverley, Worcestershire (the Site).

The WSI has been requested by Robin Smithyman of Kedd Limited (the Consultant) on behalf of NRS Aggregates Limited (the Client) who are intending on submitting a planning application for mineral extraction at the Site.

The request arises following completion of a Desk-Based Assessment (Appendix 1) and two phases of Geophysical Survey (Appendix 2 and 3) of the Site. Subsequent discussions between the Consultant and Emma Hancox, the Archaeology and Planning Advisor to Worcestershire County, the Mineral Planning Authority (the Curator) have resulted in the Curator providing the following advice:

> *'I accept that this is an area of landscape that appears to have always been rural in nature with dispersed scattered settlement. Based on the character of the landscape and the geophysical survey results, it is likely that any archaeology in the site would be not be extensive. There is still the risk that complex and expensive archaeology could exist. You have indicated that you are prepared to take that risk in terms of potential expense and time delays and I am in agreement that the risk of finding such archaeology is low and would be dealt with by the proposed mitigation strategy. Given the scale of the proposed development it is likely that some archaeology will be discovered on the site, but I am happy that further work can be undertaken as a condition of consent. However I would like to see the WSI submitted with the planning application, covering the aspects that we discussed in our meeting and laid out in your letter to ensure that we have a transparent process and a clear understanding of the mitigation work to follow* (correspondence dated 4 April 2019).

As part of these discussions it was also agreed that a Strip, Map and Sample Excavation would provide an appropriate approach to mitigate the impact of the proposed development on any archaeological deposits present (the Mitigation Strategy).

This WSI therefore defines this Mitigation Strategy and along with the already completed Desk-Based Assessment and Geophysical Survey reports will form part of the planning application to be submitted by the Client for the Site.

1.2 Location, geology and topography

The Site is located approximately 2.5km north of Kidderminster (NGR SO 8407 7902; Figure 1) and covers an area of approximately 45ha.The topography of the area is broadly undulating with ground rising in the centre of the site and falling away to the east and west.

The underlying geology of the Site is mapped by the British Geological Survey as sandstone of the Wildmoor Sandstone Member, overlain in places by sand and gravel of the Kidderminster Station Member and other glaciofluvial sand and gravel deposits (BGS 2018).

1.3 Archaeological background

The archaeological background to the Site is provided by previous archaeological investigations comprising:

- A Desk-Based Assessment (DBA) undertaken by WA (Walsh 2018; Appendix 1); and
- Two stages of Geophysical Survey of the Site (SUMO 2018 and 2019; Appendix 2 and 3);

The DBA concluded that:

> *"There is also limited evidence for early medieval and medieval activity in the Study area and the early historic mapping indicates that the site was probably agricultural (or common) land until the late 18th or early 19th century. Evidence for any activity of the prehistoric, Roman, early medieval and medieval periods would likely be considered informative at local or regional level and therefore of local to regional significance. However, given the very limited representation of such material within the Study Area the potential for survival of assets dating to these periods within the site is considered to be low.*
>
> *Any archaeological evidence from the post-medieval and modern periods would probably relate to agriculture, parkland and/or the landing strip and therefore considered as only locally informative and of low or negligible significance."*

The subsequent two phases of geophysics concluded the following:

> *'A detailed magnetometer survey at Lea Castle Farm has not identified any definite archaeological responses. Several anomalies of uncertain origin have been detected, and they could be of agricultural, natural or modern origin. Evidence of ridge and furrow, modern ploughing and a former field boundary have been identified, along with areas of natural magnetic variation, underground services and disturbance from nearby ferrous objects'* (SUMO 2018); and
>
> *'A detailed magnetometer survey at over approximately 19 ha of agricultural land at Lea Castle Farm. Like earlier work in to the west, the survey did not identify any definite archaeological responses. Several anomalies of uncertain origin have been detected, and they could be of agricultural, natural or modern origin. A former field boundary and thicket have been identified, along with areas of natural magnetic variation'* (SUMO 2019).

It is, however, recognised that the evidence base for the DBA is restricted to results from previous work in the area and that this is not comprehensive, whilst geophysical survey may not always be effective on some geologies and is not well suited to prospection for dispersed or largely ephemeral remains as are most likely to be present at the Site. It is also accepted that there is a degree of risk that complex and extensive archaeology could exist, and that neither the DBA nor geophysical survey are liable to identify potentially significant but dispersed remains, notably those of earlier prehistoric or early medieval date.

1.4 Scope

This WSI provides a Project Design for the completion of an archaeological Strip, Map and Sample Excavation since this is felt to be the most appropriate and effective technique for ensuring that any remains present within the proposed development area can be identified and appropriately recorded. In particular Strip, Map and Sample Excavation provides a highly effective approach to the identification of dispersed and ephemeral remains for which other prospection approaches such as geophysical survey and trial trenching are not particularly effective.

Strip, Map and Sample Excavation will therefore be employed within any areas within the Site which are identified for stripping of topsoil, subsoil and overburden in advance of mineral extraction or other

operations where there is a potential for ground disturbance of archaeological remains as a result of the proposed development (including haul roads, bunds, plant construction, etc).

Depending on operational requirements this is anticipated to be undertaken in several phases, with each phase of Strip, Map and Sample to be undertaken prior to each phase of mineral extraction.

This WSI is based on an existing state of knowledge as summarised above and the Client should be aware that buried archaeological evidence can be very variable, and that the Archaeological Mitigation Strategy, the Evaluation and Interim Reports may not accurately specify what may exist in the area to be affected.

1.5 Aims and objectives

The aims and objectives of the project are as follows:

(i) To determine the presence/absence of any archaeological deposits present within the Site

(ii) To determine the extents, significance, character and dating of any such deposits;

(iii) To provide a narrative on the development of the landscape and the nature of the human interaction as revealed by any archaeological deposits present;

(iv) To produce a site report which adheres to and contributes to local and regional research agendas, as defined by established industry standards;

(v) To disseminate the results of the archaeological investigation in manner appropriate to the significance of the findings; and

(vi) To deposit the project archive as appropriate.

Any deposits present will be considered within the context of both regional and national research frameworks and in particular the West Midlands Regional Research Frameworks (Watt 2011; Garwood 2007; Hurst 2017; White and Hodder 2018) as well as within the specific research frameworks developed through the ALSF for aggregate extraction landscapes within Worcestershire (Jackson and Dalwood 2007).

2 Project methodology

2.1 General

WA is part of Worcestershire County Council and is subject to the Council's policies, safeguards, practices and audit procedures.

WA is registered as an archaeological organisation with the Chartered Institute for Archaeologists, and as such is bound to the CIfA's Code of Conduct, standards and guidelines.

The following are relevant to this project:

- *Code of approved practice for the regulation of contractual arrangements in field archaeology*, Institute for Archaeologists (2008);
- *Standard and guidance: Archaeological excavation*, Chartered Institute for Archaeologists (2014a);
- *Standard and guidance: for collection, documentation, conservation and research of archaeological materials*, Chartered Institute for Archaeologists (2014b); and
- *Standard and guidance for the creation, compilation, transfer and deposition of archaeological archives*, Chartered Institute for Archaeologists (2014c).

The project and any recommendations will conform to government policy on the historic environment contained in the *National Planning Policy Framework* (DCLG 2018) and relevant guidance in Historic

England's *Good Practice Advice Notes 1-3* (HE, dated 25 March 2015; https://www.designingbuildings.co.uk/wiki/Historic_environment_good_practice_advice).

The project will conform to the following:

- *The Standards and guidelines for archaeological projects in Worcestershire* (WCC, amended March 2016).

The project will follow the procedures of the following:

- *Manual of Service Practice: Recording Manual*, 2012, Worcestershire Archaeology Worcestershire County Council internal report, **1842**. Of particular importance here are the Finds recovery policy, and Guidelines for environmental sampling.
- *Manual of Service Practice: archiving*, 2011 as amended, Historic Environment and Archaeology Service, Worcestershire County Council, internal report, **1582**.

Copies of the manuals will be supplied to the Client and Curator on request.

Six Project Stages are defined:

1. Mobilisation
2. Fieldwork
3. Post-fieldwork archiving and Interim reporting
4. Assessment
5. Analysis and reporting
6. Deposition of archive.

2.2 Stage 1 Mobilisation

Prior to commencement on site of any phase of mineral extraction or other groundworks associated with the development, the Project Manager will:

- Obtain background information necessary to undertake the project (eg HER search, liaise with consultant, principal contractor and/or client regarding access),
- Liaise with the Client, Consultant and site contractors,
- Attend set-up meetings,
- Produce any necessary documentation relating to the project (eg agreement, written scheme of investigation required by advisors to the planning authority),
- Produce safety methods statement and risk assessment, and
- Ensure that all staff and other resources (such as plant) have been programmed.

2.3 Stage 2: Fieldwork

2.3.1 Stage 2.1: Strip and Map

Each operational area of the Site will be opened by machine using a toothless bucket and operating under close archaeological supervision. Machine excavation will proceed in spits removing topsoil, subsoil and any overburden present to a level to be determined by the WA Archaeologist undertaking the monitoring.

Following machine stripping of areas, no plant will be permitted to track across investigation areas until these have been signed off by the WA Archaeologist and the Curator.

For each area following machine stripping any archaeological deposits identified will be mapped:

- Clean surfaces will be inspected and any exposed deposits identified by the WA archaeological team.
- Some limited hand investigation including cleaning of areas may be required to further define the extents and broad significance of exposed deposits.
- All deposits identified will be mapped using a differential GPS with an accuracy limit set at <0.04m.
- Upon completion of the mapping, the WA archaeologist will identify any features or deposits that they consider of sufficient interest to warrant sample excavation.

2.3.2 Stage 2.2: Sample excavation

Following completion of any phase of Strip and Map operations, sample excavation will proceed as follows:

- All excavation will be by hand.
- Clean surfaces will be inspected and exposed deposits will be fully or partially excavated to determine their nature and to retrieve artefactual material and environmental samples.
- All excavation of archaeological deposits will be undertaken using hand tools (trowel, mattock, shovel, wheelbarrow, buckets, etc).
- Excavation and recording of deposits will follow standard WA practice (WA 2012).
- Depending on circumstances (including availability of phone signal) context recording will either be undertaken using context sheets and other pro-forma recording sheets or digitally via ARK (Archaeological Recording Kit) developed by L-P Archaeology and adapted for use by WA (https://ark.lparchaeology.com/).
- Site surveying will be undertaken using a differential GPS with an accuracy limit set at <0.04m.
- Individual plans and features will be drawn on pre-printed permatrace sheets at an appropriate scale (typically 1:10 for sections and 1:20 or 1:50 for plans).
- Photographic recording will comprise digital images, at a minimum of 7 megapixels, taken with a digital SLR.
- Where appropriate geo-referenced photography may be used to record complex deposits.
- A metal detector will be used to check for presence or absence of metal artefacts.
- Sample levels and excavation strategies will be targeted to ensure that a representative and statistically viable sample is obtained.
- Selection of deposits and sample levels will be informed by ongoing research aims and archaeological priorities which may vary during the course of the project.
- Selected deposits will be fully or partially excavated to determine their nature and retrieve artefactual material and environmental samples as appropriate;
- Deposits will be selected for excavation on the basis of the minimum required to meet the aims of the project;
- Selection for excavation will be on the judgement of the Project Leader.

The intention will be to focus investigation on the more coherent, and artefact or ecofact rich, and better preserved elements of the archaeological deposits which have the greatest potential to address the aims and objectives (research questions) of the Project.

Sample levels will aim to achieve those indicated in the table below though variation may be sought with the agreement of the Curator under some circumstances.

Type of context	Percentage
Burials	100%
Structural features (postholes, floors, wall foundations, hearths, roundhouse gullies)	50%
Industrial structures (ovens, kilns)	50%
Prehistoric pits	50-100%
Later prehistoric, Roman and medieval pits	50%
Gullies and ditches – non-settlement (eg Field boundaries)	>5% to cover all intersections
Gullies and ditches – settlement or activity areas (enclosures)	>10% to cover all intersections
Layers (including occupation and burnt mound deposits)	Variable

Artefactual retrieval policy, treatment and discard will follow standard Service practice and the requirements of the receiving museum.

Selection of deposits for sampling will follow guidance set out in English Heritage (2011) *Environmental Archaeology. A Guide to the Theory and Practice of Methods, from Sampling and Recovery to Post-excavation* (2nd edition).

The sampling level for sieving for artefacts and ecofacts is set out below:

Sampling method	Features/deposits to be sampled
Hand retrieval of all artefacts and animal bone	All features
Sample retrieval (percentage?) of building materials (building stone, roof tile, brick) with total volume recorded/estimated.	All features
Bulk samples (40 litres) taken for wet sieving (plant macrofossils, small animal bone, small artefacts)	Selected pits and ditches

All artefacts and environmental samples will removed from site for processing to be undertaken at the WA offices in Worcester. Spot dates and preliminary information will be fed back to the site team by the WA specialist teams who will also be available for provision of on-site advice.

2.4 Stage 3 Post-fieldwork archiving and interim reporting

The following tasks will be completed upon completion of fieldwork to secure the archive and ensure appropriate packaging and storage of material recovered until such a time as Stages 4 and 5 (Assessment and Reporting) are undertaken:

- All records and surveys will be checked, cross-referenced and quantified;

- Artefacts will be cleaned, marked, quantified and appropriately packaged for storage. Where necessary stabilisation or conservation of fragile artefacts may be undertaken at this stage;
- Environmental samples will be processed and the resultant flots and residues will be scanned and sorted;
- Site plans and surveys will be downloaded and/or digitised (as appropriate) within AutoCAD;
- Relational databases will be established for various categories of information (structural, artefactual and ecofactual);
- Preliminary (range finding) radiocarbon dating will be secured; and
- Security copies of the documentary archive will be prepared (within four weeks of the completion of fieldwork) and kept by WA. The security copy will be entirely digital and is backed up and stored at a location remote from WA's office (County Hall).

An interim report will also be produced summarising results and highlighting any significant discoveries.

A brief review of the project progress and outcomes will be undertaken at the conclusion of each phase of fieldwork to enable identification and agreement of any alterations to the programme of works that are necessary arising from the results of completed phases of fieldwork. Any alterations identified will be agreed in writing with the Client, Consultant and Curator and where necessary an updated WSI will be issued.

2.5 Stage 4 Assessment

Following completion of all phases of Stage 2 fieldwork and associated Stage 3 Interim Reports, an Assessment Report and Updated Project Design will be prepared for submission to the Client, Consultant and Curator.

The Assessment Report will be compiled in accordance with current English Heritage guidelines (English Heritage, 2006 Management of Research Projects in the Historic Environment).

This will include assessment of the quantity, quality, range and research potential of all records, artefact classes and environmental material. Appropriate specialists will be consulted or contracted where appropriate.

Assessment of research potential will make use of appropriate national, regional and research frameworks in identifying priorities for subsequent analysis.

The Assessment Report will be accompanied by an Updated Project Design (UPD) which will summarise the results of the fieldwork and present a proposed programme of analysis and publication (Stage 5).

The Assessment Report and UPD will be submitted to the Client and Consultant in the first instance for approval and subsequently to the Curator.

2.6 Stage 5 Analysis and report

Following approval of the Assessment and UPD, a programme of analysis and reporting will be undertaken as appropriate and as defined in the UPD. Appropriate specialists will be consulted or contracted where appropriate.

Results will initially be presented through a report in the WA's internal report series.

In the first instance WA will normally supply a digital copy of the draft report to the Client and Consultant for approval. Following any editing or alterations requested a final draft will be issued to the Client and Consultant for forwarding to the Curator for approval. Alternatively where requested, WA will forward a copy directly to the Curator (in the interests of speed).

Following receipt of Curator comments and completion of any required alterations a final report will be issued.

Where requested a reasonable number of hard copies (up to three) of the finalised report will be provided.

Any report produced will contain as minimum:

- a non-technical summary;
- background;
- aims;
- methods;
- location and size of archive;
- discussion of results in relation to appropriate local, regional and national research frameworks;
- associated tables, figures and appendices.

WA has a professional responsibility to make available the results of archaeological work with reasonable despatch (CIfA Code of Conduct, principle 4). The following statement is also made with regard to best practice in stewardship (CIfA Standard and guidance for stewardship for the historic environment 2014, section 3 communication). WA recognises the need for discretion to protect the Client's interests when communicating the results of its work. The nature of our work, however, is a matter of constant public fascination. In aiming to meet its responsibilities, Client needs, and public demands, WA will take the following approach, unless notified by the Client before the project commences.

- The report will be submitted to the HER.
- A short summary will be published in one or more regional journals (e.g. West Midlands Archaeology, Transactions of the Worcestershire Archaeological Society) where appropriate. These publications are generally produced annually.
- In some instances it may be appropriate for a summary report or version of the full report to be prepared for more widespread publication in a national period journal (e.g. Britannia, Proceeding of the Prehistoric Society, Medieval Archaeology, etc), or as a stand-alone report (monograph), or as a report within the Service's digital report series, copies of which are held by the Archaeology Data Service.
- WA will register the report with OASIS.

The discovery of items (including artefacts), of particular interest may be communicated through social media at any time. See https://www.explorethepast.co.uk/ . Social media will not include information which identifies the location of the site, or the Client's name.

2.7 Stage 6 Archiving and deposition

Archiving will be undertaken following standard WA practice (HEAS 2012 *Manual of Service Practice: Digital Preservation and Project Archiving*, internal report **1582**).

Security copies of the documentary archive will be prepared within four weeks of the completion of fieldwork and kept by WA. The security copy will be entirely digital and is backed up and stored at a location remote from WA's office (County Hall).

The documentary archive (and where possible, artefacts) will be offered to an appropriate museum in this instance Museums Worcestershire.

The digital archive will be placed with ADS.

3 Resourcing and programme

3.1 Personnel

The Project Manager will be the first point of contact in all matters relating to the project.

The Project Manager for this project will be Robin Jackson.

A Project Leader will be notified upon commencement of each phase of work.

All staff will be appropriately qualified and with an established record of expertise. Profiles of key members of the team will be made available to the Client and Curator on request. The team will comprise the following, as required.

- Project Manager — Responsible for the project.
- Project Officer — Lead fieldwork and prepare report. On site liaison with Client and Contractors
- Project Supervisor — Assist in the direction of fieldwork. Deputise for Project Leader.
- Field Archaeologists — Undertake fieldwork and associated tasks.
- Specialist coordination and support — Finds, environmental and illustration support.

In-house specialist support may be provided in a number of broad areas common to this type of project.

- Artefacts - Derek Hurst, Laura Griffin, Jane Evans, Robert Hedge.
- Environmental archaeology - Elizabeth Pearson (plant macrofossils, wood and charcoal; and basic bone identification), Andrew Mann (molluscs).

In-house specialist support is also available in further more specialised areas (details will be supplied on request).

External specialists will be sub-contracted in the following areas.

- Geoarchaeology – Dr Andy Howard, Landscape Research and Management.
- Pollen and Bayesian analysis – Dr Suzi Richer, Richer Environmental
- Insects – Dr David Smith, University of Birmingham
- Animal bone – Dr Matilda Holmes, Archaeozoology

WA has worked previously with a range of specialists in other fields (details will be supplied on request).

3.2 Programme

Each phase of fieldwork (Stage 2) will commence on a date to be mutually agreed in writing.

A period of 4 weeks is identified for lead-in/mobilisation at each phase (Stage 1).

The duration of each phase of Stripping and Mapping (Stage 2.1) will be primarily determined by the extent of the area to be stripped in preparation for any individual extraction phase. This will be agreed in discussion with the Client and Consultant.

For each phase of Stripping and Mapping undertaken, a period of up to 8 weeks should be allowed for the undertaking of a Stage 2.2 Sample Excavation.

Stage 3 post-fieldwork archiving and interim reporting will follow each phase of fieldwork and will be completed within a period of 12 weeks of completion of fieldwork.

Stages 4, 5 and 6 will follow on from completion of all phases of fieldwork. A formal programme will be agreed with the Client and Curator at this point, however, the intention will be for Stage 4 to be completed within 6 months of completion of the final phase of fieldwork and Stages 5 and 6 within a further 12 month period.

4 Health and safety

The current (available through the County Council's intranet) conditions and requirements of the County Council's health and safety policies and procedures cover WA - *Health and Safety, corporate health and safety policy*.

The County Council also produces a comprehensive range of supplementary guidance.

WA is an accredited organisation with The Contractors Health and Safety Assessment Scheme.

WA has issued *Manual of service practice: safe working practice* (2012 as amended, internal report, 581) which are guidelines drawn from its risk assessments of common situations. In addition provision has been made within the guidelines for assessing further risks which may be encountered during the project. All these documents may be viewed at WA's offices, and may be copied to the Client and Curator on request.

The Client must notify WA if asbestos is known to be present on the site. All staff will be made aware of the dangers of asbestos and all access to potential areas of risk will be carried out in line with *The Control of Asbestos Regulations* 2006 (Statutory Instrument 2006 No. 2739). The presence of asbestos may prevent access to part, or the whole, of the site.

The Client must notify WA of any hazards within the archaeological site before the project commences. These include unsafe parts of any structure (eg unstable walls, rotten floors), the presence of other contractors, hidden voids and contaminated ground or materials.

The project falls within the Construction (Design and Management) Regulations 2015 and WA will act in the role of Contractor and will contribute to design for the purposes of the regulations. The Client must provide WA with the following:

- The name of the Planning Supervisor.
- The name of the Principal Contractor.
- The relevant contents of the Safety Plan.

Service staff will follow any proper instruction given by the Principal Contractor for the purposes of health and safety when on site.

Protective clothing will consist of hard hat, protective boots, and high visibility jacket.

All staff will be CSCS accredited and will be appropriately certified in the use of any equipment used during the project.

Any equipment or plant (including scaffolding) provided by the Client will be inspected before use by Service staff.

A Risk Assessment and Methods Statement will be prepared prior to the commencement of fieldwork and supplied to the Principal Contractor.

5 Bibliography

CIfA, 2014a *Standard and guidance: for archaeological excavation*. Reading: Chartered Institute for Archaeologists

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Watt, S (ed) 2011 *The Archaeology of the West Midlands. A Framework for Research,* Oxbow

White, R, and Hodder, M, (eds) 2018 *Clash of Cultures? The Romano-British period in the West Midlands*, The Making of the West Midlands, Volume **3**, Oxbow Books

6 Conditions

6.1 General

In undertaking an archaeological project Worcestershire County Council's support (or otherwise) cannot be assumed or expected for any development proposal unless specifically indicated.

Worcestershire County Council will not have, or obtain any tenancy, or other estate, or interest in the archaeological site other than the access granted for the purposes of the archaeological project.

6.2 Responsibilities of the Client

The Client will be responsible for obtaining all necessary permissions for undertaking the project. Of particular importance may be any consents for sites scheduled (or areas of archaeological importance) under the Ancient Monuments and Archaeological Areas Act 1979, or any other designated heritage assets (Listed Building, Scheduled Ancient Monument, Registered battlefield, park or garden, or wreck, Conservation Area).

In addition the Client will be responsible for ensuring all checks have been made with respect to current environmental legislation, notably the Wildlife and Countryside Act 1981 (as amended), Countryside and Rights of Way (CRoW) Act 2000, and the Natural Environment and Rural Communities Act (in England and Wales) 2006.

Access to the site is the responsibility of the Client. Permissions for access must be arranged by the Client, with the landowner and tenant, as appropriate.

The Client should notify WA of their site representative (if any) to whom WA will report when on site. Where the Client has a site representative WA will not give any instruction directly to the Construction Team, but will direct any requests through the Client's site representative. Where there is no site

representative WA will liaise directly with the Construction Team. Any recording will be undertaken where possible and as directed by the Client's site representative (if any).

6.3 Agreement

The project will only be undertaken when supported by a written agreement between Worcestershire County Council, the Client and/or the landowner (as appropriate).

6.4 Insurance

WA is covered by public and employer's liability insurance (with a limit of £50 million), and professional indemnity insurance (with a limit of £5 million). Insurance is with Maven Public Sector Limited (Policy Number 18-MPS-LIA-00000025) for public and employers liability and professional indemnity, expires 29 September 2019).

6.5 Ownership

All artefacts, except articles defined as treasure under the Treasure Act 1996 (or other legal requirements), discovered in the course of the archaeological project shall be the property of the Client (or landowner if not the Client). WA will encourage the Client to donate any artefacts to an appropriate museum where they may be curated and made available for research and education. WA will approach the Client after completion of the project with regard to the deposition of artefacts.

6.6 Copyright

WA will retain full copyright of any commissioned reports, tender documents or other project documents, under the Copyrights, Designs and Patents Act 1988 with all rights reserved; excepting that it provides an exclusive licence to the Client in all matters directly relating to the project as described in this document. This licence will only become effective on payment of any invoices issued to the Client by Worcestershire County Council.

Figure

Proposals Plan

Proposals Plan / Block Phasing

This drawings illustrates the overall proposed mineral extraction areas on a sequential phased basis over an approximate 10 year period. Phased areas would be extracted at different points of time over this period.

As a guide the length of extraction within each phase will be:

Phase	Soils & Overburden	Mineral (ST)	Years
Initial Works	45,800	450,000	1.50 years
Phase 1	57,400	225,000	0.75 years
Phase 2	37,000	300,000	1.00 years
Phase 3	54,500	375,000	1.25 years
Phase 4	62,400	975,000	3.25 years
Phase 5	52,700	675,000	2.25 years
	309,800	3,000,000	10.0 years

A further ~ 1 year would be required to complete remaining restoration

LEGEND

- Application Boundary
- Initial Works
- Phase 1
- Phase 2
- Phase 3
- Phase 4
- Phase 5
- Final Works

Soils and Overburden to be stripped (based on 1.2m soil profile) to remain on site and placed for restoration.

Planning Application Drawing No. 4

PROJECT: Lea Castle Farm

TITLE: Proposals Plan

REF NO: KD.LCF.013

DATE: September 2019

SCALE: 1:5,000 @ A3

STATUS: FINAL

Fox Studio, Much Wenlock, Shropshire TF13 6BL

Appendix 1: Desk-Based Assessment - Submitted Seperately as Technical Appendix H.1 - Archaeological DBA

Appendix 2: 2018 Geophysical Survey

Appendix 3: 2019 Geophysical Survey

GEOPHYSICAL SURVEY REPORT

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Lea Castle Farm, Wolverley, Worcestershire

Client
Worcestershire County Council
For
Kedd Development Limited

Survey Report
13353

Date
September 2018

SUMO Geophysics Ltd
Cowburn Farm
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GEOPHYSICAL SURVEY REPORT

Project name:
Lea Castle Farm, Wolverley, Worcestershire

SUMO Job reference:
13353

Client:
Worcestershire County Council
For:
Kedd Development Limited

Survey date:
28-31 August 2018

Report date:
13 September 2018

Field co-ordinator:
Chris Osborne MSc

Field Team:
Oliver Thomas

Report written by:
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CAD illustrations by:
Rebecca Davies BSc

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Simon Haddrell BEng AMBCS PCIfA

Report approved by:
Dr John Gater BSc DSc(Hon) MCIfA FSA

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1 SUMMARY OF RESULTS

A detailed magnetometer survey at Lea Castle Farm has not identified any definite archaeological responses. Several anomalies of uncertain origin have been detected, and they could be of agricultural, natural or modern origin. Evidence of ridge and furrow, modern ploughing and a former field boundary have been identified, along with areas of natural magnetic variation, underground services and disturbance from nearby ferrous objects.

2 INTRODUCTION

2.1 Background synopsis

SUMO Geophysics Ltd were commissioned to undertake a geophysical survey of an area outlined for as a proposed mineral extraction site. This survey forms part of an archaeological investigation being undertaken by **Worcestershire County Council** on behalf of **Kedd Development Limited** for **NRS Aggregates Limited**.

2.2 Site details

NGR / Postcode	SO 840 790 / DY10 3QD
Location	The site is located approximately 2.5km north of Kidderminster, immediately to the north of the B4189, Wolverley Road and east of Brown Westhead Park Playing Fields.
HER/SMR	Worcestershire
District	Wyre Forest
Parish	Wolverley and Cookley CP
Topography	Undulating
Current Land Use	Pasture
Geology	Solid: Wildmoor Sandstone Member - sandstone. Superficial: Kidderminster Station Member - sand and gravel (BGS 2018).
Soils	Bridgnorth Association (551a) - well drained sandy and coarse loamy soils over soft sandstone (SSEW 1983).
Archaeology	There is limited evidence for prehistoric and Roman activity in the area, in the form of isolated findspots of various dates and the identification of the geological deposits which may have potential for Palaeolithic remains to survive. There is also limited evidence for early medieval and medieval activity, and early historic mapping indicates that the site was probably agricultural (or common) land until the late 18th / early 19th century. The site was developed into parkland around Lea Castle during the early 19th century (WCC 2018).
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	18.8 ha

2.3 Aims and Objectives

To locate and characterise any anomalies of possible archaeological interest within the study area.

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

3.2 Survey methods

Detailed magnetic survey was chosen as an efficient and effective method of locating archaeological anomalies.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1.0m	0.25m

More information regarding this technique is included in Appendix A and B.

3.3 Data Processing

The following basic processing steps have been carried out on the data used in this report:

De-stripe; de-stagger; interpolate

3.4 Presentation of results and interpretation

The presentation of the results includes a ‘minimally processed data’ and a ‘processed data’ greyscale plot. Magnetic anomalies are identified, interpreted and plotted onto the ‘Interpretation’ drawings.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: *Abbey Wall* or *Roman Road*. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: *Probable*, or *Possible Archaeology*. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification *Possible*.

4 RESULTS

Specific anomalies have been given numerical labels [1] [2] *which appear in the text below, as well as on the Interpretation Figure(s).*

4.1 *Probable / Possible Archaeology*

4.1.1 No magnetic responses have been recorded that could be interpreted as being of archaeological interest.

4.2 *Uncertain*

4.2.1 A part rectilinear feature [1] and additional linear anomaly [2] have been detected in the south of the survey area and are of uncertain origin, though an archaeological explanation seems unlikely. It is possible that they are associated with the former parkland surrounding Lea Castle, or that they are a result of former boundaries not visible on available historic mapping.

4.2.2 A strongly magnetic linear anomaly [3] is visible at the centre of the area and is also of uncertain origin. The response is similar to that expected of an underground service and could be associated with a drain; however, its exact origin remains unclear.

4.2.3 Weak linear trends are visible running approximately east-west across the site. These may be a result of former boundaries, ploughing activity or be natural in origin.

4.3 *Former Field Boundary*

4.3.1 A weak linear trend [4] and associated area of magnetic disturbance is visible running east from the western boundary of the site. The anomaly corresponds with the location of a former field boundary visible on historic mapping from 1883.

4.4 *Agricultural – Ploughing*

4.4.1 Widley spaced, slightly curved, parallel linear anomalies [5] can be seen in the north-east of the area and are indicative of ridge and furrow cultivation.

4.4.2 Evidence of modern ploughing is visible across the site in the form of magnetically weak, closely spaced parallel linear responses.

4.5 *Natural / Geological / Pedological / Topographic*

4.5.1 Several small areas of increased magnetic response are visible across the site and are likely to be a result of localised variations in the underlying geology and superficial sand and gravel deposits.

4.6 *Ferrous / Magnetic Disturbance*

4.6.1 Three strong bipolar linear anomalies are visible in the data and are likely to be a result of underground services, such as pipes or cables. The two northernmost anomalies [6-7] appear to correspond with former field boundaries, visible from 1883. It is possible that the boundaries were removed and subsequently used as the course of pipes / drains.

4.6.2 Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil; they are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

5.1 Historic England guidelines (EH 2008) Table 4 states that the average magnetic response on sandstone is variable. The results from this survey indicate the presence of linear anomalies of uncertain origin, along with former boundaries and ridge and furrow; as a consequence, the technique is likely to have detected any archaeological features, if present.

6 CONCLUSION

6.1 The survey at Lea Castle Farm has not identified any anomalies of definite archaeological interest. A number of uncertain linear responses have been detected, though they are thought more likely to be agricultural or natural as opposed to archaeological. A former field boundary, ridge and furrow and evidence of modern ploughing indicate the site has a largely agricultural past. The remaining responses are natural or modern and include areas of magnetic disturbance, underground services and natural magnetic variations.

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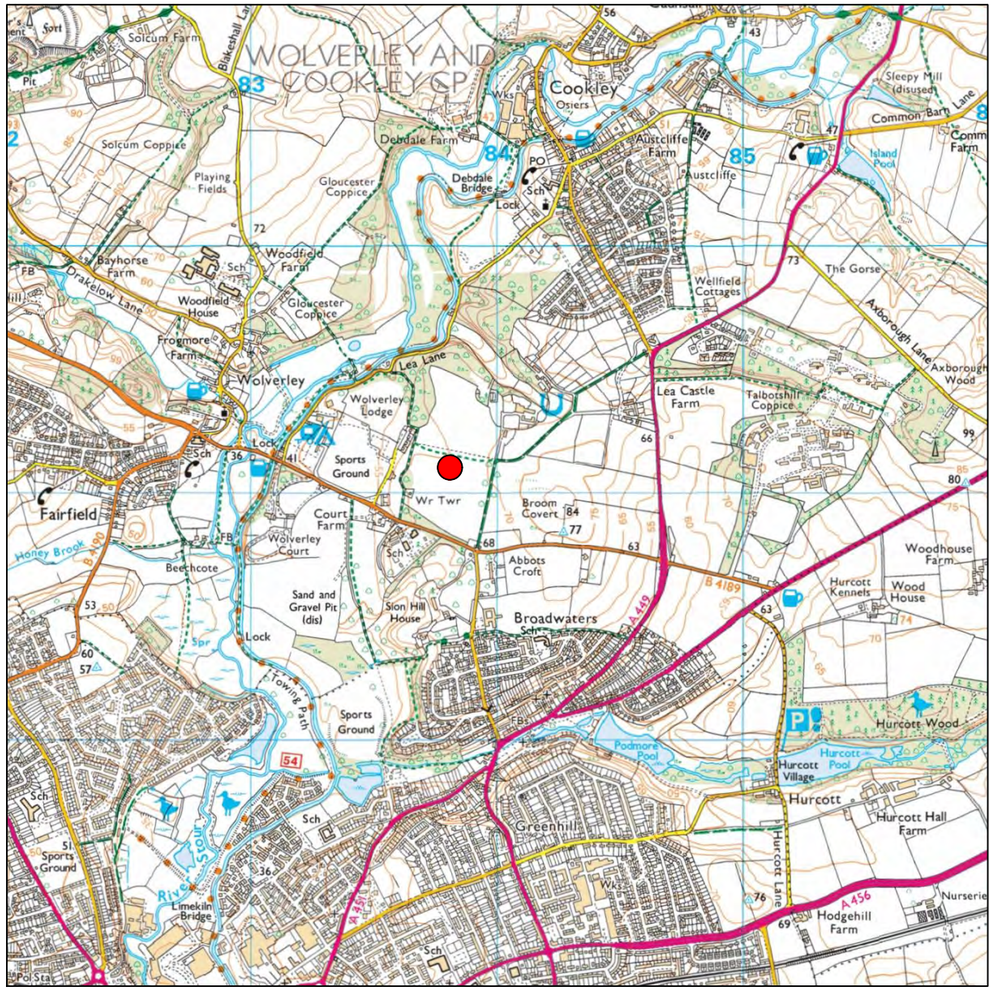


N

Site Location

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Site Location Diagram

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 1000
1:25000 @ A3

Fig No:
01

N

Survey Area - showing 30m grid

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Location of Survey Area

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 150
1:3000 @ A3

Fig No:
02

N

+2nT

-1nT

sumo Survey

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

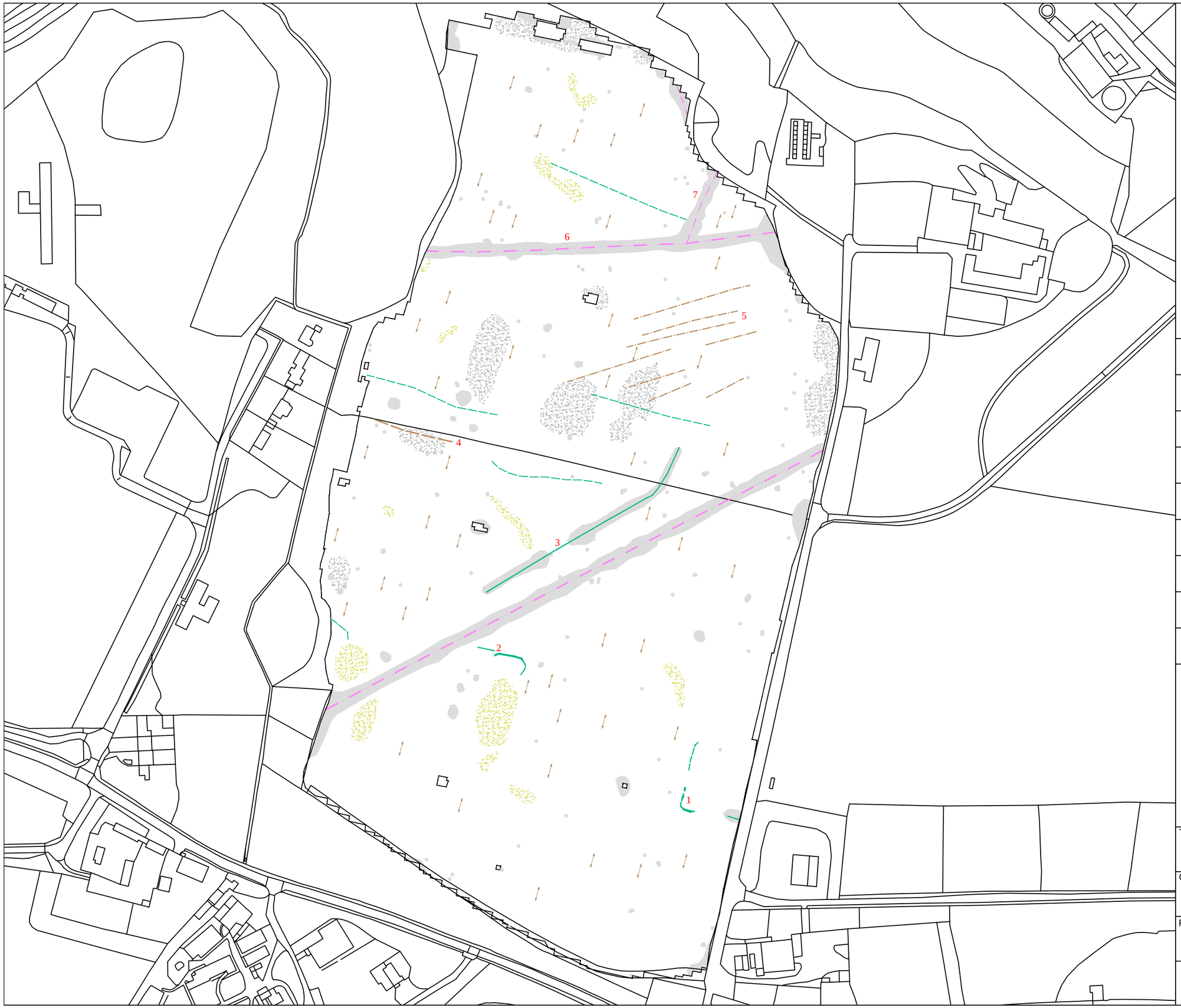
Title:
Magnetometer Survey - Greyscale Plot - Overview

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 125
1:2500 @ A3

Fig No:
03



N

KEY

	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Agriculture (ridge and furrow)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Service
	Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - Interpretation - Overview

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 125
1:2500 @ A3

Fig No:
04

N

+2nT

-1nT

sumo Survey

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

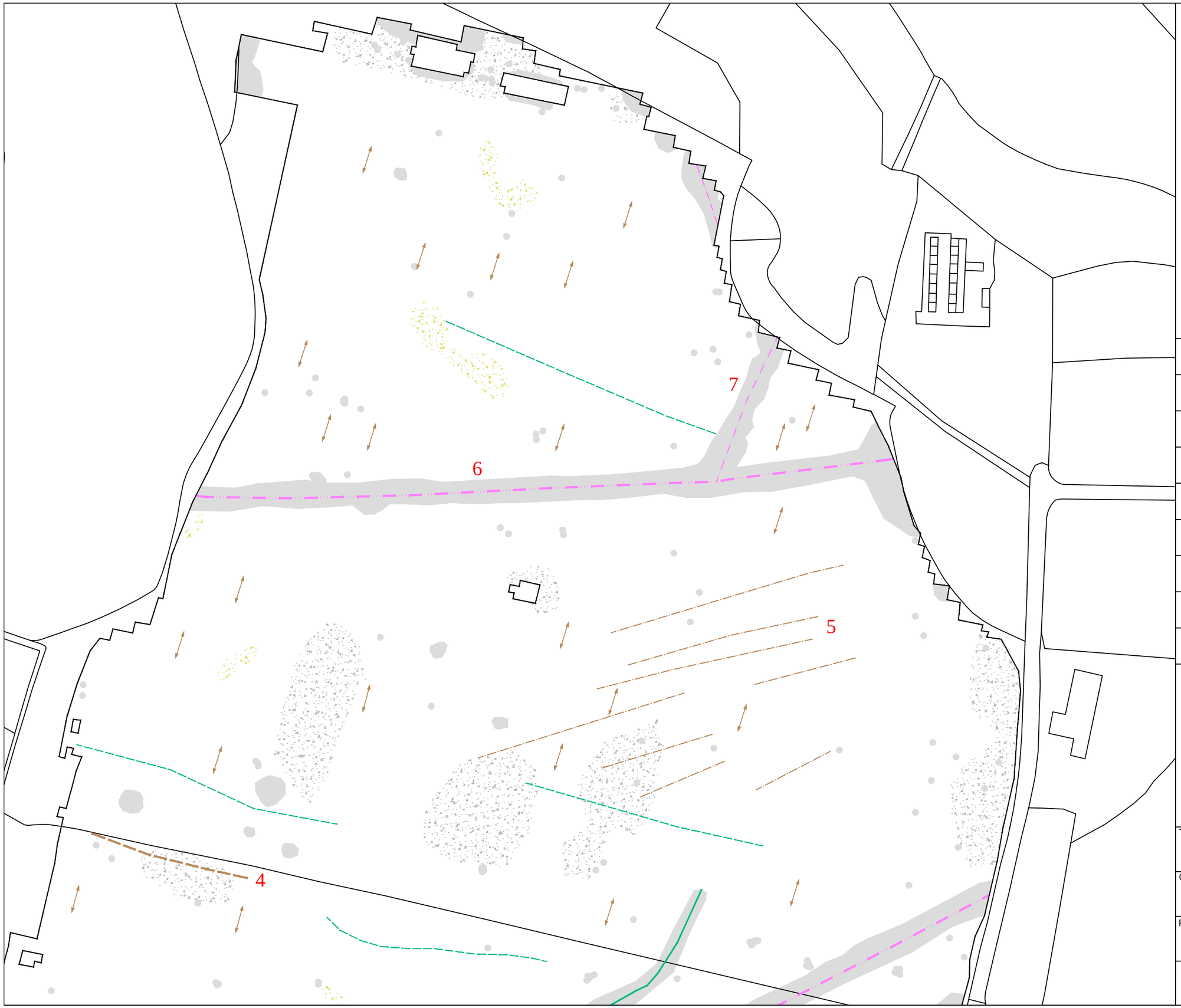
Title:
Magnetometer Survey - Greyscale Plot - North

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 62.5
1:1250 @ A3

Fig No:
05



N

KEY

	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Agriculture (ridge and furrow)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Service
	Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - Interpretation - North

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 62.5
1:1250 @ A3

Fig No:
06

N

+2nT

-1nT

sumo Survey

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - Greyscale Plot - South

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 62.5
1:1250 @ A3

Fig No:
07

N

KEY

	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Agriculture (ridge and furrow)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Service
	Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - Interpretation - South

Client:
Worcestershire County Council

Project:
13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 62.5
1:1250 @ A3

Fig No:
08

N

+5nT

-5nT

sumo Survey

GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:

Minimally Processed Data - Greyscale Plot

Client:

Worcestershire County Council

Project:

13353 - Lea Castle Farm, Wolverley, Worcestershire

Scale:

0 metres 125

1:2500 @ A3

Fig No:

09

Appendix A - Technical Information: Magnetometer Survey Method

Grid Positioning
For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad* 601-2
Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology / Probable Archaeology	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present. They are presumed to be modern.
Service	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* / *Natural* or (in the case of linear responses) *Possible Archaeology* / *Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

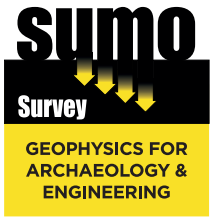
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.



- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
- Utility Mapping

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GEOPHYSICAL SURVEY REPORT

Lea Castle Farm, Wolverley, Worcestershire

Client

Worcestershire Archaeology

Survey Report

14581

Date

March 2019

Survey Report 14581: Lea Castle Farm, Wolverley, Worcestershire

Survey dates	25 February 2019
Field co-ordinator	Robert Knight BA
Field Team	Steve Weston BA Simon Lobel BSc Jay Griffiths BA
Report Date	14 March 2019
CAD Illustrations	Rebecca Davies BSc Claire Stephens BA MA
Report Author	Rebecca Davies BSc Dr John Gater BSc DSc(Hon) MCIfA FSA
Project Manager	Simon Haddrell BEng AMBCS PCIfA
Report approved	Dr John Gater BSc DSc(Hon) MCIfA FSA

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Figure 03	1:2000	Magnetometer Survey - Interpretation
Figure 04	1:2000	Minimally Processed Data – Greyscale Plot

2. SURVEY TECHNIQUE

Detailed magnetic survey (magnetometry) was chosen as the most efficient and effective method of locating the type of archaeological anomalies which might be expected at this site.

Bartington Grad 601-2 Traverse Interval 1.0m Sample Interval 0.25m

3 SUMMARY OF RESULTS

3.1 A detailed magnetometer survey at over approximately 19 ha of agricultural land at Lea Castle Farm. Like earlier work in to the west, the survey did not identify any definite archaeological responses. Several anomalies of uncertain origin have been detected, and they could be of agricultural, natural or modern origin. A former field boundary and thicket have been identified, along with areas of natural magnetic variation.

4 INTRODUCTION

4.1 Background synopsis

SUMO Geophysics Ltd were commissioned to undertake a geophysical survey of an area outlined for mineral extraction. This survey forms part of an archaeological investigation being undertaken by **Worcestershire Archaeology.**

4.2 Site details

NGR / Postcode	SO 843 790 / DY10 3RE
Location	The site is located approximately 2.5km north of Kidderminster, immediately to the north of the B4189, Wolverley Road and west of the A449.
HER	Worcestershire
District	Wyre Forest
Parish	Wolverley and Cookley CP
Topography	Undulating
Current Land Use	Pasture / arable
Geology	Bedrock: Wildmoor Sandstone Member - sandstone. Superficial (isolated occurrence): Glaciofluvial Deposits - sand and gravel – elsewhere, none (BGS 2019).
Soils	Soilscape10: freely draining slightly acid sandy soils (CU 2019)
Archaeology	Isolated findspots of various dates provide limited evidence for prehistoric, Roman, early medieval and medieval activity; early historic mapping indicates that the site was probably agricultural (or common) land until the late 18th / early 19th century. (WCC 2018). Magnetometer survey in the field to the west (SUMO 2018) failed to identify any anomalies of definite archaeological interest.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	19 ha

4.3 **Aims and Objectives**

To locate and characterise any anomalies of possible archaeological interest within the study area.

5 RESULTS

The survey has been divided into six survey areas (Areas 1-6).

5.1 *Probable / Possible Archaeology*

5.1.1 No magnetic responses have been recorded that could be interpreted as being of probable or possible archaeological interest.

5.2 *Uncertain*

5.2.1 There are several uncertain responses in the data – mainly linear and curvilinear responses in Areas 3 and 4. These are likely to be agricultural effects, perhaps tractor ruts, or they could be natural in origin, marking the divisions between soil variations. In Area 2, there is an area of amorphous responses which look natural in origin, or they could be a result of the removal of the thicket (see 5.3.1), and there is an oval-shaped trend in the data. The origin is uncertain but it probably relates to Broom Covert.

5.3 *Former Field Boundary*

5.3.1 A narrow band of magnetic disturbance is visible following a curvilinear path which passes through Area 2 and then southwards across Area 5. The feature is visible on photographic imagery up until 1945 and on early Ordnance Survey mapping dating from 1883-5. The line marks the boundary of a former thicket known as Broom Covert.

5.3.2 In Area 1 there are straight linear anomalies which look like old field boundaries. However, there is no supporting map evidence but the divisions are visible on Google imagery; hence they may mark the line of temporary fences or similar, erected between differing crop growing areas.

5.4 *Agricultural – Ploughing / Land Drains*

5.4.1 Modern ploughing effects are visible in the data a narrowly spaced, parallel linear trends.

5.5 *Natural / Geological / Pedological / Topographic*

5.5.1 The band of amorphous responses in Area 3 is a result of localised changes in the superficial deposits; the results could indicate a former braided water channel; such features are clearly visible on satellite imagery, especially in the field to the east.

5.6 *Ferrous / Magnetic Disturbance*

5.6.1 Small areas of disturbance in Area 2 are probably a result of the thicket being returned to arable agricultural. A band of ‘noise’ along the western edge of Areas 3 and 4 may be due to a track along the boundary or a realignement of the division

5.6.2 Ferrous responses close to boundaries are due to adjacent fences and gates. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil; they are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

6 DATA APPRAISAL & CONFIDENCE ASSESSMENT

6.1 Historic England guidelines (EH 2008) Table 4 states that the average magnetic response on on sandstone and glaciofluvial deposits is variable. The results from this survey indicate the presence of former boundaries and ploughing effects; as a consequence the technique is likely to have detected any archaeological features, if present.

7 CONCLUSION

7.1 This survey at Lea Castle Farm, like the earlier geophysical work, did not identify any anomalies which could be interpreted as being of definite archaeological interest. There are several uncertain responses in the data, but there is no reason to suggest that these are archaeological as opposed to the more likely explanation of being agricultural or modern. The effects of local variations in the superficial deposits are visible in the results.

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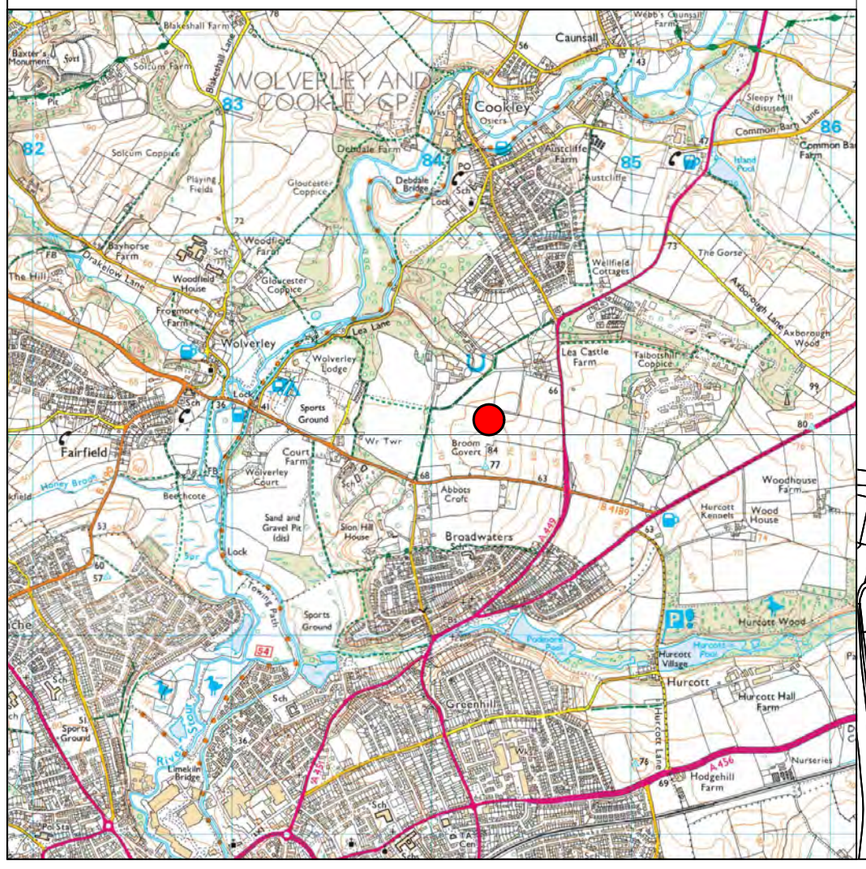
SUMO 2018 *Lea Castle Farm, Wolverley, Worcestershire,* Geophysical Survey Report, 13353, unpublished.



Survey Areas

N

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

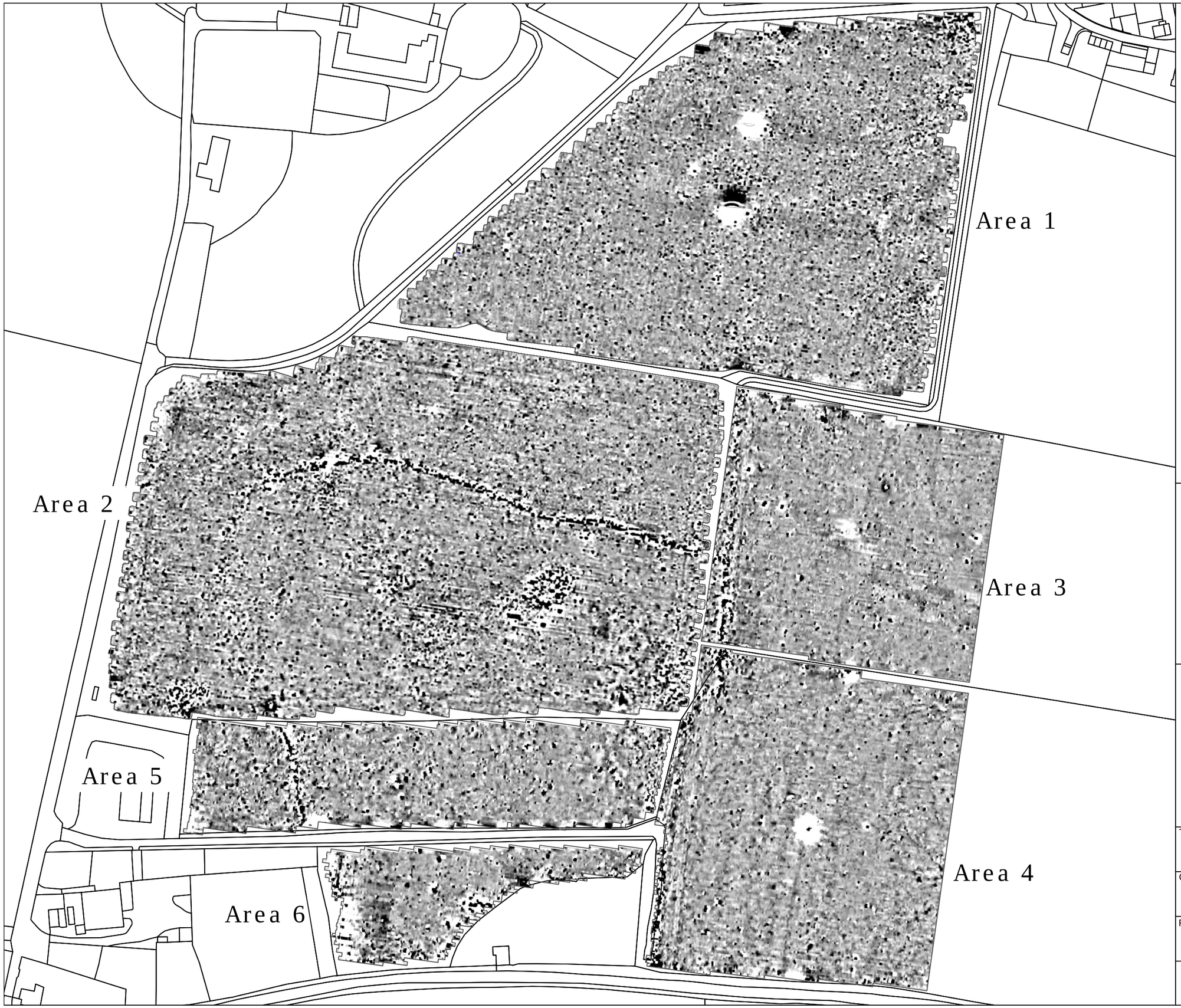
Title:
Site Location Information

Client:
Worcestershire Archaeology

Project:
14581 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
NOT TO SCALE

Fig No:
01



N

+2nT

-1nT

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Magnetometer Survey - Greyscale Plots

Client:
Worcestershire Archaeology

Project:
14581 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 100
1:2000 @ A3

Fig No:
02

N

KEY

	Uncertain Origin (discrete anomaly / trend)
	Former field boundary (corroborated)
	Former field boundary (conjectural)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Magnetic disturbance
	Ferrous

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

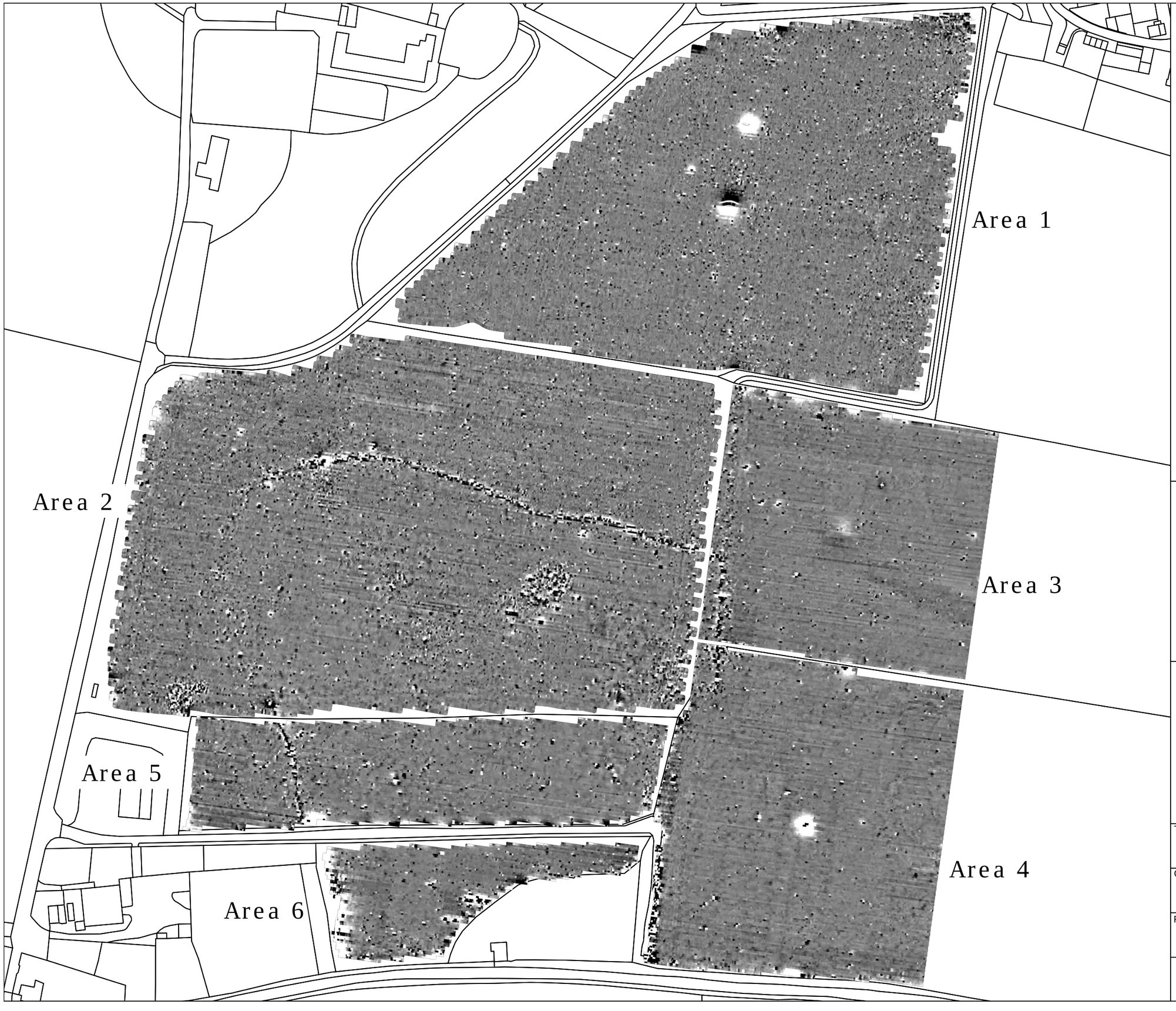
Title:
Magnetometer Survey - Interpretation

Client:
Worcestershire Archaeology

Project:
14581 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 100
1:2000 @ A3

Fig No:
03



N

+5nT

-5nT

sumo Survey
GEOPHYSICS FOR ARCHAEOLOGY & ENGINEERING

Title:
Minimally Processed Data - Greyscale Plots

Client:
Worcestershire Archaeology

Project:
14581 - Lea Castle Farm, Wolverley, Worcestershire

Scale:
0 metres 100
1:2000 @ A3

Fig No:
04

Appendix A - Technical Information: Magnetometer Survey Method, Processing and Presentation

Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (ClfA 2014) and the European Archaeological Council (EAC 2016).

Grid Positioning

For hand held gradiometers the location of the survey grids has been plotted together with the referencing information. Grids were set out using a Trimble R8 Real Time Kinematic (RTK) VRS Now GNSS GPS system.

An RTK GPS (Real-time Kinematic Global Positioning System) can locate a point on the ground to a far greater accuracy than a standard GPS unit. A standard GPS suffers from errors created by satellite orbit errors, clock errors and atmospheric interference, resulting in an accuracy of 5m-10m. An RTK system uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier it measured, and the mobile units compare their own phase measurements with those they received from the base station. This results in an accuracy of around 0.01m.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1m	0.25m

Instrumentation: Bartington *Grad* 601-2

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted vertically, set 1.0m apart. The fluxgate gradiometer suppresses any diurnal or regional effects. The instruments are carried, or cart mounted, with the bottom sensor approximately 0.1-0.3m from the ground surface. At each survey station, the difference in the magnetic field between the two fluxgates is measured in nanoTesla (nT). The sensitivity of the instrument can be adjusted; for most archaeological surveys the most sensitive range (0.1nT) is used. Generally, features up to 1m deep may be detected by this method, though strongly magnetic objects may be visible at greater depths. The Bartington instrument can collect two lines of data per traverse with gradiometer units mounted laterally with a separation of 1.0m. The readings are logged consecutively into the data logger which in turn is daily down-loaded into a portable computer whilst on site. At the end of each site survey, data is transferred to the office for processing and presentation.

Data Processing

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes striping effects and edge discontinuities over the whole of the data set.
Step Correction (De-stagger)	When gradiometer data are collected in 'zig-zag' fashion, stepping errors can sometimes arise. These occur because of a slight difference in the speed of walking on the forward and reverse traverses. The result is a staggered effect in the data, which is particularly noticeable on linear anomalies. This process corrects these errors.

Display

Greyscale/ Colourscale Plot	This format divides a given range of readings into a set number of classes. Each class is represented by a specific shade of grey, the intensity increasing with value. All values above the given range are allocated the same shade (maximum intensity); similarly, all values below the given range are represented by the minimum intensity shade. Similar plots can be produced in colour, either using a wide range of colours or by selecting two or three colours to represent positive and negative values. The assigned range (plotting levels) can be adjusted to emphasise different anomalies in the data-set.

Presentation of results and interpretation

The presentation of the results includes a ‘minimally processed data’ and a ‘processed data’ greyscale plot. Magnetic anomalies are identified, interpreted and plotted onto the ‘Interpretation’ drawings.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: Abbey Wall or Roman Road. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: Probable, or Possible Archaeology. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification Possible.

Interpretation Categories

In certain circumstances (usually when there is corroborative evidence from desk-based or excavation data) very specific interpretations can be assigned to magnetic anomalies (for example, *Roman Road, Wall,* etc.) and where appropriate, such interpretations will be applied. The list below outlines the generic categories commonly used in the interpretation of the results.

Archaeology / Probable Archaeology	This term is used when the form, nature and pattern of the responses are clearly or very probably archaeological and /or if corroborative evidence is available. These anomalies, whilst considered anthropogenic, could be of any age.
Possible Archaeology	These anomalies exhibit either weak signal strength and / or poor definition, or form incomplete archaeological patterns, thereby reducing the level of confidence in the interpretation. Although the archaeological interpretation is favoured, they may be the result of variable soil depth, plough damage or even aliasing as a result of data collection orientation.
Industrial / Burnt-Fired	Strong magnetic anomalies that, due to their shape and form or the context in which they are found, suggest the presence of kilns, ovens, corn dryers, metal-working areas or hearths. It should be noted that in many instances modern ferrous material can produce similar magnetic anomalies.
Former Field Boundary (probable & possible)	Anomalies that correspond to former boundaries indicated on historic mapping, or which are clearly a continuation of existing land divisions. Possible denotes less confidence where the anomaly may not be shown on historic mapping but nevertheless the anomaly displays all the characteristics of a field boundary.
Ridge & Furrow	Parallel linear anomalies whose broad spacing suggests ridge and furrow cultivation. In some cases, the response may be the result of more recent agricultural activity.
Agriculture (ploughing)	Parallel linear anomalies or trends with a narrower spacing, sometimes aligned with existing boundaries, indicating more recent cultivation regimes.
Land Drain	Weakly magnetic linear anomalies, quite often appearing in series forming parallel and herringbone patterns. Smaller drains may lead and empty into larger diameter pipes, which in turn usually lead to local streams and ponds. These are indicative of clay fired land drains.
Natural	These responses form clear patterns in geographical zones where natural variations are known to produce significant magnetic distortions.
Magnetic Disturbance	Broad zones of strong dipolar anomalies, commonly found in places where modern ferrous or fired materials (e.g. brick rubble) are present.
Service	Magnetically strong anomalies, usually forming linear features are indicative of ferrous pipes/cables. Sometimes other materials (e.g. pvc) or the fill of the trench can cause weaker magnetic responses which can be identified from their uniform linearity.
Ferrous	This type of response is associated with ferrous material and may result from small items in the topsoil, larger buried objects such as pipes, or above ground features such as fence lines or pylons. Ferrous responses are usually regarded as modern. Individual burnt stones, fired bricks or igneous rocks can produce responses similar to ferrous material.
Uncertain Origin	Anomalies which stand out from the background magnetic variation, yet whose form and lack of patterning gives little clue as to their origin. Often the characteristics and distribution of the responses straddle the categories of *Possible Archaeology* / *Natural* or (in the case of linear responses) *Possible Archaeology* / *Agriculture*; occasionally they are simply of an unusual form.

Where appropriate some anomalies will be further classified according to their form (positive or negative) and relative strength and coherence (trend: weak and poorly defined).

Appendix B - Technical Information: Magnetic Theory

Detailed magnetic survey can be used to effectively define areas of past human activity by mapping spatial variation and contrast in the magnetic properties of soil, subsoil and bedrock. Although the changes in the magnetic field resulting from differing features in the soil are usually weak, changes as small as 0.1 nanoTeslas (nT) in an overall field strength of 48,000 (nT), can be accurately detected.

Weakly magnetic iron minerals are always present within the soil and areas of enhancement relate to increases in *magnetic susceptibility* and permanently magnetised *thermoremanent* material.

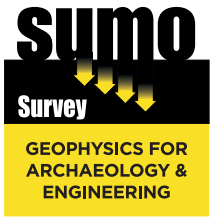
Magnetic susceptibility relates to the induced magnetism of a material when in the presence of a magnetic field. This magnetism can be considered as effectively permanent as it exists within the Earth's magnetic field. Magnetic susceptibility can become enhanced due to burning and complex biological or fermentation processes.

Thermoremanence is a permanent magnetism acquired by iron minerals that, after heating to a specific temperature known as the Curie Point, are effectively demagnetised followed by re-magnetisation by the Earth's magnetic field on cooling. Thermoremanent archaeological features can include hearths and kilns; material such as brick and tile may be magnetised through the same process.

Silting and deliberate infilling of ditches and pits with magnetically enhanced soil creates a relative contrast against the much lower levels of magnetism within the subsoil into which the feature is cut. Systematic mapping of magnetic anomalies will produce linear and discrete areas of enhancement allowing assessment and characterisation of subsurface features. Material such as subsoil and non-magnetic bedrock used to create former earthworks and walls may be mapped as areas of lower enhancement compared to surrounding soils.

Magnetic survey is carried out using a fluxgate gradiometer which is a passive instrument consisting of two sensors mounted vertically 1m apart. The instrument is carried about 30cm above the ground surface and the top sensor measures the Earth's magnetic field whilst the lower sensor measures the same field but is also more affected by any localised buried feature. The difference between the two sensors will relate to the strength of a magnetic field created by this feature, if no field is present the difference will be close to zero as the magnetic field measured by both sensors will be the same.

Factors affecting the magnetic survey may include soil type, local geology, previous human activity and disturbance from modern services.



- Archaeological
- Geophysical
- Laser Scanning
- Measured Building
- Topographic
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