GEOPHYSICAL SURVEY REPORT

Land off Horseshoe Road, Spalding, Lincolnshire

Client

Witham Archaeology

For

Seagate Homes

Survey Report

20869

OASIS Ref. No.

Sumogeop1-532077

Date

12 March 2025

Survey Report 20869: Land off Horseshoe Road, Spalding, Lincolnshire

Survey dates	08 March 2025
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Field Team	Rebeka Mazeski-Héger
Report Date	12 March 2025
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3 SURVEY TECHNIQUE

3.1 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. All survey techniques followed the guidance set out by CIfA (2020) and the European Archaeology Council (EAC) (2016).

Bartington Cart System Traverse Interval 1.0m Sample Interval 0.125m

The only processes performed on data are the following unless specifically stated otherwise:

Zero Mean Traverse	This process sets the background mean of each traverse within each grid to zero. The operation removes instrument striping effects and edge discontinuities over the whole of the data set.

4 EXECUTIVE SUMMARY OF RESULTS

4.1 A detailed magnetometer survey was conducted over approximately 3 hectares off Horseshoe Road, Spalding, and it has not identified any anomalies of definite archaeological interest, aside from weak evidence for ridge and furrow cultivation. Several weak linear trends and discrete anomalies are of uncertain origin; the proximity to Iron Age and Roman remains suggests an archaeological explanation cannot be entirely ruled out, though such an interpretation is tentative at best, and they are more likely to relate to natural or agricultural effects. Modern ploughing effects, a former track and areas of disturbance likely associated with the former railway to the south have also been identified, along with bands of natural magnetic variation.

5 INTRODUCTION

5.1 **SUMO GeoSurveys** was commissioned to undertake a geophysical survey of an area outlined for residential development. This survey forms part of an archaeological investigation being undertaken by **Witham Archaeology** on behalf of **Seagate Homes.**

5.2 Site Details

NGR / Postcode	TF 22996 21588 / PE11 3JB
Location	The survey area is located to the southwest of Spalding, Lincolnshire. The Raceground trackway bisects the site and there is an open boundary onto agricultural land to the south. Horseshoe Road forms the northern boundary of the site, with private residences to the west and a further agricultural field to the east.
HER	Lincolnshire HER
OASIS Ref. No.	Sumogeop1-532077
District	South Holland
Parish	South Holland
Topography	Flat
Land Use	Arable
Geology (BGS 2025)	Bedrock: Oxford Clay Formation - mudstone. Superficial: Tidal Flat Deposits - clay and silt.
Soils (CU 2025)	Soilscape 21: loamy and clayey soils of coastal flats with naturally high groundwater.
Survey Methods	Magnetometer survey (fluxgate gradiometer)
Study Area	3 ha

5.3 ***Archaeological Background*** *(WA 2025)*

5.3.1 HER data from within a 1km radius of the site shows extensive areas of Iron Age and Roman cropmarks and associated finds and features, with a paucity of Saxon and medieval remains. Although no heritage assets are recorded within the survey area, its proximity to a complex of cropmarks and areas of later Iron Age/Roman activity, there is a likelihood of features, including field systems and palaeochannels, existing within the site. Evidence of Roman salt making has been found at various locations in close proximity to the survey area, including at a location *c.* 140m to the northeast, and previous geophysical survey on land immediately north of Horseshoe Road revealed a small, ditched enclosure, with strongly enhanced magnetic anomaly thought to represent the remains of a saltern. Geophysical survey on land around 100m east identified a number of anomalies including ditched enclosures, and briquetage *remains of ceramic containers used in salt-making) have been recovered approximately 250m to the north. Cartographic and cropmark evidence highlights the potential for the Baston

Outgang Roman Road to continue northeast, with its projected route running through the site (see Plate 1 below).

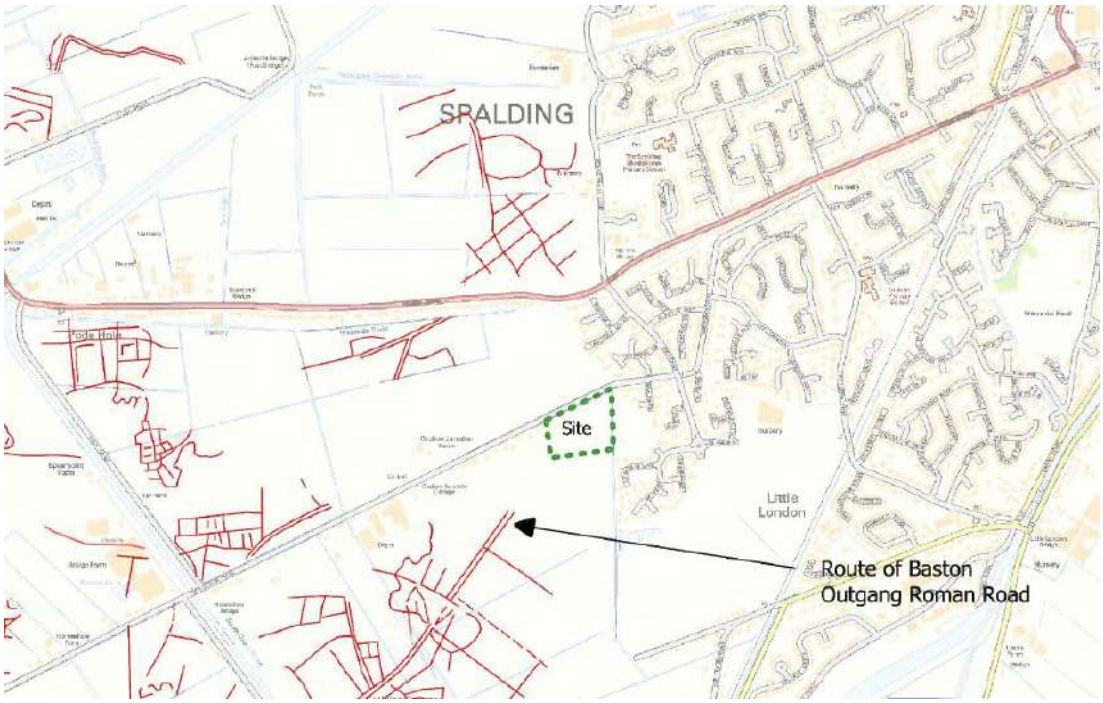


Plate 1: map of cropmarks in the vicinity of the site, including route of Baston Outgang Roman Road (WA 2025; Fig. 15)

5.4 ***Aims and Objectives***

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

6 RESULTS

6.1 ***Probable / Possible Archaeology***

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

6.2 ***Ridge and Furrow***

6.2.1 A few short linear, roughly parallel, trends have been detected in the northwest of the survey area and they are indicative of former ridge and furrow cultivation.

6.3 ***Uncertain***

6.3.1 A number of weak linear trends and discrete anomalies have been detected in the results and they have have been assigned to the category of *Uncertain*. They generally lack the defined morphology of anomalies that would usually be interpreted as being of archaeological interest and are likely to be due to natural or agricultural processes. However, given the proximity of late Iron Age and Roman remains to the north of the site, an archaeological explanation cannot be entirely ruled out.

6.3.2 A linear band of magnetic enhancement can be seen running east-west across the site and is also of uncertain origin. It could reflect a band of natural magnetic variation, i.e. changes in the underlying tidal deposits, though it is also feasible that it relates to the construction of the Midland & Great Northern Railway which lay immediately south of the site in the late 19th - early 20th centuries.

6.4 *Former Trackway – Corroborated*

6.4.1 A weak linear trend is mapped on an approximate north-south alignment in the west of the site, and it corresponds with the route of a trackway, visible on historic maps dating to 1892 (Fig. 05).

6.5 *Agricultural – Ploughing*

6.5.1 Weakly magnetic, parallel linear trends are visible in the west of the site, and they are likely to be a result of modern ploughing effects.

6.6 *Natural / Geological / Pedological*

6.6.1 Moderate strength, meandering bands and amorphous anomalies are mapped in the data and are likely to have a natural explanation. They are characteristic of responses caused by underlying geological effects and probably reflect small palaeochannels.

6.7 *Ferrous / Magnetic Disturbance / Modern Track*

6.7.1 A strongly magnetic linear response runs north-south through the centre of the survey area and is associated with The Raceground trackway which bisects the site. It is noted that the trackway shares the route of a former field boundary, visible on historic maps (Fig. 05).

6.7.2 Ferrous responses close to boundaries are due to adjacent fences and gates, while discrete ferrous anomalies in the south of the area are likely to be associated with the former railway line to the south. 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.

7 DATA APPRAISAL & CONFIDENCE ASSESSMENT

7.1 Historic England Table 4 (EH 2008) states that the typical magnetic response on the local soils / geology is variable to poor. The results from this survey indicate the presence of weak linear trends and discrete anomalies of uncertain origin, along with former ridge and furrow cultivation. Given that geophysical survey within immediate proximity revealed ditches and enclosures of archaeological origin, there is no *a priori* reason as to why archaeological features would not have been detected within the site, should they be present.

8 CONCLUSION

8.1 The magnetometer survey at Horseshoe Road, Spalding has detected a couple of linear trends indicative of former ridge and furrow cultivation, though no other features of definite archaeological interest have been identified. A number of weak linear trends and discrete anomalies have an uncertain origin; they could be archaeological, agricultural or natural, while a band of enhanced response could be natural or relate to former railway line mapped to the south of the site. Moderate strength sinuous bands of natural variation, indicative of palaeochannels, are mapped in the results, along with modern ploughing effects and a former track. Modern ferrous anomalies include The Raceground trackway, which runs north-south through the site, along with areas of disturbance likely associated with the former railway line.

9 REFERENCES

BGS 2025 *Geology of Britain Viewer,* British Geological Survey, website: (http://www.bgs.ac.uk/opengeoscience/home.html?Accordion1=1#maps)

CIfA 2020 *Standard and Guidance for Archaeological Geophysical Survey.* 2014 amended 2020. CIfA Guidance note. Chartered Institute for Archaeologists, Reading https://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_3.pdf

CU 2025 *The Soils Guide*. www.landis.org.uk. Cranfield University, UK. website: http://mapapps2.bgs.ac.uk/ukso/home.html

EAC 2016 *EAC Guidelines for the Use of Geophysics in Archaeology,* European Archaeological Council, Guidelines 2.

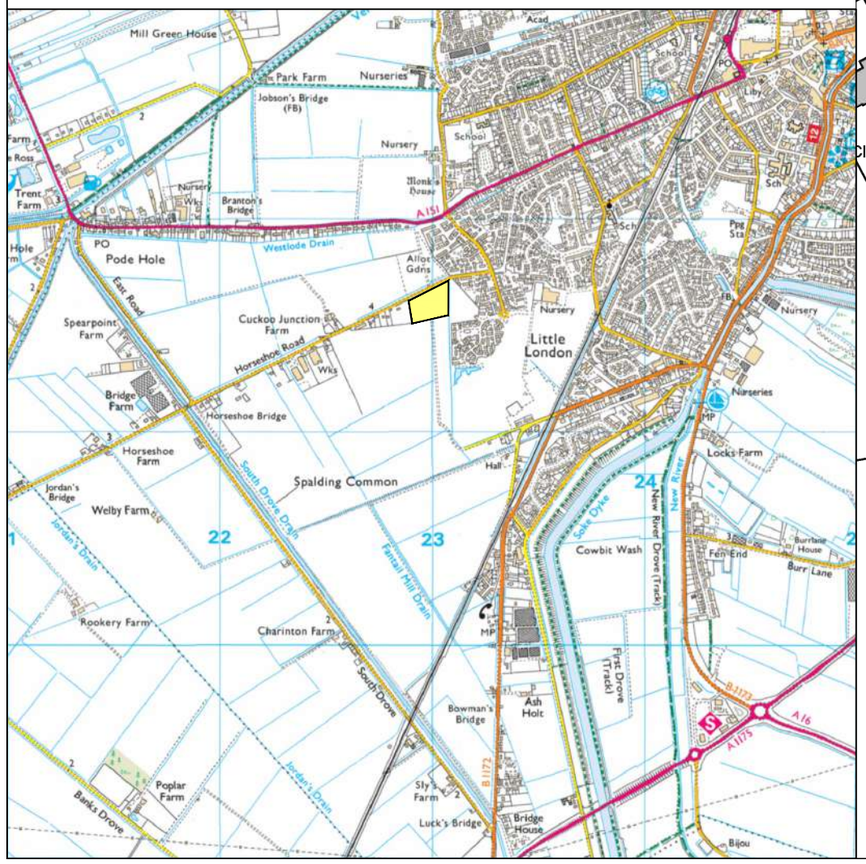
EH 2008 *Geophysical Survey in Archaeological Field Evaluation.* English Heritage, Swindon (now withdrawn, but used for evaluating suitability of soil types)

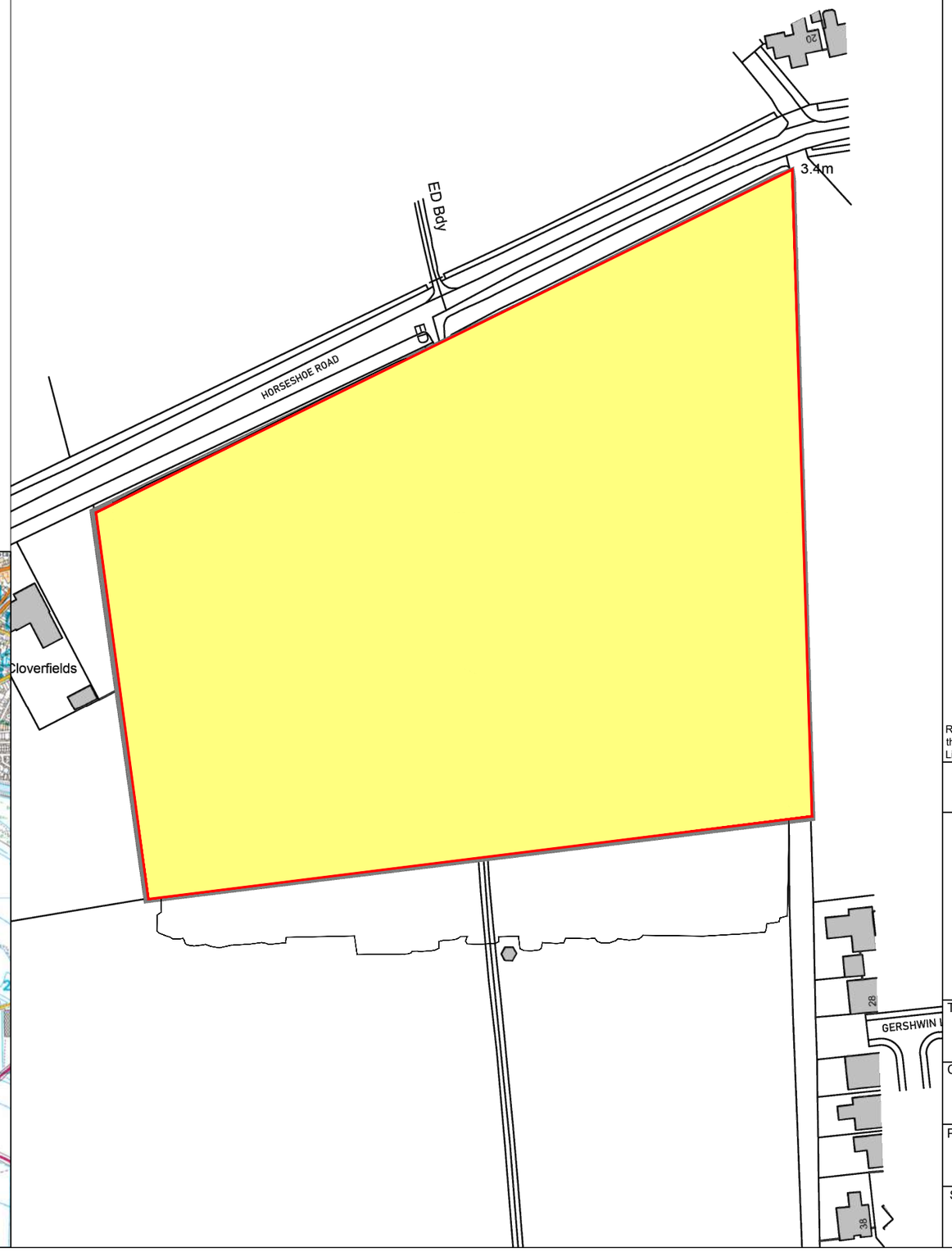
WA 2025 *Land South of Horseshoe Road, Spalding, Linclonshire, PE11 - Historic Environment Desk-Based Assessment.* Witham Archaeology; Report No. 655.

10 ARCHIVE

10.1 The minimally processed data, data images, XY traces and a copy of this report are stored in **SUMO GeoSurveys'** digital archive, on an internal RAID configured NAS drive in the Midlands Office. These data are also backed up to the Cloud for off-site storage**.**

10.2 The Grey Literature will be archived with OASIS and the relevant HER within a period of 12 months.





N

Survey Area

sumo GeoSurveys

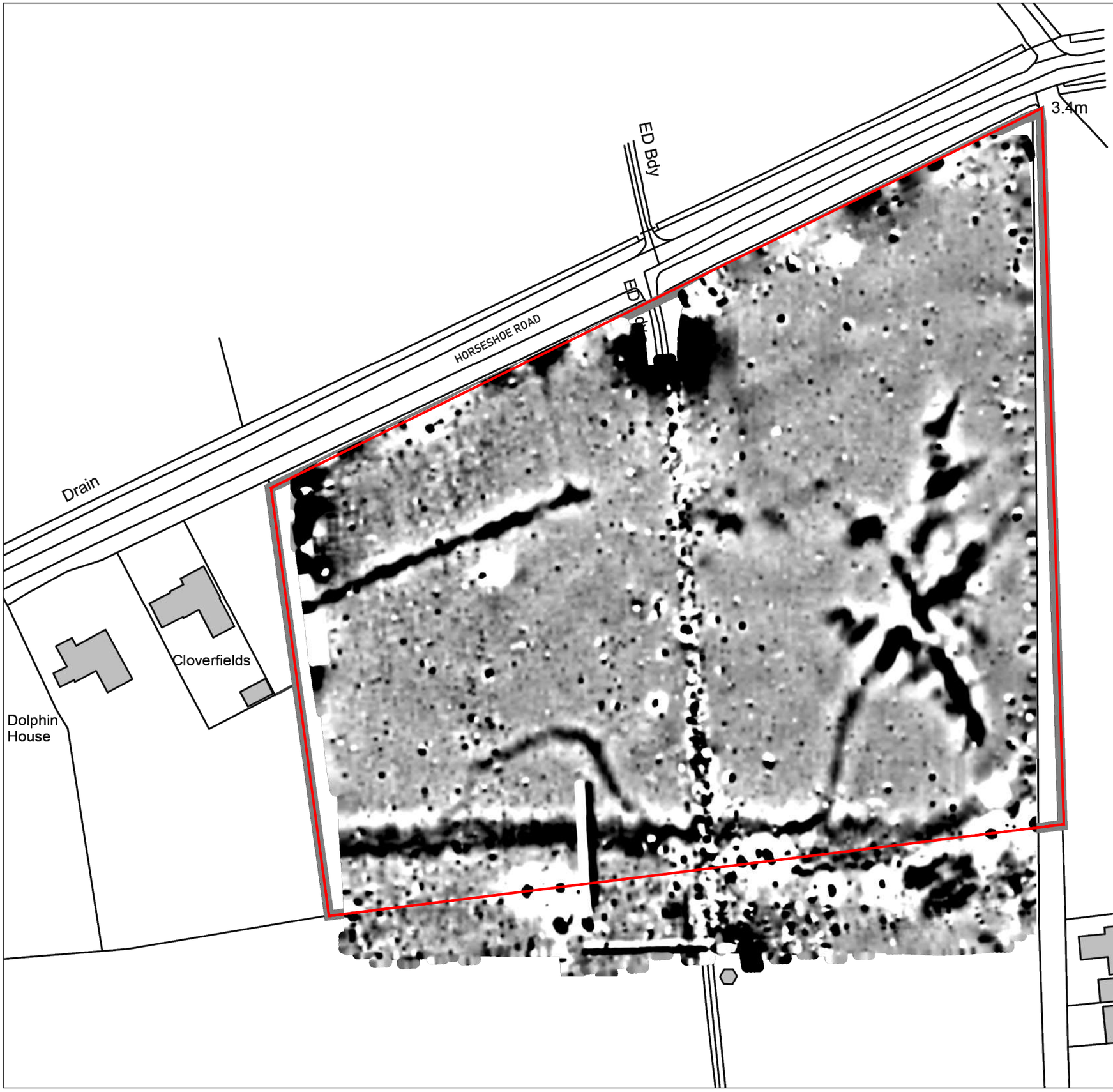
Title: Site Location

Client: Witham Archaeology

Project: SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale: NOT TO SCALE

Fig No: 01



N

+2nT

-1nT

sumo GeoSurveys

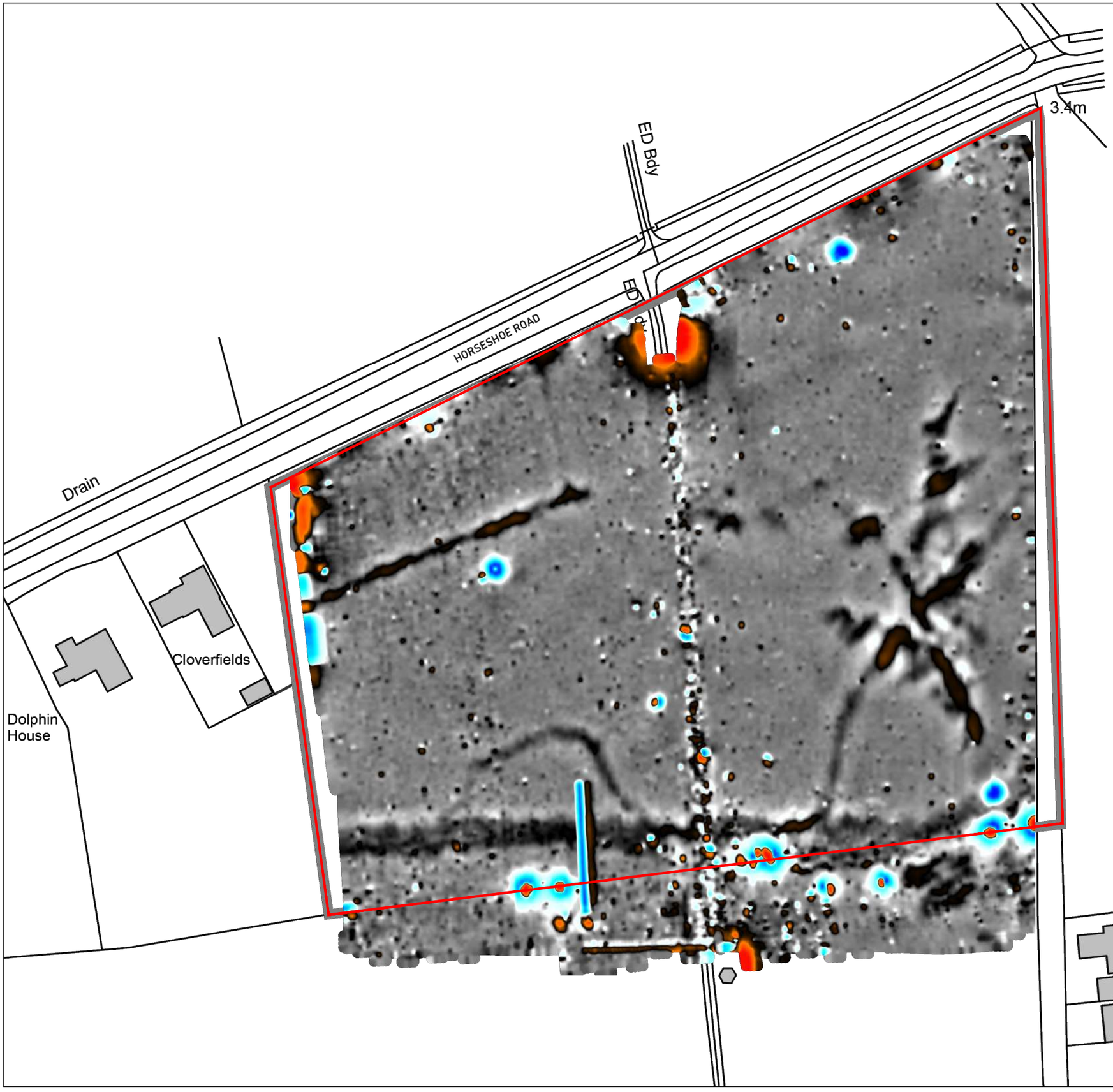
Title:
Magnetometer Survey - Greyscale Plot

Client:
Witham Archaeology

Project:
SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale:
0 metres 50
1:1000 @ A3

Fig No:
02



N

+100nT

-100nT

sumo GeoSurveys

Title:
Magnetometer Survey - Colour Plot

Client:
Witham Archaeology

Project:
SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale:
0 metres 50
1:1000 @ A3

Fig No:
03

N

KEY

	Ridge and furrow
	Uncertain Origin (discrete anomaly / trend / increased response)
	Former field boundary (corroborated)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Modern track
	Ferrous

sumo GeoSurveys

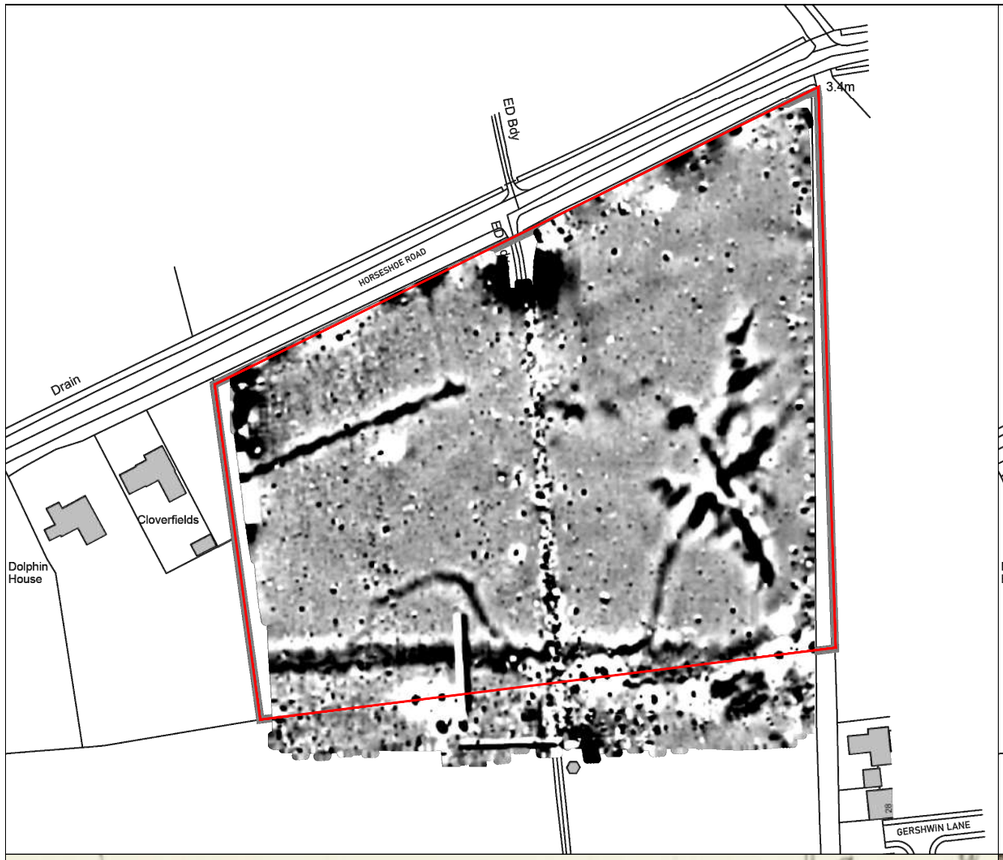
Title:
Magnetometer Survey - Interpretation

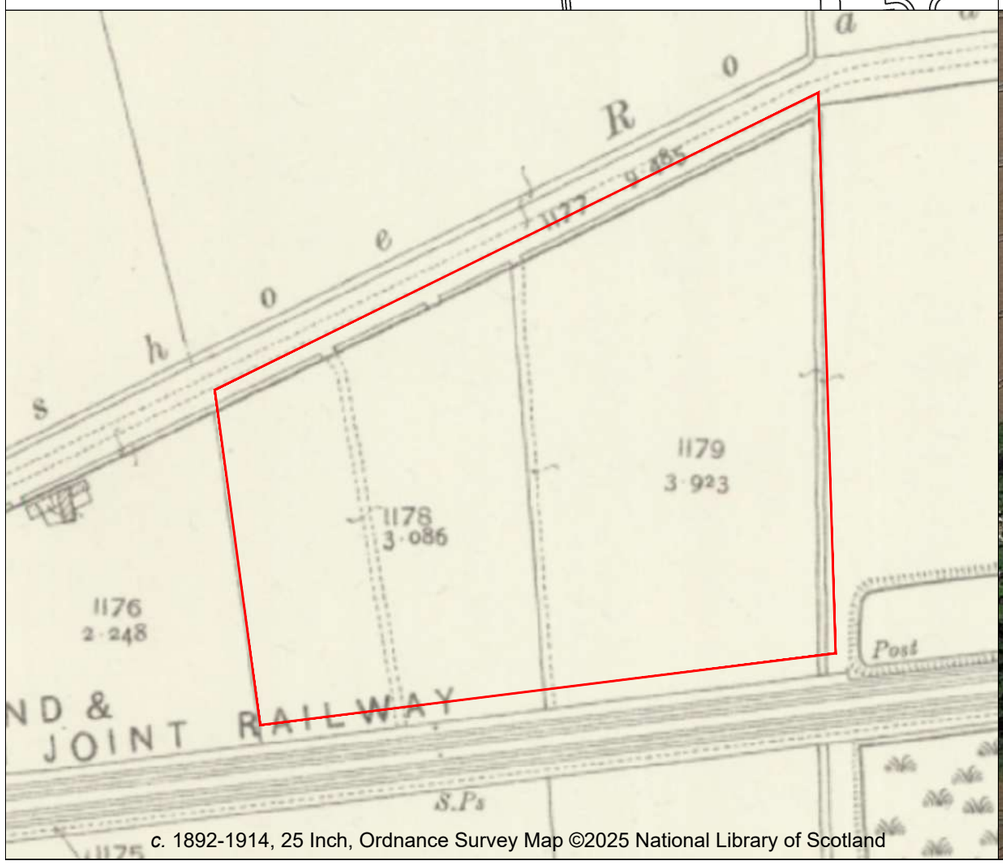
Client:
Witham Archaeology

Project:
SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale:
0 metres xx
1: @ A3

Fig No:
04





c. 1892-1914, 25 Inch, Ordnance Survey Map ©2025 National Library of Scotland

©2025 Google Earth

N

+2nT

-1nT

KEY

	Ridge and furrow
	Uncertain Origin (discrete anomaly / trend / increased response)
	Former trackway (corroborated)
	Agriculture (plough)
	Natural (e.g. geological / pedological)
	Modern track
	Ferrous

SUMO GeoSurveys

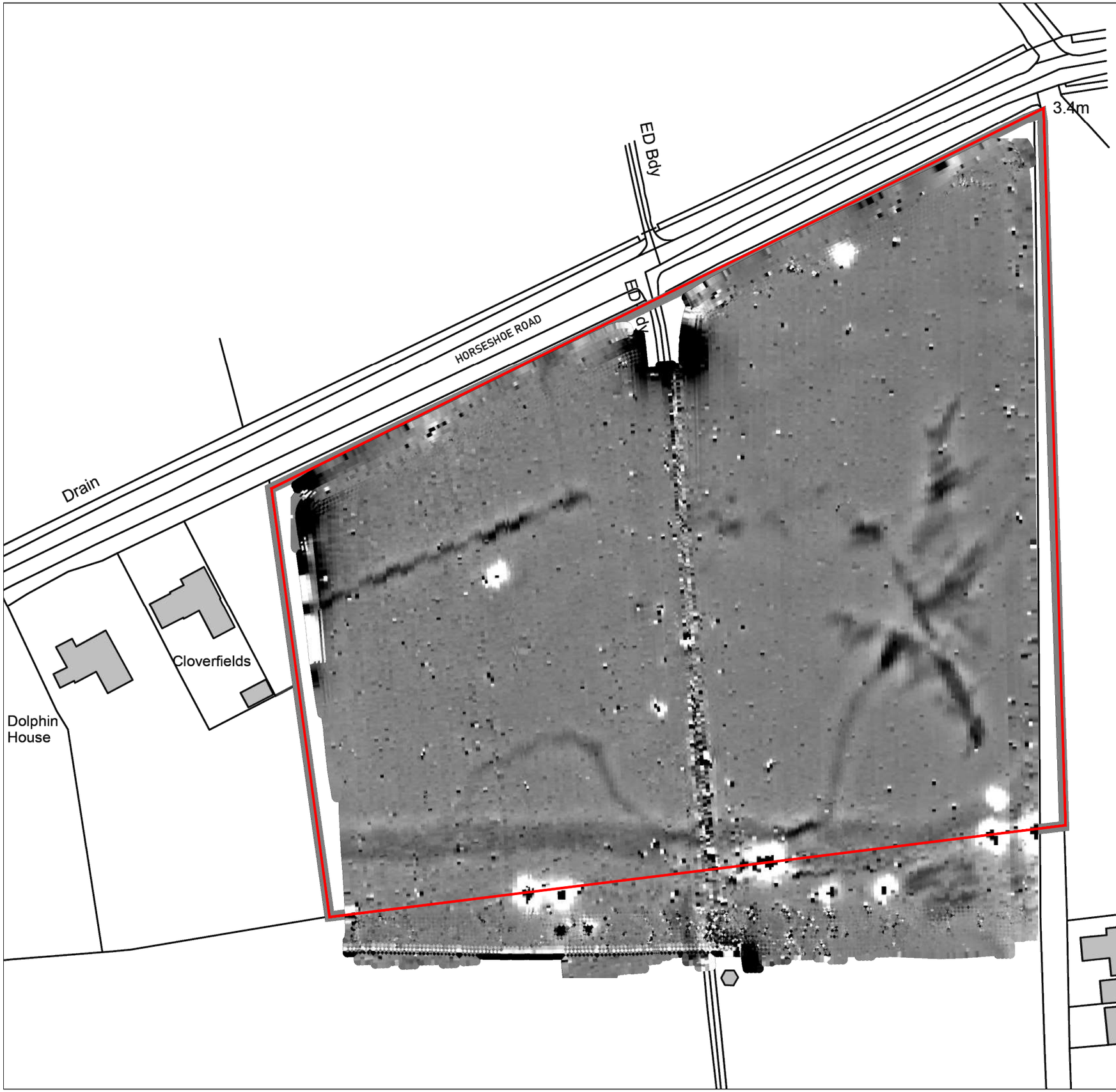
Title: Greyscale Plot / Interpretation / *c.* 1892-1914 Ordnance Survey Map / 2021 Aerial Image

Client: Witham Archaeology

Project: SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale: NOT TO SCALE

Fig No: 05



N

+10nT

-10nT

sumo GeoSurveys

Title:
Minimally Processed Data - Greyscale Plot

Client:
Witham Archaeology

Project:
SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale:
0 metres 50
1:1000 @ A3

Fig No:
06

N

sumo GeoSurveys

Title:
XY Trace Plot (clipped at +/-15nT)

Client:
Witham Archaeology

Project:
SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale:
0 metres 50
1:1000 @ A3

Fig No:
07

sumo GeoSurveys

Title:
XY Trace Plot (clipped at +/-50nT)

Client:
Witham Archaeology

Project:
SUMO-20869: Land off Horseshoe Road, Spalding, Lincolnshire

Scale:
0 metres 50
1:1000 @ A3

Fig No:
08

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	1.0m	0.25m
Magnetometer	Bartington Cart System	1.0m	0.125m

Instrumentation:

Bartington instruments operate in a gradiometer configuration which comprises fluxgate sensors mounted horizontally, 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.

Bartington Grad 601-2

Hand-Held: Data will be collected using a Bartington Grad 601-2. The instrument consists of two paired sensors and readings are logged at 0.25m centres along traverses 1.0m apart across 30m grids. The collection of data at 0.25m centres provides an appropriate methodology balancing cost and time with resolution as per Historic England guidelines

Bartington Cart System

Data will be collected using a cart carrying four paired Bartington magnetic sensors. Each data point is geographically referenced using an on-board Trimble RTK survey grade GPS system. Readings will be taken at 0.125m centres along traverses 1.0m apart.

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.
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.

Appendix C - OASIS Summary Sheet

OASIS Summary for sumogeop1-532077

OASIS ID (UID)	sumogeop1-532077
Project Name	Geophysical Survey at Land off Horseshoe Road, Spalding, Lincolnshire
Sitename	Land off Horseshoe Road, Spalding, Lincolnshire
Sitecode	20869
Project Identifier(s)	20869
Activity type	Geophysical Survey, MAGNETOMETRY SURVEY
Planning Id	
Reason For Investigation	Planning: Pre application
Organisation Responsible for work	SUMO Geophysics Ltd.
Project Dates	08-Mar-2025 - 08-Mar-2025
Location	Land off Horseshoe Road, Spalding, Lincolnshire NGR : TF 22996 21588 LL : 52.77787481773826, -0.178014001177267 12 Fig : 522996,321588
Administrative Areas	Country : England County/Local Authority : Lincolnshire Local Authority District : South Holland Parish : South Holland, unparished area
Project Methodology	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. All survey techniques followed the guidance set out by CIfA (2020) and the European Archaeology Council (EAC) (2016). Bartington Cart SystemTraverse Interval 1.0mSample Interval 0.125m
Project Results	A detailed magnetometer survey was conducted over approximately 3 hectares off Horseshoe Road, Spalding, and it has not identified any anomalies of definite archaeological interest, aside from weak evidence for ridge and furrow cultivation. Several weak linear trends and discrete anomalies are of uncertain origin; the proximity to Iron Age and Roman remains suggests an archaeological explanation cannot be entirely ruled out, though such an interpretation is tentative at best, and they are more likely to relate to natural or agricultural effects. Modern ploughing effects, a former track and areas of disturbance likely associated with the former railway to the south have also been identified, along with bands of natural magnetic variation.
Keywords	
Funder	Private or public corporation Witham Archaeology
HER	Lincolnshire HER - unRev - STANDARD
Person Responsible for work	Rebecca Fradgley
HER Identifiers	
Archives	

Report generated on: 12 Mar 2025, 11:35

Appendix D – Data Management Plan & Archive Selection Strategy

Data Management Plan

Project ID / OASIS Ref.

SUMO-20869 / sumogeop1-532077

Project Name

Land off Horseshoe Road, Spalding, Lincolnshire.

Project Description

Detailed magnetic survey over approximately 3 hectares at Spalding, Lincolnshire.

Client

Witham Archaeology

Project Manager

Rebecca Fradgley

Field Leader

Gabriel Mazeski

Date DMP created

12/03/2025

Date DMP last updated

12/03/2025

Version

1

Technique - data

Detailed magnetic survey.

Manual – cart - other

ATV cart system

Documentation and metadata

All documentation and data produced are stored on SUMO servers in a specific job file.

Data storage, access and back-up

- SUMO Secure server during the project life set up in a RAID configuration (a RAID configuration incorporates a level of data redundancy meaning if a single hard drive in fails data can still be restored).
- Snap shots of the data will be made at several intervals during the day to allow data to be restored for up to 30 days if changed / deleted.
- Once the final report has been completed data will be moved onto NAS drive set up in a RAID configuration.
- All data is backed up to an off-site location (Cloud storage).

Archive Selection Strategy

Digital Data

Selection

It is proposed that only the final version of all born digital documents (reports, images and CAD files) will be selected for inclusion in the Preserved Archive. All raw and processed survey data will be included in the preserved archive. Below is what will constitute the selected archive:

- Raw data in XYZ format .csv and .png plus .pgw world file
- Processed data as .png plus .pgw world file
- Final survey report .pdf
- CAD and Vector graphics (interpretations) in .dwg format

De-selected digital data

The de-selected material will be retained on the SUMO Secure server and Cloud storage.

Documents

Not applicable – no archive

Materials

Not applicable – no archive

- Archaeological Geophysics
- Engineering Geophysics
- Measured Building Services
- Utility and Topographic Services
- Aerial Surveys
- Rail Surveys

SUMO GeoSurveys is a trading name of SUMO Geophysics Ltd.
SUMO Services Ltd, incorporated under the laws of England and Wales,
Company Registration No.4275993.
Registered Office Unit 8 Hayward Business Centre, New Lane, Havant, Hampshire, PO9 2NL