Proof of Evidence – Appendix 3

Land at The Old Cottage, Station Road, Lingfield

Dr Jonathan Edis

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LPA REF: TA/2022/685

July 2023 | Project Ref 7677

sumo

GeoSurveys

LAND WEST OF STATION ROAD, LINGFIELD, SURREY

UAS LANDSCAPE SURVEY

Land West of Station Road, Lingfield, Surrey

UAS Landscape Survey

Prepared for:	Archaeology South-East
Authored by:	Dr Scott Williams MCIfA
Edited by:	Adam Stanford MCIfA FSA
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Field Coordinator:	Adam Stanford MCIfA FSA
Site Surveyors:	Dr Scott Williams MCIfA Simon Batsman PCIfA
Project Manager:	Adam Stanford MCIfA FSA

SUMO GeoSurveys
Vineyard House, Upper Hook Road
Upton upon Severn, Worcestershire
WR8 0SA
T: 01684 592266

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Acknowledgements

SUMO GeoSurveys would like to thank Archaeology South-East for commissioning the work documented here.

Executive Summary

SUMO GeoSurveys undertook a UAS landscape survey on land to the west of Station Road, Lingfield, Surrey. The survey was commissioned by Archaeology South-East to investigate the archaeological potential at the site in preparation for development. The survey area comprises *c*. 6 ha of land. The data were processed in Agisoft Metashape and QGIS.

The UAS landscape survey conducted at Lingfield, Surrey, has successfully produced a detailed visual record of the pre-development landscape. A series of denuded ridge and furrow earthworks were recorded in the eastern and northern parts of the site. Modern mechanical ploughing was also noted within a no longer extant field parcel that was defined in the data as micro-topographical earthworks. Further relict field boundaries, that are depicted on historic mapping, were also noted.

1. Introduction

1.1 Project Background

SUMO GeoSurveys undertook a UAS landscape survey on land to the west of Station Road, Lingfield, Surrey. The survey was commissioned by Archaeology South-East to investigate the archaeological potential at the site in preparation for development. The survey area comprises *c*. 6 ha of land (Figure 2). The data were processed in Agisoft Metashape and QGIS.

1.2 Site Details

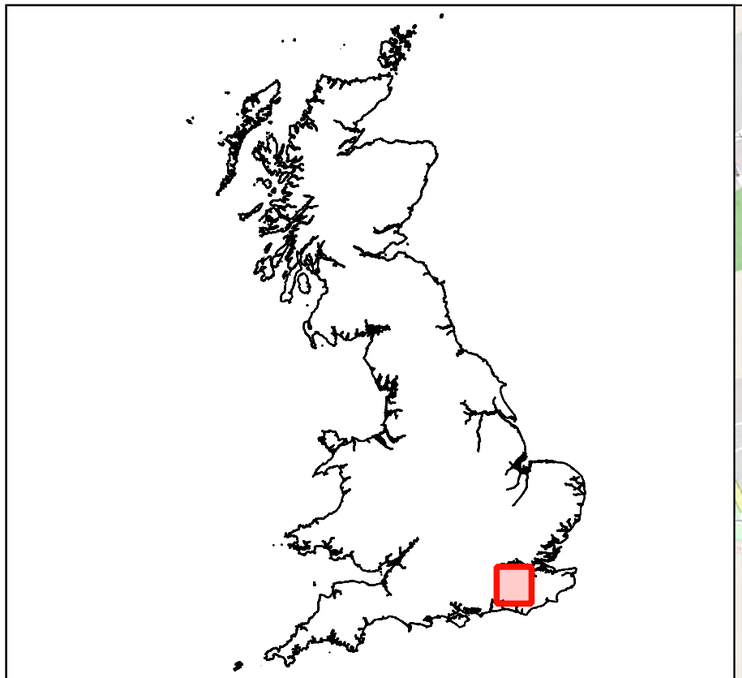
NGR / Postcode	TQ 39186 43621 / RH7 6AG
Location	The site is located to the west of the Station Road, and north of Tower Hill, in Lingfield, Surrey
HER	Surrey Historic Environment Record
District	Tandridge
Parish	Lingfield (civil)
Geology	**Bedrock:** Interbedded sandstone and siltstone of the Upper Tunbridge Wells Sand **Superficial:** None recorded (BGS 2023)
Archaeology	Probable ridge and furrow earthworks
Survey Methods	UAS RGB photogrammetry
Study Area	*c*. 6 ha
Topography	The site comprises land that is gently sloping down from the west towards the east from an elevation of *c*. 76 m to *c*. 50 m above Ordnance Datum (aOD)
Current Land Use	Agricultural

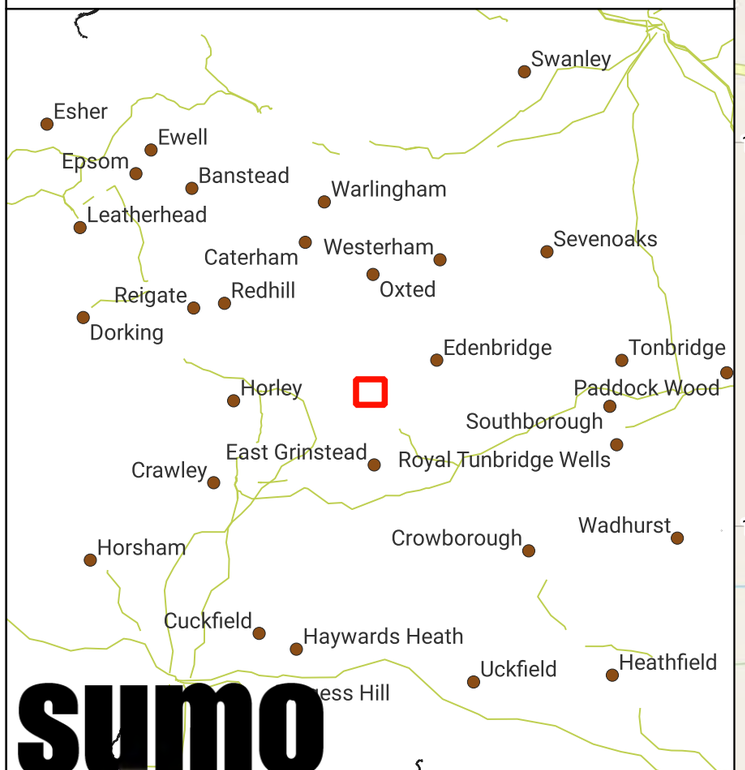
1.3 Aims and Objectives

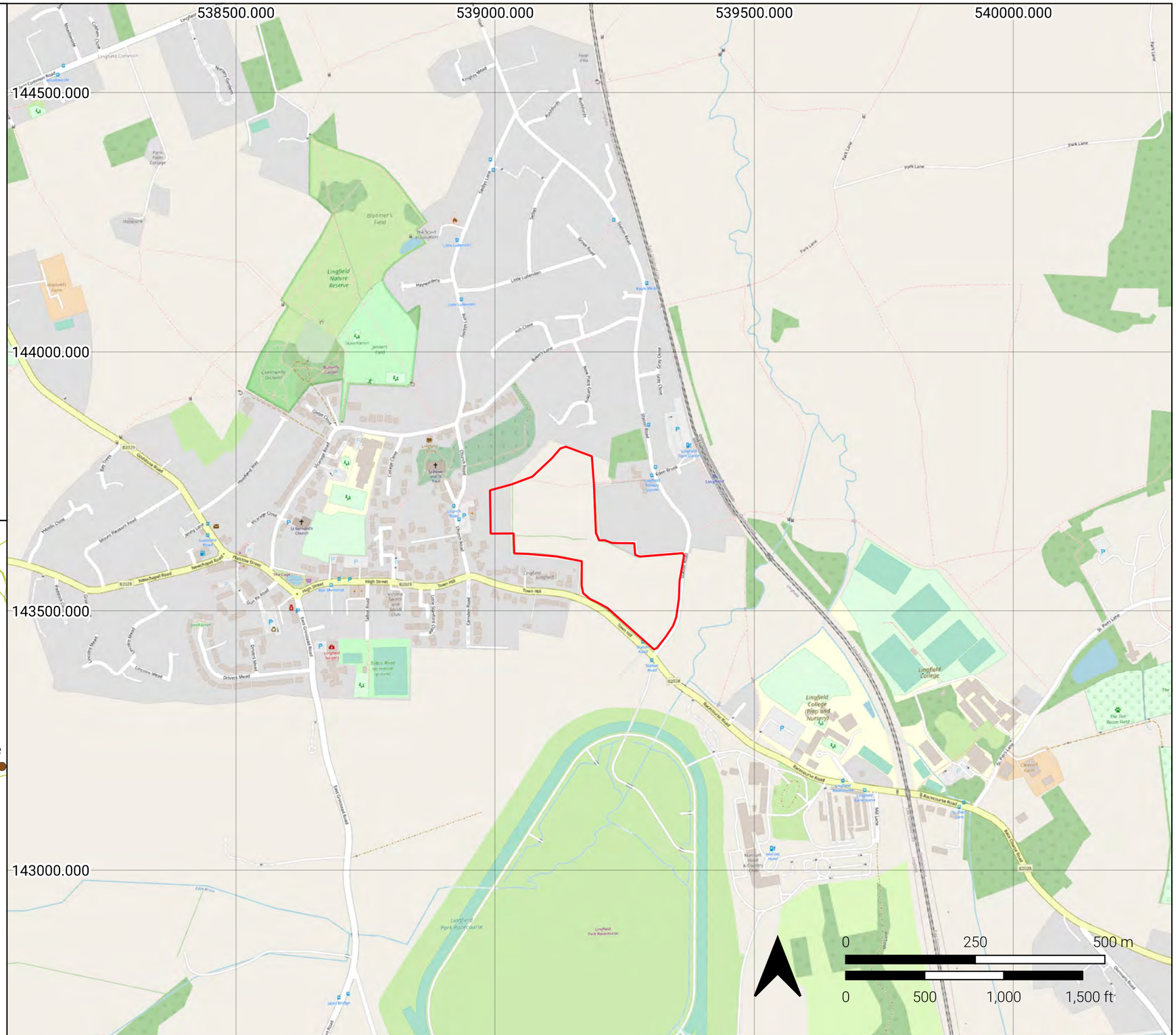
To conduct a detailed UAS (drone) geospatial landscape survey using RGB photogrammetry of the study area.

The objectives of the UAS geospatial survey were:

- Undertake a UAS geospatial survey using RGB photogrammetry for analysis
- Suggest a proposal for archaeological investigation, if required
- Document the survey result
- Ensure all work was carried out in accordance with the *Code of Conduct* of the Chartered Institute for Archaeologists (CIfA) (2022) and in line with current Historic England guidance for photogrammetry and landscape surveys (HE 2017a; 2017b)







Project	Lingfield
Client	Archaeology South-East
Date	17/04/23
Job No.	SUMO-12525

Location map

CRS: OSGB36 / British National Grid. EPSG:7405

Figure 1

2. METHODOLOGY

2.1 SURVEY METHODOLOGY – TOPOGRAPHIC

2.1.1 PHOTOGRAPHY

An Unmanned Aircraft System (UAS) with a gimbal mounted camera was flown at an average elevation of 73 m (239 ft) above ground level.

2.1.2 PHOTOGRAMMETRY

Images were processed in Agisoft Metashape photogrammetric software to produce a 3D pointcloud with an average ground resolution of 1.61 cm spatial resolution. Data were exported as a raster Digital Elevation Model (DEM) with an average 13.6 cm spatial resolution and an orthophoto with an average 1.61 cm/pix .

2.1.3 REFERENCING

The photogrammetric models were referenced by seven ground control points (GCPs) that were distributed across the area. The seven points are visible in the aerial photographs and were also surveyed using high accuracy GPS to facilitate georeferencing to OS coordinates and provide an average error of 0.08 cm across the area (Table 1).

Point	Easting	Northing	Elevation
1	539351.98	143602.647	52.281
2	539309.538	143441.465	50.278
3	539178.172	143548.404	54.465
4	539063.994	143623.837	59.099
5	539164.733	143632.852	55.201
6	539177.462	143724.515	54.888
7	539053.341	143732.228	55.446

Table 1 Coordinate data for the GCPs

2.2 DATA PROCESSING AND VISUALISATION

2.2.1 DIRECTIONAL LIGHT SHADING (HILLSHADE)

Simulated illumination of the terrain surface from a chosen light source direction. This gives the viewer an intuitive sense of the 3D topography but can fail to reveal some features that are aligned with the light source.

2.2.2 AMBIENT LIGHT SHADING (OCCLUSION)

Simulated illumination of the terrain surface from a continuous encompassing light source. Illumination of a given point is determined by surrounding terrain and other objects which occlude incoming light and simulates diffuse, and scattered light that is reflected by various surfaces. It gives the viewer an intuitive sense of the 3D topography but can fail to reveal subtle features near much larger objects.

2.2.3 TERRAIN FLATTENING

Terrain flattening entails constructing a mathematical model that approximates broad-scale variation in the topography. This model surface is then subtracted from the original DEM to produce a new dataset that reflects only smaller scale features.

3. RESULTS

3.1 INTRODUCTION

The results from the UAS RGB survey are presented below in a series of figures followed by a discussion.

Project	Lingfield	**Drawn**	SW	Orthomosaic generated from UAS photogrammetry
Client	Archaeology South-East	**Version**	1.0	
Date	17/04/23	**Surveyed**	SW	
Job No.	SUMO-12525	**Figure**	2	

0 50 100 m

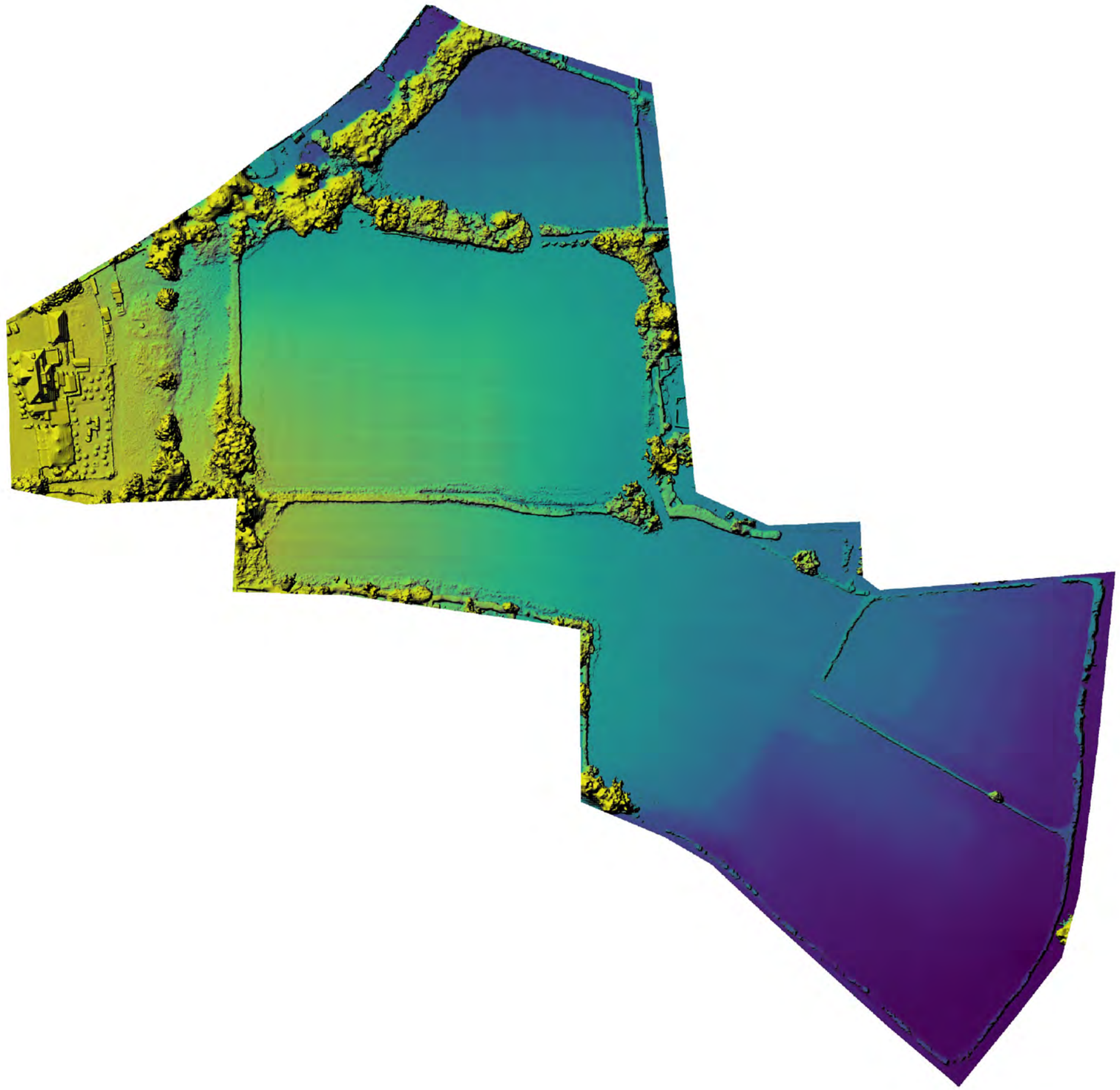
0 100 200 300 ft

Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	3

Digital Elevation model with hillshade, overlaid onto satellite imagery. Map Data: Goole

0 50 100 m

0 100 200 300 ft



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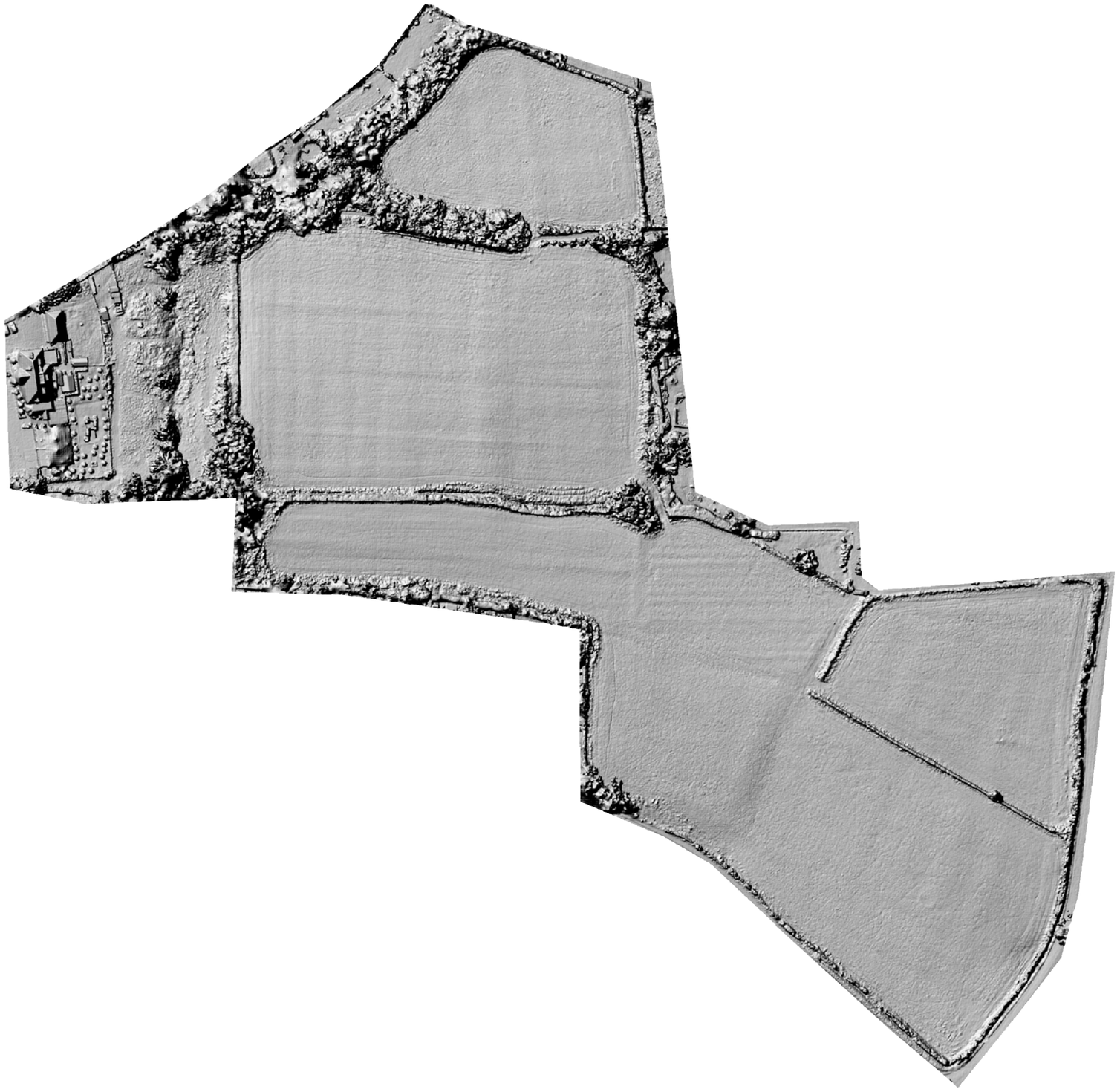
Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	4

DEM with elevation colour-scale expressed in metres above Ordnance Datum (aOD)

0 50 100 m

0 100 200 300 ft

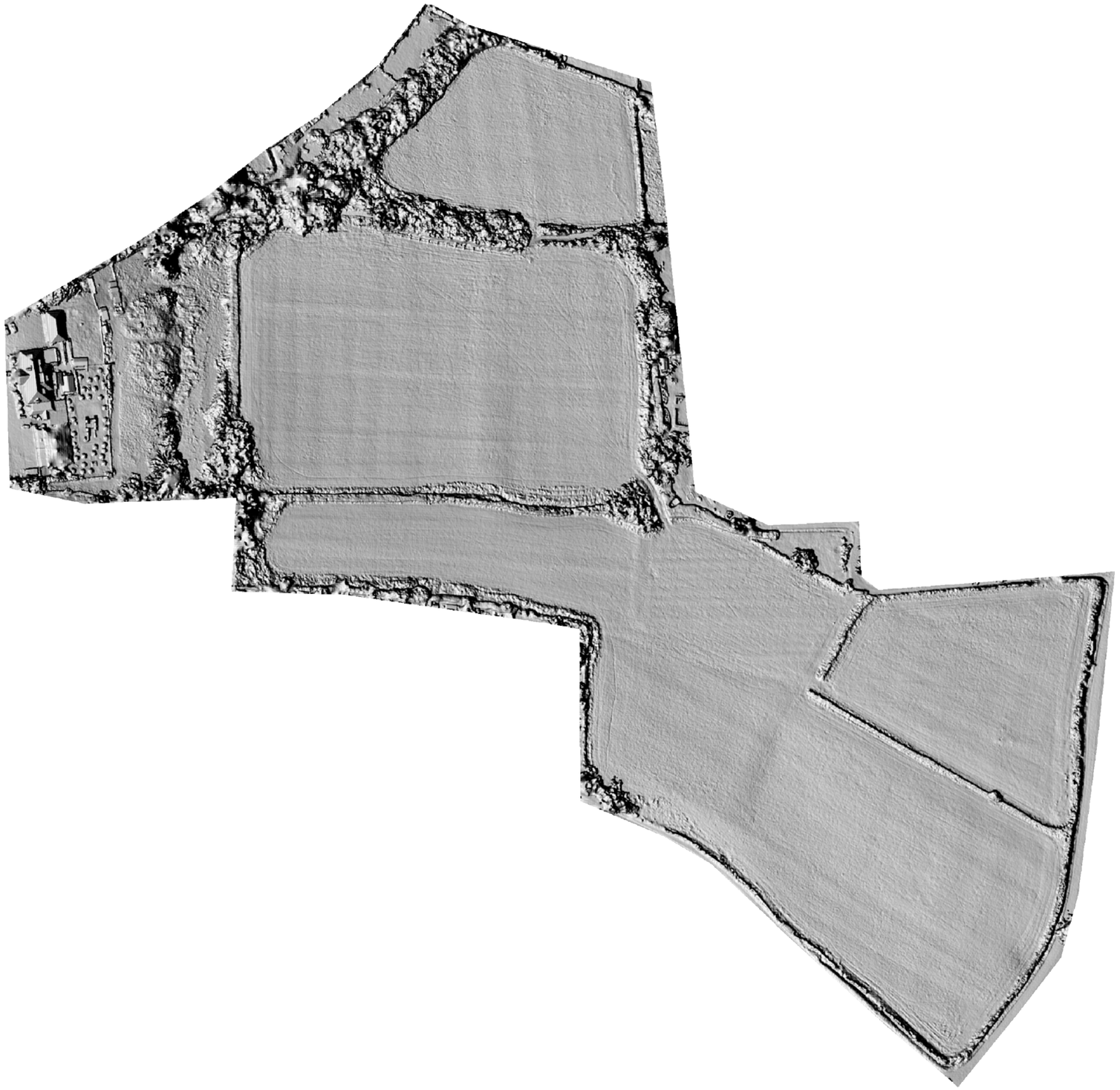


Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	5

Digital Elevation Model with hillshade. Azimuth 315 degrees / Altitude 45 degrees / Z factor 2

0 50 100 m

0 100 200 300 ft

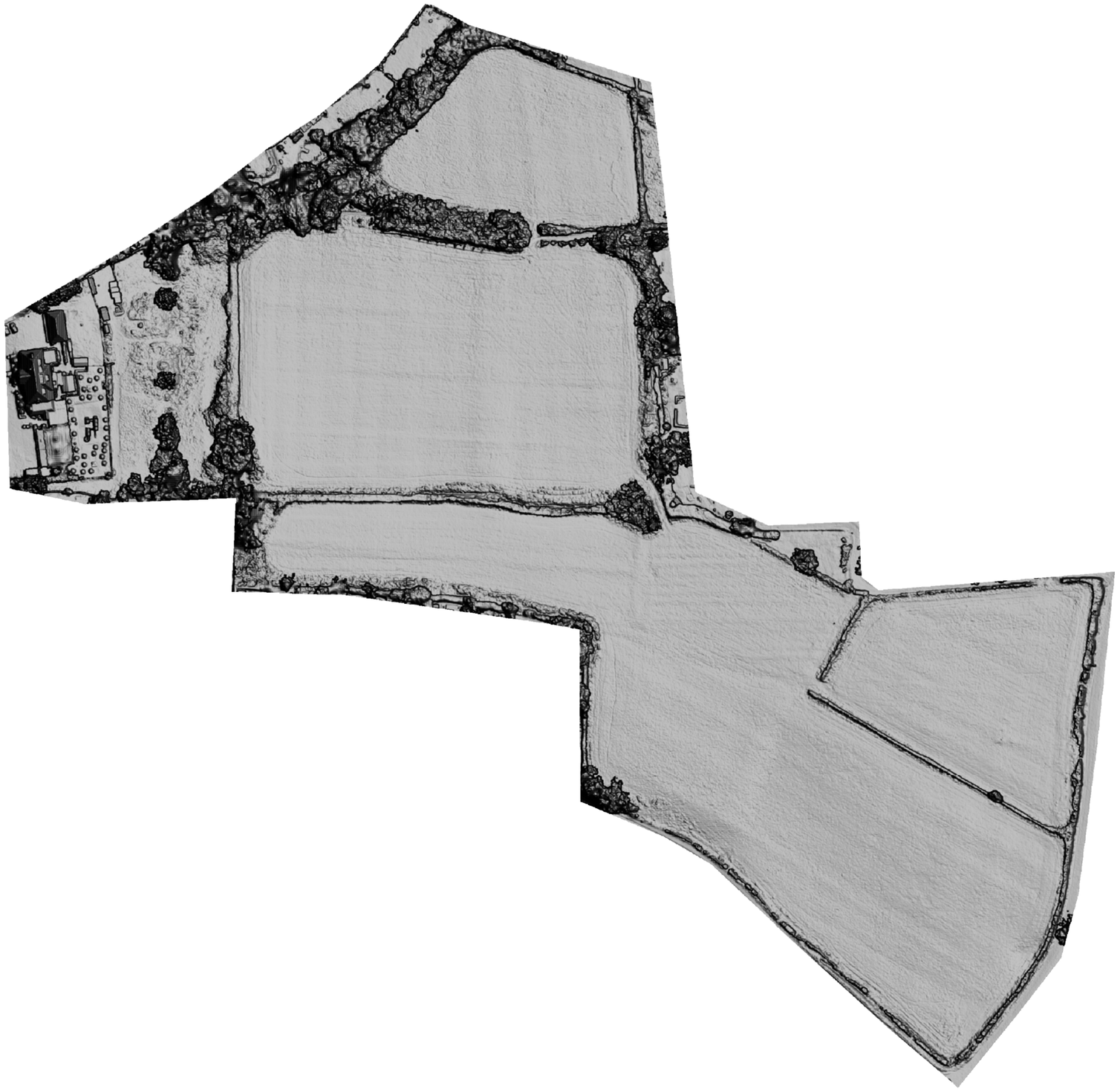


Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	6

Digital Elevation Model with hillshade. Azimuth 240 degrees / Altitude 45 degrees / Z factor 2

0 50 100 m

0 100 200 300 ft

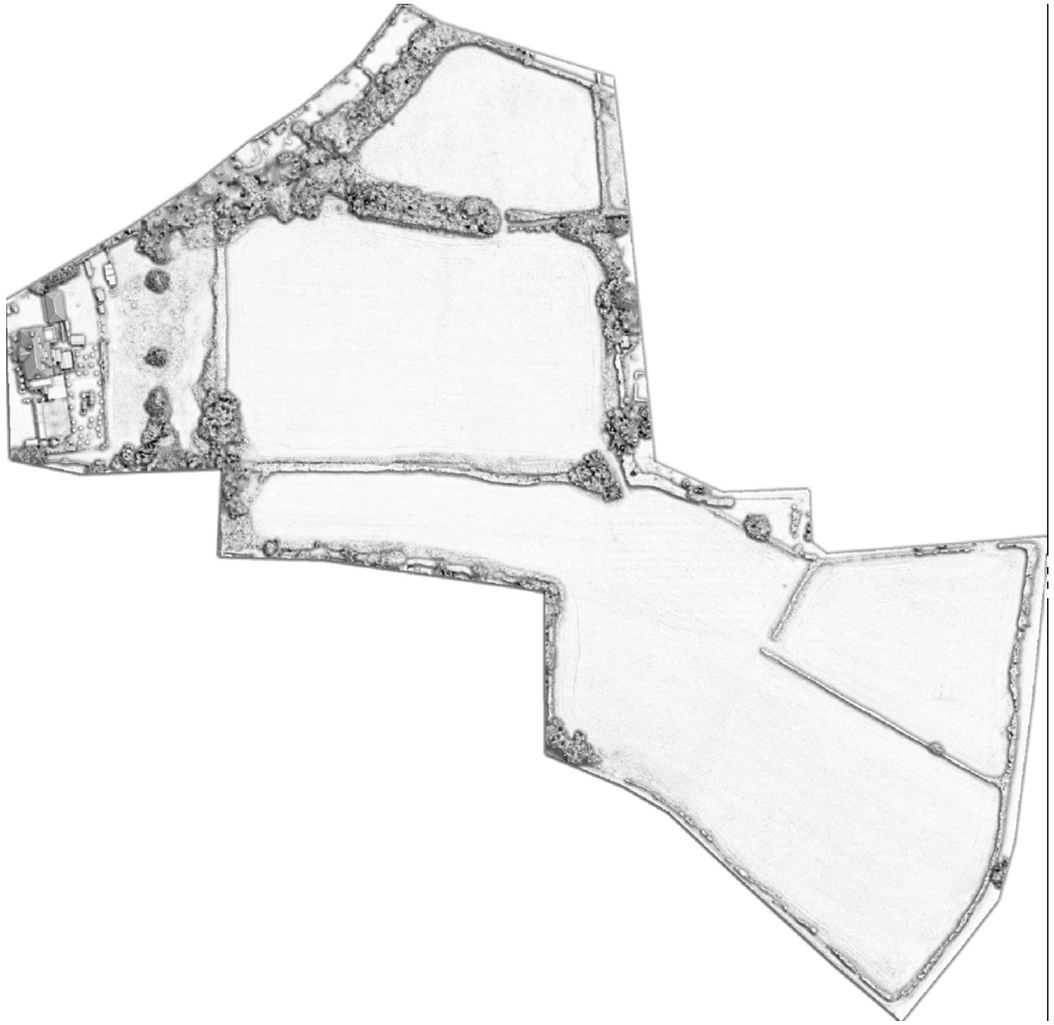


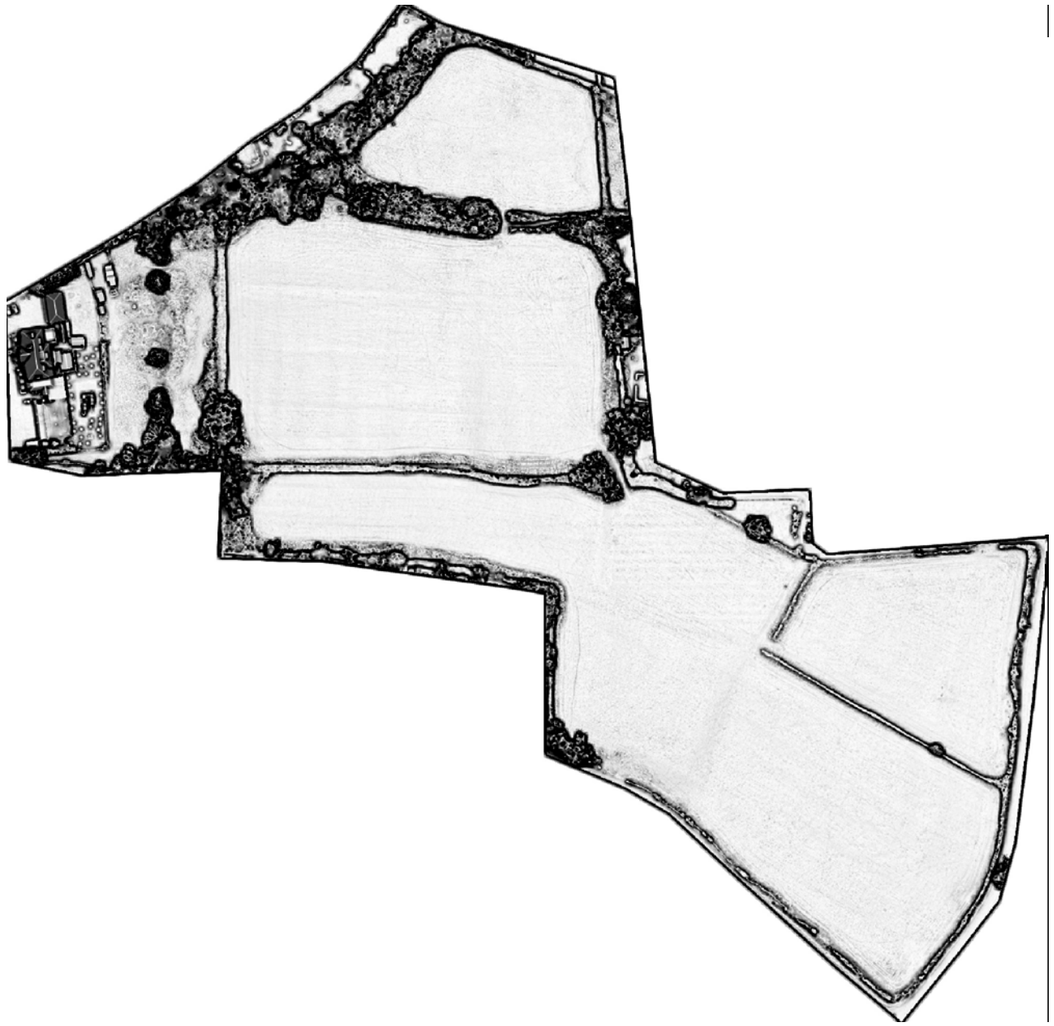
Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	7

Digital Elevation Model with hillshade using multidirectional light source

0 50 100 m

0 100 200 300 ft





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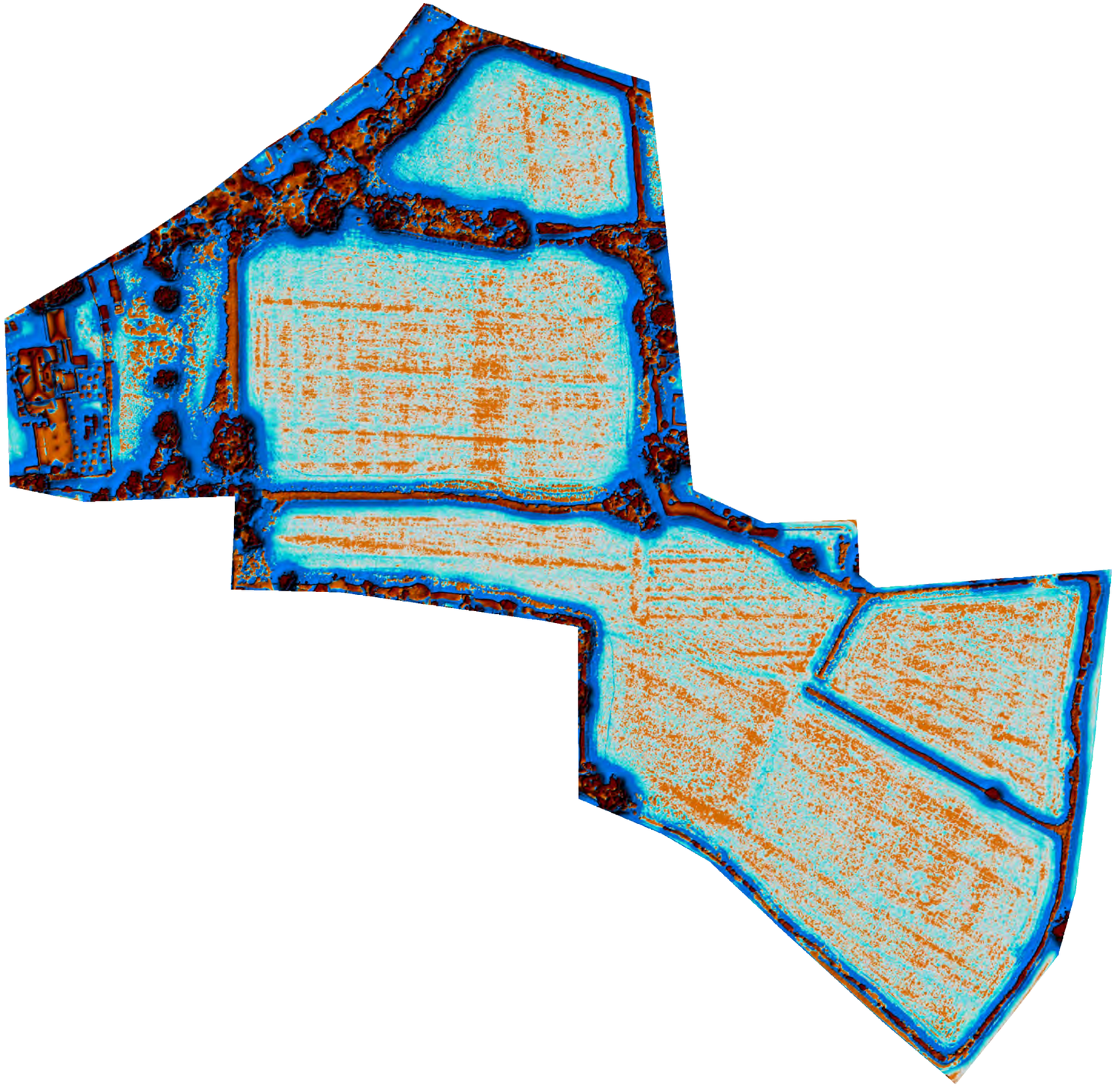
Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	8

RVT Anisotropic Sky-view analysis (left) and Terrain Shading Ambient Occlusion analysis (right)

0 50 100 150 m

0 100 200 300 400 500 ft



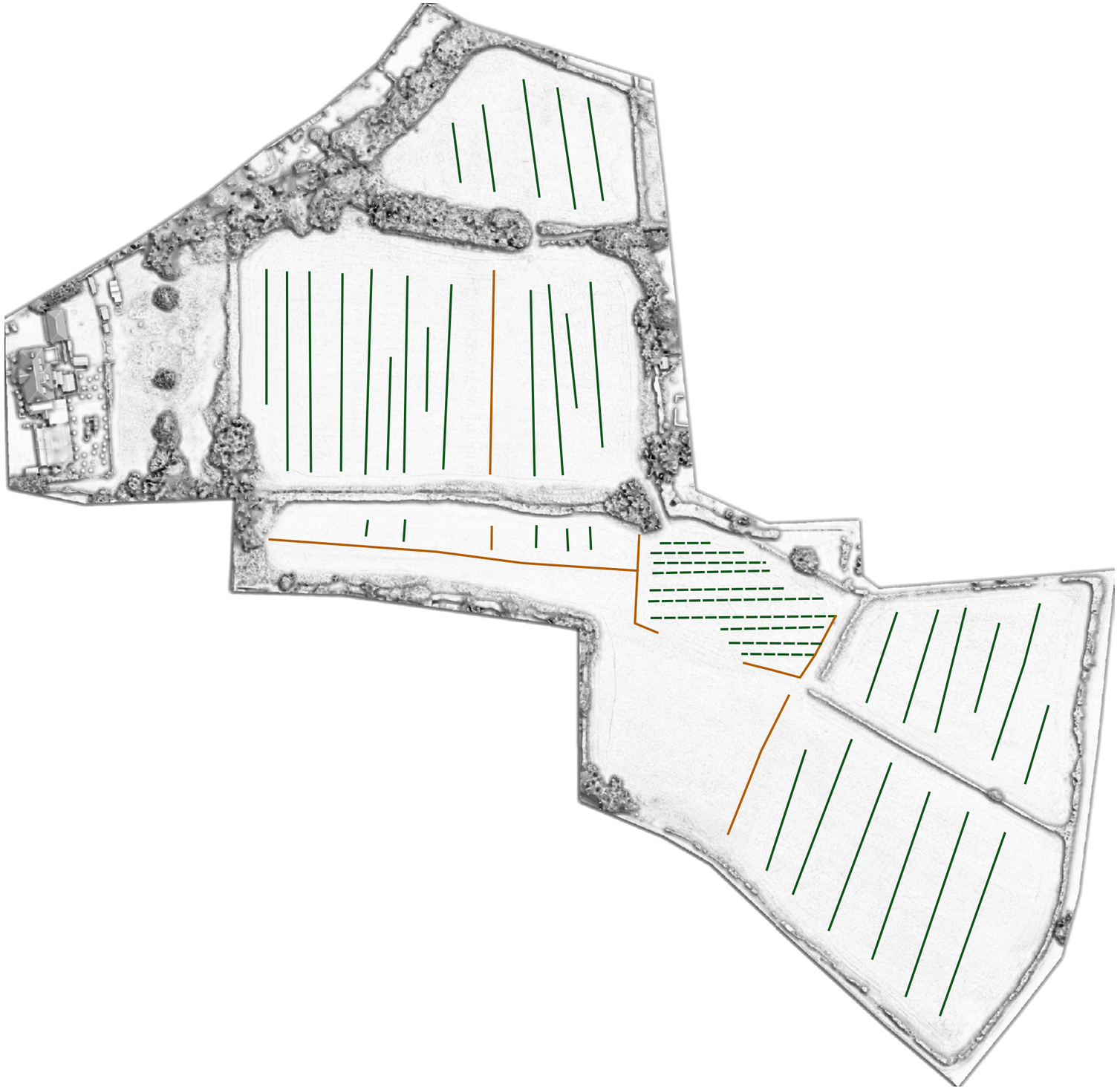
sumo GeoSurveys

Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	9

Terrain flattened Digital Elevation Model

0 50 100 m

0 100 200 300 ft



sumo GeoSurveys

Project	Lingfield	**Drawn**	SW
Client	Archaeology South-East	**Version**	1.0
Date	17/04/23	**Surveyed**	SW
Job No.	SUMO-12525	**Figure**	10

Interpretation of features

0 50 100 m

0 100 200 300 ft

4. Discussion

4.1 Introduction

The UAS photogrammetry survey has enabled the construction of an orthomosaic image (Figure 2), Digital Elevation Model (DEM), and 3D photogrammetric model of the landscape of the proposed development site to the west of Station Road in Lingfield, Surrey.

4.2 Ground Conditions

The agricultural fields of the proposed development site were under grass. The fields were divided by mature hedgerows and alignments of trees. The ground conditions were conducive to UAS survey methods.

4.3 Digital Elevation Model

A DEM was produced for the proposed development site from the RGB photogrammetry. Elevation in metres above Ordnance Datum is depicted using a colour-scale overlay (Figure 4). The DEM provides a good indication of the topographic characteristics through hillshade manipulation in a Geographical Information System (GIS) (Figure 5 to Figure 7). This technique is also useful for the identification of micro-topographical archaeological features expressed at surface level.

4.4 GIS Analysis

Hillshade analysis of the DEM using different light azimuths has illustrated several micro topographical features that are not clearly visible on the ground. More detailed analysis using RVT Anisotropic Sky-view did not produce any significant results beyond features already identified, and so this was cross-checked using Terrain Shading Ambient Occlusion analysis from which the results were similar (Figure 8). The DEM was flattened using Anomaly software to enhance the visibility of micro-topographic features (Figure 9).

4.5 Assessment

4.5.1 Archaeological Features

The predominant archaeological features within the proposed development site are denuded ridge and furrow earthworks which are in the south-east and the north of the site. The medieval/post-medieval earthworks are aligned along a general north to south orientation, and respect the external field boundaries of the site, which appear to have remained unchanged for a considerable time (Cooper 2022). A small, enclosed parcel of modern mechanical ploughing is visible toward the centre of the site. This area is defined by relict field boundaries which are depicted on the 1965 and 1988–1993 Ordnance Survey editions (Cooper 2022, figures 15–16) and are depicted in the data as micro-topographical earthworks. Additional relict field boundaries, which are depicted on 18th–19th century mapping (Cooper 2022, figures 9–11) are also visible in the data as micro-topographic earthworks.

4.5.2 Topography

The land is generally sloping from the west towards the east. A low-lying, generally level terrace of land is visible adjacent to the southern border of the site, to the west of the easternmost ridge and furrow. The area measures approximately 0.4 ha in size and is defined along its eastern side by a bank sloping down to the east. The area is notable for a lack of agricultural activity. However, no archaeological features were noted in the aerial survey results. It is possible that this terrace is a natural feature.

5. Conclusions

5.1 Limitations

The ground was boggy and saturated due to heavy rainfall. The weather on the day of the survey was generally overcast with some sunny spells, therefore, variations in cloud cover and light exposure are evident in the completed orthomosaic, however this has had no impact on the results.

5.2 Conclusion

The UAS landscape survey conducted at Lingfield, Surrey, has successfully produced a detailed visual record of the pre-development landscape. A series of denuded ridge and furrow earthworks were recorded in the eastern and northern parts of the site. Modern mechanical ploughing was also noted within a no longer extant field parcel that was defined in the data as micro-topographical earthworks. Further relict field boundaries, that are depicted on historic mapping, were also noted.

5.3 Recommendations

It is recommended that a targeted geophysical survey of the level terrace area would be desirable to determine the presence or absence of archaeological features at a subsurface level. This is advised due to the absence of agricultural activity at this location and the preservation that might be afforded were such features encountered.

6. Sources

6.1 Bibliography

Chartered Institute for Archaeologists (CIfA). 2022. *Code of Conduct*. Reading, Chartered Institute for Archaeologists.

Cooper, E. 2022. L*and West of Station Road, Lingfield. Archaeological Desk Based Assessment*. HCUK Group unpublished report. Reference 07677A

Historic England (HE). 2017a. *Historic England Photogrammetric Applications for Cultural Heritage, Guidance for Good Practice*. Swindon: Historic England.

Historic England (HE). 2017b. *Understanding the Archaeology of Landscapes - A Guide to Good Recording Practice (Second Edition)*. Swindon: Historic England.

6.2 Websites

BGS. 2023. *British Geological Survey - Geology of Britain Viewer*. Available from: https://geologyviewer.bgs.ac.uk (Accessed 17/04/2023)

Appendix 1 – RGB Processing Report

Lingfield

Processing Report
06 April 2023

Survey Data

Fig. 1. Camera locations and image overlap.

Number of images:	389	Camera stations:	389
Flying altitude:	73.3 m	Tie points:	144,244
Ground resolution:	1.61 cm/pix	Projections:	1,356,590
Coverage area:	0.0716 km²	Reprojection error:	1.11 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
L1D-20c, 28.0 mm f/2.8 ...	5464 x 3640	10.26 mm	2.41 x 2.41 µm	No

Table 1. Cameras.

Camera Calibration

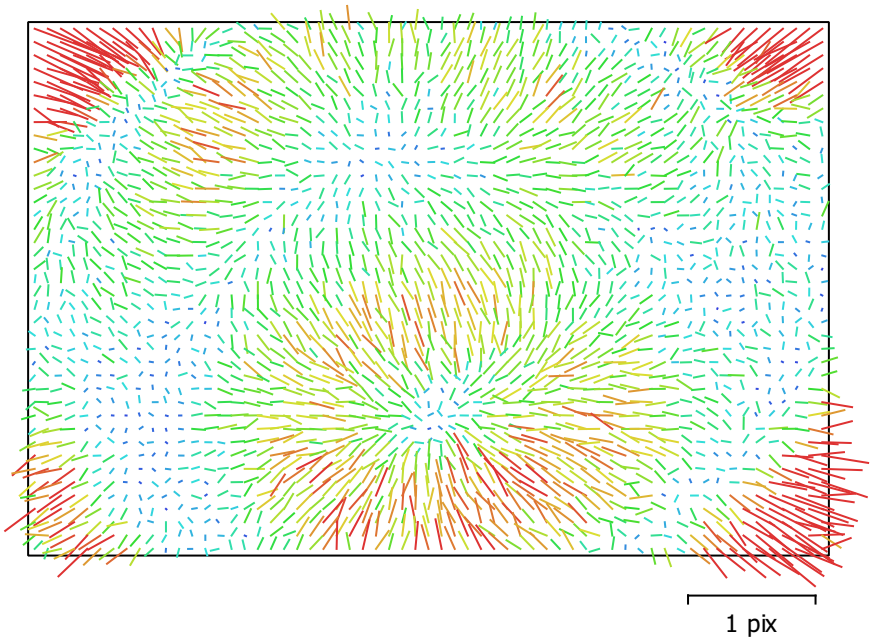


Fig. 2. Image residuals for L1D-20c, 28.0 mm f/2.8 (10.26mm).

L1D-20c, 28.0 mm f/2.8 (10.26mm)

389 images

Type	Resolution	Focal Length	Pixel Size
Frame	**5464 x 3640**	**10.26 mm**	**2.41 x 2.41 µm**

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
F	**4451.75**	2.4	1.00	-0.14	-0.05	-0.04	-0.14	-0.47	0.15	-0.01	-0.21	0.25	-0.22
Cx	**-30.9037**	0.44		1.00	-0.01	0.45	0.04	0.10	-0.08	0.07	-0.04	-0.66	0.17
Cy	**-55.4929**	0.55			1.00	-0.12	0.55	0.07	-0.08	0.09	-0.09	0.16	-0.77
B1	**-0.989725**	0.028				1.00	-0.07	0.03	-0.03	0.03	-0.02	-0.19	0.25
B2	**-0.0236747**	0.032					1.00	0.08	-0.05	0.04	-0.02	0.08	-0.48
K1	**-0.0303746**	7.7e-05						1.00	-0.92	0.82	-0.66	-0.13	0.07
K2	**0.0272519**	0.00049							1.00	-0.98	0.89	0.06	0.01
K3	**0.0083236**	0.0013								1.00	-0.97	-0.02	-0.05
K4	**-0.0696737**	0.0013									1.00	-0.03	0.11
P1	**0.00109966**	3.4e-06										1.00	-0.24
P2	**-0.00169223**	3.3e-06											1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

Fig. 3. GCP locations and error estimates.
Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.
Estimated GCP locations are marked with a dot or crossing.

Count	X error (mm)	Y error (mm)	Z error (mm)	XY error (mm)	Total (mm)
7	3.85296	6.40105	2.99018	7.4712	8.04736

Table 3. Control points RMSE.
X - Easting, Y - Northing, Z - Altitude.

Label	X error (mm)	Y error (mm)	Z error (mm)	Total (mm)	Image (pix)
point 1	5.66486	3.10244	-3.68812	7.43761	0.623 (11)
point 2	-2.62955	4.42985	3.06315	5.99341	0.132 (19)
point 3	-3.26942	-12.7617	-3.29986	13.5809	0.153 (21)
point 4	5.48254	6.69661	-0.0744503	8.65496	0.124 (13)
point 5	0.939086	1.85531	1.60111	2.62443	0.102 (36)
point 6	-4.53246	-6.18328	4.61005	8.94587	0.124 (28)
point 7	-1.65506	2.8608	-2.21188	3.97691	0.137 (23)
Total	**3.85296**	**6.40105**	**2.99018**	**8.04736**	**0.208**

Table 4. Control points.
X - Easting, Y - Northing, Z - Altitude.

Digital Elevation Model

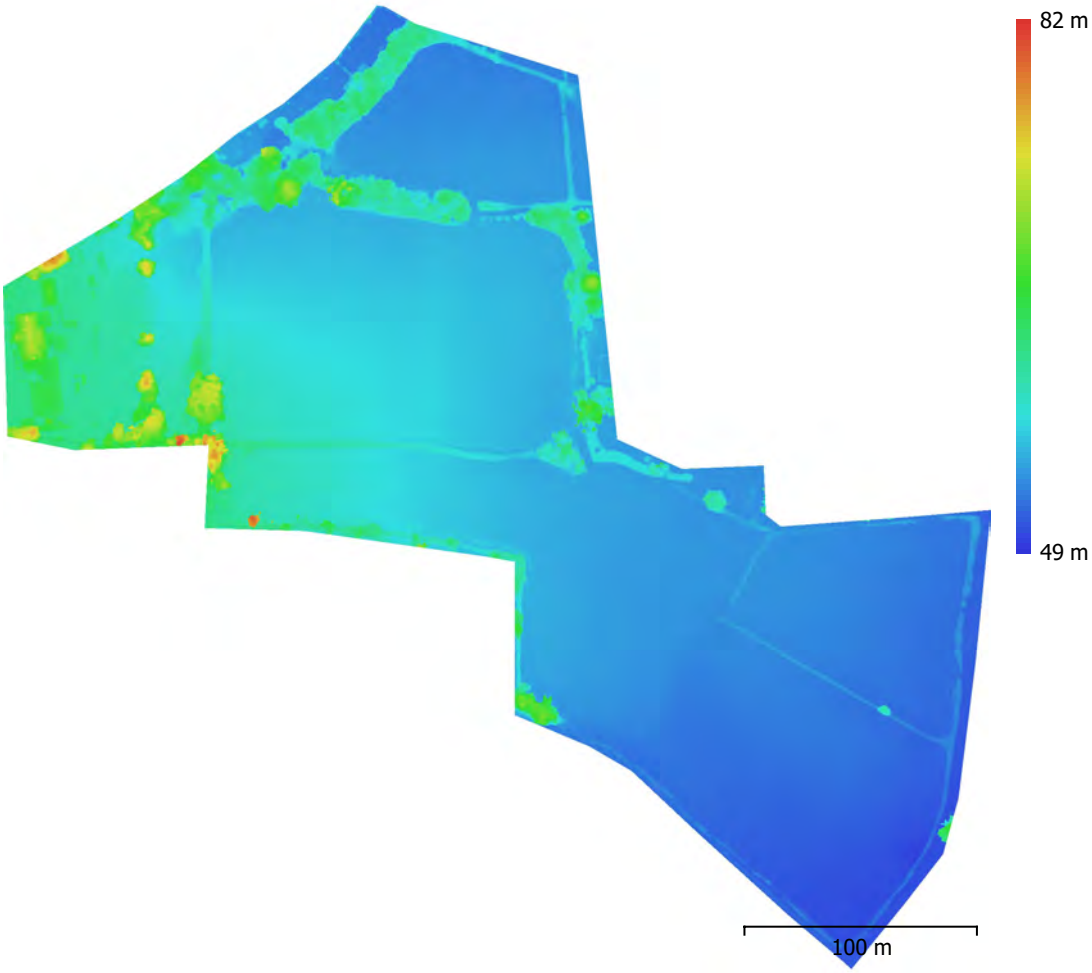


Fig. 4. Reconstructed digital elevation model.

Resolution:	13.6 cm/pix
Point density:	53.8 points/m²

Processing Parameters

General	
Cameras	389
Aligned cameras	389
Markers	7
Shapes	
Polygon	1
Coordinate system	OSGB36 / British National Grid + ODN height (EPSG::7405)
Rotation angles	Yaw, Pitch, Roll
Tie Points	
Points	144,244 of 168,308
RMS reprojection error	0.163365 (1.10744 pix)
Max reprojection error	0.679184 (44.2613 pix)
Mean key point size	5.97161 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	10.2228
Alignment parameters	
Accuracy	Medium
Generic preselection	Yes
Reference preselection	Source
Key point limit	1,000,000
Key point limit per Mpx	1,000,000
Tie point limit	4,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	No
Matching time	6 minutes 31 seconds
Matching memory usage	442.06 MB
Alignment time	7 minutes 15 seconds
Alignment memory usage	139.87 MB
Optimization parameters	
Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	10 seconds
Date created	2023:04:05 15:19:01
Software version	2.0.1.15986
File size	43.16 MB
Depth Maps	
Count	389
Depth maps generation parameters	
Quality	Medium
Filtering mode	Mild
Max neighbors	16
Processing time	16 minutes 5 seconds
Memory usage	1.20 GB
Date created	2023:04:06 07:41:31
Software version	2.0.1.15986
File size	694.08 MB
Point Cloud	
Points	28,445,672

Point attributes	
Position	
Color	3 bands, uint8
Normal	
Point classes	
Created (never classified)	28,445,672
Depth maps generation parameters	
Quality	Medium
Filtering mode	Mild
Max neighbors	16
Processing time	16 minutes 5 seconds
Memory usage	1.20 GB
Point cloud generation parameters	
Processing time	14 minutes 28 seconds
Memory usage	6.84 GB
Date created	2023:04:06 07:55:59
Software version	2.0.1.15986
File size	373.00 MB
Model	
Faces	4,068,975
Vertices	2,039,035
Vertex colors	3 bands, uint8
Depth maps generation parameters	
Quality	Medium
Filtering mode	Mild
Max neighbors	16
Processing time	16 minutes 5 seconds
Memory usage	1.20 GB
Reconstruction parameters	
Surface type	Arbitrary
Source data	Depth maps
Interpolation	Enabled
Strict volumetric masks	No
Processing time	4 minutes 29 seconds
Memory usage	5.30 GB
Date created	2023:04:06 08:20:21
Software version	2.0.1.15986
File size	170.85 MB
DEM	
Size	3,231 x 3,197
Coordinate system	OSGB36 / British National Grid + ODN height (EPSG::7405)
Reconstruction parameters	
Source data	Mesh
Interpolation	Enabled
Processing time	15 seconds
Memory usage	287.42 MB
Date created	2023:04:06 09:16:14
Software version	2.0.1.15986
File size	26.60 MB
Orthomosaic	
Size	12,924 x 12,788
Coordinate system	OSGB36 / British National Grid + ODN height (EPSG::7405)
Colors	3 bands, uint8
Reconstruction parameters	
Blending mode	Mosaic
Surface	DEM

Enable hole filling	Yes
Enable ghosting filter	No
Processing time	3 minutes 40 seconds
Memory usage	841.02 MB
Date created	2023:04:06 09:19:08
Software version	2.0.1.15986
File size	1.68 GB

System

Software name	Agisoft Metashape Professional
Software version	2.0.1 build 15986
OS	Windows 64 bit
RAM	255.68 GB
CPU	Intel(R) Xeon(R) W-2275 CPU @ 3.30GHz
GPU(s)	NVIDIA GeForce GTX 1660 Ti

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GEOPHYSICAL (GRADIOMETER) SURVEY

LAND TO THE WEST OF STATION ROAD, LINGFIELD

CENTRED AT NGR TQ 39197 43615

REPORT PREPARED BY DAVID BUNN

ON BEHALF OF

HCUK GROUP AND WOOLBRO GROUP & MORRIS INVESTMENT

MAY 2023

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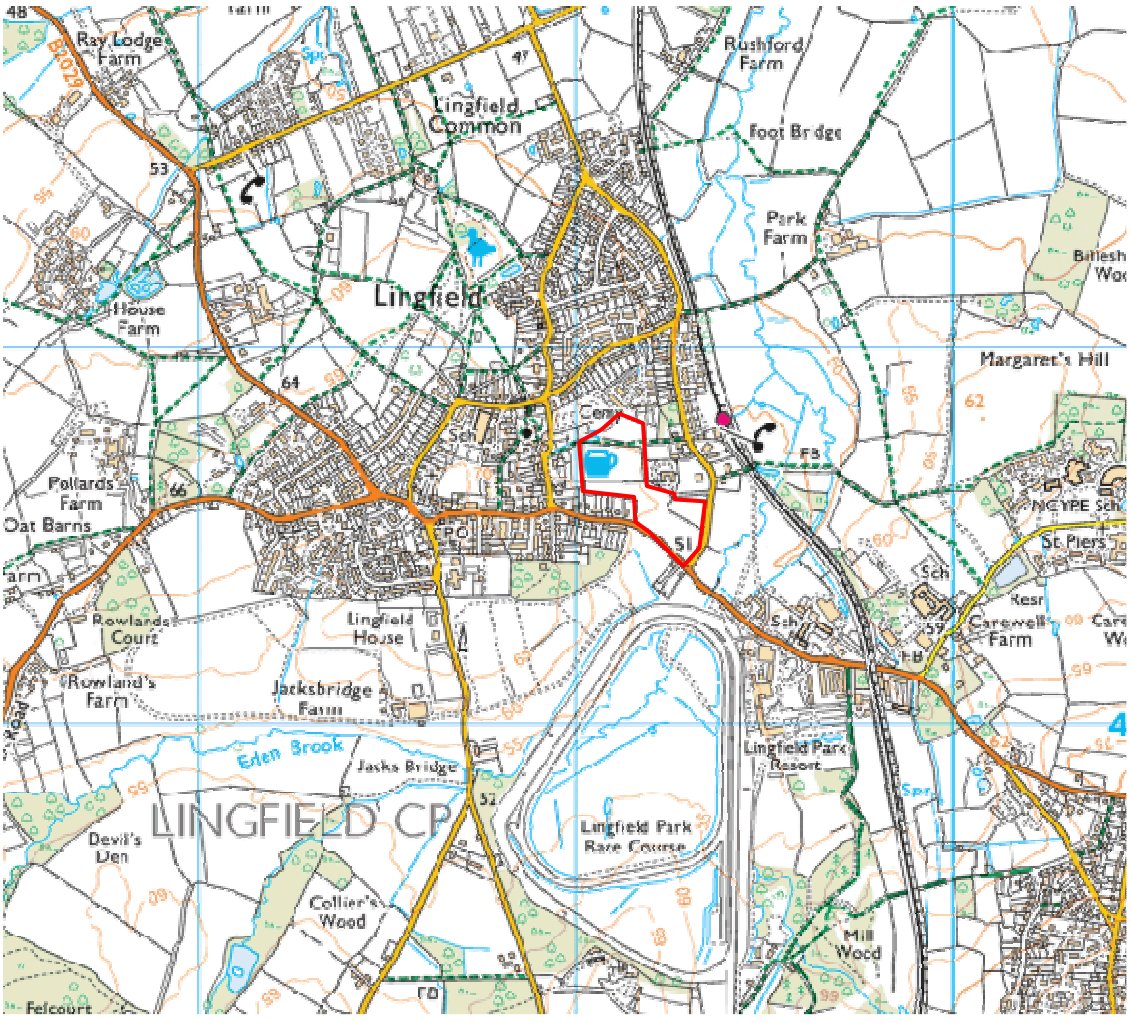
PRE-CONSTRUCT GEOPHYSICS LTD
47, MANOR ROAD, SAXILBY, LINCOLN, LN1 2HX
TEL: 01522 704900/07734958015

e-mail: pcgeophysics@outlook.net
www.geophysicalsurveying.uk

Non technical summary

- *A geophysical survey was undertaken on land to the west of Station Road, Lingfield.*
- *For the most part, the geophysical survey has not identified magnetic variation that can be attributed to archaeological remains with any level of confidence. A possible exception is an isolated linear anomaly that exhibits some potential as a buried ditch though alternative interpretations as a recently removed boundary or a land drain are also feasible.*
- *The majority of stronger responses clearly signify modern features or materials, including at least two buried services and boundary ferrous.*
- *It is concluded that the proposed development area has low archaeological potential.*



Location of site
(1:25000)

1.0 Introduction

Acting for Woolbro Group and Morris Investment, HCUK Group commissioned a fluxgate gradiometer survey of land to the west of Station Road, Lingfield (centred at NGR TQ 39197 43615).

The objective of the geophysical survey is to provide information relating to potential archaeological resources within the site, forming part of a heritage assessment designed to inform a planning application for the construction of c.99 residential dwellings, with associated access roads and landscaping.

This report references information contained within an Archaeological Desk Based Assessment prepared by HCUK Group (Cooper, 2022).

The proposed development site comprises approximately 6.2ha of agricultural land located in the village of Lingfield, Surrey.

The site is bounded to the north, north-east and west by residential properties; to the south-east by Station Road; to the south by the B2028; to the north-west by Peter and St Pauls Church. An east-west aligned public footpath extends across the northern extent of the site.

3.0 Geology and topography

The solid geology comprises Tunbridge Wells Sand - Interbedded Sandstone and Siltstone, sedimentary bedrock formed approximately 134 to 139 million years ago during the Cretaceous Period (BGS, 2023).

No superficial geological deposits have been identified within the site.

The northern region is situated c.58m AOD, the ground level to c.51m at the southern boundary.

4.0 Archaeological Context

An Archaeological Desk-Based Assessment has been prepared by HCUK, which includes a detailed review of the recorded archaeological resource (Cooper, 2022).

The assessment has confirmed that the Site contains no designated archaeological assets such as scheduled monuments or registered battlefields. However, there is one Scheduled Monument within the 1km Study Area, the Linfield Village Cage and St Peter's Cross (NHLE1005942) which sits within the village of Lingfield, this is also designated as a County Site of Archaeological Importance. The assessment identified sixty-two archaeological monument records on the Surrey Historic Environment Record (SHER) within the 1km study area. None of these entries are within the Site itself but there are five assets directly adjacent to the Site boundary. Four of these assets relate to New Place Farm, which sits to the north-east of the Site, and the fifth relates to undated deposits identified during a previous archaeological investigation. The SHER records two Areas of High Archaeological Potential within the 1km Study Area, the St Peter and St Paul's 14 th century church and church area that sits immediately adjacent to the north-western boundary of the Site and the Plaistow Street, Lingfield- Historic Town Core that lies 300m to the west of the Site.

During the site walkover an area of ridge and furrow was identified in the south-east and north of the Site. LIDAR coverage of the Site did confirm the presence of ridge and furrow at this location and therefore further investigations within the Site may be needed to ascertain the form and function of the earthworks.

This assessment has indicated that there is a high potential for archaeological remains to be identified within the Site, probably relating to the Medieval, Post Medieval and Modern periods.

5.0 Methodology

5.1 The survey methodology is based on relevant heritage industry guidance and best practice advice, including the *EAC Guidelines for the use of Geophysics in Archaeology* (Schmidt et al. 2016), and the '*Standard and Guidance for Archaeological Geophysical Survey'* (Chartered Institute for Archaeologists, 2014).

5.2 Fluxgate Gradiometry is a non-intrusive scientific prospecting tool that is used to determine the presence/absence of some classes of sub-surface archaeological features (e.g. pits, ditches, kilns, and occasionally stone walls).
The use of magnetic surveys to locate sub-surface ceramic materials and areas of burning, as well as magnetically weaker features, is well established, particularly on large green field sites. The detection of anomalies requires the use of highly sensitive instruments; in this instance the Bartington 601 Dual Fluxgate Gradiometer. This is accurately calibrated to the mean magnetic value of each survey area. Two sensors mounted vertically and separated by 1m measure slight, localised distortions of the earth's magnetic field, which are recorded via a data logger.

This technique only records magnetic variation in relation to natural background levels, established by careful selection of magnetically 'quiet' zones where instrument sensors are calibrated to 0nT. As such, the magnetic response of archaeological remains will vary according to geology/pedology, with a possibility that buried features could remain undetected should their magnetic susceptibility closely match that of the surrounding soils. Additionally, some remains may be buried beyond the effective 1m - 2m range of the instrumentation; for example beneath alluvium. Back-filled shallow pits or ditches might also exhibit minimal variation.

5.3 The fieldwork was undertaken on the 8th and 9th of May, 2023. The zigzag traverse methodology was employed, with readings taken at 0.25m intervals along 1.0m wide traverses.

The survey grid was established by Global Positioning Satellite using a Leica GS015 RTX, to an accuracy of +/- 0.1m.

The data were processed by using *Terrasurveyor V3*.

The raw data set is presented as a greyscale image on Fig. 2 (data clipped to +/-20nT).

The trace plot image is presented on Fig. 3 (processed unclipped data).

A 'Despike' function was applied to reduce the effect of extreme readings induced by metal objects, and 'Destripe' to eliminate striping introduced by zigzag traversing. The data were clipped to +/-3nT on the greyscale images of the processed data (Fig. 4).

Anomalies in excess of +/-10nT are highlighted pink and blue on the interpretive figure (Fig.5). These are characterised magnetically as dipolar 'iron spikes', often displaying strong positive and/or negative responses, which reflect ferrous-rich objects. Examples include those forming/deposited along current or former boundaries (e.g. wire fencing), services and random scatters of horseshoes, ploughshares etc across open areas. Fired (ferro-enhanced) material, such as brick/tile fragments (often where the latter are introduced during manuring or land drain construction) usually induce a similar though predominately weaker response, closer to c+/-5nT (highlighted in pink/blue on the interpretive image). Collectively, concentrations of such anomalies typically indicate probable rubble spreads, such as backfilled ponds/ditches and demolished buildings. On a cautionary note, fired clay associated with early activity has the same magnetic characteristics as modern brick/tile rubble. As such, the interpretation of such variation must consider the context in which it occurs.

It should be noted that the strong responses of modern features can mask those of underlying archaeological remains.

This technique only records magnetic variation (relative to natural background levels). As such, the magnetic response of archaeological remains will vary according to geology/pedology. Additionally, remains may be buried beyond the effective 1 - 2m range of the instrumentation.

A digital archive of the geophysical data and report will be retained by PCG.

6.0 Results and discussion (Figs. 2 – 5)

The survey recorded a magnetically weak isolated linear anomaly in the mid-northern part of F3 (Fig. 5: **1**, red line). This extends approximately north-east to south-west toward the northern edge of a magnetically strong buried service (**2**: pink and blue/blue line), with no geophysical indications of any continuation beyond into the southern side of the field. This has been primarily interpreted as a buried ditch of potential archaeological origin, though it is also speculated that it might reflect a relatively recent field boundary. However, no such feature is depicted on historic maps (Cooper, 2022). This hypothesis references a possible association with the service that extends along the extent of a known former boundary. Similarly, a further north-south aligned service that conjoins with it in the central part of the field also corresponds to a recent boundary (**3**).

An enigmatic east-west aligned, partially fragmented, array of strong discrete anomalies was registered in F2 (**4**: dashed blue line). Clearly of modern origin, these extend from the eastern boundary and terminate in the western side of the field. However, it has not been possible to establish a specific origin by non-intrusive investigation (e.g. as remnants of a buried service or a linear array of *in situ* remains of metal posts).

Strong readings (pink and blue) were also recorded in close proximity to existing field boundaries, with more isolated examples (typically) indicators of miscellaneous ferrous-rich objects contained within the plough soil.

The discussed anomalies were recorded against a backdrop of minimal natural variation (greenscale). Slighter stronger responses are more likely to reflect either near surface natural inconsistencies or magnetically weak objects in the plough soil rather than pits, though an archaeological origin for such anomalies cannot be entirely discounted (e.g. green dots).

7.0 Conclusions

For the most part, the geophysical survey has not identified magnetic variation that can be attributed to archaeological remains with any level of confidence. A possible exception is an isolated linear anomaly that exhibits some potential as a buried ditch though alternative interpretations as a recently removed boundary or a land drain are also feasible.

The majority of stronger responses clearly signify modern features or materials, including at least two buried services and boundary ferrous.

The survey has not recorded clearly-defined traces of relict ridge and furrow cultivation, the lack of magnetic contrast suggesting that it might have been almost completely levelled by subsequent ploughing.

With reference to the geophysical survey results, it is concluded that the proposed development area has low archaeological potential. This concurs with the findings of the Archaeological Desk Based Assessment,

8.0 Acknowledgements

Pre-Construct Geophysics thanks HCUK Group for this commission.

9.0 References

British Geological Survey. 2023. Geology of Britain viewer, 1:50,000 geological mapping, bedrock and superficial - http://mapapps.bgs.ac.uk/geologyofbritain/home.html

CIFA 2014 *Standard and Guidance for Archaeological Geophysical Survey.* Chartered Institute for Archaeologists.

Cooper, E. 2022 *Land West of Station Road, Lingfield*. Archaeological Desk Based Assessment, Project Ref 07743A.

Schmidt, A; Linford, Linford, P; N; David, A; Gaffney, C; Sarris, A; & Fassbinder, J; 2016. EAC *Guidelines for the use of Geophysics in Archaeology: Questions to Ask and Points to Consider. EAC Guidelines 2.* Euopae Archaeologiae Consilium.

Fig.2: Greyscale images of unprocessed data

Fig.3: Trace plot images

Fig.4: Greyscale images of processed data

Fig.5: Interpretation