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An archaeological earthwork survey by LiDAR study for land off Station Road, Hilary Bevins Close and Main Street, Higham on the Hill, Leicestershire (SP 379 956)

Matthew Beamish and Patrick Clay

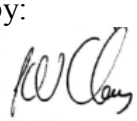
ULAS Report No.2014-162

An archaeological earthwork survey by LiDAR study for land off Station Road, Hilary Bevins Close and Main Street, Higham on the Hill, Leicestershire (SP 379 956).

Matthew Beamish and Patrick Clay

For: David Wilson Homes East Midlands Ltd

Checked by:

Signed: 

Date: 18/09/2014

N**ame:** Patrick Clay

University of Leicester
Archaeological Services
University Rd., Leicester, LE1 7RH
Tel: (0116) 2522848 Fax: (0116) 2522614

ULAS Report Number 2014-162

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CONTENTS

FIGURES

An archaeological earthwork survey by LiDAR study for land off Station Road, Hilary Bevins Close and Main Street, Higham on the Hill, Leicestershire (SP 379 956).

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Summary

An archaeological earthwork survey by LiDAR study has been prepared for David Wilson Homes by University of Leicester Archaeological Services (ULAS) for land adjacent to Hilary Bevins Close, Higham on the Hill, Leicestershire, (SP 379 956). The survey was undertaken to address a planning condition in advance of the proposed residential re-development of the site, which is currently under pasture.

Previous desk-based assessments and geophysical survey (Clarke 2012; Clarke and Clay 2013; Richardson 2013) identified the remains of well-preserved earthworks pertaining to medieval ridge and furrow.

The archive will be deposited with Leicestershire Museums as part of Accession Number X.A114.2012

Introduction

In accordance with National Planning Policy Framework (NPPF), Section 12 (Conserving and Enhancing the Historic Environment) this document outlines the results of archaeological earthwork survey by LiDAR study, at Hilary Bevins Close and Main Street,, Higham on the Hill, Leicestershire (NGR: SP 379 956). The assessment was commissioned by David Wilson East Midlands Ltd from University of Leicester Archaeological Services (ULAS) in advance of the proposed residential of the site, which is currently under pasture and used for grazing.

The village of Higham on the Hill is located approximately 3km to the north-east of Nuneaton and 4km to the north-west of Hinckley, close to the Leicestershire-Warwickshire border (Figure 1). The assessment area is located in between the disused Ashby and Nuneaton Joint Railway Line and Main Street, on the eastern side of Station Road, adjacent to Hilary Bevins Close (Figure 2).

The assessment area consists of three fields covering approximately 3.5 ha of land, lying at a height of *c*. 110m aOD. The Ordnance Survey Geological Survey of Great Britain Sheet 156 indicates that the underlying geology is likely to consist of Wolston Sands and Gravel overlying Mercia Mudstone.

Desk-based assessments have been undertaken for the area (Clarke 2012; Clarke and Clay 2013). The Leicestershire & Rutland Historic Environment Record indicates that this site contains well-preserved Ridge and Furrow earthworks, which represent the upstanding remains of medieval and post-medieval agricultural cultivation. Ridge and Furrow earthworks are a characteristic feature of the Leicestershire landscape and are a diminishing resource.

The Senior Planning Archaeologist, Leicestershire County Council has therefore requested a survey of the ridge and furrow earthworks prior to the levelling of the ground. This has been secured by Condition 11 of the planning permission (P.A. 14/00503/FUL).

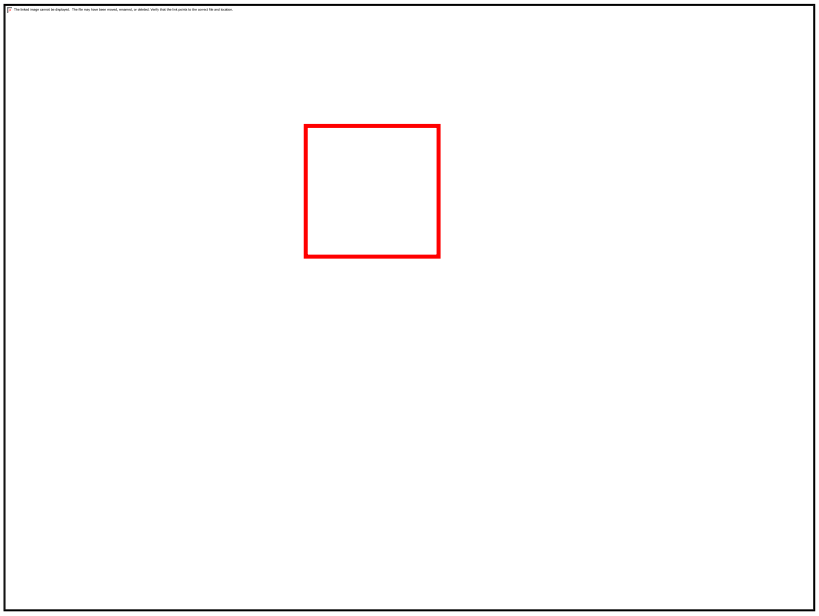


Figure 1: Site location

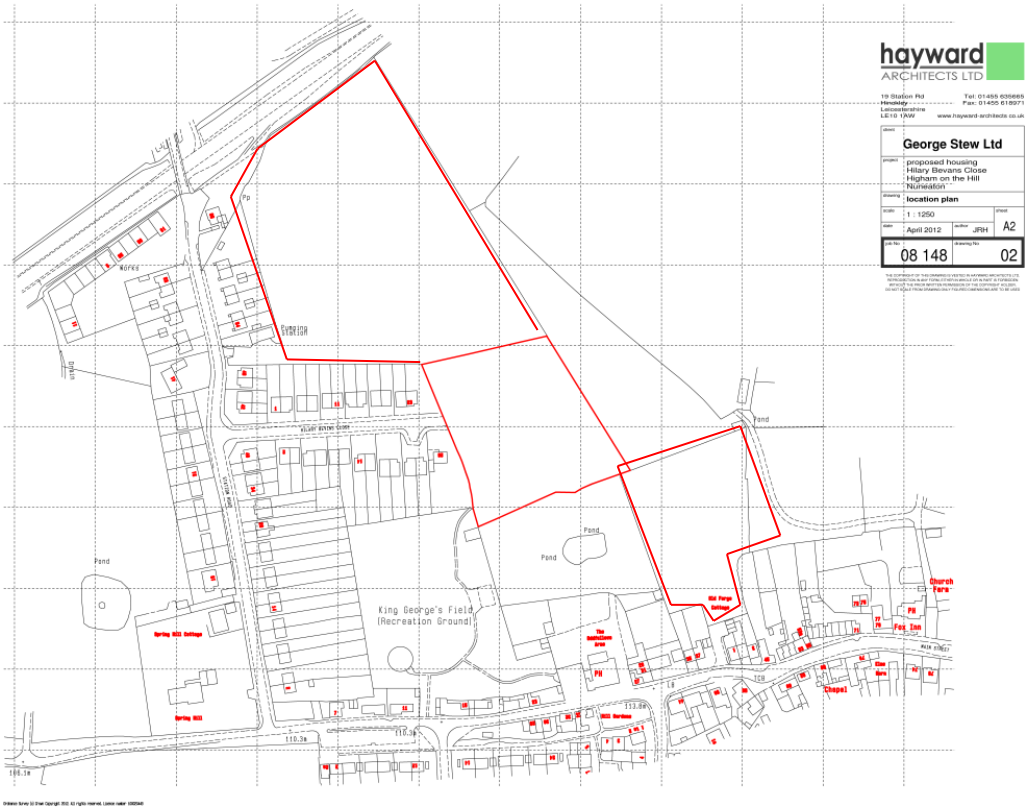


Figure 2: Location of assessment area east of Station Road and Hilary Bevins Close, Higham on the Hill (supplied by Hayward Architects, 50m Grid)

Ridge and Furrow

A survey of the preserved medieval ridge and furrow of Leicestershire undertaken by R.F. Hartley in the 1980s and derived from earlier aerial photographs, shows ridge and furrow aligned roughly south-west to north-east, north to south, and west to east across the site (Figure 3).

Figure 3: R. F Hartley's ridge and furrow survey map of Higham, with assessment area highlighted.

Geophysical Survey and trial trench evaluation

A geophysical survey was undertaken for CgMs Consulting (Richardson 2013). The survey at Higham on the Hill corroborates the findings of the desk-based assessment (Clarke 2012; Clarke and Clay 2013) and field evaluation (Hyam 2012), with the only probable archaeological anomalies being related to ridge and furrow cultivation (Figure 4). Five 20m evaluation trenches were excavated across the central field none of which revealed any evidence of archaeological features or deposits (Hyam 2012).

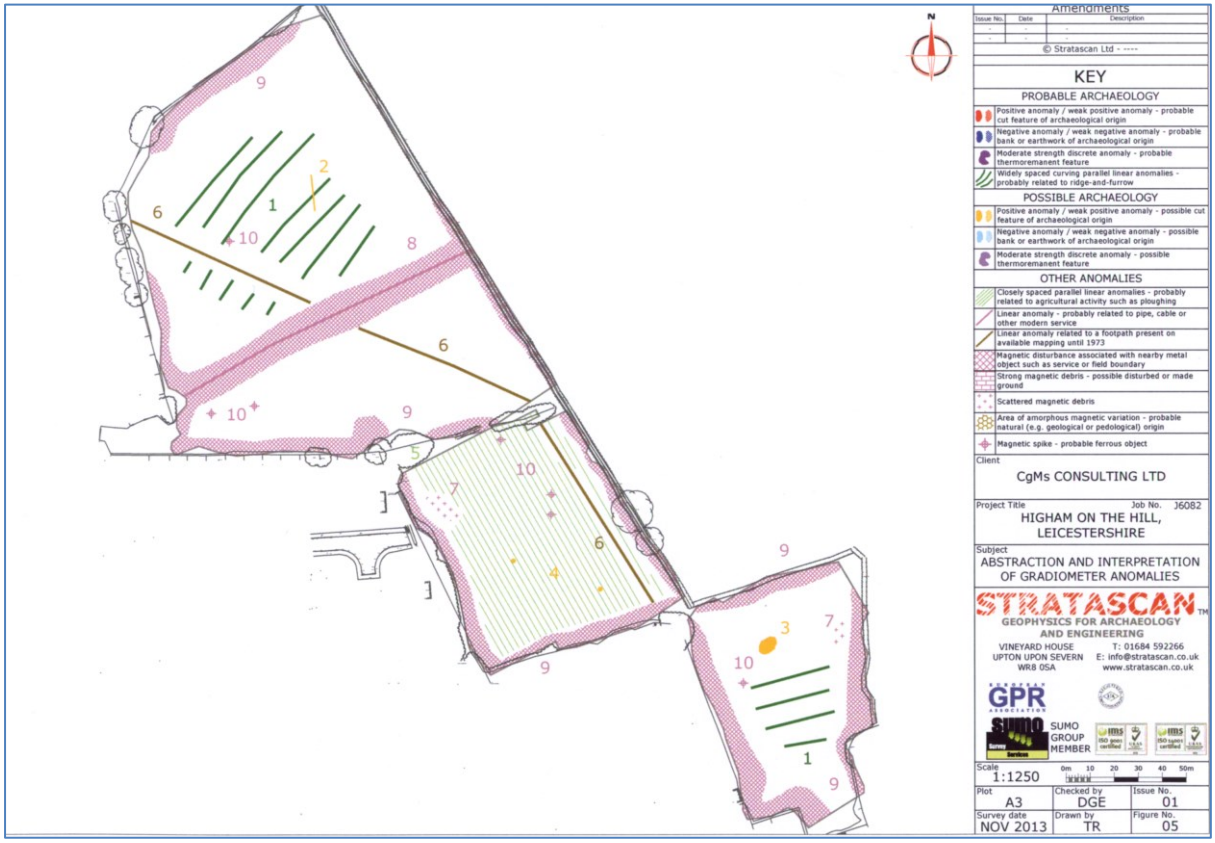


Figure 4: Interpretation of gradiometer anomalies from the geophysical survey (From Richardson 2013, Fig. 5)

Aim of the Survey

The overall aim of the survey was to accurately record the visible ridge and furrow that will be destroyed by the development and to put it into the context of other surviving ridge and furrow in the immediate vicinity.

Methodology

The Written Scheme of Investigation (WSI ULAS 2014) suggested a survey using a Topcon Hyper V Global Positioning System (GPS). This can provide resolution to an accuracy of 10mm. The changes in level of all the earthworks and sections across the earthworks were to be recorded. However following a site visit on 10.09.2014 and discussion with the ULAS LiDAR specialist it was clear that better resolution and greater accuracy could be obtained across a wider area by the analysis of LiDAR data that was available from the Environment Agency.

Provision of LiDAR Data

Composite aerial LiDAR data at 1m resolution was supplied electronically in ASCII file format by National Geomatics Unit of the Environment Agency. The data was flown between 2011 and 2013: details of the data source are given below (p16). The data was acquired in DTM format, that has been filtered, where possible, to remove obstructions such as buildings and vegetation and provide a 'bare-earth' model. If the removal of said obstruction left a gap in the surface data this gap was interpolated by the EA (using an undisclosed algorithm) to

provide a continuous surface.

The methodology used followed that set out by Hannon (Hannon *et al* 2014, 8).

LiDAR ASCII Data Processing

Unless otherwise stated, all operations were conducted in Esri ArcMap10.1 SP1 build 3143.

Each of these files were imported into ArcGIS using the ASCII to Raster function (System Toolboxes>Conversion Tools>To Raster>ASCII to Raster), the output data type was set to 'Float' and the original ASCII filename was retained as the output raster name. These files were placed in a newly created file geodatabase called '15501_HighamontheHill.gdb'.

The two individual files were combined to form one continuous raster using the Mosaic To New Raster Function (System Toolboxes> Data Management Tools>Raster>Raster Dataset>Mosaic To New Raster) using 'British National Grid' as the spatial reference, with the pixel type set to '32_BIT_FLOAT', number of bands set to '1' and the cellsize set to mirror the resolution of the input rasters (i.e. 1). The resulting raster was saved to the same file geodatabase.

Creation of Hillshade layers

To aid feature identification, four basic hillshade layers were generated for each LiDAR flight. 'Hillshades' are a data processing method available in most GIS which allow an artificial sun to be shone from any chosen compass bearing and from angle above the horizon onto a DEM. This process helps identify ground features by casting an artificial shadow behind changes in elevation (for a full discussion of the process see Bewley et al 2005).

Each of these layers were created using the hillshade function (System Toolboxes>Spatial Analyst Tools>Surface>Hillshade). The input raster for each hillshade was the mosaicked DEM or the Clipped DEM if one was generated, for each LiDAR flight. Three basic parameters were utilised to generate the four different hillshade views and Z factor relating to the degree of exaggeration applied to the input DEM, with 1 indicating no exaggeration.

Each output raster was named to preserve the original input DEM information and include the hillshade parameters (e.g.'HH_1m_HS_315_45_1') and saved to '15501_HighamontheHill.gdb'. Once each hillshade was generated they were grouped within the TOC to aid navigation.

Sky-View Factor Analysis

'Sky-View Factor' (SVF) analysis was also applied to the LiDAR data (Zakšek *et al* 2011). This method, instead of applying false shadows to a surface, calculates the volume of sky visible from a given position, a position at the bottom of a ditch affords a lower level of visibility to one atop a mound. This method produces a raster layer showing the volume of sky visible from each position within the raster which can highlight subtle archaeological features. SVF is not a function available in ArcMap, therefore a free to use version of the tool is available online (http://iaps.zrc-sazu.si/index.php?q=en/svf).

To utilise the tool the DEM for the area was exported as a TIFF. This was achieved by right-clicking on the DEM layer within the TOC (Data>Export Data) selecting a destination for the TIFF file and leaving all other parameters at default. Once the TIFF had been exported the SVF tool was run. The exported TIFF was used as the input DEM and Search Radius was left

at the default 10. The Vertical exaggeration was set to either 1, 2 or 3 and Direction set to either 16 or 32, multiple Sky-Views were run for each focus area using a range of values. The tool created an output TIFF file which reflected the name of the input DEM and settings used (e.g. 'LiDAR_1m_SVF_d32_r10_ve3'). This TIFF was then imported into ArcMap and added to the TOC.

The SVF images were then also interrogated and potential features recorded in the same manner as is detailed above for the initial feature identification process.

Feature Identification

The hillshade layers that had been generated were systematically analysed for potential archaeological features, working from north to south and west to east. This was achieved by cycling through each of the hillshade and Sky View Factor layers individually. The shapefile layers containing both the HER and scheduled monument data were enabled to prevent re-identification of an already recorded archaeological feature.

Once the areas of ridge and furrow within the study area had been identified as part of the LiDAR analysis, the hillshade plots that contained the clearest representations of the different elements were combined using varying transparencies to produce figures contained in this report.

Profiles

Profiles were generated with ARCGIS from the DTM data using the 3d Analyst tool, Interpolate line, choosing the profile line and Profile Graph options. The profiles are presented individually (Figure 6-Figure 8) and together at uniform scale (Figure 9).

Images were processed in Standard Raster image and CAD packages.

Results

Ridge and furrow is the product of ploughing strip-shaped plots using a non-reversible plough in a clockwise manner. The mould board turned the soil into the centre creating a self-draining ridge. This form of topography seems to be normally associated with common fields systems although such systems did not invariably have ridge and furrow in all regions. Common fields seem to have originated by the late Saxon period. They comprised strips of land scattered throughout the furlongs and fields giving equal shares of good and bad land. Such fields in the East Midlands normally had a three or four field system by which part of the land was left fallow on a rotating basis. They reached their maximum extent with the population rise of the 13th century. The East Midlands was a classic common field landscape in the Middle Ages and has particularly good survival of ridge and furrow. This reflects the move to sheep farming in the century after the Black Death followed by a concentration on livestock production in many parishes, particularly on poorer soils, which continued to the present day. Ploughing, for instance, to improve grassland has contributed to widespread destruction since WWII (Hall 1982; 1988; Roberts and Wrathmell 2000).

Leicestershire still had extensive surviving areas of ridge and furrow in the late 1940s when the RAF undertook vertical air surveys. This extent has been plotted by Leicestershire County

Council and published for many areas by Fred Hartley in a series of volumes on the county's earthworks. Higham on the Hill is included in Hartley 2008, Map 13.

In the late 1990s, English Heritage sponsored a survey of surviving ridge and furrow in the Midlands: Leicestershire, Northamptonshire, Rutland, Cambridgeshire, Bedfordshire, Buckinghamshire and Oxfordshire. This indicated widespread destruction of open fields over the last half century. The survey also listed 43 townships with significant surviving areas of ridge and furrow. Of these, nine were in Leicestershire: Owston and Newbold, Hungarton, Hallaton, Welham, Thorpe Langton, Saddington, Mowsley and Gumley (Anderton and Went 2002; Hall 2001).

Figure 5: Composite hillshade plot of LiDAR 1m DTM data

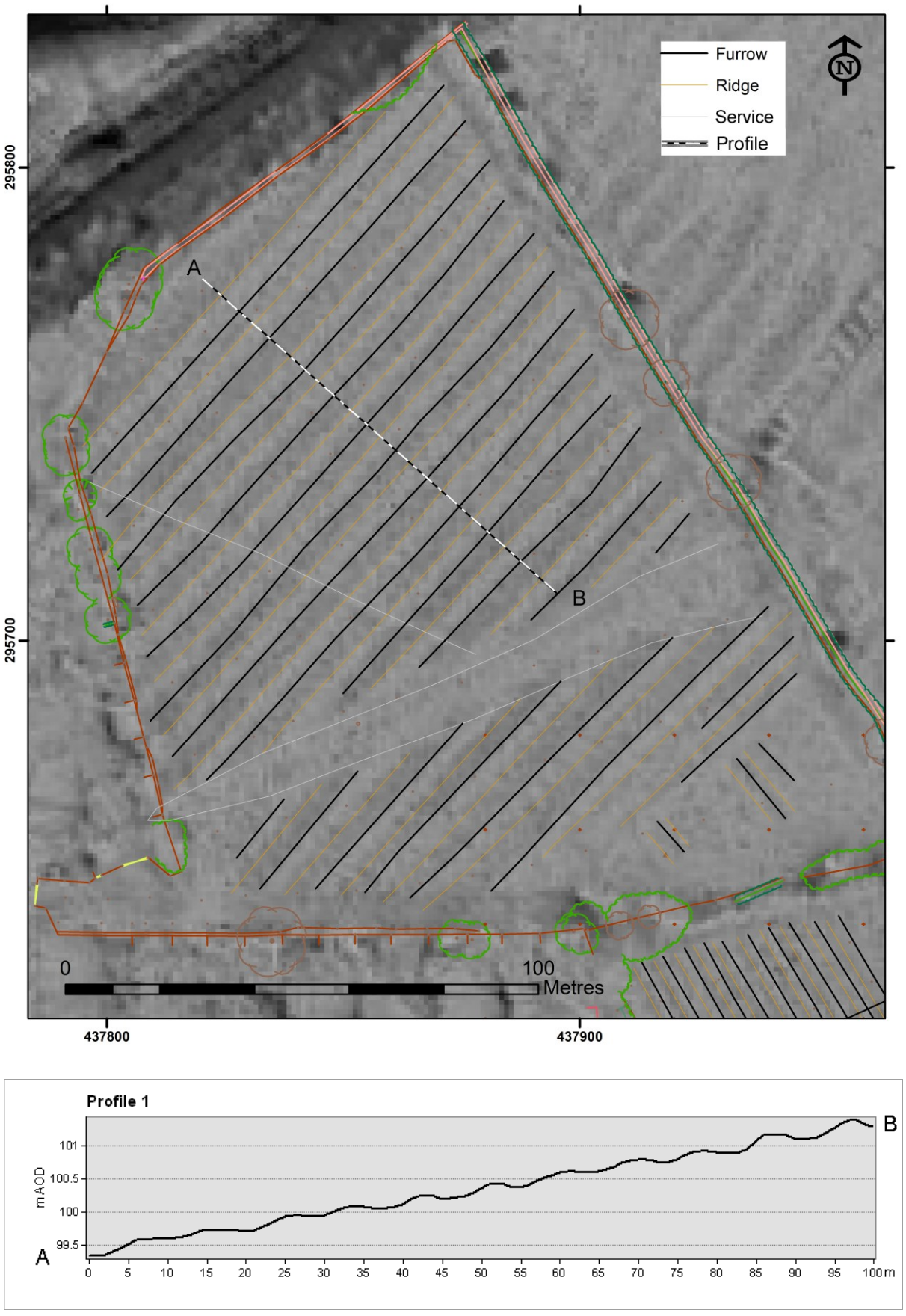
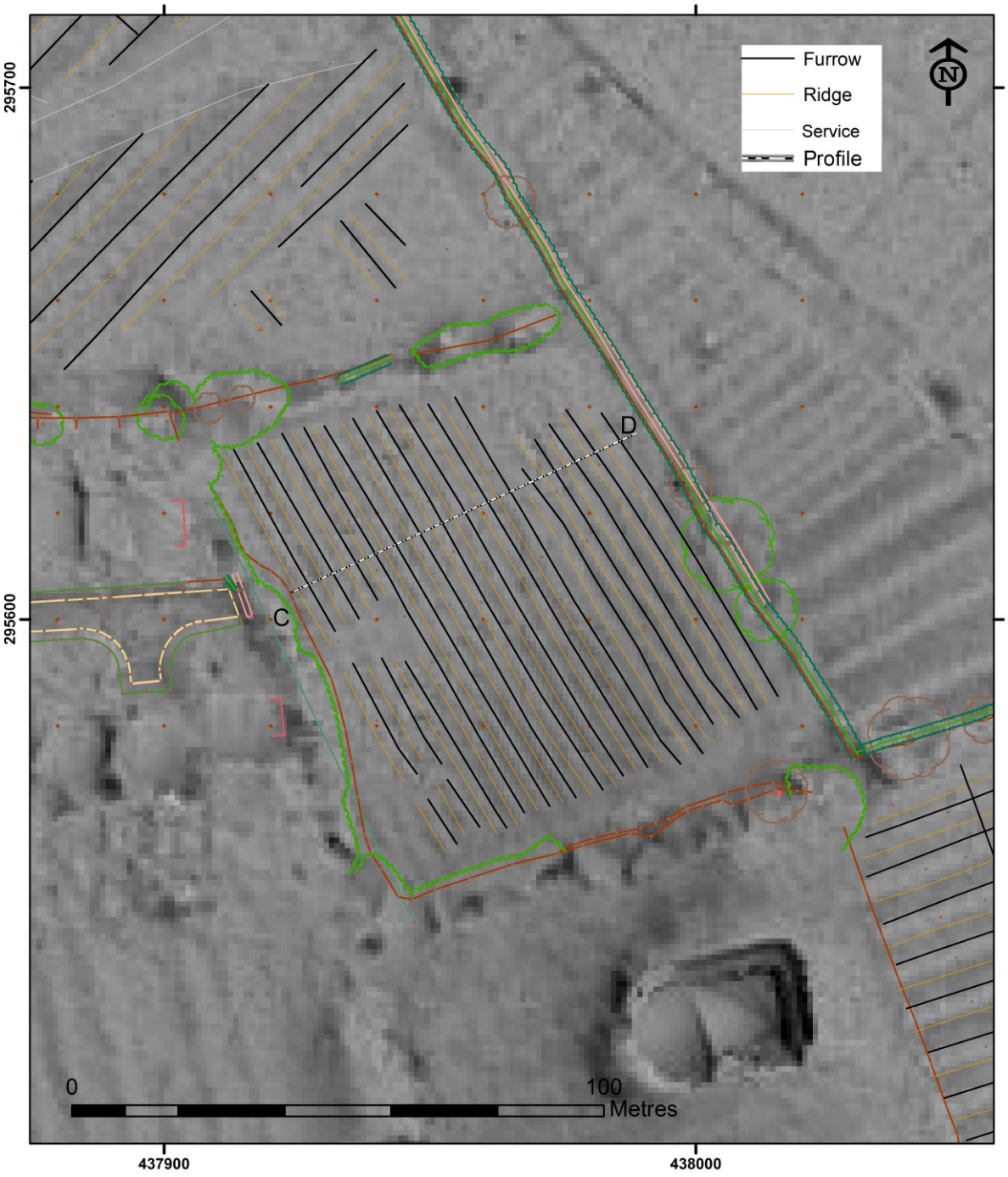


Figure 6: Composite hillshade plot. Profile 1

Development area mapping (supplied).
LiDAR Source – Environment Agency



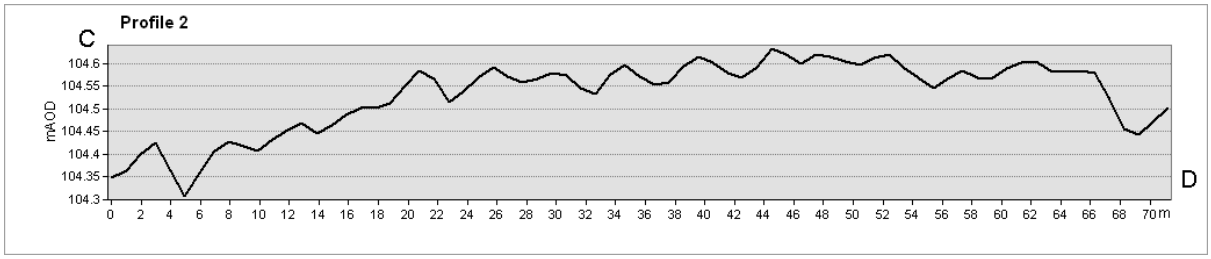
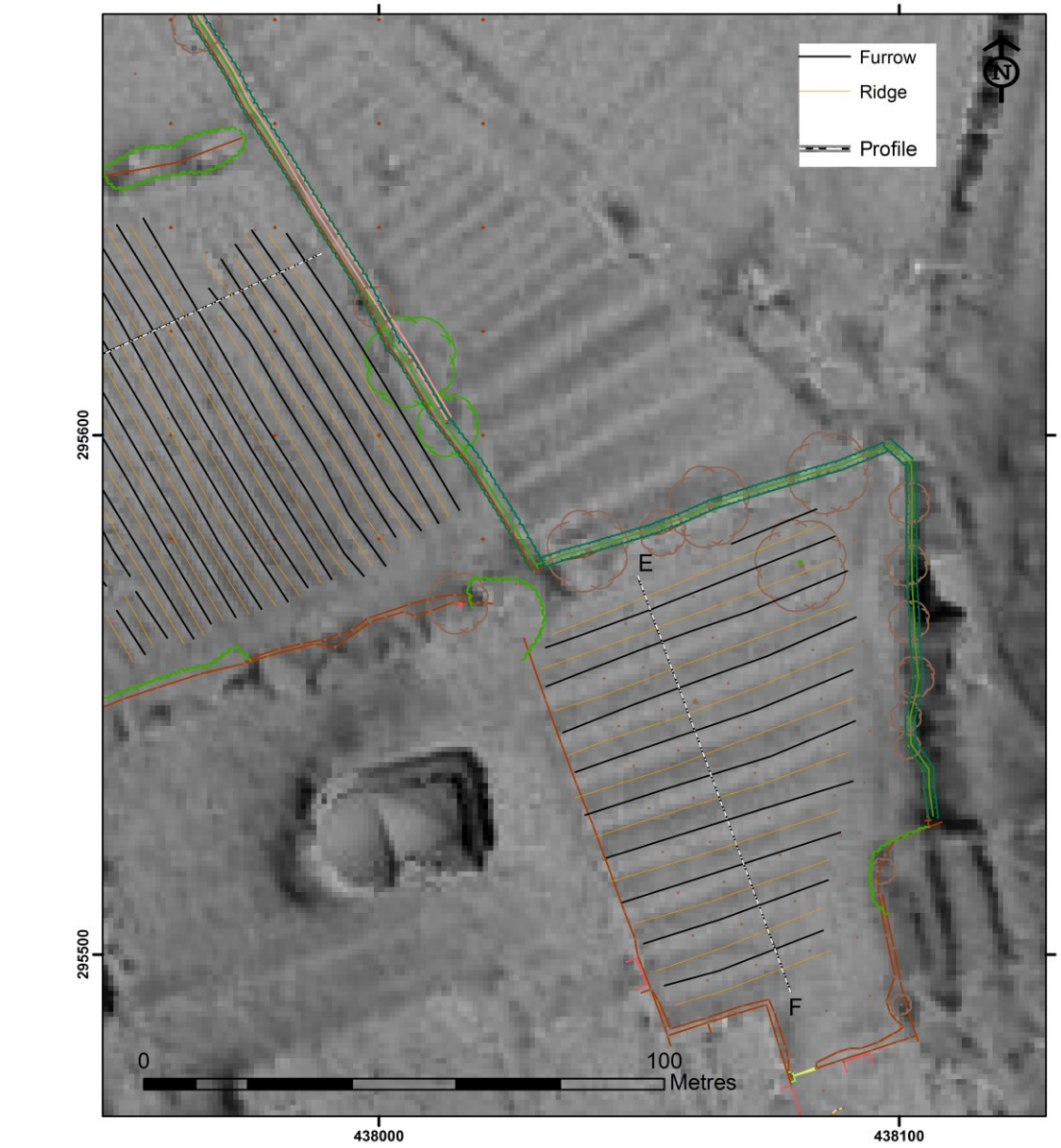


Figure 7: Composite hillshade plot. Profile 2

Development area mapping (supplied).
LiDAR Source – Environment Agency



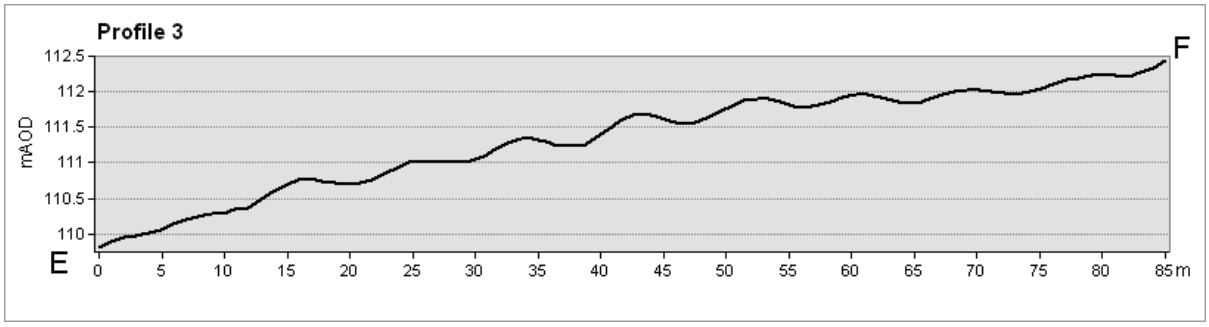


Figure 8: Composite hillshade plot. Profile 3

Development area mapping (supplied).
LiDAR Source – Environment Agency

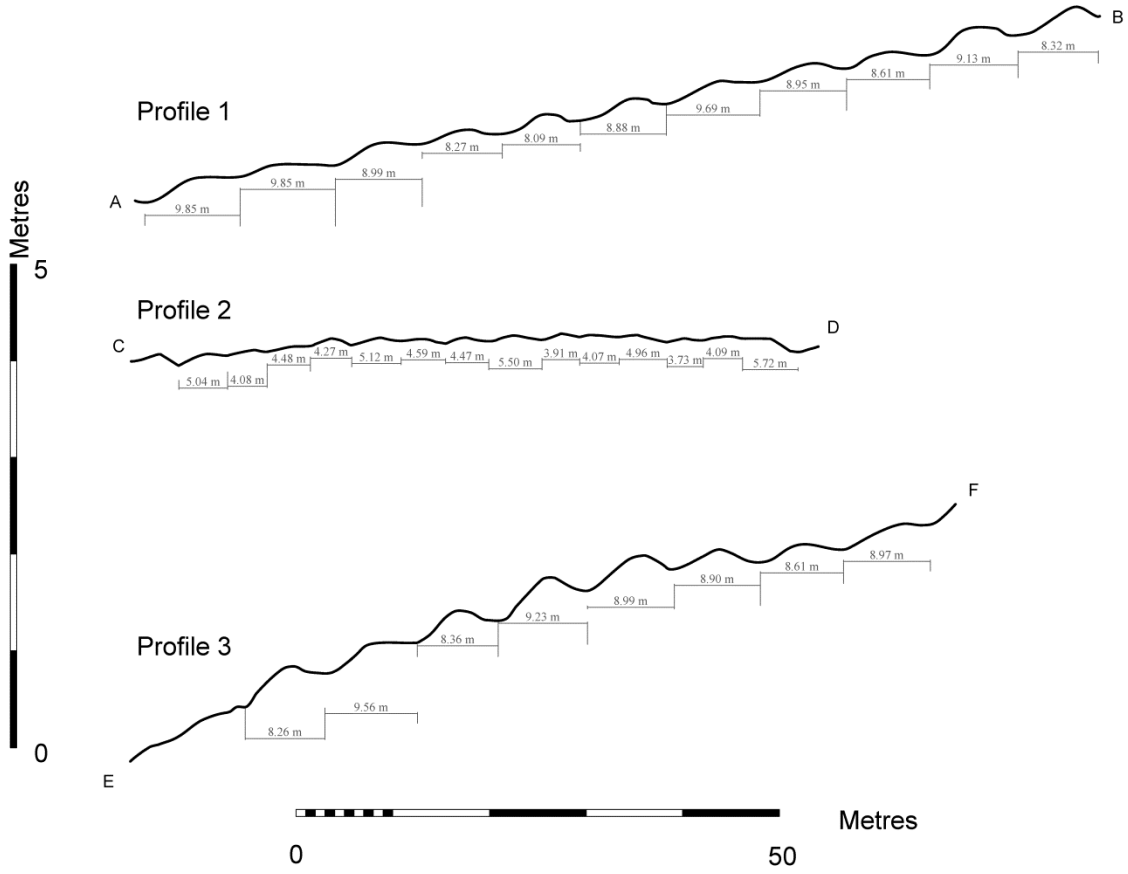


Figure 9: Combined profiles with dimensions at uniform scale (vertical exaggeration x10).

Figure 10: Northernmost field looking north

Figure 11: Central field, looking north-west

Figure 12: Southernmost field viewed from the south

The ridge and furrow at Higham on the Hill shows two distinct types. The northern and southern fields comprise wider spaced systems 8 to 9 metres apart aligned east-north-east to west-south-west in the southern field and north-east to south-west in the northern field. The central field has ridge and furrow aligned north-west to south-east 4 to 5 metres apart, the northern extent of which extends into the south-eastern part of the northern field (Figure 5, Figure 7). This last area is particularly denuded, and in many of the shade plots was not visible at all.

It is possible that the central field with its narrower system my pre-date the wider system. The fields form part of a wider system of surviving ridge and furrow being part of the open fields to the north-west of the village (Figure 5).

The linear feature crossing north-west to south-east in the northern most field was identified in the geophysical survey and represents a former footpath that survived until at least 1973 (Richardson 2013, 6) and is shown on the 1st edition Ordnance Survey (Clarke and Clay 2013, 9).

The wide feature crossing west southwest to east northeast that truncates the ridge and furrow in the northernmost field is clearly identified as a service in the geophysical survey (Richardson 2013, 6). The feature is visible in the 1945/6 vertical imagery made available through GoogleEarth, and is possibly related to the 'Works' which appear to east of the proposed area between the 1924 and 1961 maps (Clarke and Clay 2013, 12-13).

Archive

The archive will be deposited as part of X.A114.2012 and consists of:
This report,
CD of digital data and photographs.
1 GIS project in mxd format containing the layers created for the analysis.

The EA LiDAR data and images derived from that data have been used under Licence from the EA, and are not included in an archive deposition.

Bibliography

Anderton, M. and Went, D, 2002, 'Turning the Plough: Loss of a Landscape Legacy', *Conservation Bulletin* 42, March 2002, 52-5. English Heritage website: http://www.english-heritage.org.uk/publications/turning-the-plough-loss-of-a-landscape-legacy/turningplough.pdf/ (Last accessed 14/08/2012).

Bewley, R.H., Crutchley, S.P. & Shell, C.A. 2005. New light on an ancient landscape: LiDAR survey in the Stonehenge World Heritage Site. *Antiquity* (79) 636-647.

Clarke, S., 2012 *An archaeological desk-based assessment for land off Hilary Bevins Close, Higham on the Hill, Leicestershire, (SP 379 956).* ULAS Report 2012-81

Clarke, S., and Clay, P., 2013 *An archaeological desk-based assessment for land off Station Road, Hilary Bevins Close and Main Street, Higham on the Hill, Leicestershire, (SP 379 956).* ULAS Report 2013-172

Hall, D 2001. *Turning the Plough. Midland open fields: landscape character and proposals for management*. English Heritage and Northamptonshire County Council.

Hall, D. 1982, *Medieval Fields*, Princes Risborough: Shire.

Hall, D. 1988, 'Medieval fields in their many forms', *British Archaeology* 33 (April 1988): CBA website: http://www.archaeologyuk.org/ba/ba33/ba33ftml (Last accessed 01/08/2012).

Hannon, N., Hyam, A., and Beamish M., 2014 *An Archaeological LiDAR study and Walkover Survey at Bradgate Park, Newtown Linford, Leicestershire***.** ULAS Report 2014-076

Hartley, R. 2008, *The Medieval Earthworks of South-West Leicestershire*. *Hinckley and Bosworth* Leicestershire Museums Archaeological Fieldwork Group Monograph No. 2..

Hyam, A., 2012 *An Archaeological Field Evaluation at Hilary Bevins Close, Higham on the Hill, Leicestershire. NGR: SP 379 956* ULAS Report 2012-184

Richardson, R., 2013 *Geophysical Survey Report. Higham on the Hill, Leicestershire*. Stratascan Report J6082

Roberts, B. and Wrathmell, S. 2000*, An Atlas of Rural Settlement,* English Heritage

Zakšek, K., Oštir, K. & Kokalj, Ž . 2011 Sky View Factor as a Relief Visualisation Technique. *Remote Sensing* 2011(3), 398 415.

Matthew Beamish
Patrick Clay
ULAS
University of Leicester
University Road
Leicester LE1 7RH
Tel: 0116 252 2848
Fax: 0116 252 2614

Email: ulas@le.ac.uk

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Appendix: LiDAR metadata

FILENAME	TILENAME	DATE_FLOWN	%_COVERAGE	POLYGON_ID	RESOLUTION (m)
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D0141105	SP3894	12 Feb 2011	51.92	P_7458	1
D0148349	SP3694	17 Nov 2011	20.52	P_8014	1
D0148353	SP3894	17 Nov 2011	71.5	P_8014	1
D0161114	SP3694	4- 6 Feb 2013	99.86	P_8705	1
D0161128	SP3894	4- 6 Feb 2013	99.31	P_8705	1

Source of composite data used in the LiDAR analysis.

ULAS Contact Details

Richard Buckley or Patrick Clay
University of Leicester Archaeological Services (ULAS)
University of Leicester,
University Road,
Leicester LE1 7RH

T: +44 (0)116 252 2848
F: +44 (0)116 252 2614
E: ulas@le.ac.uk
W: www.le.ac.uk/ulas

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