University of Leicester

Archaeological Services

An archaeological earthwork survey by LiDAR study for land off Leicester Road, Market Harborough, Leicestershire (SP 725 884)

Matthew Beamish

ULAS Report No.2015-089

An archaeological earthwork survey by LiDAR study for land off Leicester Road, Market Harborough, Leicestershire (SP 725 884)

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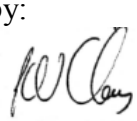
Matthew Beamish

For: Parkers of Leicester Ltd

Checked by:

Signed: 

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Summary

An archaeological earthwork survey by LiDAR study has been prepared for Parkers of Leicester by University of Leicester Archaeological Services (ULAS) for land to the east of Leicester Road, Market Harborough, Leicestershire, (SP 725 884). The survey was undertaken in advance of the proposed re-development of the site, which is currently under pasture.

Previous desk-based assessments and geophysical survey (Hunt 2015; Slater 2015) identified the remains of well-preserved earthworks surviving from medieval ridge and furrow field systems. LiDAR analysis has further confirmed the survival of these earthworks and also identified those relating to a windmill known to have been extant in 1814. Some other elements of topography are discussed.

The archive will be deposited with Leicestershire Museums as part of Accession Number X.A54.2015.

Introduction

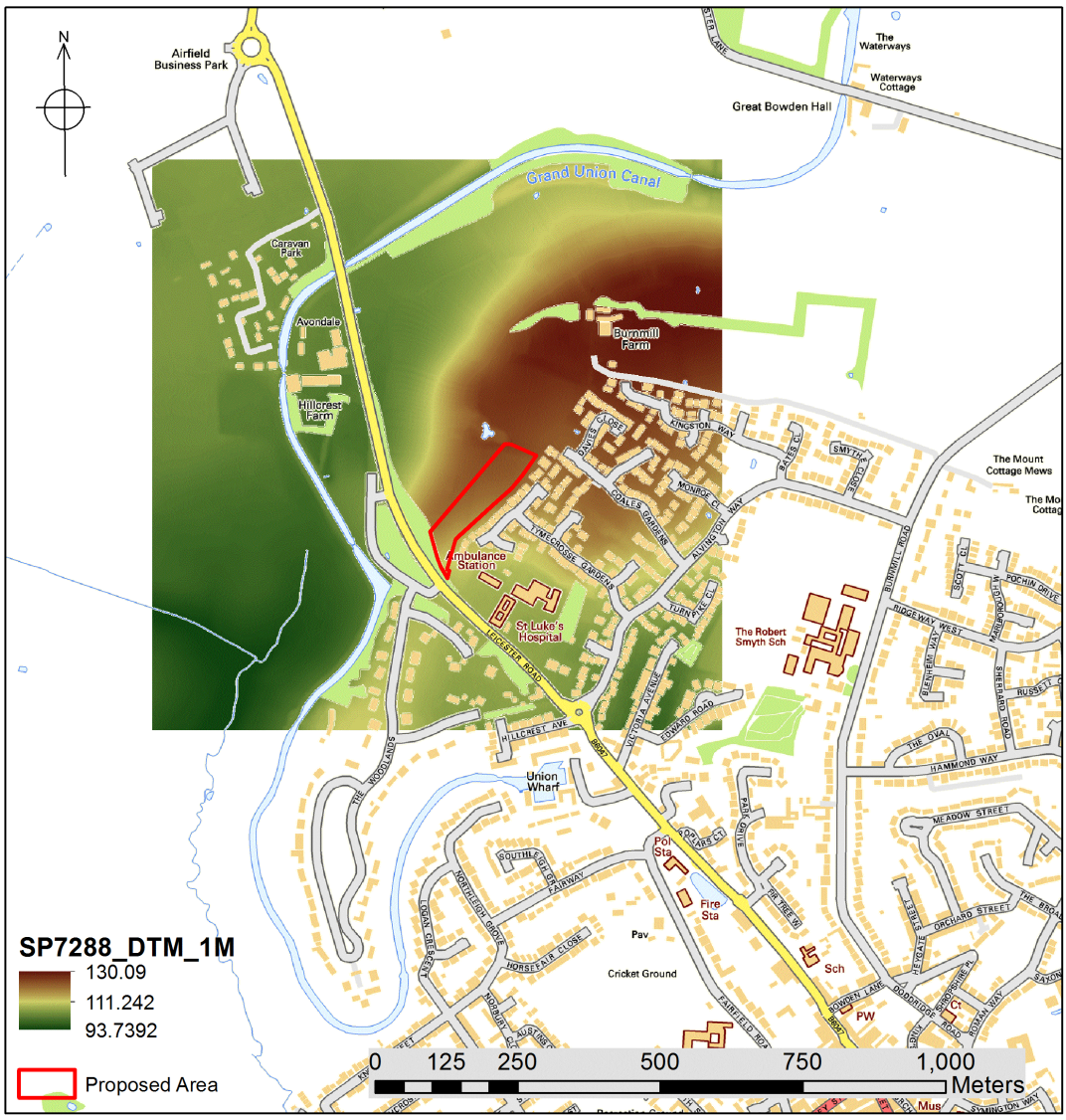
In accordance with National Planning Policy Framework (NPPF), Section 12 (Conserving and Enhancing the Historic Environment) this document outlines the results of archaeological earthwork survey by LiDAR study for land off Leicester Road, Market Harborough, Leicestershire (SP 725 884). The assessment was commissioned by Parkers of Leicester Ltd from University of Leicester Archaeological Services (ULAS) in advance of the proposed development of the site.

The site is currently a narrow pasture field of some 1.3ha lying at a height of between 110 and 120m OD at the north-western edge of Market Harborough. The site contains visible ridge and furrow earthworks which have survived from medieval and possibly post-medieval field systems, and also the remains of a mill mound known to have survived until 1814 when recorded in an Ordnance Surveyors drawing (Figure 3).

The Historic Environment Record for Leicestershire and Rutland indicates that there are several known sites containing prehistoric remains close to the site. Roman and medieval remains are also known from the vicinity of the site (Hunt 2015).

The LiDAR study has been commissioned with the aim of enabling clear assessment of the significance of the earthwork features within and immediately adjacent to the site. Specifically it is intended to clarify the location and state of preservation of the mill mound, and the extent and survival of the ridge and furrow earthworks.

Figure 1: Site location



LiDAR Data Source: Environment Agency 2015
Contains Ordnance Survey data © Crown copyright and database right 2015

Figure 2: Location of proposed area west of Leicester Road with 1m resolution LiDAR Digital Terrain Model data used in the study, with ground height in metres AOD.

Figure 3: Extract of Ordnance Surveyor Henry Stevens drawing of Leicestershire, British Library, 1814. British Library, OSD 262. Original scale 2" to 1 Mile (1:31680). Mill is arrowed

Geophysical Survey

A geophysical survey was undertaken for ULAS by Stratascan Ltd (Slater 2015). The survey identified north-south aligned ridge and furrow as the only probable archaeology (Figure 4, 1), with two areas of possible archaeological responses in the north-eastern half of the survey (Figure 4, 2). A north –south field boundary that bisects the proposed area was also identified (Figure 4, 3). Magnetic disturbance from fencing around the proposed area (Figure 4, 4) probably prevented the identification of the windmill mound in the south-west of the area.

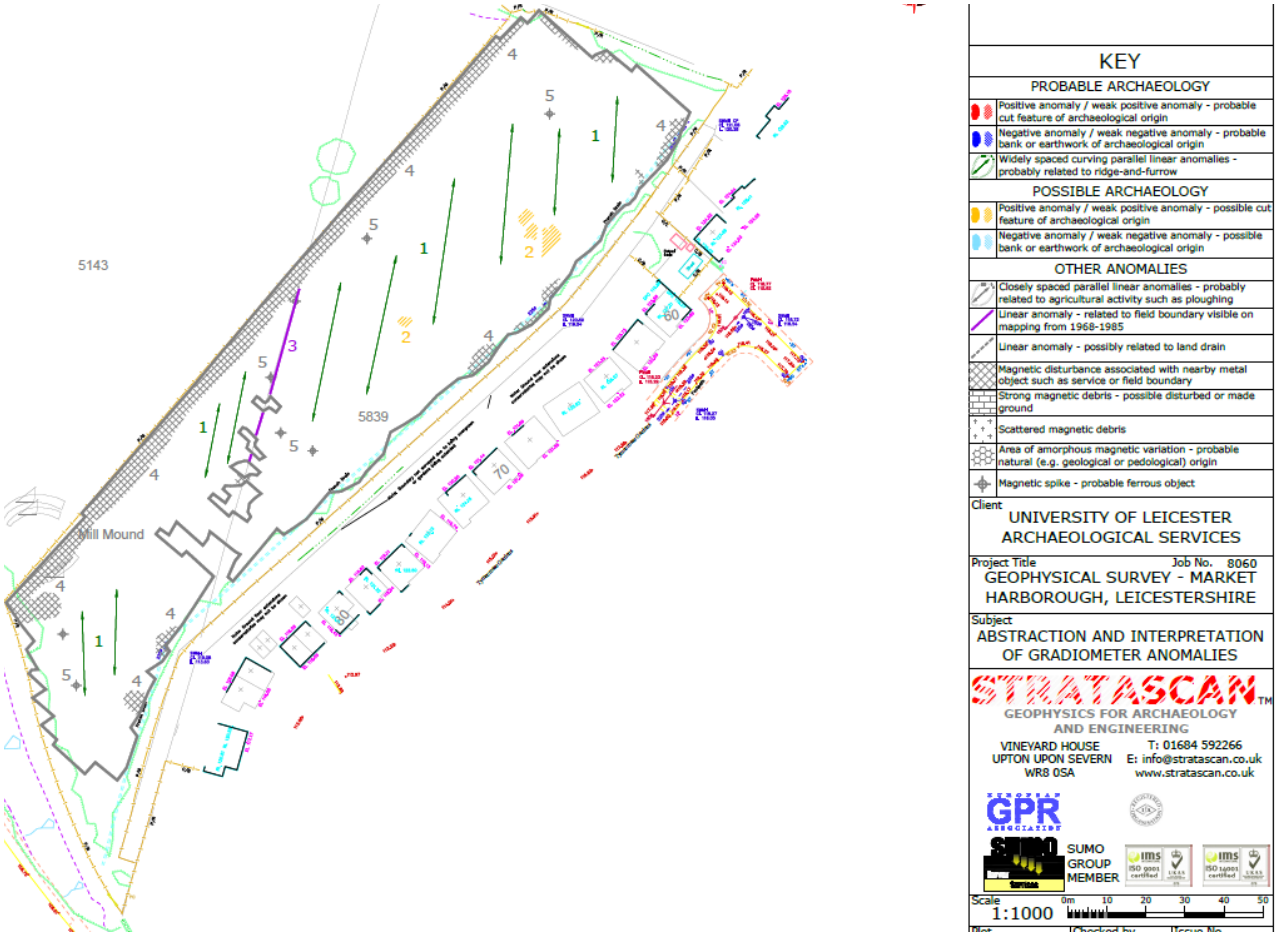


Figure 4: Interpretation of gradiometer anomalies from the geophysical survey (after Slater 2015, Fig. 5)

Aim of the Survey

The overall aim of the survey was to accurately record the location and state of preservation of surviving earthwork features within and immediately adjacent to the site in order that their significance could be assessed. Specifically any surviving earthworks of the mill mound were to be clarified.

Methodology

Analysis based upon aerial LiDAR data was requested by Teresa Hawtin of Leicestershire County Council as archaeological planning advisor to Harborough District Council. Following a search of Environment Agency archived data, composite aerial LiDAR data at 1m resolution was supplied electronically in ASCII file format by National Geomatics Unit of the Environment Agency. The area was flown and the data collected in February 2009: details of the data source are given below (p19). The data were 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 any 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) with some modification.

LiDAR ASCII Data Processing

Most operations were conducted in Esri ArcMap10.1 SP1 build 3143. The Relief Visualisation Toolbox which enables the rapid output of multiple hillshade, slope analysis, relief model and sky view analysis was also used (Zakšek et al. 2011; Kokal et al. 2011).

Data 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 '15710_MarketHarborough.gdb'.

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 DTM 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.'MH_1m_HS_315_45_1') and saved to '15710_MarketHarborough.gdb'. Once each hillshade was generated they were grouped within the TOC to aid navigation.

Automatic multiple hillshade using the Relief Visualisation Toolbox (no of directions 16, sun elevation angle 30^{o}) were also created and saved to the Geodatabase (SP7288_DTM_1M1_MULTI_HS_D16_H30_RGB)

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 working 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.

Images were processed in Standard Raster image and CAD packages.

Results

Ridge and furrow at between 5m and 7m spacing is present on a north-south alignment across most of the proposed area. To the west, the alignment of the ridge and furrow is west to east, and this was influenced by the steep west and south-west facing slope, with the plough being pulled down rather than across the contour (see Figure 13).

The ridge and furrow survives to an amplitude of some 40cm, The survival is weakest in the south-west of the proposed area.

There is no clear relationship between the mill mound and the ridge and furrow, although a feature on the north side of the mound appears to truncate the ridge and furrow of both systems. There is no clear indication that the west-east ridge and furrow continued to the south of the mill mound.

The mill mound which is some 20m in diameter is located at the south-western end of a broad ridge, just below the apex. The ridge and furrow to the north of the mound on the apex sits somewhat higher: the mound in north-south profile appears more as a levelled area than a construction, although in west–east profile a mound is very clear particularly with vertically exaggerated scale (Figure 7 & Figure 9, A & B).

On the northern and eastern side of the mound is a weak linear feature between 4 and 7m wide and up to 70m long, which appears to post-date the ridge and furrow. The feature is represented by a slight levelling of the ground, and not by a clear cut (Figure 7 & Figure 9, C). The presence of the feature is indicated strongly in shade computations (e.g. Figure 5), but it is barely perceptible in elevation data DEM plots (Figure 11). The feature is sharply defined on the immediate north side of the mound (Figure 6) where it curves around the edge of the mound and then terminates, so separating the mound from the ridge to the north. To the east the feature is more irregular. The feature terminates in the south-east at the proposed site boundary and is subsequently lost to modern development.

A field boundary parallel with the north-south ridge and furrow can be identified (Figure 6). This boundary appears first on the 1984 mapping – it was not mapped in 1929 (Hunt 2015, Figure 8)

Some 40m to the north of the mill mound, an area 17m long by 11m wide has been disturbed by a negative feature (Figure 8). The feature lies in the plough headlands where the north-south and east-west furlongs meet and is shown in profile (Figure 8, E, F)

Discussion

At between 5m and 7m centres the ridge and furrow identified in the proposed area is of *broad rig* character and is probably of medieval date. Ridge and furrow spaced at less than 5m centres is termed *narrow rig* and has been shown to be of later post-medieval date. Broad rig is thought to have been formed by the Ox drawn plough, and Narrow rig by horses. Narrow rig in places may relate to cultivation of new land in the Napoleonic period when pressure for domestic grain production increased.

The mill site clearly survives and is bisected by the proposed site boundary. A 3d visualisation shows the mill site to be located above south and west facing slopes at the south-western end of a broad ridge which skirts the north side of Market Harborough (Figure 13). A mill in this location was well exposed to south-westerly winds.

The linear feature identified crossing the proposed area and terminating on the north side of the mill mound was partly surveyed on the 1886 Ordnance Survey map as a line abruptly terminating to the immediate north-east of the mill which was by this stage no longer shown (Figure 12). Arguably this line was also recorded on the 1814 drawing (Figure 3). At the time of geophysical survey in 2015, the area covering the south-eastern end of the feature was too vegetated to allow recording, although the feature was not identifiable in the survey data to the north.

The linear feature at its western end where it separates the mound from the ridge behind, might be interpreted as evidence of a quarry for the mound material. Equally, the concentric shape of the linear feature might indicate that the feature was used in the mill's life for a tail pole – the wooden pole extending from a post or tower/cap mill structure on the opposite side of the sails allowing the mill to be turned into, and out of, the wind (cf Thomas 2009, 117).

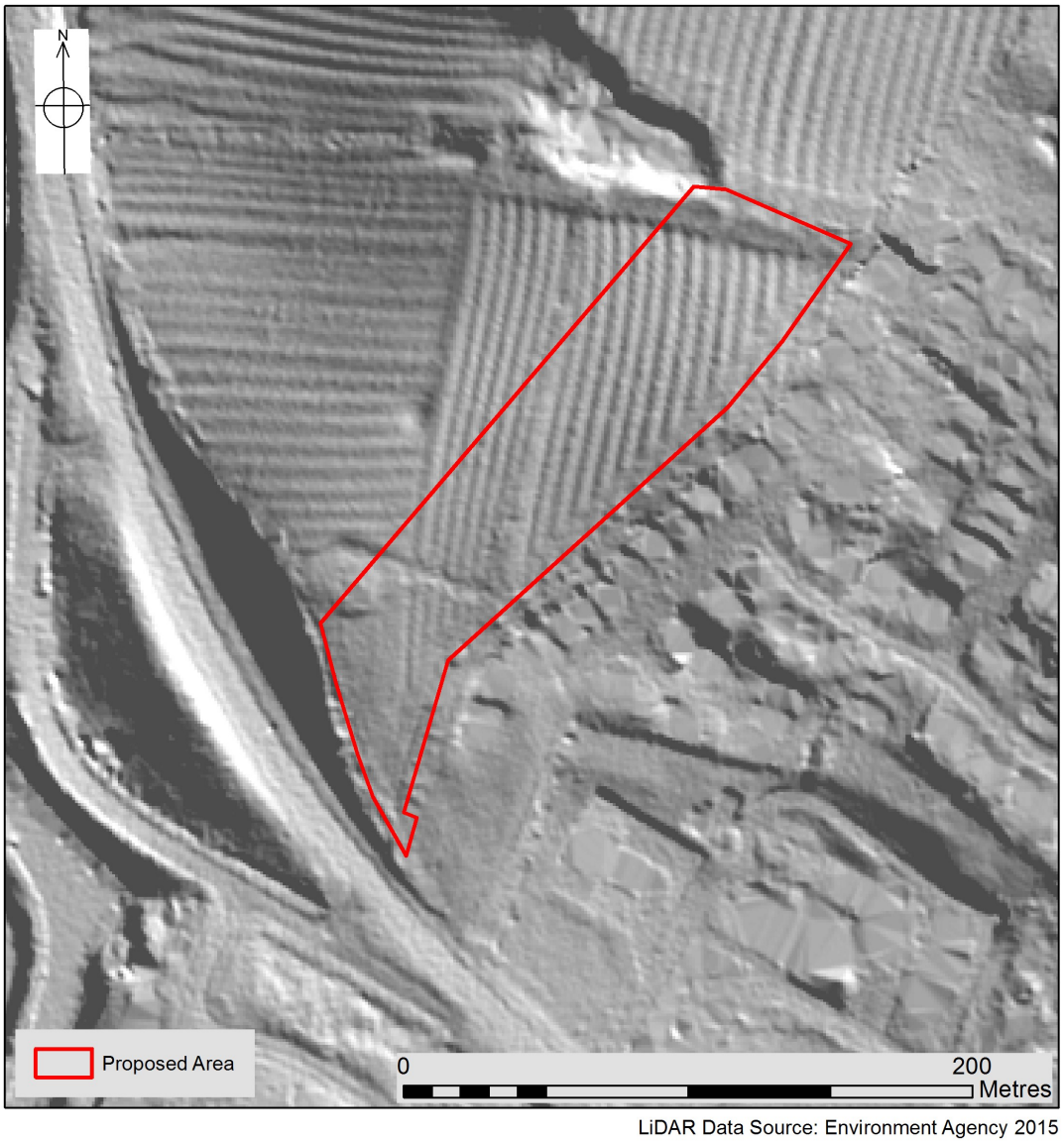


Figure 5: Hillshade plot of LiDAR 1m DTM data (Azimuth 45, Elevation 30 Vertical exaggeration 2)

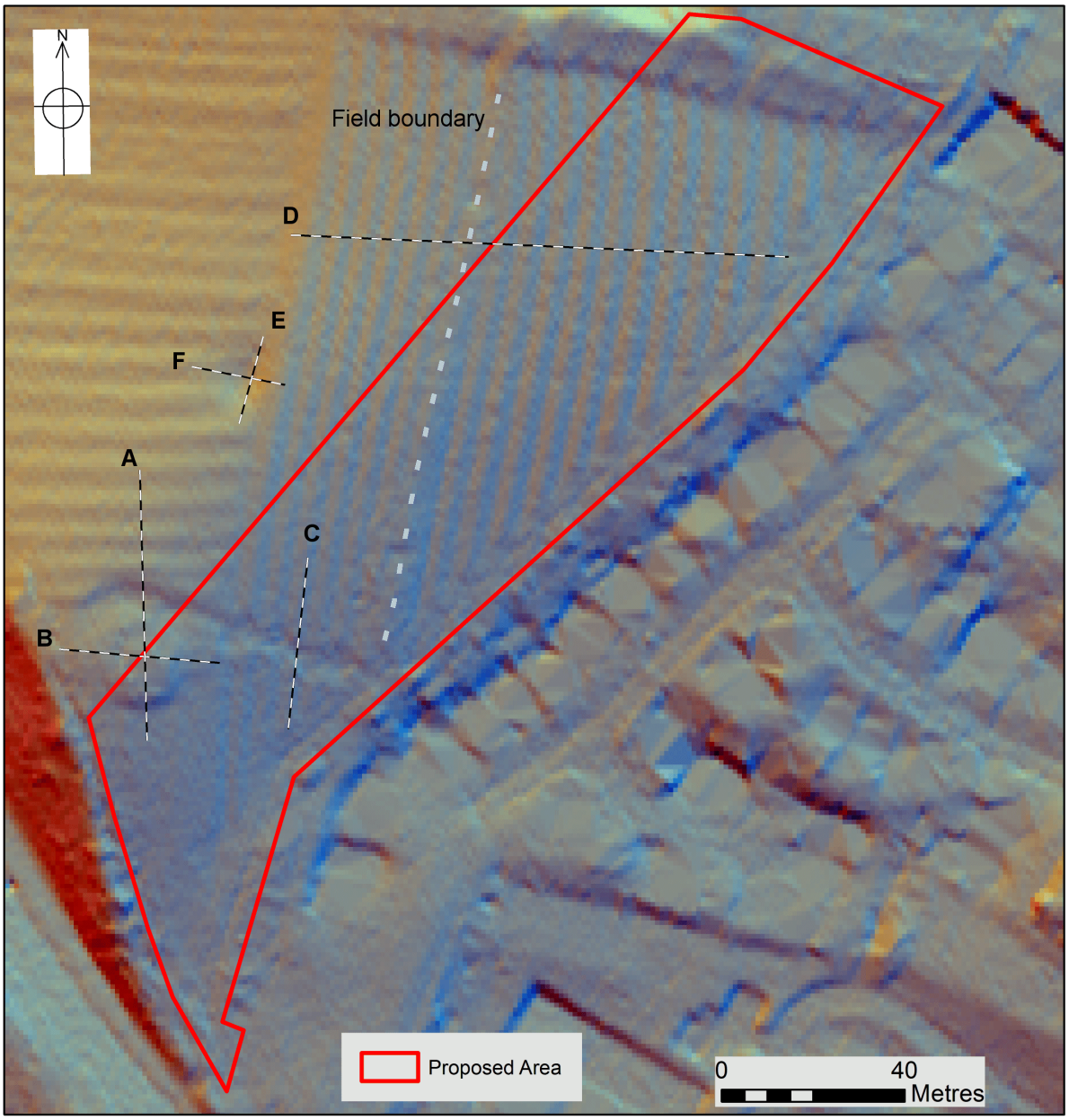


Figure 6: Multiple hillshade plot. Location of Profiles A-F. The dashed line field boundary is 20th Century in date (cf Hunt 2015, Figure 8).

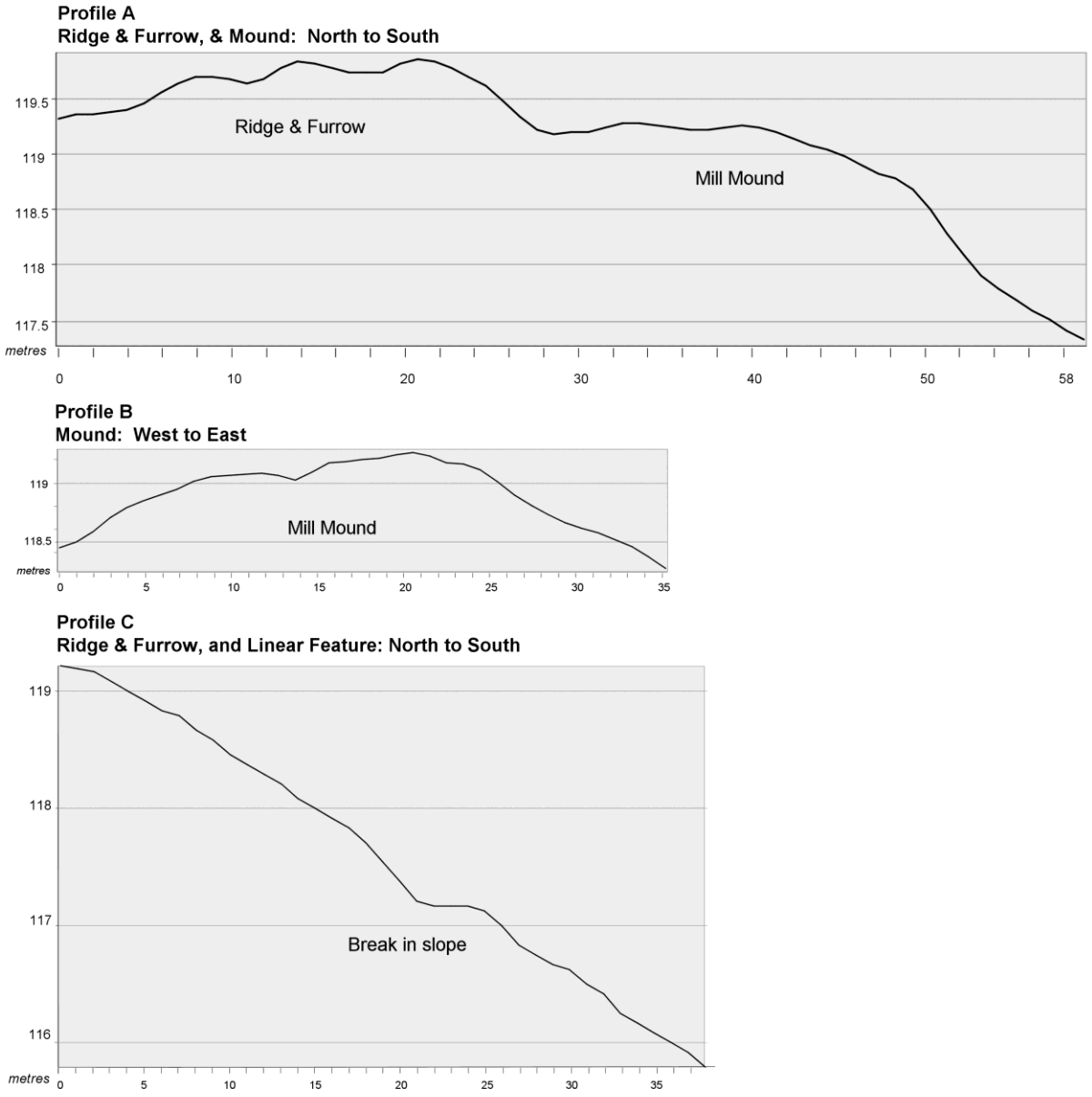
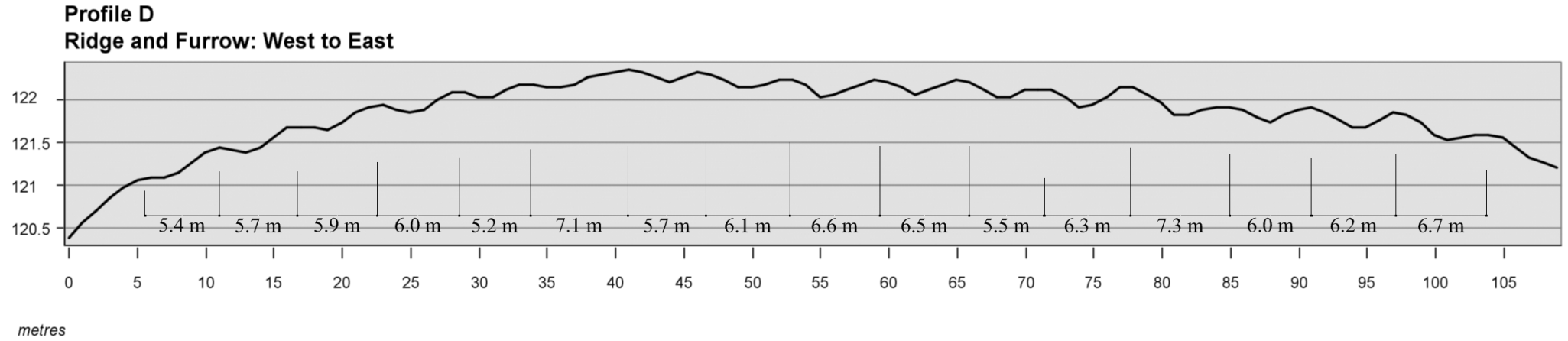


Figure 7: Profiles A, B and C with dimensions at uniform scale (vertical exaggeration x6.5).



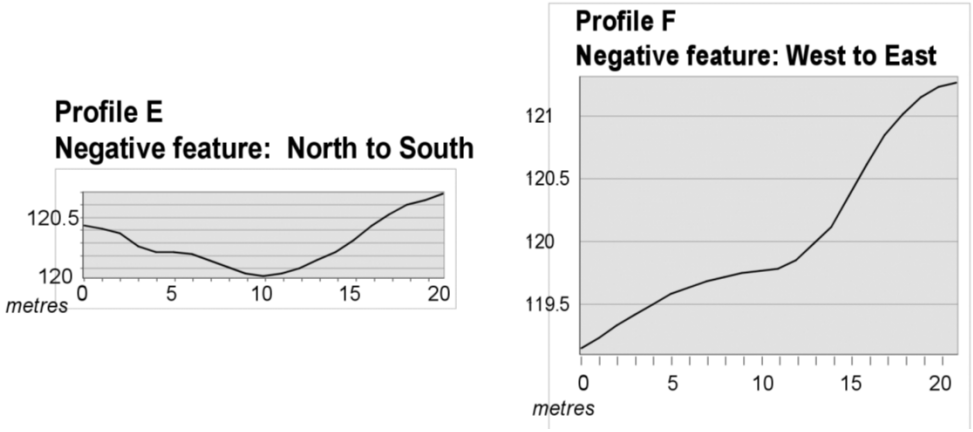


Figure 8: Profiles D, E and Fat uniform scale (vertical exaggeration x6.5).

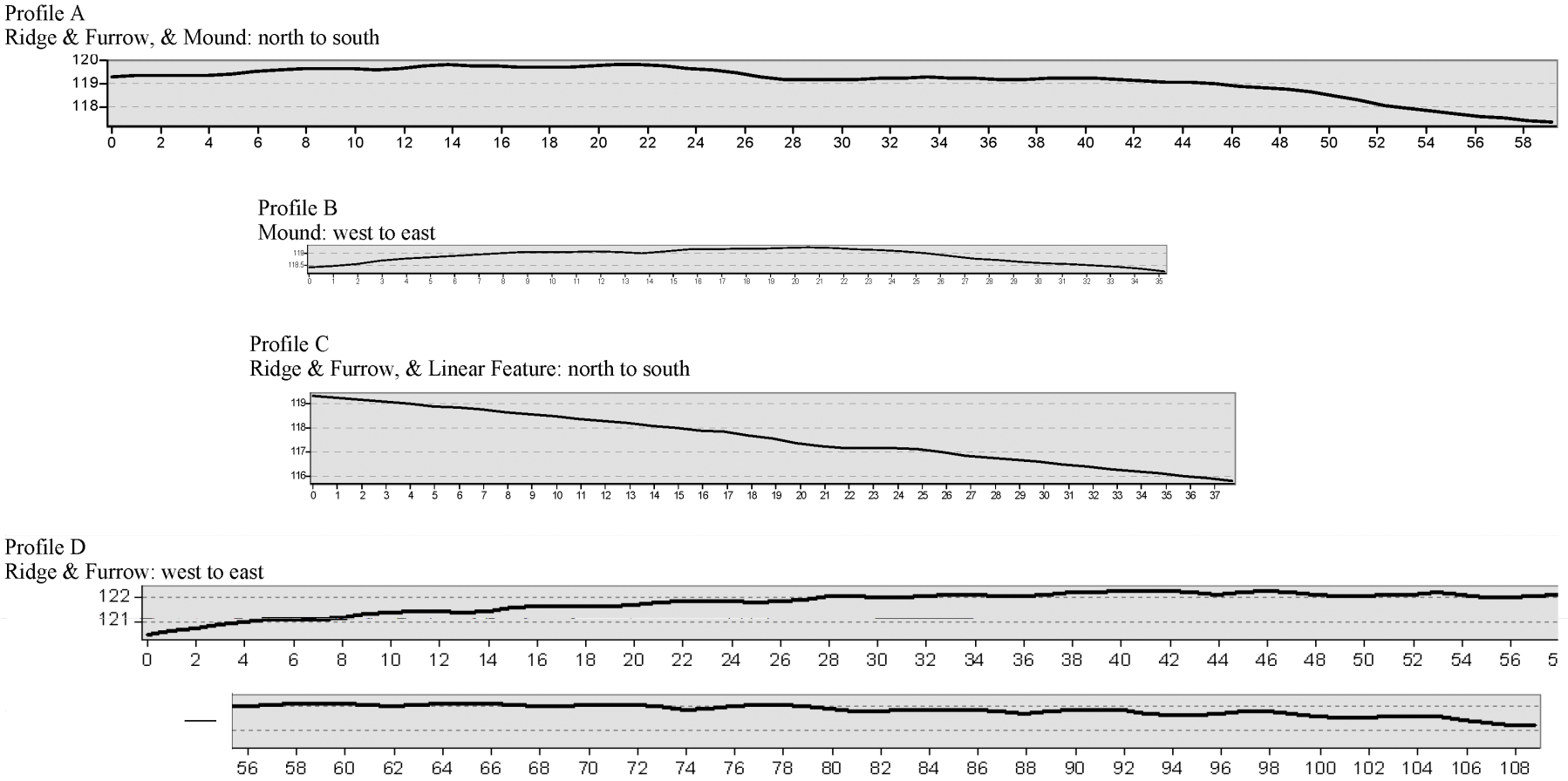


Figure 9: Profiles A-D at uniform scale (no vertical exaggeration)

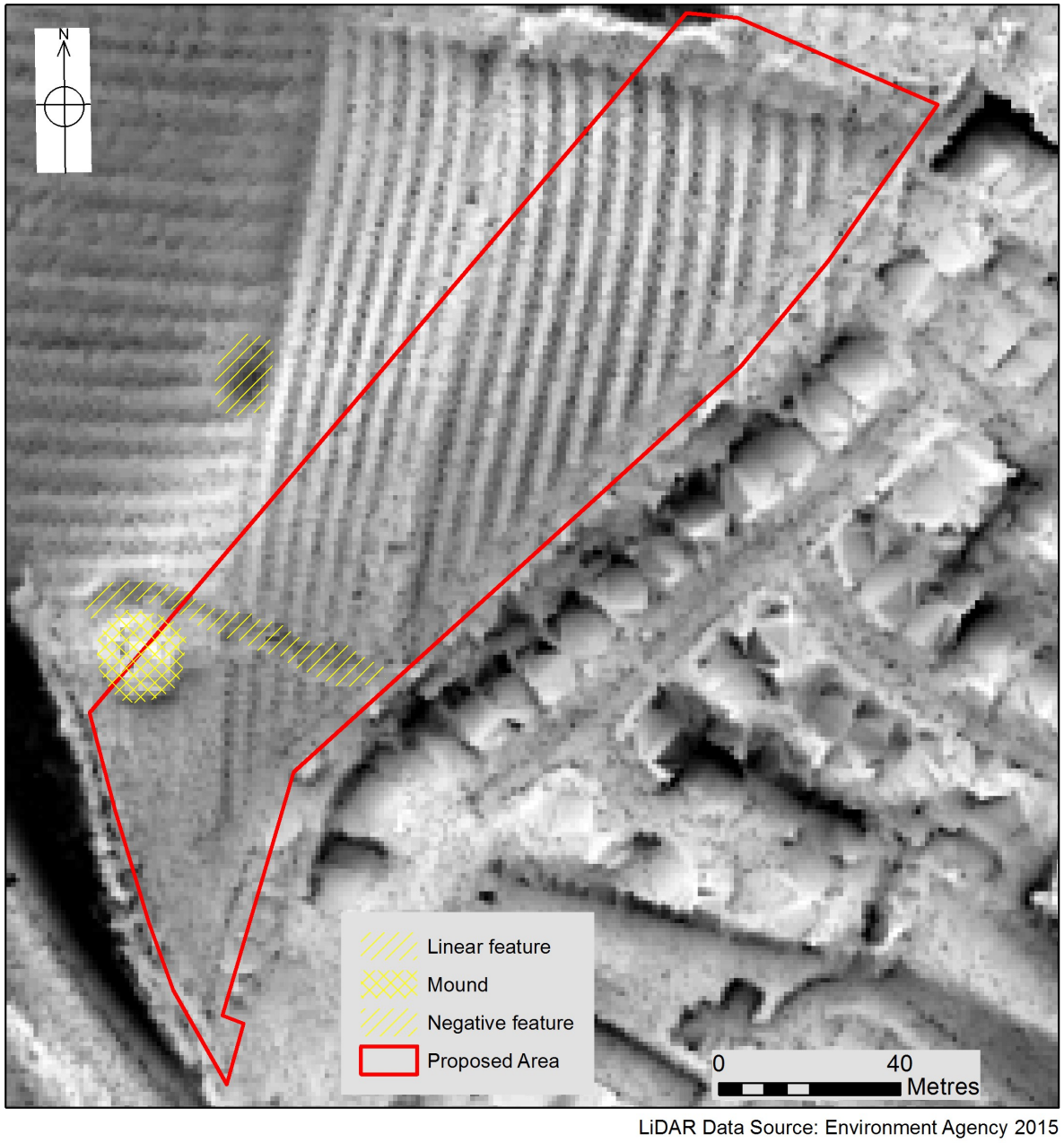


Figure 10: SkyView Factor shade plot with interpreted LiDAR features

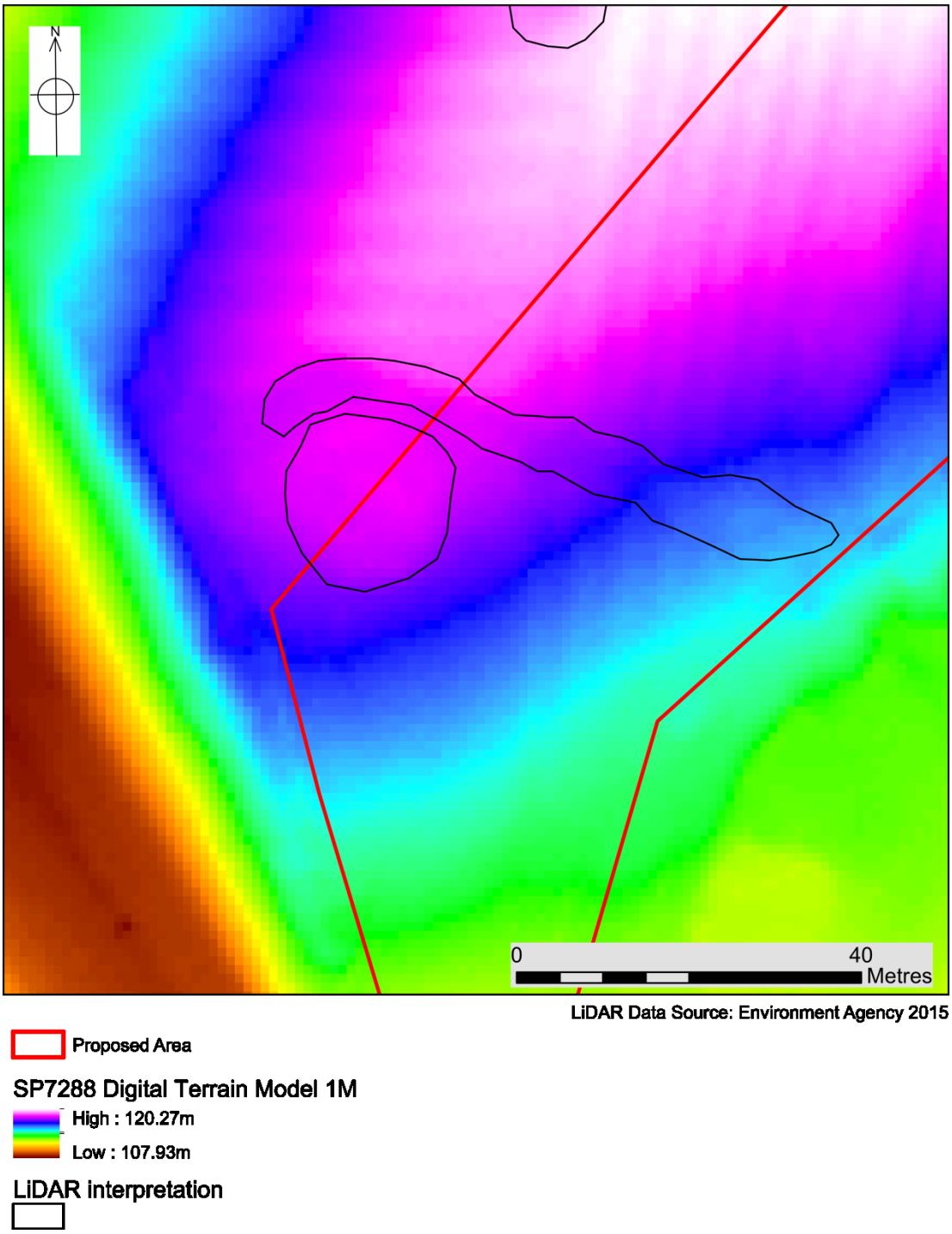


Figure 11: Coloured Digital Elevation Model (DEM) of LiDAR data. Although giving some indication of mill mound and ridge and furrow, the limitation of such a plot compared with a shade or sky view plot is clear.

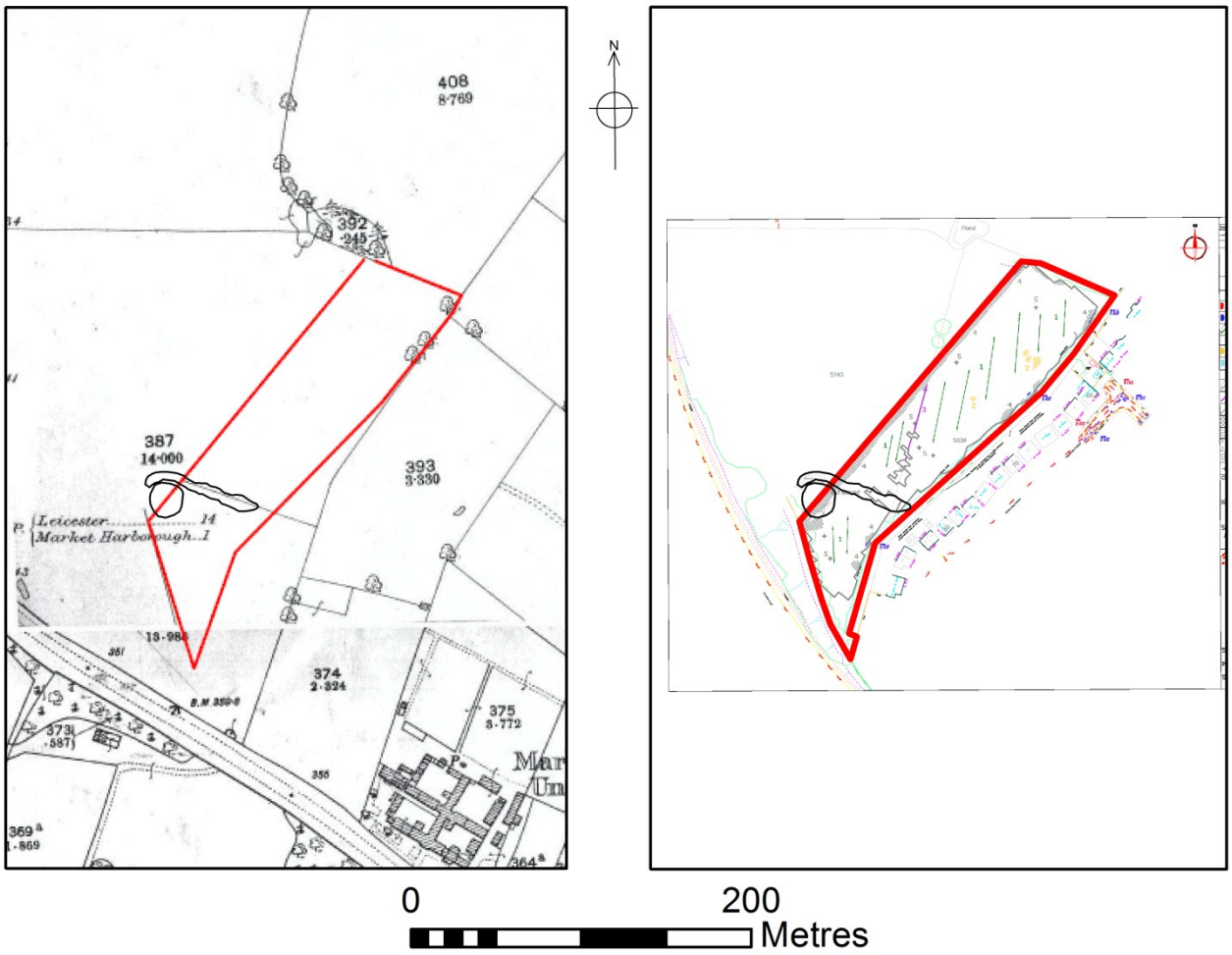


Figure 12: Left - extract of 1886 Ordnance Survey 1:2500 County Series (after Hunt 2015) and right, Results of Geophysical Survey (after Slater 2015), both with interpreted Lidar features

The linear feature may simply represent an enclosure field boundary that post-dated the ridge and furrow although the abrupt termination of the line on the 1886 mapping makes this seem unlikely. Alternatively, the feature might represent the remains of a trackway that served the mill.

The canal serving Market Harborough was constructed in 1809 following Act of Parliament in 1793. Originally intended to continue through to Northampton and therefore provide a direct canal link between Leicester and Northampton, the canal terminated at a wharf on the north side of Market Harborough and was never extended. The wharf is now integrated into the urban spread of the town (Union Wharf, Figure 2). Both wharf and mill were surveyed on the 1814 Ordnance Survey drawing of Leicestershire (British Library OSD 262, Burton Overy) and are proved to have some contemporaneity.

Figure 13: 3d visualisation facing east using Sky View Factor shade plot at x2 vertical exaggeration with proposed area in red, and interpreted features in blue. The mill mound occupies the south-western end of a ridge above a west and south facing slope. A linear feature running away from the mill to the east may represent a track way serving the mill.

Conclusion

The LiDAR study has indicated the survival of historic landscape features from medieval and post-medieval period within the proposed area. The mill mound survives and partly lies within the proposed site area. There is some indication that the mill mound was constructed by the levelling and mounding of an area at the end of a ridge, and also that the mill used a tail pole.

There is some indication that the ridge and furrow is of medieval origin, and that the mill was located on the very edge of two field systems. The ridge and furrow of both field systems has been has been truncated by a linear feature that may relate to the mill's use. At normal scale (Figure 9) the ridge and furrow is not significantly pronounced.

Archive

The archive will be deposited as part of X.A54.2015 and consists of:
This report,
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.

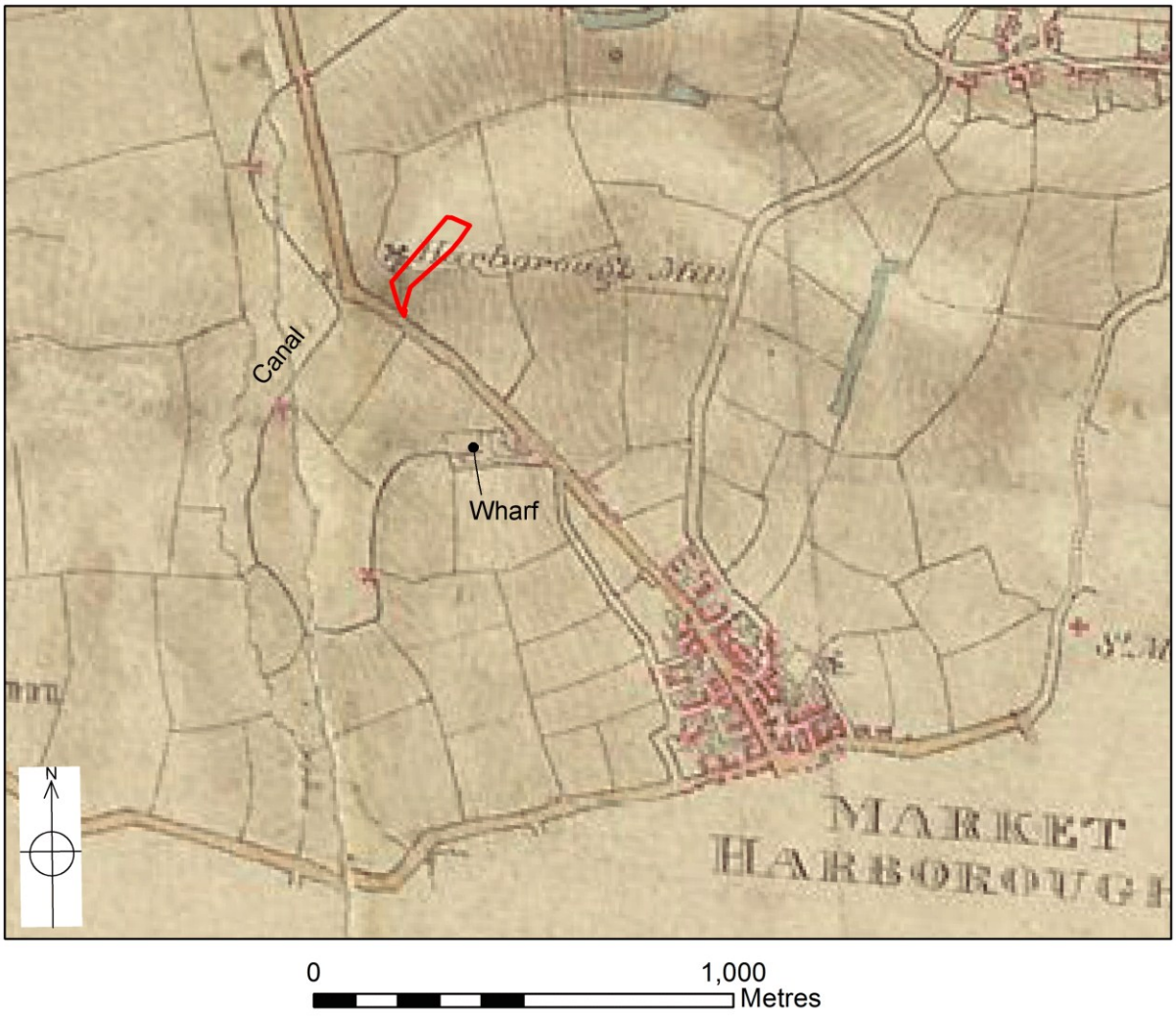


Figure 14: Extract of Ordnance Surveyor Henry Stevens' drawing of Leicestershire, British Library, 1814. British Library, OSD 262. Original scale 2" to 1 Mile (1:31680) with proposed area in red.

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19/05/2015
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Appendix: LiDAR metadata

FILENAME	TILENAME	DATE_FLOWN	%_COVERAGE	POLYGON_ID	RESOLUTION (m)
D0116891	SP7288	16-21 Feb 2009	75	P_6235	1

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