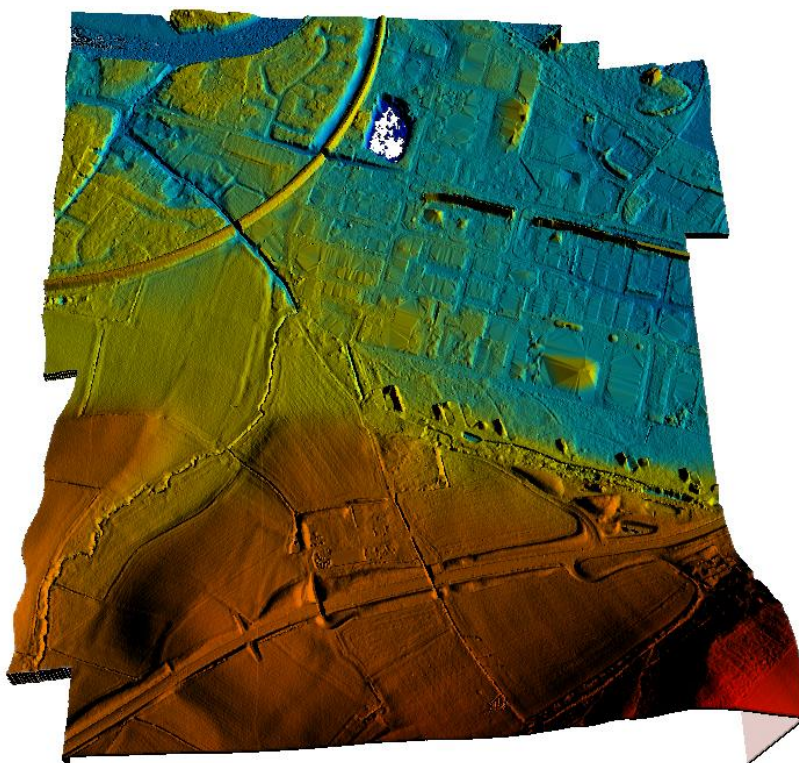


Further investigation of the Rotherwas Ribbon Stage 1a: LIDAR Survey

A Herefordshire Archaeology Report for English Heritage in Execution of
EH PD 5463

Prepared by
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Herefordshire Archaeology is Herefordshire Council's county archaeology service. It advises upon the conservation of archaeological and historic landscapes, maintains the county Sites and Monument Record, and carries out conservation and investigative field projects. The County Archaeologist is Dr. Keith Ray.

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Section 1: Background

1.1 Introduction

This report presents an analysis of lidar survey data relating to the vicinity of Rotherwas, Herefordshire. The survey and analysis was undertaken as part of a programme of further work to evaluate the enigmatic 'Rotherwas Ribbon' (first discovered in 2007), and was funded by English Heritage (HEEP) via EH Project Design 5463.

The project was managed by Herefordshire Archaeology, and the lidar survey data was commissioned from and supplied by the Environment Agency. The initial results of the lidar survey were combined with a parallel programme of EH funded geophysics survey of the Ribbon vicinity to inform the design of further excavation of the Rotherwas Ribbon (undertaken with additional EH funding support) in February and March 2010 (see February 2010 'Further Investigation of the Rotherwas Ribbon: Additional fieldwork' Project Design'). The present document therefore provides a full report of the lidar data and analysis which was presented in preliminary form in the February 2010 Project Design, and includes treatment of additional parts of the survey area (including the Lower Bullingham DMV Scheduled Monument) which were not included in that initial analysis.

The lidar data manipulation and archaeological analysis was undertaken by Christopher Atkinson with assistance from Herefordshire Council ICT services, and the report was completed by Ian Bapty (the principal Project Manager).

1.2 Further evaluation of the Rotherwas Ribbon

The Rotherwas Ribbon is an unusual and enigmatic Neolithic or Early Bronze Age linear structure consisting of a 6 to 8 metre wide burnt stone surface located within a hollow/cut. A 67m length of the Ribbon was identified, uncovered and partly excavated in 2007 during a PPG16 supported archaeological recording exercise in advance of the construction of the Rotherwas Access Road, Herefordshire. The structure was associated with a significant bone, pottery and flint artefact assemblage, and also appeared to be spatially and chronologically linked with a group of eight pits (six of which were filled with burnt stone) which were located immediately adjacent to the Ribbon. The Ribbon was also cut by two later (Iron Age/Roman?) ditches on broadly the same alignment, and itself cut an earlier linear feature. A group of six radiocarbon dates (obtained from carbonised hazel samples from two of the pits and a charcoal spread on the Ribbon surface) lie within a late 3rd/early 2nd millennium BC date range, and suggest that the last use of the feature was during this period.

The initial post excavation work and analysis has been reported within an Assessment Report and Updated Project Design including a detailed structural description and assessment of the excavated section of the Ribbon (Sworn *et al* 2009). The 2007 post excavation process raised a series of questions about the nature and status of the Rotherwas Ribbon. On the one hand, the Ribbon appears to represent a 'new' category of Early Bronze Age (and perhaps later Neolithic?) monument of uncertain purpose, but with potentially significant implications for the understanding of local, regional and national archaeological sequences from this period. On the other hand, the apparently unusual nature of the structure demands that it is more fully understood before its wider significance can be evaluated. In particular, key issues concerning the site formation process (relative interplay of natural and cultural processes in the creation of the Ribbon?), the extent of the

Ribbon beyond the Access Road corridor, the detailed structural composition of the monument, and its date across the full period of cultural activity associated with the structure, cannot be answered simply from the data provided by the 2007 excavation work.

1.3 Aims and Objectives

Against this background, the Lidar survey and analysis had the following aims and objectives:

Aims

- To refine the current evidence base for the Rotherwas Ribbon;
- Following on from the spatially limited investigation possible under the PPG16 mitigation work, to use remote sensing techniques to undertake additional assessment of the extent, nature and geological and topographical context of the Rotherwas Ribbon;
- To inform such further investigation of the Rotherwas Ribbon as may be deemed appropriate in the light of the results of the work within the Project Design;
- To contribute to the process of determining future management of the Rotherwas Ribbon;
- To contribute to wider understanding of the archaeological resource that may be affected by future industrial, housing and infrastructure development in the South Hereford area.

Objectives

- To deliver a high resolution LIDAR survey of the 1 km grid square SO 52 37 (which is centred on the known section of the Rotherwas Ribbon);
- To undertake full analysis of the data provided by the LIDAR survey with specific respect to assessment of the extent, nature and geological and topographical context of the Rotherwas Ribbon;
- To integrate the LIDAR results with the evidence presented in the existing WHEAS PPG16 derived *Assessment and Updated Project Design*.

Section 2: Data Collection and Analysis

2.1 Survey Location and Context

The lidar survey area lies within the civil parishes of Lower Bullingham and Dinedor (Herefordshire), and was selected to incorporate the vicinity of the known length of the Rotherwas Ribbon, and specifically to also include Scheduled Monument HE 219 (Lower Bullingham Deserted Medieval Village).

Centred on SO 52570 37690, the survey area measured 1.5km north-south by 1.1km east-west, and included a total area of 5.7km squared (Plate 1). As such, the area also includes the western part of the former Rotherwas Munitions Factory (now the Rotherwas Futures Industrial Estate), although recording and analysis of this area was not a primary objective of the survey exercise.

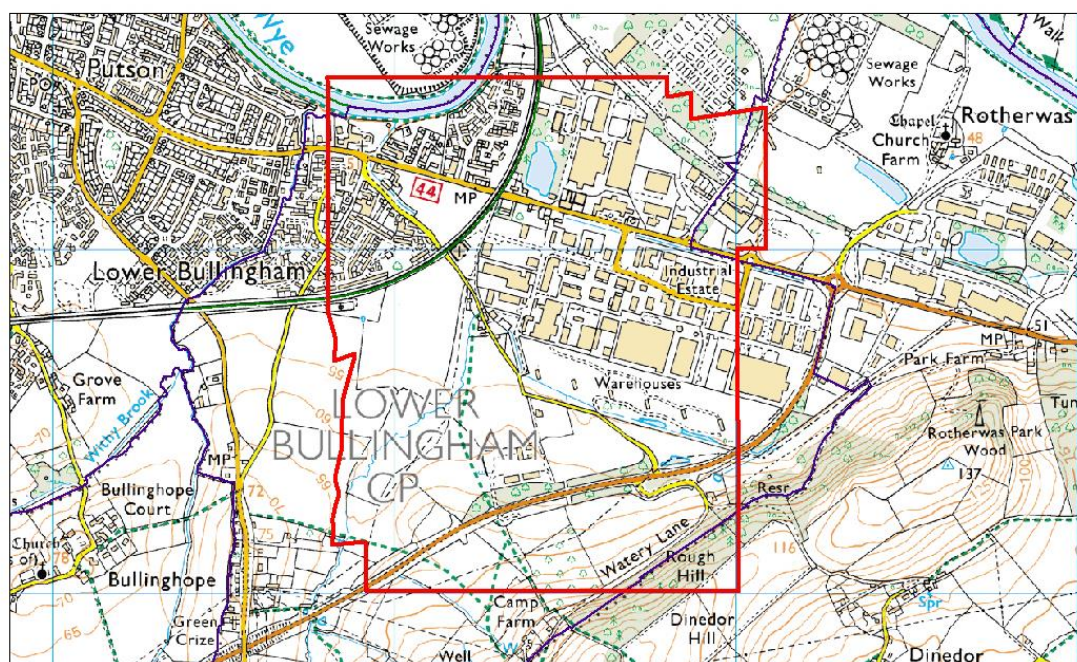


Plate 1: 1:25 000 Ordnance Survey indicating area covered by the LiDAR survey. © OS crown copyright 100024100 and Herefordshire Archaeology.

Topographically, the survey area is divided between the alluvial flood plain of the River Wye (to the north-west), the gently rising lower slopes of the Wye Valley (across the central part of the survey area), and, to the south, the steeply rising slopes of Dinedor Hill.

Geologically, the flood-plain zone incorporates the first terrace deposits of the River Wye which overlay an underlying geology of Mudstone, red brown and sandstone bedrock, giving way to calcretes of the St. Maughans Formation as the topography rises to form Dinedor Hill¹.

¹ British Geological Survey, Ross-on-Wye, England and Wales Sheet 215, Solid and Drift Geology, 1:50 000 Provisional Series, 2000 © NERC 2000

2.2 Data Collection, Format and Treatment

As per the brief/Project Design, the survey area was flown at a 0.25m grid with data collected to the standard error specification for high resolution lidar surveys (RMSE of +/- 5cm). The survey was carried out on 6th November 2009 using the ALTM Gemini 06SEN191 and 08SEN230 lidar instruments mounted on the Environment Agency's aerial survey platform based at Coventry Airport.

The resulting lidar data product, as supplied by the Environment Agency, consists of a 0.25m by 0.25m ArcView ASCII ESRI compatible Grid file for the whole polygon. The data was classified and filtered to produce a core Digital Surface Model (DSM) – essentially an elevation model that contains the heights of objects such as buildings and vegetation as well as open ground (Plate 2).

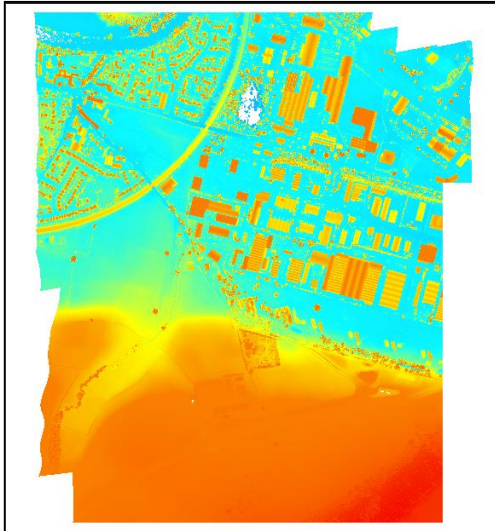


Plate 2: *The DSM including elevations of structures and vegetation. © 2009 Environment Agency, Geomatics Group*

In addition, a Digital Terrain Model (DTM) was also supplied (Plate 3). This consists of 'bare-earth' elevation models produced via classification and filtering routines that strip out vegetation and buildings.

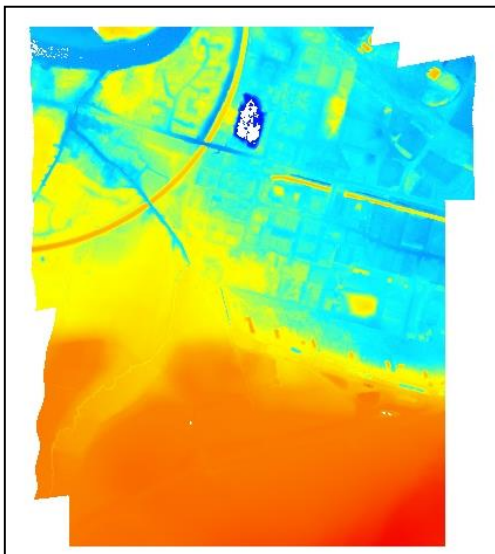


Plate 3: *The DTM 'bare-earth' results with elevations of structures and vegetation filtered. © 2009 Environment Agency, Geomatics Group*

2.3 Analysis and Presentation

The DTM has been principally used to facilitate the analysis of historic landscape and archaeological features within the Dinedor and Lower Bullingham landscape. It should be noted that the EA data could only be imported within ArcGIS Spatial Analyst (and the data was supplied in millimetre units as a floating-point grid, requiring the Map Calculator function of Spatial Analyst to convert it to metre units). Since ArcGIS Spatial Analyst was not directly available to Herefordshire Archaeology, the data was processed by Herefordshire Council ICT Services to be accessible within MapInfo Professional 6.5, and the data manipulation and analysis presented within this report has been generated within that application

In order to produce clear and consistent results, the DTM was manipulated in Mapinfo to a resolution of 2000 by 2000 DPI (Dots per Inch), with shadows generated from a light source elevation of 2.0km. Unless otherwise stated, the light direction is from the *x-axis*. Within the model, the blue to yellow to orange to red colour sequence reflects increasing overall height.

In order to facilitate better understanding of the apparent features observed, the lidar data has been interrogated against additional evidence from the First Edition Ordnance Survey and the modern OS mapping.

2.4 Archive

The full dataset, inclusive of the DSM, DTM data, metadata and other accompanying information is lodged in the Herefordshire SMR, and a copy will be supplied to English Heritage.

Section 3: Results

3.1 Overview

In overview, the DTM highlights a range of landscape features spread over four principal zones (Area 1 – North- West, Area 2 –North-East, Area 3 – South-East and Area 4 – South-West).

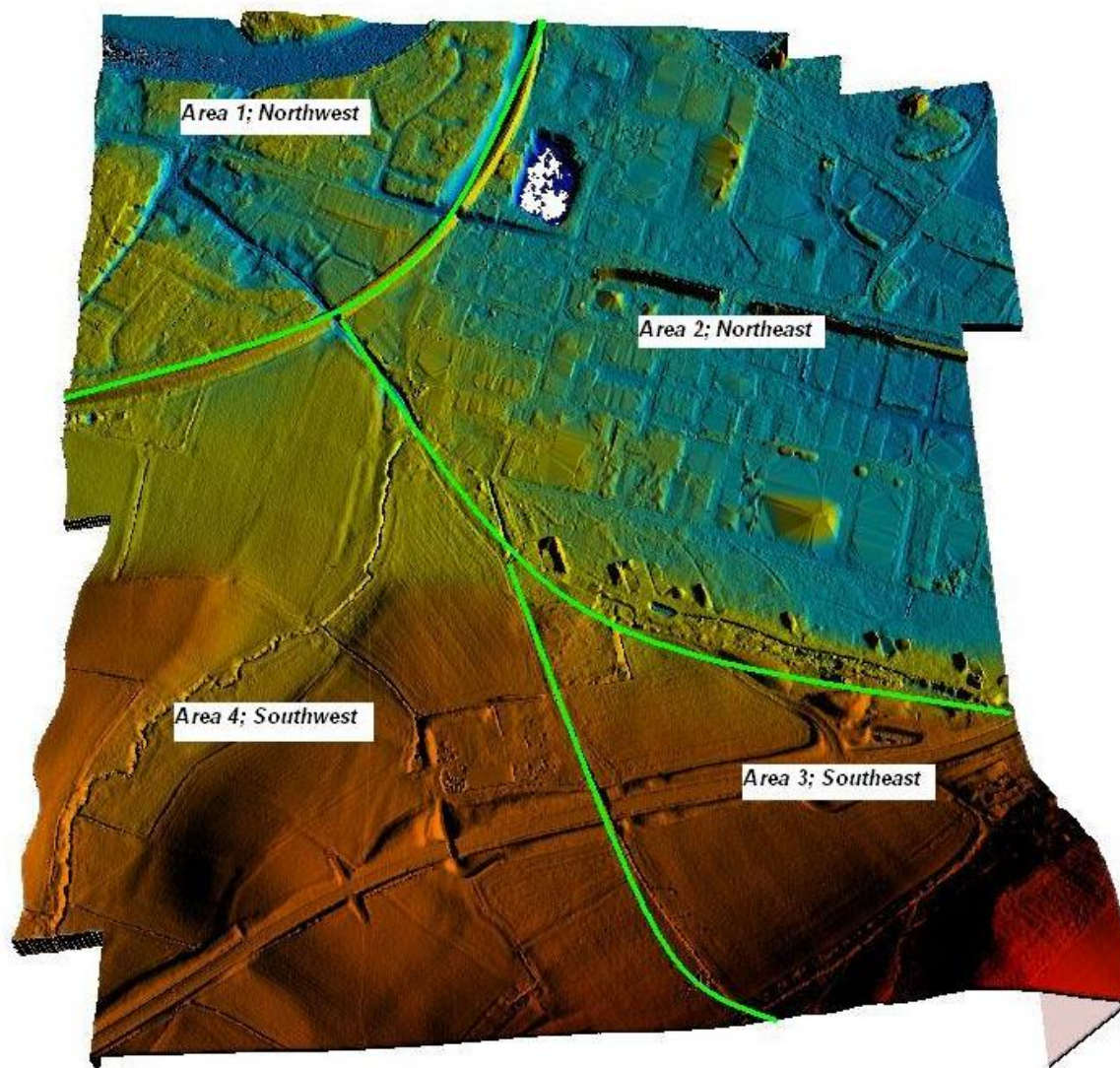


Plate 4: DTM 'bare-earth' results highlighting the topography with the modern infrastructure and vegetation filtered out. The green lines demarcate the boundaries of the four areas which have been defined for discussion within this report. © 2009 Environment Agency, Geomatics Group & Herefordshire Archaeology.

- Within the south of the survey area the recently completed east-west aligned Rotherwas Access Road is a significant landscape feature;
- To both the north and south of the road, current field boundaries and associated track ways (including public rights of ways) are clearly identifiable;
- The Rotherwas Industrial Estate (previously the Rotherwas Munitions Factory) occupies the north-east quarter of the survey area, and although little underlying

topographical variation is revealed within the DTM, the floodplain context of the site is clearly expressed by the elevation data;

- In the north-west of the survey area, the semi-circular course of the Hereford – Newport rail link is clearly identifiable as a large embankment. The two breaks within the course of the embankment represent the location of bridge crossings (Holme Lacy Road to the north and Watery lane to the south);
- To the north of the embankment, apparent earthworks revealed by the DTM mainly relate to the modern settlement of Lower Bullingham, and to 20th century housing estates adjoining the historic settlement (whose roadways typically show up as sunken blue features within the DTM);
- The triangular area of land bounded by Holme Lacy Road and Watery lane is the site of Lower Bullingham Deserted Medieval Village (SM HE 219).

3.2 Area 1 (North- West)

The area lies within the parish of Lower Bullingham, and has seen considerable housing development in recent times. As a result of this growth, areas of agricultural land once used as orchards and agriculture have been incorporated into the built-up area, although the historic core of the settlement core around the cross-roads is still recognisable (see plates 5 and 6).

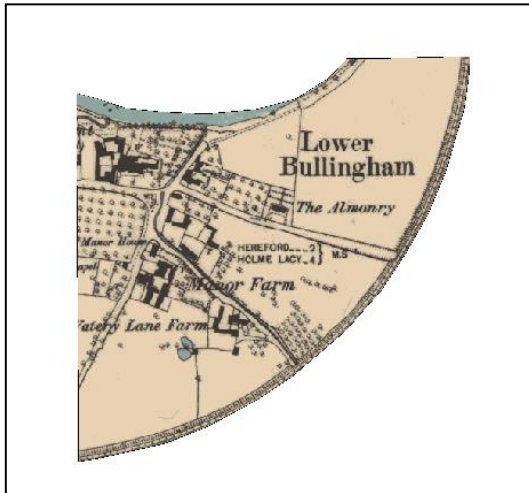


Plate 5: Area 1 survey area extracted from First Edition Ordnance Survey. © Herefordshire Archaeology.

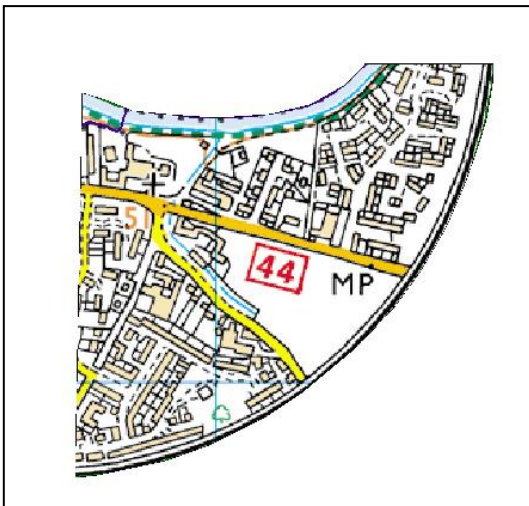


Plate 6: Area 1 survey area extracted from Ordnance Survey 1:25 000 scale mapping. © OS crown copyright 100024100.

The principal area of historic environment interest freshly revealed by the DTM is the Lower Bullingham DMV (bounded by the railway line to the east, Holme-Lacy Road to the north, and Watery Lane to the south). The site is under pasture, and a complex rectilinear arrangement of platforms, hollow-ways, ridge and furrow and fields/paddocks is visible (Plate 7). An extant post medieval farm (also shown on the First Edition) obscures the pattern at the western end of the land unit.

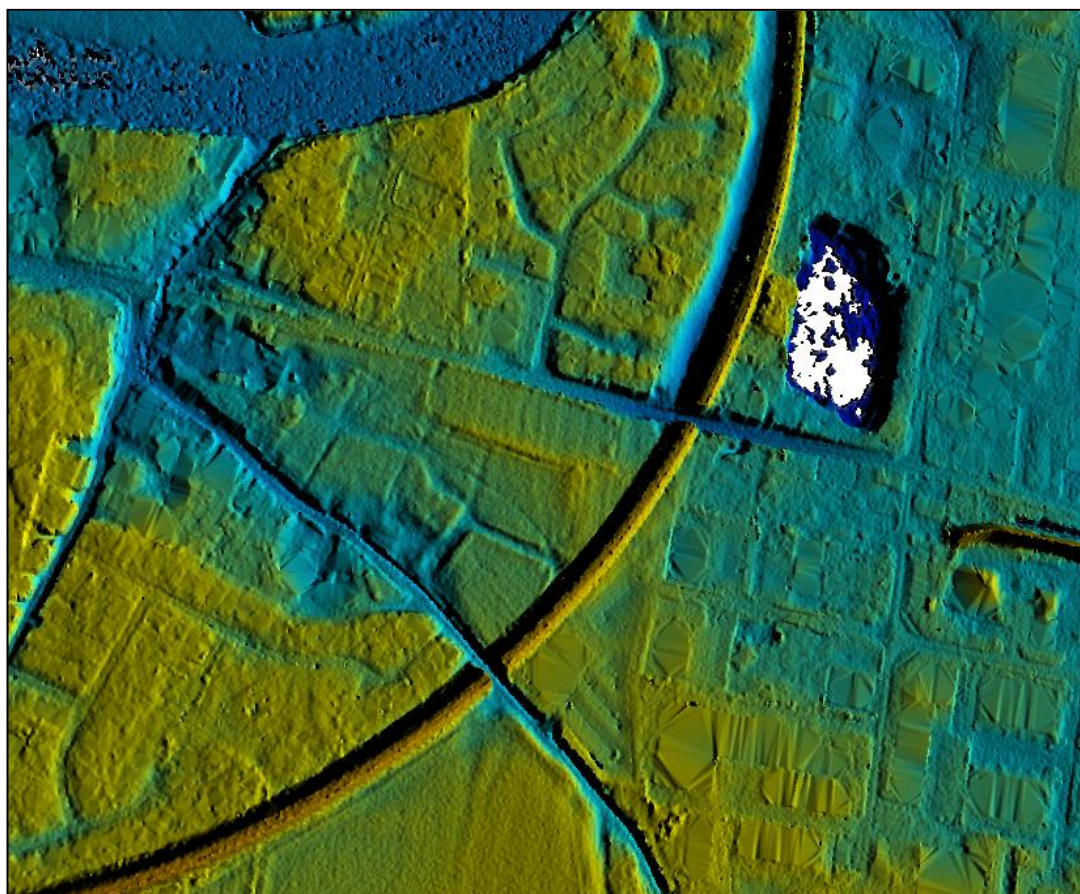


Plate 7: DTM highlighting earthworks visible within the DMV site (HE219). © 2009 Environment Agency, Geomatics Group & Herefordshire Archaeology.

The principal sequence of earthworks appears to be associated with a series of fields separated by sunken tracks/lanes which evidently linked the area to the historic settlement core (focused along the northern edge of Watery Lane and the cross-roads). The DTM indicates at least six sub rectangular field units of varying size, each bounding surviving ridge and furrow earthworks which show a predominantly north-south orientation (although with an east-west alignment in the far southern field).

In essence, the lidar data suggests that the Lower Bullingham site is best interpreted as a complex of former enclosed arable fields adjoining the medieval settlement of Lower Bullingham, rather than as a 'shrunken' extension of the former built up area of that settlement. Nevertheless, it does show the extent of preservation of that complex, provides a detailed record of the site, and emphasises the significance of the scheduled area as a surviving element of a historic landscape otherwise significantly masked by 19 and 20th century development.

3.3 Area 2 (North-East)

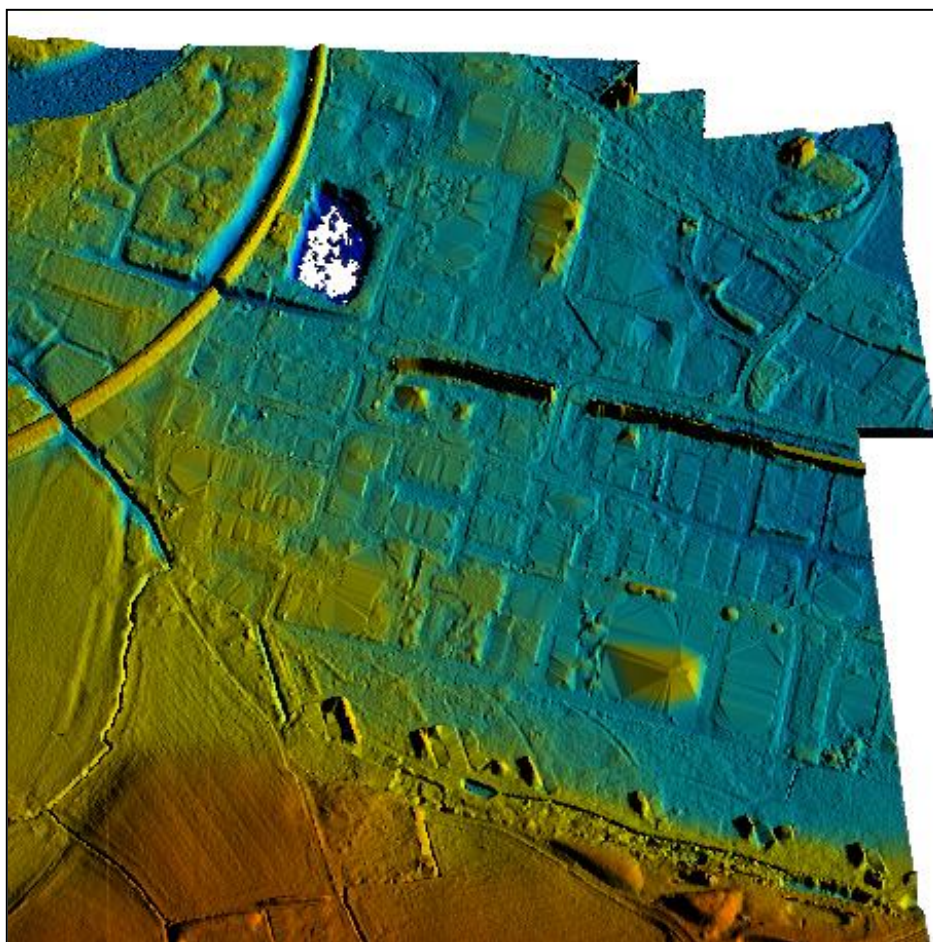


Plate 8: DTM highlighting the site of the Munitions Factory/Industrial Estate. Using the filtered data only the platforms of each structure remain visible allowing for the identification of more subtle features such as railway links and earthworks associated to activity of the Munitions Factory. © 2009 Environment Agency, Geomatics Group & Herefordshire Archaeology.

The north-eastern part of the survey area has altered dramatically since the 19th century (see Plates 9 and 10). At the time of the First Edition the area formed part of an agricultural landscape associated with the Rotherwas Estate, and lay to the south-west of the Rotherwas House complex. The locality was transformed in 1916 by the construction of the Rotherwas Munitions Factory, and in its developed form as the Rotherwas Futures Industrial Estates, that site remains a key settlement feature today.

As a result of the presence/disruption of the Munitions Factory/Industrial Estate, the DTM in this area does not reveal any significant evidence of earlier historic landscape features. However, it should be emphasised that, particularly with respect to the Digital Surface Model (not shown here), the lidar has provided an important record of the surviving elements of the munitions factory complex, and very clearly shows some of the key features of the site. One notable element is the six magazines (on the southern edge of the site) complete with their blast embankments and rail access alignments.



Plate 9 & 10: Area 2- northeast, comparison of the First Edition Ordnance Survey (left) and the 1:25 000 Ordnance Survey (right) © OS crown copyright 100024100 & Herefordshire Archaeology.

3.4 Area 3 (South-East)

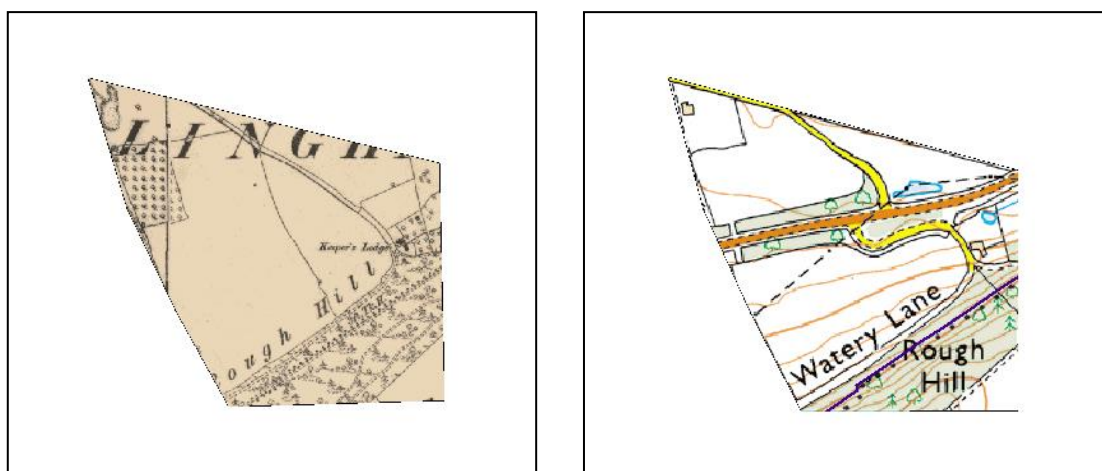


Plate 11 & 12: Comparison between the First Edition Ordnance Survey (left) and the 1:25 000 Ordnance Survey (right) © OS crown copyright 100024100 & Herefordshire Archaeology.

The south-east of the survey area is centred on the site of the Rotherwas Ribbon as identified in 2007 (marked on Plate 13 by the adjacent dip in the embankments on either side of the Rotherwas Access Road).

Comparison of the First Edition with the current 1:25 000 Ordnance Survey coverage demonstrates significant change since the 19th century, with field boundary loss (including the north-west to south-east aligned boundary linking Watery Lane with the foot of Dinedor/Rough Hill) and the removal of an orchard. More recently, the course of Watery Lane was altered during the construction of the Rotherwas Access Road.

Generally, the lidar does not obviously reveal features of significant historic-environment interest, and even the 'lost' features known from the map evidence are not readily apparent, perhaps emphasising the local impact of 20th century agricultural intensification.

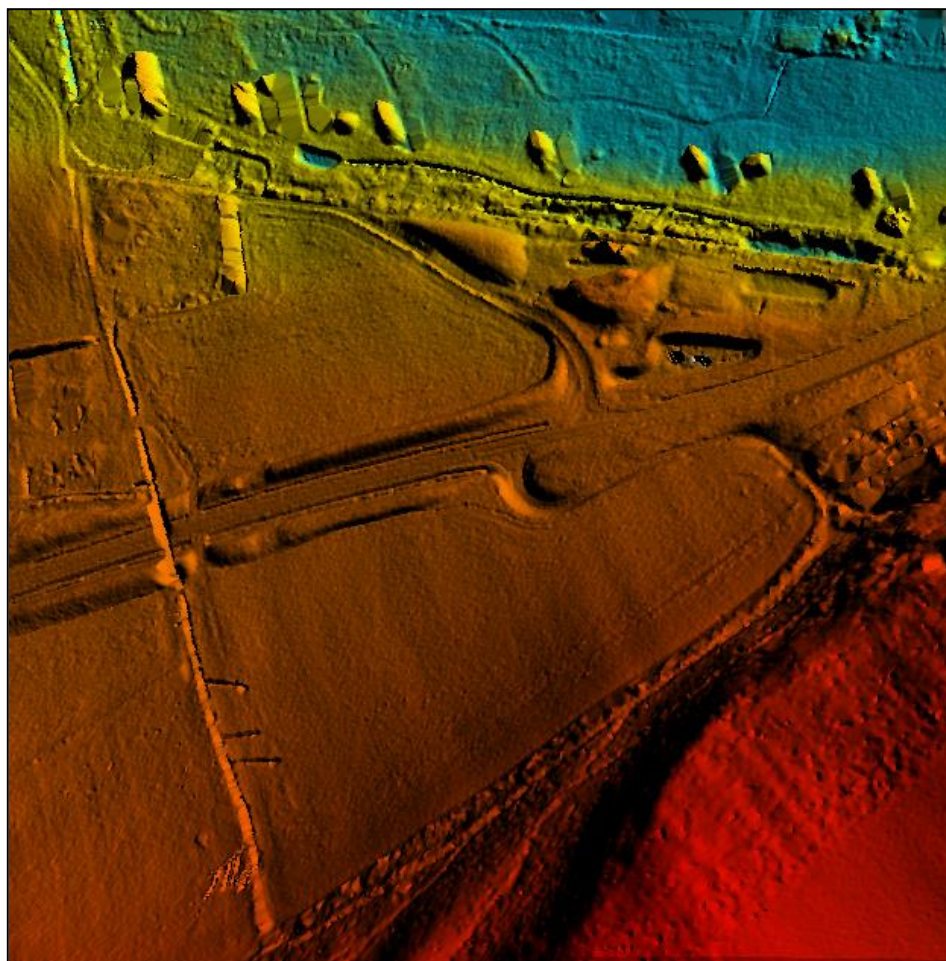


Plate 13: DTM of Area 3. The location of the 'Rotherwas Ribbon' exaction is indicated by a break within the embankment either side of the road (within west of image). © 2009 Environment Agency, Geomatics Group & Herefordshire Archaeology.

A principal objective of the present survey was to evaluate potential topographical evidence for the possible northward and southward extension of the Rotherwas Ribbon. As previously reported (see February 2010 Project Design for Further Investigation of the Rotherwas Ribbon Stage 2: Additional Fieldwork), the DTM does indicate the presence of a subtle hollow continuing on a sinuous line southwards from the Ribbon site. This is mirrored to the north by a slightly raised north-south ridge feature apparently marking a continuation of the alignment.

However, not only are these very slight features, but the lidar projection presented here also demonstrates that they appear to be just one component of a broad and repeated pattern of similar parallel north-south aligned hollows/ridges which exist in this vicinity. The precise interpretation of this extremely subtle pattern is not clear, although it may be associated with colluvial action linked to agricultural activity. What it does strongly suggest is that there is no particular archaeological significance to the hollow/ridge which appears to coincide with the Ribbon, and it may be that

colluvial accumulation hereabouts is deeply masking the ancient land-form of the area.

3.5 Area 4 (South-West)

The south-west quadrant is essentially of rural character, and is now bisected by the Rotherwas Access Road. The comparison between the First Edition and the modern 1:25 000 Ordnance Survey map (Plates 14 and 15) shows comparatively little landscape change, with features such as field boundaries and the course of Dinedor brook largely unaltered. The most significant changes are associated with orchard removal, with one former orchard site now re-developed as a farm building complex.

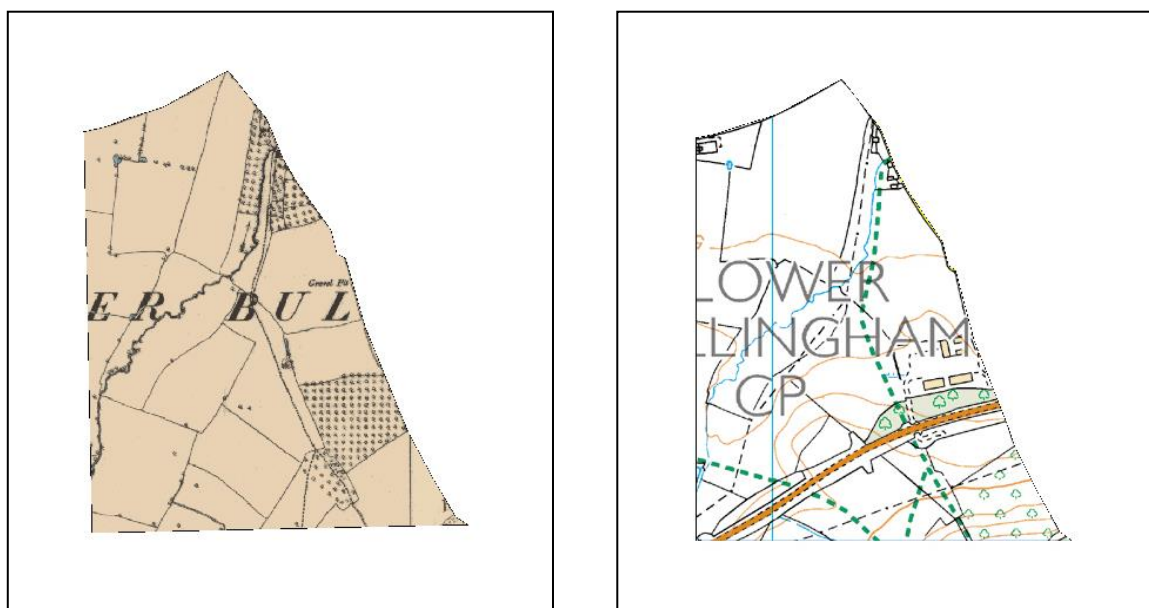


Plate 14 & 15: Comparison between the First Edition Ordnance Survey (left) and the modern 1:25 000 Scale OS Map (right) © OS crown copyright 100024100 & Herefordshire Archaeology.

The most significant additional historic environment feature revealed by the DTM is a substantially ploughed down pattern of rectilinear boundaries. These survive as low lynchets, terraces and hollows, and apparently represent an earlier field system with associated track-ways and lanes.

This pattern is best preserved in the western half of the quadrant, particularly in the area to west of the brook and directly south of the railway embankment. Here, on a zone of gentle north-facing slopes, the ancient field-system contrasts with the modern deep cut drainage ditches which clearly truncate the earlier east-west aligned boundaries. At least seven individual fields can be defined, each demarcated by what is now a subtle bank approximately three to five metres wide.

The original access routes associated with the fields are less easy to certainly define (and may have been entirely ploughed out), but a probable hollow-way can be traced on a north-south alignment which appears to follow the western bank of the brook. To the north, this feature links with Watery Lane, although to the south it disappears into the slopes of Dinedor Hill.

Similar relic divisions are visible on the higher ground to the south-west. Here again, subtle banks demarcate areas of sub-rectangular fields which appear to arranged on

an east-west alignment either side of the brook. However, the pattern hereabouts is less easy to distinguish from the later field enclosures.

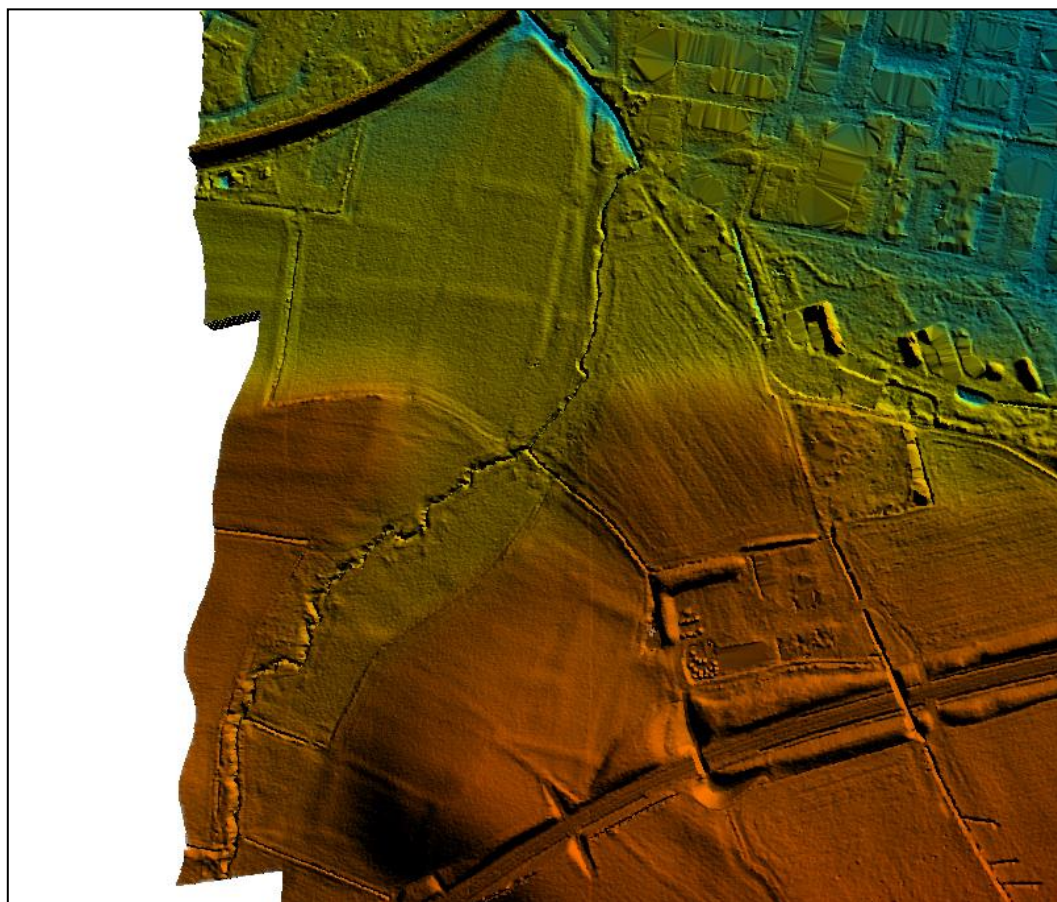


Plate 16: DTM indicating the earlier subdivisions within the landscape. The sub-rectangular fields likely to relate to the medieval period were enclosed by banks visible as subtle rises on a roughly east-west axis. © 2009 Environment Agency, Geomatics Group & Herefordshire Archaeology.

What is very evident is that these linear boundaries and features are a direct extension of the same field system previously described in the north-west quadrant as being the principal element of the Lower Bullingham scheduled site (and exceptionally well preserved in that location). That continuity can clearly be seen in Plate 4 to the north and south of the railway embankment. Following on from the analysis of the Lower Bullingham site, it is also reasonable to date the fields in the south-west quadrant to the medieval period, and to relate them to the wider agricultural landscape surrounding Lower Bullingham.

Section 4: Conclusions

4.1 Conclusions against the project aims

The survey did not identify significant topographical evidence to support the identification of a possible extension of the Rotherwas Ribbon. The area of the Ribbon discovery appears to have been subject to a combination of intensive agricultural activity and (perhaps) colluvial accumulation which has significantly masked landforms which may have existed in a Neolithic/Bronze Age context.

However, the survey has elucidated the broader landscape context of the Ribbon site, and particularly indicates the location of the known length of the Ribbon in a key topographical mid-slope position between the Wye flood-plain to the north and the rapidly rising ground of Dinedor Hill to the south.

4.2 General Conclusions

The survey has provided a high resolution lidar dataset (including Digital Surface and Digital Terrain Models) for an important part of the Rotherwas historic landscape including visible multi-period remains from the medieval period to the 20th century.

As well as generating a detailed record of the Lower Bullingham Scheduled Monument (HE 219), the survey results have also clarified the nature of the earthworks on that site which now emerge as a well preserved medieval field system including a rectilinear group of fields associated with ridge and furrow, and a network of hollow-ways.

Importantly, the survey has also demonstrated that the field system within the Scheduled Monument is just one part of a more extensive system which once extended over a significant area, and which still survives as a much reduced pattern of ploughed-down boundaries under the modern field systems to the south-west of the railway line.