Gloucestershire
COUNTY COUNCIL

NHPP 2D1: Agriculture and Forestry Impacts
Project No. 6468

Turning the Plough
Update Assessment 2012

Summary Report for

ENGLISH HERITAGE

Toby Catchpole and Russell Priest

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Summary

During the 1990s a number of projects undertaken through the English Heritage Monuments Protection Programme investigated survival and loss of medieval and post-medieval agricultural earthworks in the English Midlands. The combined results of these projects were published as 'Turning the Plough' (Hall 2001). This included a gazetteer of 40 parishes (relating to 43 'townships') where the most significant surviving earthworks were located. The project included an assessment of the extent of survival in the priority townships based on aerial photographs taken in 1999.

In 2011 it was decided to update records of what ridge and furrow survives in the 40 parishes, in order to inform future management of these nationally significant heritage assets. English Heritage undertook a programme of flights and produced over 3000 oblique digital photographs of the project area. A brief was produced and tender documents issued for a new project, the aim of which was to assess the survival and loss of ridge and furrow in the project area, using the new photographs, through the production of updated ridge and furrow mapping and the recording of the condition of earthworks in each land parcel where ridge and furrow was present or had been lost since 1999.

This document is a technical summary report on the Turning the Plough Update Assessment 2012. It has been produced the Archaeology Service of Gloucestershire County Council and funded through the English Heritage National Heritage Protection Commissions Programme.

Only a relatively small amount (4.24%) of the ridge and furrow recorded in 1999 has been entirely lost but a larger amount (12%) has been lost or badly damaged. The total area of ridge and furrow recorded in 2012 was, however, significantly larger than in 1999, as the earlier project had only recorded high quality ridge and furrow whereas the current project recorded all visible ridge and furrow, irrespective of condition. Despite this, 76.6% of all ridge and furrow recorded in 2012 is in good (well preserved and slightly degraded) condition and thus worthy of consideration for preservation.

1 Introduction

1.1 General introduction and project background

1.1.1 The Turning the Plough Update Assessment (TTP2) project has been undertaken by the Archaeology Service of Gloucestershire County Council (GCCAS), funded by English Heritage through the National Heritage Protection Commissions Programme (NHPCP). The work was identified by English Heritage as an additional priority in the National Heritage Protection Plan 2011-15 under 2D1 (Agricultural and Forestry Impacts).

1.1.2 The primary project outputs of TTP2 are shapefile mapping of ridge and furrow polygons together with associated record tables. These shapefiles include detailed information relating to individual modern land parcels containing visible ridge and furrow earthworks within the 40 project parishes.

1.1.3 This document is intended to be primarily a technical summary report that describes project methodology and outputs. It includes an initial analysis of the results for the entire project area, drawn up with the aim of informing further research and facilitating decision making regarding the future management of the most significant groups of medieval agricultural earthworks. It does not include detailed analysis at a parish or even county level but it is clear that there are wide differences between results at local levels, which have not been investigated by this project.

1.1.4 The report has been amended based on comments from English Heritage. It is the final version for circulation.

1.1.5 The archaeological background to the project is set out in detail in the project brief (English Heritage 2012). In summary, the 1990s Midlands Open Fields project used aerial photography to examine loss and survival of medieval and later agricultural earthworks in the Inner and East Midland sub-Provinces, as defined by Roberts and Wrathmell (2000), minus those parts in Derbyshire, Essex, Hertfordshire, Wiltshire and Worcestershire. The work was funded by the English Heritage Monuments Protection Programme (MPP). The results of the project were published in full by Hall (2001) as 'Turning the Plough' (TTP1) and in summary by Anderton and Went (2002).

1.1.6 A major output of TTP1 was the identification of 43 'township' field systems in 40 parishes, which represented the best surviving examples (Figure 2) of the *c.* 2000 identified within the project area. Aerial reconnaissance of these sites in 1999 identified that destruction of the earthworks was on-going, and many examples were found to have suffered significant damage in the previous four years. The effects of ploughing on earthworks are well known but have recently been scientifically quantified by the English Heritage 'Effects of Arable Cultivation on Archaeology' project (pnum 3874, Spandl *et al* 2010). It has been estimated that 94% of all ridge and furrow in the East Midlands has already been lost (English Heritage 2003). The Turning the Plough Update Assessment has provided a review and record of the current condition of agricultural earthworks in the 40 parishes, utilising new oblique aerial images taken by English Heritage in 2011 and 2012.

1.1.7 It is hoped to add the results of the project into the Selected Heritage Inventory for Natural England (SHINE) database in near future, subsequent to guidance from English Heritage on selection and technical procedures. This should assist in the making of appropriate management decisions in areas under consideration for entry into Environmental Stewardship (ES) schemes.

1.1.8 The core project team comprised:

Role	Person
Aerial Survey Quality Assurance Officer (QAO)	Damian Grady, English Heritage
Project Assurance Officer (PAO)	Helen Keeley, English Heritage
Project Experts (PE)	Amanda Dickson, Josephine Janik and Russell Priest, Gloucestershire County Council
Project Manager (PM)	Toby Catchpole, Gloucestershire County Council
Project Executive	Jan Wills, Gloucestershire County Council

Table 1: Core project team

Additional advice and support were received from Vince Holyoak, Helen Winton and Simon Crutchley, all of English Heritage.

1.2 Definition of the study area

1.2.1 The project area is defined as the Turning the Plough (TTP1) parishes listed in the gazetteer produced by Hall (2001, Appendix 2) and as shown in the accompanying maps (not included in the publication) provided to the project team by English Heritage as low resolution Adobe Acrobat (.pdf) files. Modern civil parish boundaries are shown on Figure 1.

1.2.2 To ensure that the results of TTP2 can be compared with TTP1 please note that for the purposes of this project:

- Denchworth (Oxon) includes Denchworth and West Hanney civil parishes.
- Weston-sub-Edge (Glos) includes both the main and detached sections of Weston-sub-Edge parish and Aston Subedge parish which lies between them (see Figure 4).
- The area referred to as Passenham in the gazetteer mostly comprises the modern Old Stratford (Northants) civil parish with some ridge and furrow now in Deanshanger parish and a small amount of land area (but no surviving ridge and furrow recorded) now in Pottersbury parish.
- Clipston and Newbold (also referred to as Nobold) in the gazetteer equates to Clipston (Northants) civil parish.
- Easton Neston only includes the southern part of the modern civil parish but does include part of Towcester parish.
- Great Oxendon excludes approximately the western third of the civil parish.

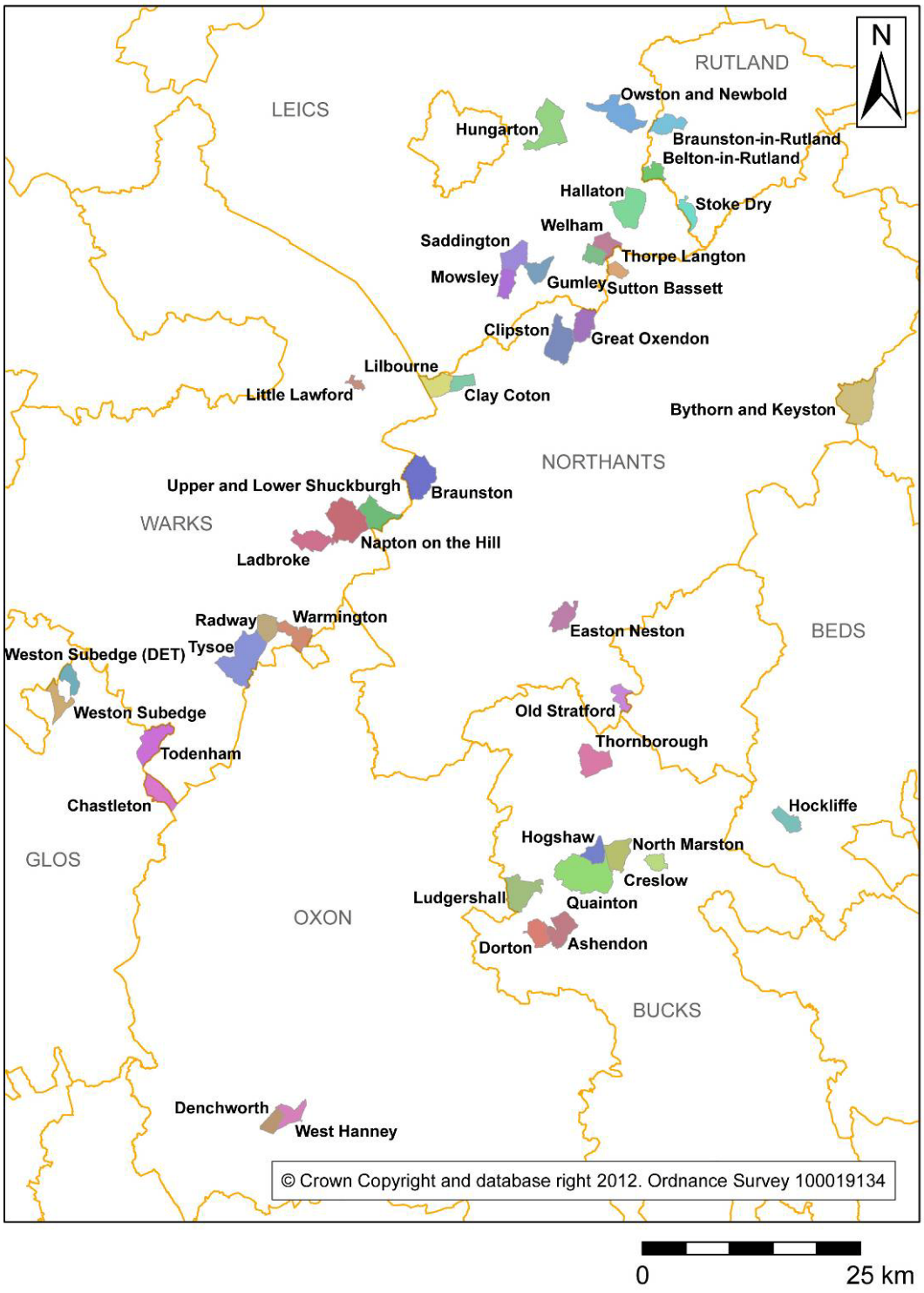

Figure 1: Location of Turning the Plough civil parishes

Parish and modern county/unitary authority boundary shapefiles provided by English Heritage.

2 Aims and Objectives

2.1 Aims

Project aims were set out in the brief (English Heritage 2012):

> "The primary aim of the project is to use existing aerial photographic coverage to assess current survival of ridge and furrow in the 43 priority townships, in order to determine whether the previous trajectory of loss has continued or been ameliorated by initiatives such as Environmental Stewardship".

It continues:

> "In the light of Defra's wish to place more emphasis upon the management of environmental assets at a landscape level post-2013, this re-assessment will assist future targeting of grant resources by Defra (principally through the Environmental Stewardship Scheme administered on behalf of Defra by Natural England and through future amendments to the Environmental Impact (Agriculture) Regulations (2006)). It will also help to inform discussions internally within EH on heritage protection options and designation on a landscape level."

2.2 Objectives

Project objectives were to:

- produce up to date digital mapping and records of the survival or destruction since 1999 of ridge and furrow within the priority townships identified by Turning the Plough;
- produce statistics regarding the survival of ridge and furrow in the townships relating to its current area in comparison with records created by Turning the Plough in 1999 and regarding the effects to date of various stewardship schemes on survival;
- produce a report summarising and illustrating the above;
- provide all of the above to English Heritage.

2.3 NHPP

The NHPP (EH 2011) describes the programme under which the project was funded as follows:

> "Measure 2: Threat Assessment and Response, 2D: Impact of Resource Exploitation, 2D1 Agricultural and Forestry Impacts: Agriculture and forestry present very significant threats to our designated and undesignated archaeological heritage, buried and built. Intensification appears inevitable. Out of the 19,721 Scheduled Monuments, just under 20% are at immediate risk of destruction or loss, with agriculture and forestry land management practices outside the development control framework being the main reasons. Agricultural buildings and complexes are under threat from piecemeal change, redundancy or conversion. Action will focus on reducing cultivation impact and developing practical management regimes."

3 Methodology

3.1 General

The project work was undertaken in accordance with the brief and as agreed with English Heritage. Proposed methodology was set out in detail in the project design, which was submitted in support of a tender bid for the project, and subsequently amended once the tender had been awarded to GCCAS (Catchpole 2012). The requirement for further refinement of methodology was identified at training sessions and during the early stages of mapping and recording. These changes are detailed below.

3.2 Sources consulted for the project

3.2.1 The following sources have been consulted:

Provided by English Heritage:

- Oblique digital aerial photographs located along flight paths viewable in Google Earth;
- Environment Agency lidar jpegs (where held);
- Turning the Plough 1999 mapping in shapefile and pdf format.

Accessed by GCCAS via EH IT systems and library and other libraries:

- Online sources of aerial photographs: Google Earth, with Bing or Google Images as backup/reference (for example to help understand the reasons for absence);
- Relevant additional published sources.

Downloaded from Natural England website:

- Natural England mapping of current Environmental Stewardship agreements

3.2.2 The images

Digital oblique aerial photographs were supplied by English Heritage along with a .kmz file viewable in Google Earth. The .kmz file linked the GPS flight trace with a thumbnail of each image to assist in location of the area covered by each photograph.

The thumbnails viewed through Google Earth were for guidance purposes only and not used for interpretation. Images were opened in Adobe Bridge software and then detailed observations and interpretation made by viewing them in Camera Raw. The foregrounds of photographs were used wherever possible rather than trying to interpret features in the distance, to help ensure accurate interpretation.

In total 3345 digital oblique APs were provided and viewed by the project team. Selected prime images were recorded in the attribute table for each ridge and furrow polygon mapped (see 3.4.4 below). The flight numbers and dates during which these images were taken are shown in Table 2 below.

Parish	County	Flight 1	Date	Flight 2	Date	Flight 3/4	Date
Ashendon	Bucks	S2900	12-Dec-11	S2901	06-Jan-12		
Belton-in-Rutland	Rutland	S2903	02-Feb-12				
Braunston	Northants	S2899	09-Dec-11				
Braunston-in-Rutland	Rutland	S2908	19-Mar-12	S2912	28-Mar-12		
Bythorn	Cambs	S2900	12-Dec-11	S2912	28-Mar-12		
Chastleton	Oxon	S2898	17-Nov-11	S2918	16-May-12		
Clipston and Newbold	Northants	S2900	12-Dec-11	S2902	01-Feb-12	S2908 S2918	19-Mar-12 16-May-12
Clay Coton	Northants	S2902	01-Feb-12	S2908	19-Mar-12		
Creslow	Bucks	S2901	06-Jan-12	S2911	27-Mar-12		
Denchworth (& West Hanney)	Oxon	S2901	06-Jan-12				
Dorton	Bucks	S2900	12-Dec-11	S2901	06-Jan-12		
Easton Neston	Northants	S2899	09-Dec-11				
Gumley	Leics	S2902	01-Feb-12				
Hallaton	Leics	S2908	19-Mar-12	S2912	28-Mar-12		
Hockliffe	Beds	S2900	12-Dec-11				
Hogshaw	Bucks	S2899	09-Dec-11	S2901	06-Jan-12		
Hungarton	Leics	S2903	02-Feb-12	S2910	21-Mar-12		
Ladbroke	Warks	S2898	17-Nov-11	S2899	09-Dec-11	S2902	01-Feb-12
Little Lawford	Warks	S2902	01-Feb-12				
Lilbourne	Northants	S2902	01-Feb-12	S2908	19-Mar-12		
Ludgershall	Bucks	S2900	12-Dec-11				
Marston, North	Bucks	S2899	09-Dec-11	S2901	06-Jan-12		
Mowsley	Leics	S2902	01-Feb-12				
Napton on the Hill	Warks	S2899	09-Dec-11	S2902	01-Feb-12	S2918	16-May-12
Owston and Newbold	Leics	S2910	21-Mar-12	S2912	28-Mar-12		
Oxendon, Great	Northants	S2900	12-Dec-11				
Passenham (Old Stratford)	Northants	S2899	09-Dec-11				
Quainton	Bucks	S2901	06-Jan-12				
Radway	Warks	S2898	17-Nov-11				
Saddington	Leics	S2902	01-Feb-12				
Shuckburgh, Upper and Lower	Warks	S2899	09-Dec-11	S2902	01-Feb-12		
Stoke Dry	Rutland	S2908	19-Mar-12	S2912	28-Mar-12		
Sutton Bassett	Northants	S2902	01-Feb-12				
Thornborough	Bucks	S2899	09-Dec-11				
Thorpe Langton	Leics	S2902	01-Feb-12				
Todenham	Glos	S2898	17-Nov-11	S2903	02-Feb-12	S2918	16-May-12
Tysoe	Warks	S2898	17-Nov-11				
Warmington	Warks	S2898	17-Nov-11				
Welham	Leics	S2902	01-Feb-12				
Weston Subedge	Glos	S2898	17-Nov-11	S2913	28-Mar-12		

Table 2: English Heritage flights providing digital oblique APs used by TTP2

Most of the photographic sorties were flown between November 2011 and March 2012, with a final sortie flown on the 16th of May 2012 to provide coverage of a small number of areas in four parishes. These holes in the coverage were identified during the course of the mapping. The later flights were not flown under optimal conditions, in some cases ridge and furrow that was clearly visible on mid-winter photography was obscured by long grass or crops in May. Photographs were taken as runs of overlapping images and where weather conditions allowed each run overlapped the next. Occasionally close ups were taken to record fine detail of scheduled monuments, particular damage issues, illustrations, etc.

Interpretation of images was augmented by the use of Environment Agency lidar (in the form of hill shaded jpegs) and Google Earth. Environment Agency Lidar was not available for the entire study area. However, in many cases, lidar was useful for confirming areas of ridge and furrow, and both lidar and Google Earth were sometimes useful in providing a recent historical context for individual fields. For example, being able to see what the history of cultivation has been over the last ten years was helpful in being able to ascribe a reason for the current condition of the ridge and furrow.

All aerial photographs and Lidar images made available to be consulted were examined on screen only, with no rectification necessary.

3.2.3 Turning the Plough data

Shapefiles were provided by English Heritage in February 2012 (as additional information for tendering organisations), which delineated the relevant civil parish boundaries and ridge and furrow recorded by TTP1 in 1999. Unfortunately the original digital data had inadvertently been deleted and the ridge and furrow dataset provided was not complete. Comparison of the ridge and furrow data with TTP1 data held by Northamptonshire's HER indicated a significant number of differences between the data sets, mostly caused by clipping of shapefiles that removed 'township' fields outside the modern civil parish with the same name. Likewise examination of the parish mapping raised issues with differing names used (due, for example, to historic parishes being merged into modern civil parishes and parishes containing more than one 'township'). Due to these anomalies between the various available data sets it was agreed that wherever possible TTP2 should use the same physical areas of land and naming of settlements as the TTP1 gazetteer and mapping.

Therefore the plans produced for the digital version of the TTP publication (Hall 2001) and provided by English Heritage in low resolution pdf format were used as the prime reference material regarding TTP1 mapping to be updated by TTP2.

The pdf plots for all TTP gazetteer entries (apart from Hogshaw, see next paragraph) were georeferenced and used as base mapping for copying into vector format the extents of alluvium, woodland, earthworks, and ridge and furrow recorded in 1999 (see 3.4 below for description of features mapped). Digitisation was carried out as accurately as possible but the pdf scans were not capable of being magnified beyond 1:10,000 without becoming pixelated. See 1.2.2 above for discrepancies between the gazetteer entries and civil parish boundaries.

No pdf plot was available for Hogshaw parish however, and therefore the base mapping of extant ridge and furrow in 1999, for this parish only, was the shapefile provided by English Heritage (Ridge_Furrow_1999_region.shp) via DEFRA. Earthworks were newly mapped for Hogshaw parish using the 2012 oblique APs.

3.2.4 Map sources

The project used OS 1:10000 mapping supplied via the Pan Government Agreement.

3.3 Training and finalisation of methodology

A training session and update meeting was organised by Damian Grady for the GCCAS project team on 28th March 2012, at which use of the oblique images and software was discussed, pointers for identification and interpretation given, and final definitions of attribute table terminology agreed. The bulk of the meeting was taken up looking at examples of photographs to highlight the following potential issues:

- Consistency in recording the condition attribute.
- Light direction parallel to ridges and furrows, requiring use of photographs taken from a different position (or lidar) to double check when this (or other reason for uncertainty) occurs.

Figure 2: Effect of light direction at Bythorn, Cambridgeshire.

The light in the image is low and from the right. The ridge and furrow which extends parallel with the light (particularly on both sides of the dual carriageway) appears to be less well preserved, when in fact it is simply casting less shadow. Extract from 27372_036 12-DEC-2011. © English Heritage.

- Building development at settlement edges.
- Pheasant hides.
- Miscanthus giganteus and other energy crops. It was assumed that earthworks were destroyed where these are present as this is the inevitable result when roots are grubbed out.
- Overgrazing and 'poaching' by livestock.

- Badger and other burrowing animal damage.
- Other agricultural practices such as ploughing, spraying and haymaking and how they might appear on aerial photographs at particular times of the year.
- Crop types, cultivation regimes, grass lengths etc and how they will affect the confidence of an interpretation of ridge and furrow condition.

Figure 3. Effect of long grass on earthwork visibility at Quainton, Buckinghamshire.

The longer grass across much of this image makes assessing the condition of the ridge and furrow less reliable. Extract from 27378_047 06-JAN-2012. © English Heritage.

3.4 Interpretation, mapping and recording

3.4.1 Rectification

TTP1 gazetteer pdf maps (Figure 4) were exported as jpegs and georeferenced mostly within AutoCAD, using matching points on parish boundary shapefiles or other OS mapping if necessary. At least three control points (more where necessary) were matched on each of the 39 maps to ensure that subsequent digitisation of data recorded in 1999 was as accurately located as possible. A few were rapidly rectified within Aerial, where adequate control points were lacking.

3.4.2 Mapping

The project mapping and records were produced entirely in digital format. The required information was plotted as closed polygons onto the OS map base in AutoCAD MAP 3D 2008. The mapping which has been produced falls into three categories:

- Original TTP mapping of woodland, alluvium and earthworks, not previously available in shapefile format has been digitised from the rectified versions of the gazetteer maps. No attributes other than assignment of their basic categories have been recorded with this data.

- All areas containing ridge and furrow mapped in 1999, whether present or absent, recording its current condition. Ridge and furrow not mapped in 1999 but visible on the recent images has been mapped and attributes recorded (see Table 3).

- Anomalies in the 1999 shapefiles have been identified on a layer called 1999 ANOMALY. This is to enable improvements to the accuracy of the mapping without causing problems with statistical analysis and to highlight where the project team noted errors in boundaries on the earlier mapping. This was only used when a polygon or part polygon that was mapped in 99 is clearly mistaken – for example where it overlaps a road or development that would certainly have been there in 1999.

In many cases larger 1999 blocks of ridge and furrow had to be split into two or more polygons for TTP2 as many of them include several modern fields found to contain variable condition levels on modern images. Fields have however, been grouped together and surrounded by a single polygon where the condition of the earthworks is very similar.

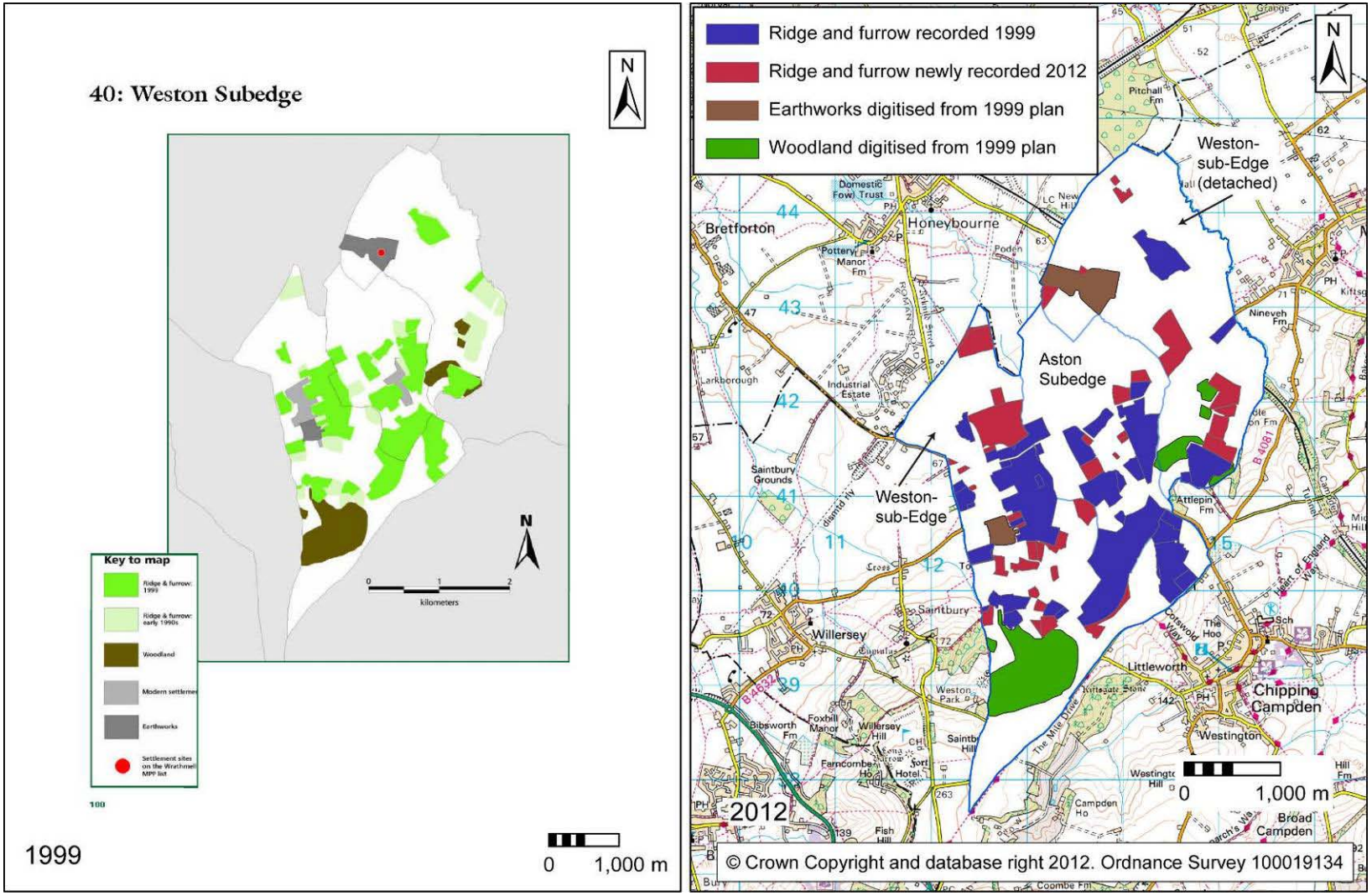

Figure 4: 1999 and 2012 Turning the Plough project mapping at Weston-sub-Edge

Note inclusion of Aston Subedge.

Mapping of TTP1 woodland, alluvium and earthworks has been based on the 1999 gazetteer maps, although polygons have generally been drawn up to the field boundaries shown on the modern OS 1:10,000 mapping. The 1999 polygons were based on earlier 1:10,560 mapping and so there were some areas which did not fit exactly. Figure 5 below shows examples where the position of the 1999 polygon does not correspond with the position of the modern hedges.

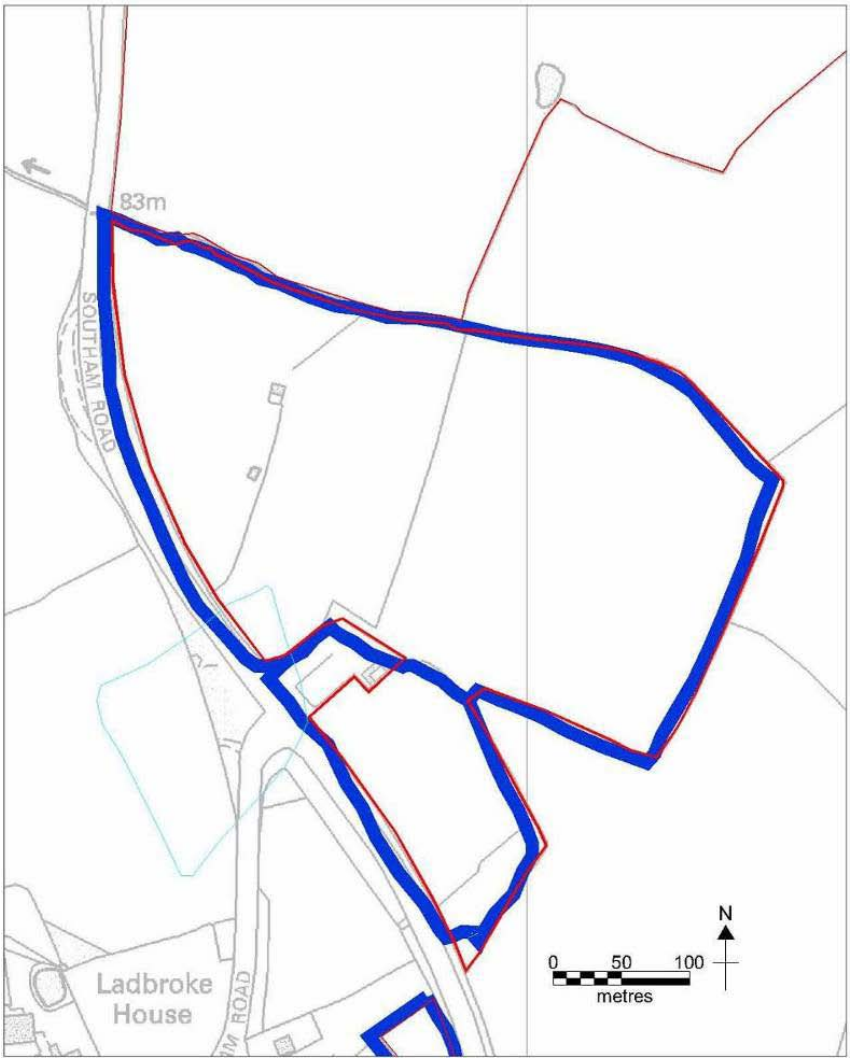

Figure 5: Discrepancies between 1999 and 2012 mapping to the north of Ladbroke, Warwickshire.

The 1999 ridge and furrow mapping is shown in blue. 2012 ridge and furrow mapping is shown in red, following the grey field boundaries on the Ordnance Survey mapping. OS Map Base © Crown copyright. All rights reserved. Gloucestershire County Council 100019134 2012.

3.4.3 Quality Assurance

Each Project Expert's first parish was used for a detailed examination and discussion of results with Damian Grady. Subsequent parishes were given decreasing amounts of detailed examination as the project team became more familiar with various issues including consistent assessment of condition, the direction of light, vulnerabilities etc.

3.4.4 Object data/attribute tables

The required tabulated information (Object Data Tables in AutoCAD or Attribute Tables in ArcGIS) was attached to each newly mapped polygon of ridge and furrow. This was arranged so as to make it possible to interrogate the data to produce the required statistics. The final Object Data table (below) was agreed at a project set up meeting with Damian Grady on 18th of April 2012. The table was checked by English Heritage for MIDAS compatibility. The condition and confidence attributes were discussed at weekly meetings by the project team during the course of the project to ensure that they continued to be applied in a consistent fashion.

Attribute	Example Data/explanation
1. FeatID	N:nn *(the first figure being the gazetteer parish/township entry no: the second being issued sequentially for each polygon drawn within that township/parish)*
2. Parish	As listed in the TTP gazetteer
3. Ridge and furrow	New 1999 Straight (i.e. 1999 = recorded in 1999)
4. Record source	Prime image(s) of the area. Using film/frame reference(s)
5. Date	Date 4. taken
6. Survival	Present Absent
7. Condition	Well preserved Slightly degraded Heavily degraded Uncertain Absent
8. Confidence rating	High Medium Low *Level of certainty that survival and condition attributes are correct.*
9. If absent reason If present current vulnerability	Ploughing Tree/scrub growth Building development Burrowing animal damage Livestock damage Pipelines Leisure activities None identified Other *(Dominant reason only recorded here, other information can be recorded in comments field)*
10. Comments	Free text for other pertinent comments
11. Compiler	ALD, JJ, RAP

Table 3: Project record attribute table

The following amendments were made to the attribute table in discussion with English Heritage, after production of the final version of the project design:

- The area of each polygon was automatically generated within AutoCAD and included in the shapefile export. It was therefore unnecessary for the project team to repeat this process manually.
- The 'Ridge and Furrow' attribute previously had a yes/no choice. It was felt that this might lead to confusion and the choices changed to '1999' (i.e. shown on TTP 1999 mapping) or ‘new’ (as in not recorded in 1999 but visible on images used in 2012).
- In addition Damian Grady had noted a few examples of straight rig resulting from steam ploughing on the photographs. This was not included in TTP1 records. It was agreed to further amend the 'Ridge and Furrow' attribute column to include three options: '1999', 'New' and 'Straight'.
- There is not a place on the attribute table for recording use of Lidar as no statistics were to be produced on this subject. Where Lidar has been used to clarify survival/condition this was to be recorded (with the date of the Lidar) in the free text comments field.
- Where condition is ‘Well preserved’, then there won’t necessarily be an entry for the vulnerability attribute. ‘None identified’ was identified as a necessary additional option.
- The condition of the ridge and furrow was described as ‘Uncertain’ in cases where areas were obscured by trees and scrub, under heavy shadow or covered by temporary storage. In each case, we have used our best estimate of whether any earthworks have survived. For this reason, ‘Uncertain’ condition ridge and furrow has been recorded as both ‘Present’ and ‘Absent’ in the 'Survival' attribute.

3.5 Data processing in GIS

3.5.1 Final shapefiles were exported from AutoCAD at The Engine House, broken down into shapefiles by AutoCAD layers as follows;

1. Ridge and Furrow layer minus MPolygons (Donuts in ArcGIS)

2. Ridge and furrow layer MPolygons (Donuts). Although these were meant to be part of the same layer as shapefile 1 polygons with internal ‘holes’ could not be made to export correctly from AutoCAD but would do so if exported separately. The area field, despite displaying correctly in AutoCAD, remained incorrect in the shapefile export (see below) and had to be recalculated in ArcGIS.

3. Woods/Alluvium/Earthworks digitised from scanned 1999 publication maps (see 3.4.2 above).

4. 1999 anomalies (for description of these see 3.4.2 above)

3.5.2 Correction and checking of main ridge and furrow mapping

Shapefile 1. contains 2005 entries and 2. has 25. This concurs with the number of records created in AutoCAD. The files as exported from AutoCAD could not be merged in ArcGIS.

Therefore in arctoolbox - Data management tools – Features – Check Geometry run for shapefiles 1. and 2. For ridge and furrow layer this produced 912 instances of “incorrect ring ordering”. For M Polygons it produced 25 instances of the same error. The errors are recorded in CHECK_GEOM.dbf files (see digital archive list at 3.7 below).

In arctoolbox - Data management tools – Features – Repair Geometry was run for shapefiles 1. and 2, allowing them to be merged without the process failing.

In arctoolbox - Data management tools – General – Merge run for shapefiles 1. and 2. producing shapefile complete_RnF_layer_15Jun12. This appended a few date and vulnerability entries into new columns for reasons unknown. The data was copied back over into the correct columns and the new columns turned off. Most importantly the new merged shapefile contained 2030 polygons as hoped for. There was however, a discrepancy with the total area calculated as covered by the polygons when figures calculated by AutoCAD and ArcGIS were compared (see 3.5.3 below).

The following columns were checked for null entries – Area, Condition, Feature ID, Layer, Ridge and Furrow, Township, Source, Survival and Vulnerability. None were present.

Consistency of terminology was then checked in ArcGIS using Layer Properties - symbology tab – Categories – Unique values – Add All Values. This was identified as a simple method of demonstrating slight differences that aren't immediately obvious in the attribute table as it picks up on variation in the use of capital letters and spacing which could affect statistics. It was used for the following columns with predetermined options for entry – Condition, Rating, Layer, Ridge and Furrow, Township, Survival and Vulnerability. Several instances of inconsistent use of capitals and spacing were noted and corrected.

It was noted that the format used in the date field is not consistent but as no statistics were to be based on this attribute it was not amended.

3.5.3 MPolygon/Donut issues

A minor error was noted in Tysoe Parish. Polygon 37:128 should occupy a donut within 37:47 whereas as exported it was a small overlapping polygon with no donut in 37:47. Therefore the following instruction from ArcGIS desktop help was followed:

> "Cutting donut holes in existing polygons.....To use an existing overlapping polygon for the shape of the hole, use the Clip command. When using this method, keep in mind that all editable features underneath the feature you are using to clip with will be clipped.
>
> 1. Select the inner polygon.
> 2. Click the Editor menu and click Clip.
> 3. Set the buffer distance to 0 and choose to discard the area that intersects.
> 4. Click OK.
> 5. Delete the inner polygon."

This worked successfully but didn't update the now reduced area covered by 37:47. This was checked using the measure tool and the area field manually updated. The new area did equal the old area of 37:47 minus 37:128.

As a consequence it was noted that for some reason the area calculations exported from AutoCAD for Mpolygons included the blank space occupied by the donuts. The difference in the total area of ridge and furrow calculated by AutoCAD and ArcGIS was 137,978m². All donut polygons were therefore checked in ArcGIS using the measure tool and area fields manually corrected in shapefile complete_RnF_layer_15Jun12.shp as follows:

Original area	Feat_ID	Township	Checked area
110723.4517115	2:18	Belton-In-Rutland	109118.098629
304301.8979510	6:01	Chastleton	289204.359637
31565.7869805	6:14	Chastleton	29373.877866
51227.1499128	7:39	Clipston and Newbold	44940.707168
312199.1468013	9:07	Creslow	308569.549168
208106.5778824	10:06	Denchworth	207613.037243
365485.0959388	10:26	Denchworth	365023.300919
36704.4195020	10:45	Denchworth	36521.479089
378423.1368657	12:09	Easton Neston	359282.357930
128670.2174277	14:24	Hallaton	127958.746475
130355.1630921	14:54	Hallaton	126071.474544
417030.4269188	18:30	Ladbroke	410704.467189
247854.1875577	18:31	Ladbroke	245373.467212
548884.4613840	21:43	Ludgershall	542096.601797
610220.6970288	22:22	Marston North	605100.336125
182927.1937397	25:19	Owston and Newbold	173887.610595
360856.1116356	26:05	Great Oxendon	351356.475350
77816.0220038	26:28	Great Oxendon	77099.725670
409129.4163338	29:05	Radway	390820.524826
83397.8104860	34:15	Thornborough	78140.712697
45357.1398127	36:14	Todenham	42359.562744
82502.7018307	36:60	Todenham	79589.482950
130112.2794606	37:18	Tysoe	126724.597669
326918.5529490	37:72	Tysoe	314742.271824
414058.7187572	40:44	Weston Subedge	406409.719476

Table 4: Corrected Mpolygon area calculations

Once these changes had been made the difference between the corrected AutoCAD total area of ridge and furrow and the area calculated in ArcGIS was 3.6m² over 110km², which seemed to be a reasonably low discrepancy compared with the original 138,000m².

Software	Calculation (m²)
AutoCAD	110,171,349.78
GIS	110,171,353.39
Difference	3.61

Table 5: Total area of extant ridge and furrow calculated by AutoCAD and ArcGIS

3.5.4 Environmental Stewardship mapping

The Natural England website was checked on 18th June 2012 for updated information. The latest shapefiles available were dated 18 April 2012, so these had been updated since previous versions were downloaded during project design production. The latest shapefiles were therefore downloaded for OS grid squares SK, SP, SU and TL. These four were then merged (ArcToolbox – Data Management Tools – General – Merge, producing shapefile skesh_Merge.shp)

3.6 Statistics

3.6.1 The project brief, project design and discussions with English Heritage informed the production of the following statistical tables derived from the project mapping and records.

A The total area of ridge and furrow (all conditions) in 1999 and 2012.

B Ridge and furrow present in 1999 but absent or heavily degraded in 2012 by reason.

C Ridge and furrow present now (i.e. 1999+new) by condition.

D Environmental Stewardship status of extant ridge and furrow.

E Vulnerabilities identified for extant ridge and furrow.

F The proportion of the area of each parish containing good quality ridge and furrow.

Most of these statistics (except D) could be generated relatively simply using shapefile dbf attribute tables manipulated in Excel. In order that they can be checked or replicated as necessary, detailed methodologies by which tables of statistics were produced are given below.

3.6.2 Stat A: Total area of ridge and furrow (all conditions) in 1999 and 2012

The attribute table for complete_RnF_layer_15Jun12 was saved as stat A.xlsx and copied onto two worksheets one labelled 1999 and the other 2012.

- 1999 sheet:
  - Sorted by R+F column and ‘New’ and ‘Straight’ rows deleted.
  - area column totalled by parish.
- In 2012 sheet:
  - Sorted by SURVIVAL and all rows where entry is ‘Absent’ removed.
  - Sorted by R+F column and rows where entry is ‘Straight removed.’
  - Sorted by parish and then by Ridge and Furrow.
  - Sub-Total ‘1999’ by parish.
  - Sub-total ‘New’ by parish.
- Sub-totals copied over to final table worksheet for adding of totals and percentages.

Parish	R+F area recorded 1999	1999 R+F present in 2012	% 1999 R+F present 2012	'New' R+F present 2012	Total R+F present 2012	% change in total R+F 2012
Ashendon	2,282,402	2,282,402	100.00	1,978,035	4,260,438	186.66
Belton-In-Rutland	1,407,920	1,383,465	98.26	144,730	1,528,196	108.54
Braunston	3,461,496	3,411,754	98.56	949,422.33	4,361,177	125.99
Braunston-In-Rutland	2,249,820	2,211,313	98.29	262,179	2,473,492	109.94
Bythorn	966,221	923,529	95.58	118,184	1,041,713	107.81
Chastleton	1,416,872	1,366,830	96.47	1,386,808	2,753,638	194.35
Clay Coton	811,696	811,696	100.00	225,362	1,037,058	127.76
Clipston and Newbold	2,573,998	2,523,425	98.04	1,322,936	3,846,360	149.43
Creslow	1,162,349	905,191	77.88	83,928	989,120	85.10
Denchworth	2,483,890	2,414,057	97.19	1,571,914	3,985,971	160.47
Dorton	1,178,716	1,140,747	96.78	776,789	1,917,536	162.68
Easton Neston	629,848	575,971	91.45	231,456	807,426	128.19
Great Oxendon	1,502,970	1,489,198	99.08	787,074	2,276,272	151.45
Gumley	1,253,341	1,253,341	100.00	1,053,161	2,306,502	184.03
Hallaton	2,523,079	2,495,858	98.92	984,907	3,480,765	137.96
Hockliffe	918,571	902,406	98.24	565,102.85	1,467,509	159.76
Hogshaw	1,290,452	1,283,479	99.46	337,006	1,620,484	125.57
Hungarton	3,761,824	3,683,395	97.92	805,755	4,489,150	119.33
Ladbroke	1,391,199	1,126,002	80.94	486,160	1,612,162	115.88
Lilbourne	1,697,547	1,200,704	70.73	911,513	2,112,218	124.43
Little Lawford	601,668	590,177	98.09	6,077	596,255	99.10
Ludgershall	4,595,272	4,492,140	97.76	1,432,228	5,924,368	128.92
Marston North	3,203,762	2,837,706	88.57	1,895,569	4,733,275	147.74
Mowsley	979,906	933,513	95.27	600,643	1,534,156	156.56
Napton on the Hill	4,580,895	4,389,518	95.82	2,244,828	6,634,346	144.83
Owston and Newbold	1,419,230	1,342,196	94.57	1,173,873	2,516,069	177.28
Passenham	413,488	402,500	97.34	208,180	610,680	147.69
Quainton	5,349,414	5,166,148	96.57	2,199,902	7,366,049	137.70
Radway	1,340,860	1,249,373	93.18	197,103	1,446,476	107.88
Saddington	1,887,763	1,775,378	94.05	846,849	2,622,226	138.91
Shuckburgh (Upper and Lower)	3,045,287	3,040,641	99.85	838,435	3,879,077	127.38
Stoke Dry	740,906	733,721	99.03	126,957	860,678	116.17
Sutton Bassett	1,137,716	1,027,328	90.30	322,260	1,349,588	118.62
Thornborough	1,540,736	1,522,908	98.84	1,258,996	2,781,904	180.56
Thorpe Langton	938,482	891,321	94.97	134,236	1,025,557	109.28
Todenham	1,670,546	1,597,964	95.66	733,996	2,331,960	139.59
Tysoe	3,887,155	3,801,401	97.79	1,864,387	5,665,788	145.76
Warmington	1,402,104	1,375,377	98.09	359,095	1,734,472	123.70
Welham	1,116,557	1,029,580	92.21	81,279	1,110,859	99.49
Weston Subedge	2,369,092	2,325,228	98.15	1,119,389	3,444,616	145.40
Total	77,185,049	73,908,881	95.76	32,626,705	106,535,586	138.03

Table 6: Total area of ridge and furrow (all conditions) recorded in 1999 and 2012

(Excludes steam ploughed ‘straight’ ridge and furrow)

The results indicate that a much greater than expected amount of ‘new’ ridge and furrow was recorded in 2012, which was not noted in 1999 (Figure 6). The result is that the total area of known surviving ridge and furrow has increased by a considerable proportion.

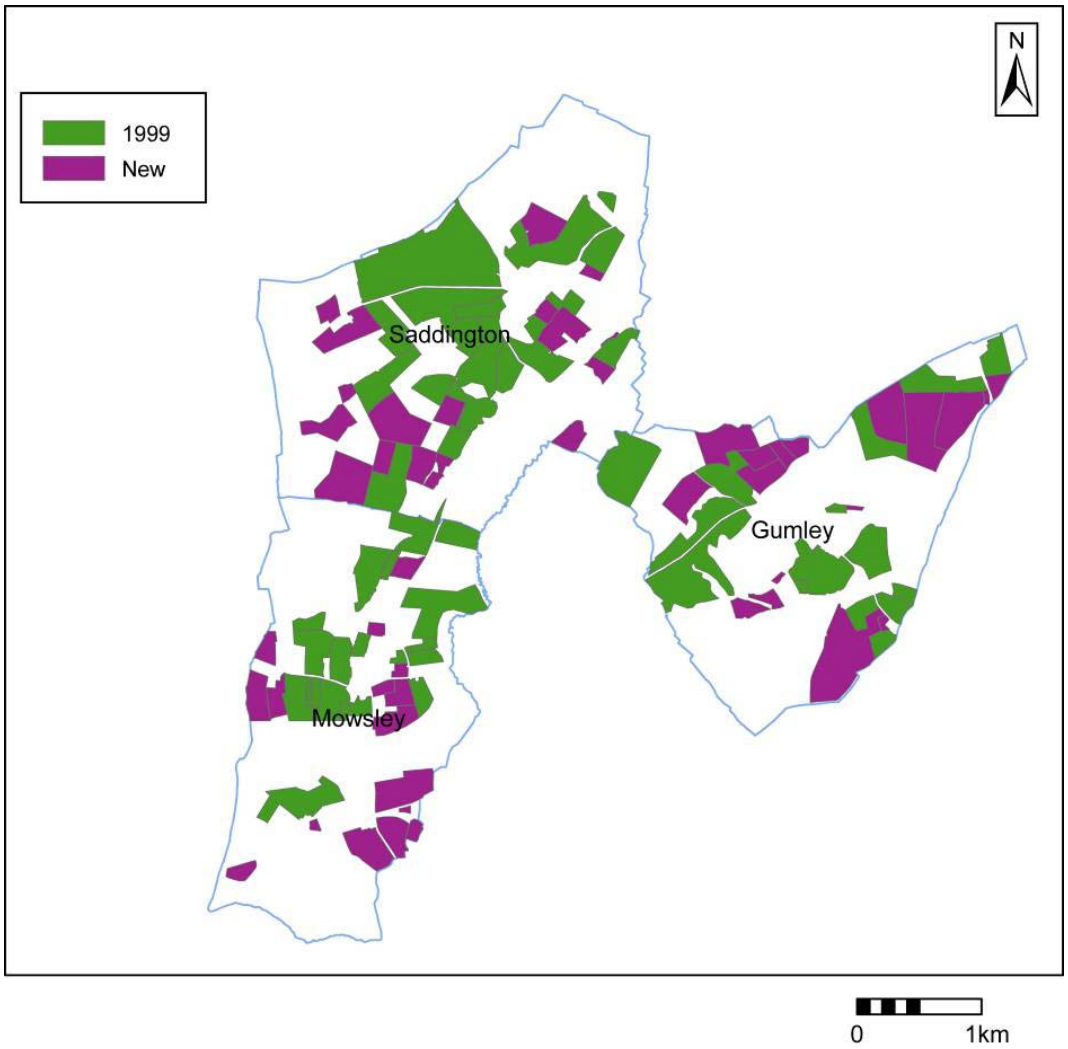

Figure 6: Ridge and furrow recorded in 1999 and newly recorded in 2012 in Mowsley, Saddington and Gumley parishes.

Further analysis (Stat C, 3.6.4 below) makes it clear that much of the ‘new’ ridge and furrow is in less than perfect condition. Although not stated explicitly in the 1999 project report it appears that the original survey took a strict decision to adhere to the MPP Monument Class Description on condition which states that “the condition of ridge and furrow should be very high, i.e. it has never been ploughed since it ceased to be part of the open field system. Ridge and furrow that has been ploughed just once or twice may still be considered worthy of preservation" (Hall 2001, 53). There was not time to compare the 1999 photography with new images, but a few samples were examined and it appears that where a field was being ploughed the condition of the ridge and furrow was not recorded. The TTP1 polygons therefore represent the ridge and furrow worthy of scheduling. The current project has taken a different approach, especially in light of recent experimental work on the effects of different ploughing techniques on archaeological sites

(Spandl et al 2010) and made professional judgements on whether the ridge and furrow is still in good enough condition to warrant preservation, even if there have been recent episodes of ploughing.

Figure 7: Ridge and furrow recently ploughed at Sutton Bassett, Northants.

The two ploughed fields beyond the farm buildings are recorded as slightly degraded; the example partly visible at the bottom of the image is heavily degraded. 27398_005 01-FEB_2012. © English Heritage.

In order to further assess the survival and condition of ridge and furrow recorded in 1999 a further table was produced that summarises the totals in good and bad condition, those polygons recorded as 'Well preserved' and 'Slightly degraded' being 'good', and those recorded as 'Absent', 'Heavily degraded' and 'Uncertain' being 'bad'.

The method followed was:

- Attribute table for complete_RnF_layer_15Jun12 was saved as stat A2.xlsx.
- Sorted by Ridge and Furrow column and 'New' and 'Straight' rows removed.
- Sorted by Condition and categories sub-totalled.

Category	category total area	total in 'good' or 'bad' condition	% good or bad condition
Absent	2,814,936	9,263,333	12.00
Heavily degraded	5,115,640		
Uncertain	1,332,757		
Slightly degraded	15,833,947	67,921,716	88.00
Well preserved	52,087,769		
Total	77,185,049		

Table 7: Ridge and furrow recorded in 1999 now in 'good' or 'bad' condition

This indicates that 88% of the ridge and furrow recorded in 1999 remains worthy of preservation but that 12% has been destroyed or badly damaged.

3.6.3 Stat B: Ridge and furrow present in 1999 but absent or heavily degraded in 2012 by reason

The attribute table for complete_RnF_layer_15Jun12 saved as stat B.xlsx.

- Required columns are area, condition, R+F, Parish, Survival, Vulnerability.
- Sorted by R+F and 'New' and 'Straight' rows deleted.
- Sorted by Condition and 'Well preserved' and 'Slightly degraded' rows deleted.
- Sorted by vulnerability/reason then totals/percentages added as required.

Reason for loss/damage	area	% of lost/heavily degraded by reason
None identified	4,134,566	44.63
Ploughing	3,227,510	34.84
Other	690,260	7.45
Tree/scrub growth	489,046	5.28
Building development	478,670	5.17
Leisure activities	140,154	1.51
Pipelines	103,128	1.11
Total	**9,263,333**	**100.00**

Table 8: Ridge and furrow recorded in 1999 now absent or heavily degraded by reason

Ploughing, as expected, has provided the greatest identified threat to the survival of ridge and furrow in the TTP project area. Only 4.18% of the total ridge and furrow recorded in 1999 has been specifically identified as being badly damaged by the plough, which is a lower figure than might have been expected. It was not possible however, to identify the specific reason for this damage over almost half the area where it has occurred. It is perhaps more significant that where a reason for loss and serious damage to the ridge and furrow recorded in 1999 could be identified, ploughing comprised 63% of that area.

The 'Other' category was used as a catch-all for types of damage which were not covered by the remaining categories. These can be broken down as follows:

- Farmyard and agricultural activities, including temporary storage, silage, equipment dumps, paddocks and heavy vehicle activity;
- Groundworks not associated with building development, including ponds, allotments, spoil heaps and gardens;
- Geological processes including alluviation, streams changing course, hill slope slumping;
- Land improvement such as obvious land drains;
- Active sand and gravel extraction.

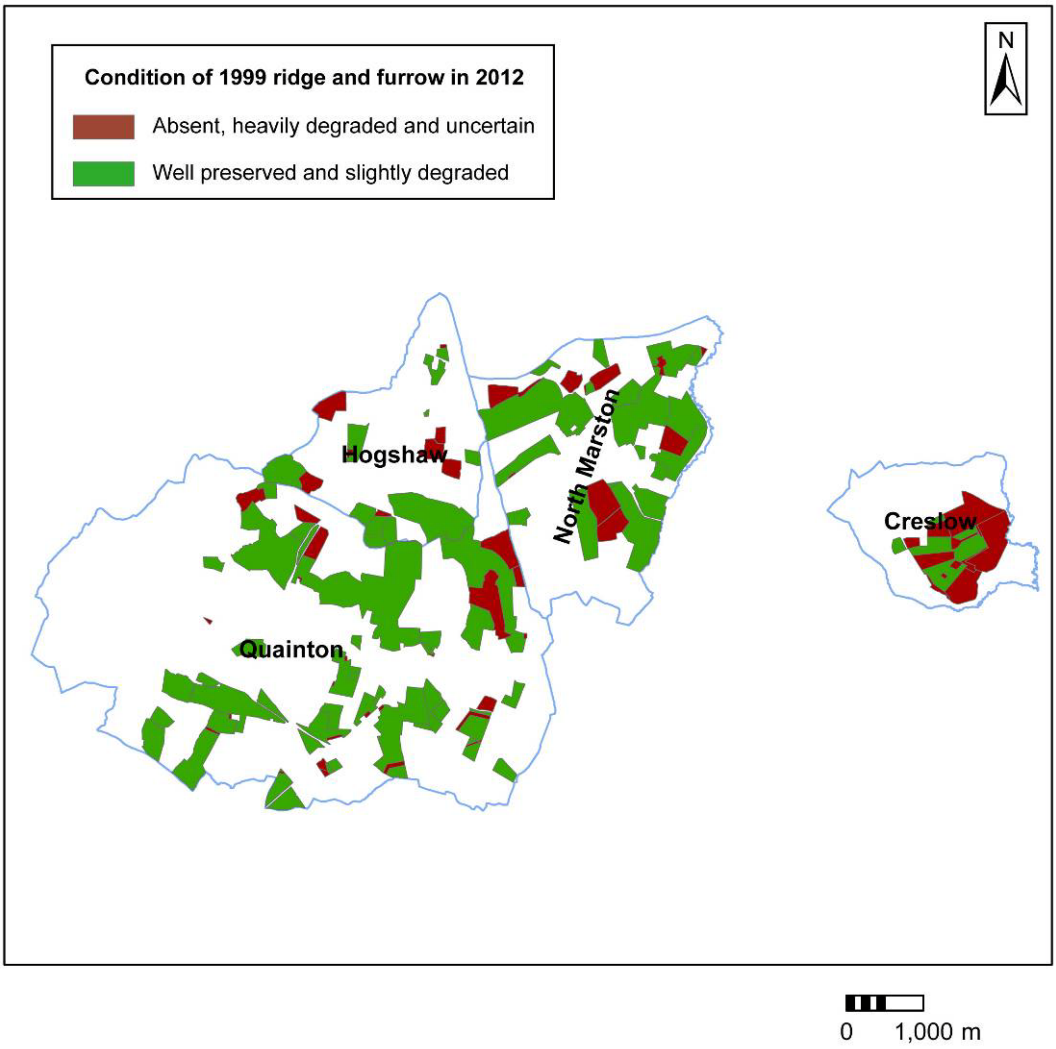

Figure 8: Ridge and furrow recorded in 1999, in good and bad condition in 2012, in Quainton, Hogshaw, North Marston and Creslow parishes.

3.6.4 Stat C: Ridge and furrow present now by condition.

It became apparent early in the project that a significant proportion of the ridge and furrow being recorded in 2012 hadn't been noted in 1999. After discussion with English Heritage, it was decided to calculate the relative condition by area of surviving 1999 ridge and furrow and the newly recorded earthworks as well as the condition of the total area of surviving ridge and furrow. It was suspected that much of the 'New' ridge and furrow was poorly preserved. Table 9 includes a breakdown of the condition of extant ridge and furrow by whether it was recorded in 1999 or newly identified in 2012, which strongly supports that suspicion.

The attribute table for complete_RnF_layer_15Jun12 was saved as stat C.xls.

- Required columns Area, Condition, ridge and furrow, Parish & Survival.
- Sorted by Survival and 'Absent' rows deleted.
- Sorted by ridge and furrow and 'Straight' rows deleted.

For totals new and 1999:

- Sort each by condition and sub-total each category.

Condition	Area of extant 1999 R+F	% 1999 R+F	Area of 'New' R+F	% 'New' R+F	Project total	% project total
Well preserved	52,087,769	70.48	3,372,134	10.34	55,459,903	52.06
Slightly degraded	15,833,947	21.42	10,307,474	31.59	26,141,422	24.54
Heavily degraded	5,115,640	6.92	18,918,950	57.99	24,034,589	22.56
Uncertain	871,525	1.18	28,146	0.09	899,672	0.84

Table 9: Condition of surviving ridge and furrow

This indicates that, despite the recording of ridge and furrow in poor condition, 76.6% of all ridge and furrow recorded by TTP2 is in 'good' condition and worthy of preservation.

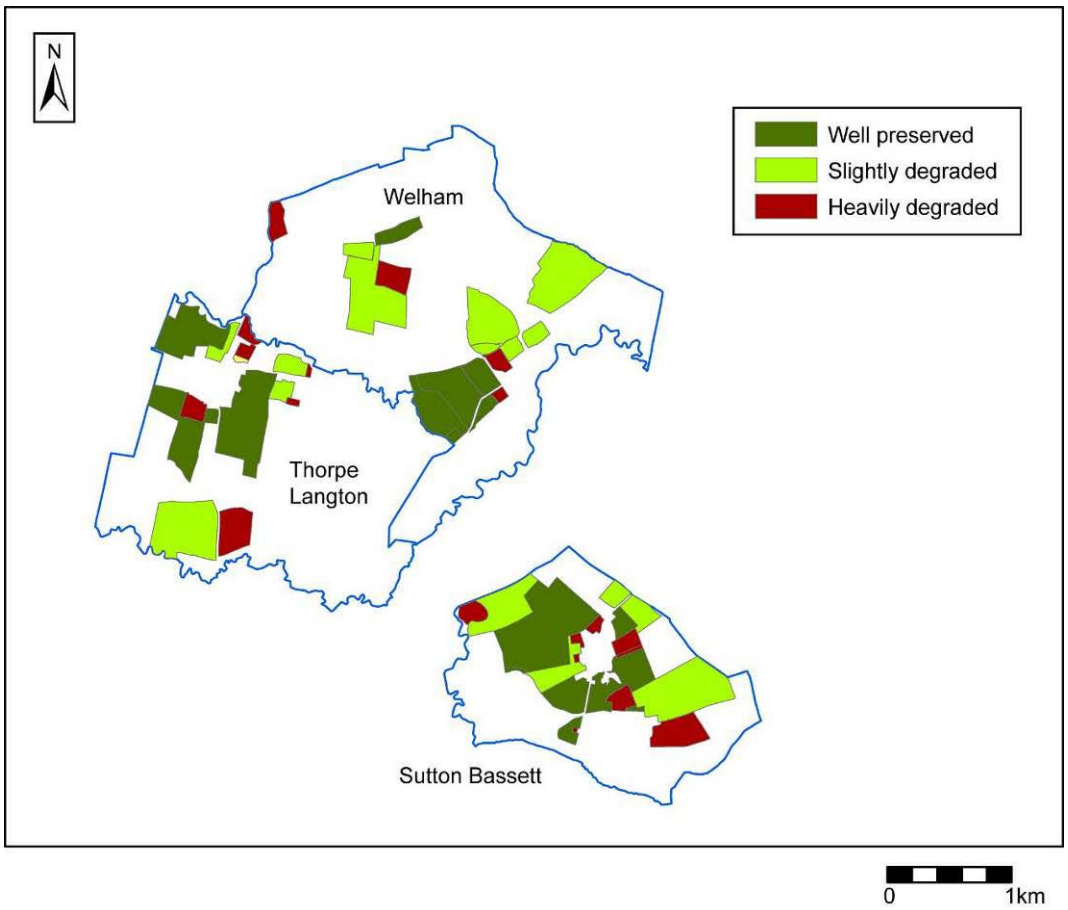

Figure 9. Ridge and furrow recorded in 2012 shown by condition in Thorpe Langton, Welham and Sutton Bassett parishes.

There was no ridge and furrow with condition recorded as uncertain in these parishes. OS Map Base © Crown copyright. All rights reserved. Gloucestershire County Council 100019134 2012.

A table indicating the condition of surviving ridge and furrow in each parish is included at Appendix 1 below. This was calculated using the data sorted for Stat C as follows:

- Sorted by parish and then condition.
- Total each category by parish.
- Paste special sub-totals by value into new column.
- Delete unnecessary rows.

The variability of condition between parishes merits further analysis. The data has been further interrogated to indicate the proportion of land within each parish that contained ridge and furrow in good condition (see 3.6.7 and Table 13 below).

3.6.5 Stat D: Environmental Stewardship status of extant ridge and furrow

It was originally intended to assess the effect of Environmental Stewardship by calculating the differences in survival of 1999 ridge and furrow in ES and non-ES landholdings. The level of loss of the ridge and furrow recorded in 1999 is low, at 4.24% however, and there has also been an increase in the total area of ridge and furrow recorded from 77km² in 1999 to 106km² in 2012. It was therefore felt that any statistic based on 4.24% of the original 77km² would be unrepresentative even of the project area and thus even less so of the national effect of ES.

After discussion with English Heritage it was agreed to present figures demonstrating the proportion of Ridge and furrow identified by TTP2 that is currently in good condition (i.e. well preserved and slightly degraded) inside and outside Environmental Stewardship.

The method followed was:

- In shapefile complete_RnF_layer_15Jun12 a selection was made where Survival = 'Present' and Ridge_And_Furrow = '1999' or 'New' and this was saved as new shapefile RnF_present_2012.shp. (Number and total area of polygons selected checked against other stats).
- Clip (ArcToolbox – Analysis tools –Extract- Clip) ES shapefile (skesh_Merge.shp - see 3.5.4) to the RnF_present_2012 subset produced above (NB Clip rather than select by location as the latter will include outlier fields that are within a holding only partly within one of our parishes). Output = ES_clipped_to_extant_RnF.shp.
- In the ArcToolbox – Analysis tools – Overlay – Union dialogue box input features RnF_Present_2012.shp and ES_clipped_to_extant_RnF.shp. Output shapefile was named ES_and_Present_RnF_Union.shp.
- Where TTP2 polygons were split by the Union tool the full area field is repeated for each new sub-polygon. In ArcToolbox – Spatial Statistics Tools – Utilities – Calculate Areas, input = ES_and_Present_RnF_Union.shp, and output = ES_and_Present_RnF_Union_Cal.shp. New area measurements are in the F_Area column.
- Attribute table for ES_and_Present_RnF_Union_Cal.shp saved as Stat D.xlsx.
- Sorted on scheme and then condition and F_Area column sub-totalled by well preserved and slightly degraded for each scheme and for the area not in ES.

ES Scheme	area of ridge and furrow	% of total area	area in 'good' condition	% of scheme in 'good' condition
Not in ES	**55,832,330**	**52.41**	**42,583,869**	**76.27**
Entry Level Stewardship (ELS)	36,512,951	34.27	28,052,833	76.83
ELS plus Higher Level Stewardship (HLS)	8,622,661	8.09	6,905,024	80.08
Organic Entry Level plus HLS	4,540,886	4.26	3,441,289	75.78
Organic Entry Level Stewardship	1,003,555	0.94	595,106	59.30
HLS	23,207	0.02	23,207	100.00
All ES schemes	**50,703,260**	**47.59**	**39,017,459**	**76.95**
Total	106,535,590	100.00	81,601,329	76.60

Table 10: The proportion of ridge and furrow in good condition in relation to Environmental Stewardship status

There are many edge anomalies in the shapefile used to produce Table 10, caused where field boundaries had not been drawn in exactly the same place by GCC and Natural England. Therefore overlaying of the shapefiles left many slivers at the edge of fields with a different ES status. These figures should therefore be treated as a reasonable overall estimate.

It is difficult to assess the relative impacts of the different ES schemes, particularly as so little of the project area are covered by certain Stewardship schemes. If all levels of ES are compared with the area not in ES, however, two roughly similar sized areas are being compared. The results given in Table 10 seem to indicate that to date Environmental Stewardship has had minimal effect on the survival rate of ridge and furrow in the TTP2 project area.

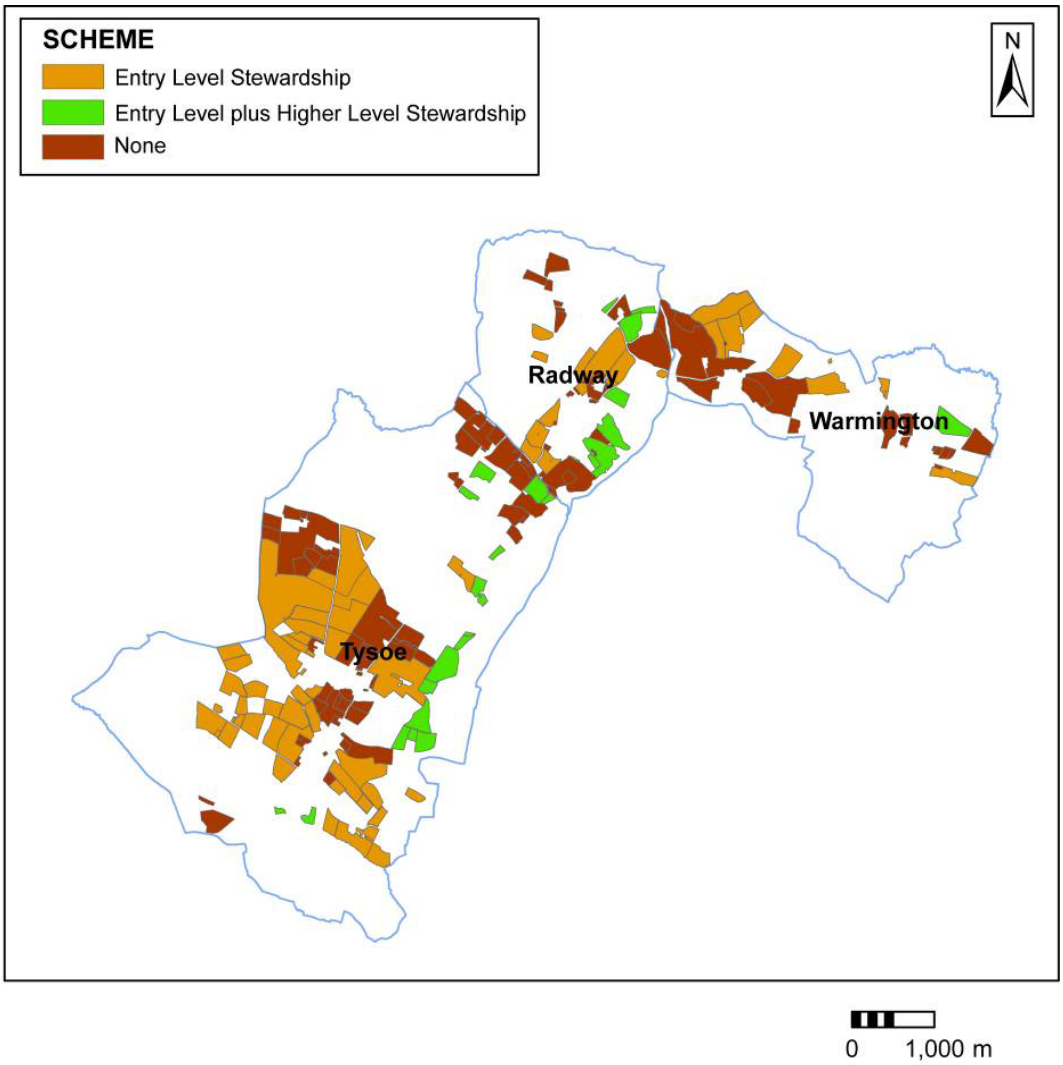

Figure 10: Environmental Stewardship coverage (as of April 2012) in areas with surviving ridge and furrow in Tysoe, Radway and Warmington parishes.

OS Map Base © Crown copyright. All rights reserved. Gloucestershire County Council 100019134 2012. ES mapping copyright Natural England 2012.

In order to highlight when renewals of ES agreements are due, the data was sorted on the end date attribute (in ES_and_Present_RnF_Union_Cal.shp). The total areas of extant ridge and furrow mapped by TTP2 were then calculated by the year at which current agreements end (saved as Stat D2.xlsx, Table 11).

The majority of the area of extant ridge and furrow which is currently protected through ES, is within agreements due to end in 2015 and 2016.

End date of current ES agreements	Area covered (Hectares)	% of all ridge and furrow under ES	% of all extant ridge and furrow
No ES agreement	5583.23	N/A	52.41
2012	496.35	9.79	4.66
2013	201.50	3.97	1.89
2014	252.46	4.98	2.37
2015	1475.73	29.11	13.85
2016	1588.60	31.33	14.91
2017	116.80	2.30	1.10
2018	47.53	0.94	0.45
2019	335.07	6.61	3.15
2020	323.04	6.37	3.03
2021	212.21	4.19	1.99
2022	21.04	0.41	0.20

Table 11: End dates for Environmental Stewardship schemes which include extant ridge and furrow

3.6.6 Stat E: Identified vulnerabilities of extant ridge and furrow

The attribute table for complete_RnF_layer_15Jun12 saved as stat E.xlsx

- Sorted on Ridge and furrow and 'Straight' rows deleted.
- Sorted on presence and 'Absent' rows deleted.
- Sorted by vulnerability.
- Areas sub-totalled by vulnerabilities.

Vulnerability	area	% of total area
Ploughing	3,316,812	3.11
Other	2,210,130	2.07
Tree/scrub growth	1,143,918	1.07
Leisure activities	862,611	0.81
Livestock damage	356,245	0.33
Pipelines	246,054	0.23
Burrowing animal damage	197,326	0.19
Building development	86,849	0.08
None identified	98,115,641	92.10

Table 12: Vulnerabilities identified for extant ridge and furrow

92.1% of surviving ridge and furrow has no identified vulnerabilities. Ploughing, as expected, forms the greatest identifiable threat, comprising 39.39% of the area of extant ridge and furrow for which a vulnerability was identified, followed by tree and scrub growth (13.59%) and leisure activities (10.24%).

3.6.7 Stat F: Proportion of each parish containing good quality ridge and furrow

The 1999 TTP survey made a judgement to include only townships/parishes where over 18% of their area comprised ridge and furrow surviving in good condition (Hall 2001, 30). Table 13 includes the current percentage of the land area within each parish that contains ridge and furrow judged as either ‘well preserved’ or ‘slightly degraded’. The method followed was:

- The attribute table for complete_RnF_layer_15Jun12 saved as stat F.xlsx.
- Sorted on ridge and furrow and 'Straight' rows deleted.
- Sorted on survival and 'Absent' rows deleted.
- Required columns parish, condition, area.
- Custom sort by parish and then condition.
- total per parish.
- Import parish areas from TTP parishes shapefile provided by EH (See provisos under Table 13).
- Calculate % of parish area where condition = well preserved or slightly degraded.

Parish	Ridge and furrow in 'good' condition	Area of civil parish	% parish containing r+f in good condition
Ashendon	2,304,278	8,607,810	26.77
Belton-In-Rutland	1,117,909	4,135,384	27.03
Braunston	3,674,017	13,182,500	27.87
Braunston-In-Rutland	1,932,645	6,383,857	30.27
Bythorn [(1)]	864,921	17,201,462	5.03
Chastleton	1,618,988	7,144,910	22.66
Clay Coton	744,904	3,992,610	18.66
Clipston and Newbold	3,428,591	11,716,313	29.26
Creslow	419,540	3,594,451	11.67
Denchworth [(2)]	3,097,299	9,591,479	32.29
Dorton	1,272,806	5,979,056	21.29
Easton Neston [(3)]	696,150	2,171,394	32.06
Great Oxendon [(3)]	1,978,971	7,538,281	26.25
Gumley	1,533,840	5,436,729	28.21
Hallaton	2,376,346	11,993,944	19.81
Hockliffe	1,149,798	5,126,170	22.43
Hogshaw	1,045,587	4,972,261	21.03
Hungarton	3,395,081	14,553,626	23.33
Ladbroke	1,269,207	7,967,797	15.93
Lilbourne	1,440,163	6,920,262	20.81
Little Lawford	554,154	1,681,589	32.95
Ludgershall	5,462,238	11,058,638	49.39
Marston North	4,055,668	7,998,975	50.70
Mowsley	1,046,174	5,268,165	19.86
Napton on the Hill	5,166,942	16,266,709	31.76
Owston and Newbold	1,279,043	12,435,984	10.29
Passenham [(3)]	460,782	5,133,899	8.98
Quainton	5,772,740	22,012,403	26.22
Radway	1,247,038	5,908,831	21.10
Saddington	2,038,347	7,090,559	28.75
Shuckburgh (Upper and Lower)	3,243,283	8,700,987	37.27
Stoke Dry	782,724	4,025,997	19.44
Sutton Bassett	1,141,345	3,022,197	37.77
Thornborough	2,049,282	9,669,317	21.19
Thorpe Langton	863,676	4,211,522	20.51
Todenham	1,550,324	10,045,776	15.43
Tysoe	4,525,545	19,422,660	23.30
Warmington	1,460,735	7,318,061	19.96
Welham	991,902	5,169,311	19.19
Weston Subedge [(2)]	2,538,943	13,039,770	19.47
Totals	81,591,924	332,838,732	24.51

Table 13: **The proportion of each parish containing ridge and furrow in good condition**

NB regarding Table 13:

1. The TTP2 project team had no access to maps of township boundaries. Therefore the low figure at Bythorn (and others) is due to the medieval 'township' being a small constituent part of

the modern civil parish. In fact 96% of the ridge and furrow recorded at Bythorn in 1999 survives in 2012 (Figure 11).

2. The total area given for Denchworth parish is actually Denchworth plus West Hanney and that for Weston-sub-Edge is for both blocks of Weston-sub-Edge plus Aston Subedge.

3. Easton Neston, Great Oxendon and Passenham parishes were digitised in ArcGIS over the TTP1 pdfs and the resulting area calculation included in Table 13, rather than the civil parish area totals.

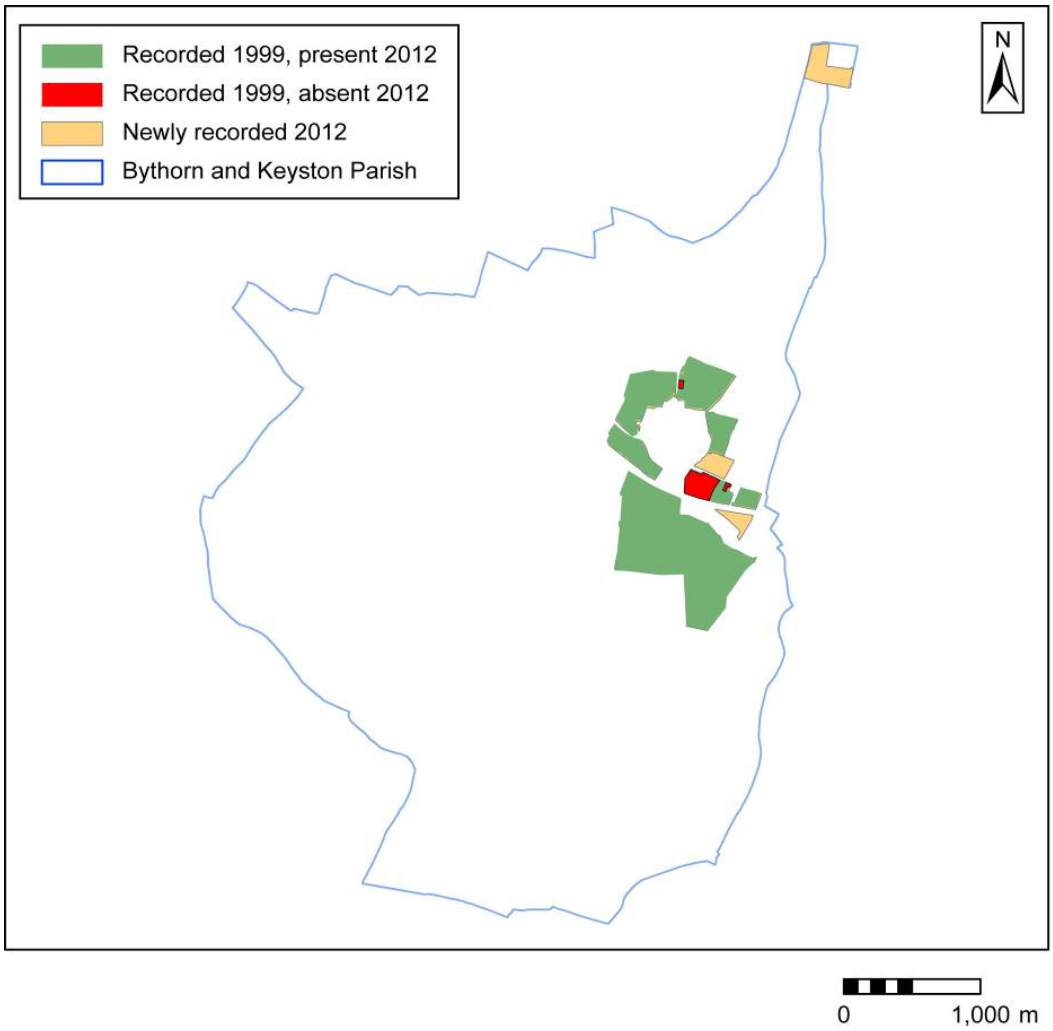

Figure 11: Ridge and furrow recorded in Bythorn and Keyston Parish 1999 and 2012.

3.7 Digital archive

The following files have been provided to English Heritage as the digital archive of the project.

3.7.1 Core project outputs:

- Folder - Core project outputs
    - This report.
    - complete_RnF_layer_15Jun12.shp (see 3.5.1-3.5.3 above)
    - ES_and_Present_RnF_Union_Cal.shp (see 3.6.5 above)
    - TTP2_1999Anomaly_12JUN2012.shp
    - TTP2_Wood_Alluv_Ewks_12JUN2012.shp

3.7.2 Supplementary information:

- Folder - supplementary archive files.

3.7.2.1 Original project shapefiles as exported from AutoCAD.

- Sub-folder - Uncorrected AutoCAD export (of ridge and furrow layer - see 3.5.1 above):
    - TTP2_RnF_12JUN2012.shp
    - TTP2_RnF_MPOLYGONS_12JUN2012.shp

3.7.2.2 Files generated by ArcGIS listing the geometry errors in AutoCAD exports.

- Sub-folder - Geometry error logs:
    - TTP2_RnF_12JUN2012_CheckGeom.dbf
    - TTP2_RnF_MPOLYGONS_12JUN20121_CHECK_GEOM.dbf

3.7.2.3 Excel tables to indicate formulas by which statistical tables were produced.

- Sub-folder - Stat spreadsheets:
    - Stat A.xlsx, Stat A2.xlsx
    - Stat B.xlsx
    - Stat C.xlsx
    - Stat D.xlsx, Stat D2.xlsx
    - Stat E.xlsx
    - Stat F.xlsx

3.7.2.4 TTP1 gazetter pdf scans exported as jpegs and georeferenced in ArcGIS.

- Sub-folder TTP1 pdfs:
    - 39 georeferenced jpegs, one for each TTP parish except Hogshaw and ArcGIS layer file.

3.7.2.5 Original AutoCAD drawings (But note corrections made to these once in shapefile format).

Naming format requested by English Heritage:

- AF30037301.dwg

3.7.2.6 Supplementary documents in pdf format

- Sub-folder - written documents
    - Project brief.
    - Project design.
    - Parish notes made during mapping task by project team.

3.7.2.7 Revised parish shapefiles digitised over TTP1 gazetteer plots, produced for Table 13

- Sub-Folder - TTP parishes
    - Easton_Neston_TTP_CalculateA.shp
    - Oxendon_Gt_TTP_CalculateArea.shp
    - Passenham_TTP_CalculateAreas.shp
    - Weston_subedge_TTP_Calculate.shp

4 Discussion of vulnerabilities

4.1 Ploughing

Very little (4.18%) of the ridge and furrow recorded in 1999 has been demonstrably severely damaged or lost to ploughing. This figure is artificially low due to the difficulty of identifying a specific reason for damage from the air in 2012. Where a reason for significant damage could be identified, the majority (63%), was due to piecemeal degradation and loss as a result of arable cultivation. Overall loss and severe damage to the ridge and furrow recorded in 1999 remains fairly low, however, at 12%. Although at least the first of these figures is lower than might have been expected, the fact that the study parishes are those that have already been identified as containing the most significant ridge and furrow in the country may have served to reduce levels of destruction, as may have the inclusion of just under a half (by area) within Environmental Stewardship agreements. Even so, examples of very recent ploughing have been mapped and, in terms of area, cultivation remains the most significant threat identified to the ridge and furrow recorded as part of this project.

There is anecdotal evidence from local authority historic environment curators in these and other areas that reform proposals for the Common Agricultural Policy (which seek to introduce new so-called 'Greening' measures whereby the existing area of pasture on farm holdings will be retained) have placed renewed pressure on pasture, in that land managers are cultivating land that has not previously been cultivated in order to beat the new proposals. Similarly, there is concern that the 2006 EIA (Agriculture) Regulations which might otherwise prevent such occurrences (particularly where they coincide with nationally important but undesignated landscape features) have not been effectively applied.

Ploughing does not necessarily cause the immediate destruction of ridge and furrow. Between 1999 and 2012 there are episodes of ploughing visible on some successive Google Earth images where earthworks now survive in pasture. It appears that fields which were under the plough in 1999 were excluded from the TTP1 mapping, regardless of whether the ridge and furrow was still visible as an earthwork (see 3.6.2 above). In some cases, fields which had been ploughed in 1999 were put back into pasture shortly afterwards, and contain ridge and furrow recorded by the current project as slightly or heavily degraded (see Figure 12).

Figure 12. Well preserved and heavily degraded ridge and furrow at Tysoe, Warwickshire.

The fields below the road at the centre of the image were under the plough on the TTP1 photos taken in 1999, and were not recorded as ridge and furrow. Extract from 27348_011 17-NOV-2011. © English Heritage.

An example of recent destruction, in Warmington, Warwickshire (see Figure 13), was visible in well preserved condition as recently as 2010 on Google Earth images but had been severely damaged by ploughing in November 2011. A substantial area of 582,427m² was reduced from well preserved to a combination of slightly and heavily degraded condition. There is also an example of fields being ploughed during the period of photography for this project. At Creslow, Buckinghamshire, there are a couple of fields which were visible as slightly degraded ridge and furrow on the 6th January 2012, but which had been ploughed by the 27th March 2012 (see Figure 14). There are no earthworks clearly visible, but they were categorised as heavily degraded because the surface of the fields on the later photographs was obscured by the application of lime.

Figure 13. Recently ploughed fields in Warmington, Warwickshire.

Extract from 27352_006 17-NOV-2011. © English Heritage.

Figure 14. Freshly ploughed fields at Creslow, Buckinghamshire which formerly contained slightly degraded ridge and furrow.

Extract from 27440_048 27-MAR-2012. © English Heritage.

4.2 Equestrian activity

Equestrianism is widespread across the study area, and only a handful of parishes did not have at least some areas of ridge and furrow levelled in order to create stables, hard standings, barns and horse exercise areas. This type of activity appears to have become much more widespread and increased in both scale and scope since 1999. In many parishes there are up to a dozen stables in outlying fields, as well as horse-related extensions to farmyards and the larger country houses. These equestrian developments have been recorded as a mixture of building developments and leisure activities, depending on the type of construction (see Figure 15).

Figure 15. New stables and horse exercise areas (centre right) located at Ladbroke, Warwickshire.

Extract from 27352_023 17-NOV-2011. © English Heritage.

There is a large example at Radway (see Figure 16), where construction of a substantial riding school and associated infrastructure has destroyed over two hectares of well preserved ridge and furrow. Excavation plant was visible on site in November 2011 levelling more ground and extending the complex.

Figure 16. A large equestrian centre at Radway, Warwickshire, constructed since TTP1.

Extract from 27350_032 17-NOV-2011. © English Heritage.

4.3 Game cover crops and plantations

Many new areas of game cover crops have been planted since 1999. They are generally planted along the edges of fields in strips, or arranged in polygonal shapes. The main type of crop used to provide forage and cover for young game birds is maize. The areas are usually ploughed for planting, which impacts on the condition of the ridge and furrow, although fully grown maize obscures the extent of earthwork survival so that this assertion must be provisional.

Figure 17. Cover crops obscuring ridge and furrow in Creslow, Bucks.

Extract from 27382_025 06-JAN-2012. © English Heritage.

Small coniferous plantations have also been either been planted or extended along the edges of many fields since 1999 (see Figure 18). These are likely to have caused degradation of the ridge and furrow, and further damage is likely to be caused during felling.

Figure 18. Small plantations in field corners at Hallaton, Leicestershire.

Extract from 27444_039 28-MAR-2012. © English Heritage.

4.4 Building development

Recent building development has generally been small in scale in the project area. The main impact of building development on the ridge and furrow since 1999 has been from extensions to agricultural buildings around farmyards and to a lesser extent new housing in the villages. Most of these expansions are in the form of large livestock barns and new farmyards (Figure 19).

Figure 19. Farm development at Todenham, Gloucestershire.

The built up area has roughly tripled in size since 1999. Extract from 27344_027 17-NOV-2011. © English Heritage.

New housing developments typically comprise small numbers of houses with significantly smaller plots than older properties in the village. They usually fill gaps within the existing 'footprint' of the village. A good example is at Quainton, Bucks (Figure 20).

Figure 20. Two post-1999 housing developments in Quainton, Buckinghamshire.

New housing labelled A and B. Both of these developments appear to have levelled areas of well preserved ridge and furrow. Extract from 27379_044 06-JAN-2012. © English Heritage.

4.5 Pipelines

Major pipelines are few in number, but their impact is significant because of the extensive ground works involved in their construction. Pipelines built in the last 10 years generally require a wide easement which is stripped of topsoil.

Figure 21. Ridge and furrow levelled by a pipeline at Quainton, Bucks.

This pipeline appears on Google Earth between 2004 and 2009. Extract from 27378_047 06-JAN-2012. © English Heritage.

At Dorton, Buckinghamshire, there is an example of differing treatment of the ridge and furrow by pipeline construction (see Figure 22). One pipeline (on the left in the figure) may be older, and has just been backfilled to a flat surface. A second pipeline (to its right) has had the ridge and furrow reinstated and is therefore far less visible on the photographs. Presumably this difference is due to different curatorial requirements being imposed on the construction companies at different times. Although the construction company seems to have missed a few areas, the overall effect is largely positive and the reinstatement does act to retain the overall cohesiveness and integrity of the open field system. The construction company have not reinstated the slightly more degraded ridge and furrow towards the bottom right of the image.

Figure 22. A reinstated pipeline easement in Dorton, Bucks.

The older pipeline (black arrows) can be seen running almost vertically across the centre of the photograph before turning to the right. The second (red arrows) is to the right of centre and is only clearly visible at bottom right where the reinstatement of the ridge and furrow is less complete. Extract from 27377_032 06-JAN-2012. © English Heritage

4.6 Leisure activities

The majority of impacts from leisure activities are due to construction of equestrian facilities, which have been discussed above. Other identified impacts include tennis courts, dirt bike tracks, skate parks and other recreation areas.

One of the most dramatic impacts is the motocross track at Warmington, Warwickshire. This is in an area of well-preserved ridge and furrow, and appeared on Google Earth between 1999 and 2006. It has been extended and enlarged slightly since, with the addition of a pit stop area. Although this track has a very visually dramatic impact on the appearance of the ridge and furrow, the total area which has been levelled is relatively small.

Figure 23. The motocross track at Warmington, Warks.

Extract from 27351_037 17-NOV-2011. © English Heritage.

A large number of tennis courts have been constructed since 1999, with at least one in most parishes.

One example of where leisure activities have had a negative impact on ridge and furrow is within a golf course at Great Oxendon (Figure 24). Although the ridge and furrow was recorded as 'New' in 2012, most is well preserved, although construction of some fairways has levelled earthworks or reduced them to heavily degraded condition. Various golf course features, such as greens, tees and bunkers, cut into the ridge and furrow but overall the earthworks are quite well preserved. This is clearly a case where management decisions will have a major role to play in whether the earthworks survive into the future.

Figure 24. Market Harborough golf club, Great Oxendon, Leics.

Extract from 27373_011 12-DEC-2011. © English Heritage.

4.7 Livestock damage

Livestock damage is difficult to quantify from aerial photographs, and was only recorded where there was significant and substantial damage to an area of ridge and furrow. Small areas of poaching around animal feeders were not considered significant enough to record.

The area of paddocks at Mowsley shown in Figure 25 is all newly recorded ridge and furrow, but is in the process of being degraded by a combination of overgrazing and possibly deliberate levelling.

Figure 25. Overgrazing in a group of horse paddocks, Mowsley, Leicestershire.

Extract from 27395_025 01-FEB-2012. © English Heritage.

4.8 Burrowing animal damage

Burrowing animal damage was only recorded where it has caused significant and widespread damage to the ridge and furrow. This damage is most commonly caused by rabbits or badgers, or a combination of both. Significant burrowing animal damage was quite rare across the project area, with only a handful of examples recorded.

Figure 26. Burrowing animal damage at Creslow, Buckinghamshire (centre and right).

Some of the holes now grassed over (bottom left) were the anchor points for aerial masts. Extract from 27382_036 06-JAN-12. © English Heritage.

4.9 Quarrying, ponds and vehicles

Most of the quarrying visible on the aerial photographs was historic and relatively small in scale. There was at least one area, however, where quarrying is causing an on-going impact on well preserved ridge and furrow. At Passenham, Northamptonshire, a large area of newly recorded ridge and furrow is in the process of being removed by a sand and gravel quarry. The expansion of the site over recent years is clearly visible on successive Google Earth images.

Figure 27. Sand and gravel quarrying at Passenham, Northamptonshire.

Extract from 27362_016 09-DEC-2011. © English Heritage.

There are a number of large ornamental ponds which have been recently constructed. These are quite different in scale and location to the smaller ponds for watering livestock. One at Lilbourne, Northamptonshire was constructed at some time after 2005 and has caused a significant loss to an area of well preserved ridge and furrow (Figure 28).

Figure 28. An ornamental pond at Lilbourne, Northamptonshire.

Extract from 27430_003 19-MAR-2012. © English Heritage.

Vehicular damage was rarely significant enough to be recorded by the project. In a few examples however, high numbers of vehicle movements around a farm, particularly in wet conditions, appear to be causing significant damage to ridge and furrow (Figure 29).

Figure 29. Vehicular damage to ridge and furrow at Great Oxendon, Warks.

Extract from 27373_026 12-DEC-2012. © English Heritage.

5 Conclusions

The main aim of the project (2.1 above) has been met with the proviso that the effects of Environmental Stewardship have been difficult to assess for reasons already discussed (3.6.5 above). Nonetheless, the significant coverage of Environmental Stewardship in relation to the parishes assessed (covering over 47% of the land parcels containing ridge and furrow) may well have been a major contributory factor in reducing degradation and loss. Similarly, the figures for degradation and loss are themselves only cumulative totals over the period 1999-2012. They do not - beyond photographic evidence for new instances of ploughing in three of the parishes assessed - provide any indication as to whether the scale or pace of loss has accelerated over the past year or so as a consequence of Common Agricultural Policy 'Greening' proposals, an issue that has been raised anecdotally by several local authority archaeologists. Nevertheless, all objectives have been successfully achieved.

The current state of ridge and furrow in the 40 parishes has been mapped and recorded in some detail. Figures have been tabulated that indicate total areas of ridge and furrow visible in 2012, areas lost since 1999 by reason, the condition of the surviving earthworks, current threats to their survival, and the proportion in good condition in each parish. The attributes attached to each mapped polygon have been drawn up so that they are capable of further interrogation on local and project wide scales.

Technical issues that have arisen include differences in the accuracy of field edge mapping between the 2012 and original 1999 project polygons and also with Natural England mapping of landholdings in Environmental Stewardship. These factors clearly affect the absolute accuracy of project statistics. In addition, the lack of boundary maps for the townships used by TTP1 complicates direct comparison of the proportion of township ridge and furrow surviving.

Other minor issues arose due to AutoCAD exports to shapefile format needing detailed checking and some correcting particularly in the crucial field of area calculation. Although it was clear that this arose from Mpolygons in AutoCAD not exporting correctly to donuts in ArcGIS, it did not prove possible for IT support teams to resolve these issues and therefore fields were manually updated.

Possibly the major unexpected result of TTP2 was the significant increase in the total area of ridge and furrow recorded in 2012 compared with 1999. As is made clear by Table 9 however, the majority of 'New' ridge and furrow was in heavily degraded condition and, as discussed above (3.6.2) the 1999 project only recorded ridge and furrow in very good condition. Nevertheless, the quality of the images available to the 2012 project team, in conjunction with the backup provided by Environment Agency lidar and Google Earth images, allowed less clearly visible earthworks to be mapped and their attributes to be confidently recorded.

The second major surprise is the low level of total loss (4.24% by area) of the ridge and furrow recorded by TTP1 in 1999, although if lost and heavily degraded ridge and furrow are combined, 12% of the 1999 earthworks fall into those categories. Assessments of the loss of ridge and furrow based solely in the project area are likely to underestimate the national rate of loss and damage.

The almost immediate availability of English Heritage advice and guidance allowed requirements to be clarified and issues addressed, and in conjunction with the regular quality assurance, have contributed greatly to the successful completion of the project.

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7 Abbreviations/terms used in the report

AerSI	Aerial Survey and Investigation, English Heritage
AP	Aerial photography/photograph(s)
EH	English Heritage
ES	Environmental Stewardship
FEP	Farm Environment Plan (supporting information provided by HLS applicants)
The Gazetteer	Hall 2001, Appendix 2
GCCAS	Gloucestershire County Council, Archaeology Service
HER	Historic Environment Record
HLS	Higher Level Stewardship
NHPCP/T	National Heritage Protection Commissions Programme/Team
NMP	National Mapping Programme
PAO	Project Assurance Officer
PD	Project Design
QAO	Quality Assurance Officer (for EH aerial survey specific issues)
SM	Scheduled Monument
TTP(2)	Turning the Plough (Update Assessment)

Appendix 1 Condition of ridge and furrow surviving in 2012 for each TTP parish

Parish	Condition	area	%
Ashendon	Heavily degraded	1,945,663	45.67
	Slightly degraded	1,480,967	34.76
	Uncertain	10,497	0.25
	Well preserved	823,311	19.32
		4,260,438	100.00
Belton-In-Rutland	Heavily degraded	402,089	26.31
	Slightly degraded	370,425	24.24
	Uncertain	8,197	0.54
	Well preserved	747,485	48.91
		1,528,196	100.00
Braunston	Heavily degraded	687,160	15.76
	Slightly degraded	484,359	11.11
	Well preserved	3,189,657	73.14
		4,361,177	100.00
Braunston-In-Rutland	Heavily degraded	510,034	20.62
	Slightly degraded	502,635	20.32
	Uncertain	30,813	1.25
	Well preserved	1,430,010	57.81
		2,473,492	100.00
Bythorn	Heavily degraded	176,792	16.97
	Slightly degraded	88,698	8.51
	Well preserved	776,223	74.51
		1,041,713	100.00
Chastleton	Heavily degraded	1,127,295	40.94
	Slightly degraded	471,978	17.14
	Uncertain	7,355	0.27
	Well preserved	1,147,010	41.65
		2,753,638	100.00
Clay Coton	Heavily degraded	133,710	12.89
	Slightly degraded	135,097	13.03
	Uncertain	158,445	15.28
	Well preserved	609,807	58.80
		1,037,058	100.00

Clipston and Newbold	Heavily degraded	417,769	10.86
	Slightly degraded	1,198,834	31.17
	Well preserved	2,229,757	57.97
		3,846,360	100.00
Creslow	Heavily degraded	558,086	56.42
	Slightly degraded	419,540	42.42
	Uncertain	11,494	1.16
		989,120	100.00
Denchworth	Heavily degraded	888,672	22.29
	Slightly degraded	2,463,947	61.82
	Well preserved	633,352	15.89
		3,985,971	100.00
Dorton	Heavily degraded	644,729	33.62
	Slightly degraded	497,692	25.95
	Well preserved	775,114	40.42
		1,917,536	100.00
Easton Neston	Heavily degraded	101,921	12.62
	Slightly degraded	20,525	2.54
	Uncertain	9,356	1.16
	Well preserved	675,625	83.68
		807,426	100.00
Great Oxendon	Heavily degraded	297,301	13.06
	Slightly degraded	83,831	3.68
	Well preserved	1,895,140	83.26
		2,276,272	100.00
Gumley	Heavily degraded	772,662	33.50
	Slightly degraded	462,488	20.05
	Well preserved	1,071,352	46.45
		2,306,502	100.00
Hallaton	Heavily degraded	1,046,658	30.07
	Slightly degraded	546,594	15.70
	Uncertain	57,761	1.66
	Well preserved	1,829,751	52.57
		3,480,765	100.00

Hockliffe	Heavily degraded	316,463	21.56
	Slightly degraded	264,124	18.00
	Uncertain	1,249	0.09
	Well preserved	885,673	60.35
		1,467,509	100.00
Hogshaw	Heavily degraded	548,211	33.83
	Slightly degraded	1,045,587	64.52
	Uncertain	26,686	1.65
		1,620,484	100.00
Hungarton	Heavily degraded	1,033,723	23.03
	Slightly degraded	972,342	21.66
	Uncertain	60,347	1.34
	Well preserved	2,422,738	53.97
		4,489,150	100.00
Ladbroke	Heavily degraded	331,887	20.59
	Slightly degraded	249,877	15.50
	Uncertain	11,068	0.69
	Well preserved	1,019,330	63.23
		1,612,162	100.00
Lilbourne	Heavily degraded	531,669	25.17
	Slightly degraded	259,643	12.29
	Uncertain	140,386	6.65
	Well preserved	1,180,520	55.89
		2,112,218	100.00
Little Lawford	Heavily degraded	39,629	6.65
	Slightly degraded	41,076	6.89
	Uncertain	2,472	0.41
	Well preserved	513,078	86.05
		596,255	100.00
Ludgershall	Heavily degraded	462,130	7.80
	Slightly degraded	732,781	12.37
	Well preserved	4,729,456	79.83
		5,924,368	100.00

Marston North	Heavily degraded	677,607	14.32
	Slightly degraded	1,817,223	38.39
	Well preserved	2,238,445	47.29
		4,733,275	100.00
Mowsley	Heavily degraded	481,454	31.38
	Slightly degraded	431,219	28.11
	Uncertain	6,528	0.43
	Well preserved	614,955	40.08
		1,534,156	100.00
Napton on the Hill	Heavily degraded	1,412,429	21.29
	Slightly degraded	1,438,969	21.69
	Uncertain	54,975	0.83
	Well preserved	3,727,973	56.19
		6,634,346	100.00
Owston and Newbold	Heavily degraded	1,237,026	49.17
	Slightly degraded	334,397	13.29
	Well preserved	944,646	37.54
		2,516,069	100.00
Passenham	Heavily degraded	149,898	24.55
	Slightly degraded	142,546	23.34
	Well preserved	318,236	52.11
		610,680	100.00
Quainton	Heavily degraded	1,515,803	20.58
	Slightly degraded	2,523,945	34.26
	Uncertain	77,505	1.05
	Well preserved	3,248,795	44.10
		7,366,049	100.00
Radway	Heavily degraded	190,037	13.14
	Slightly degraded	166,777	11.53
	Well preserved	1,089,662	75.33
		1,446,476	100.00

Saddington	Heavily degraded	583,880	22.27
	Slightly degraded	553,619	21.11
	Well preserved	1,484,727	56.62
		2,622,226	100.00
Shuckburgh (Upper and Lower)	Heavily degraded	635,793	16.39
	Slightly degraded	453,384	11.69
	Well preserved	2,789,900	71.92
		3,879,077	100.00
Stoke Dry	Heavily degraded	77,954	9.06
	Slightly degraded	422,172	49.05
	Well preserved	360,553	41.89
		860,678	100.00
Sutton Bassett	Heavily degraded	208,243	15.43
	Slightly degraded	521,443	38.64
	Well preserved	619,902	45.93
		1,349,588	100.00
Thornborough	Heavily degraded	626,402	22.52
	Slightly degraded	866,312	31.14
	Uncertain	106,220	3.82
	Well preserved	1,182,970	42.52
		2,781,904	100.00
Thorpe Langton	Heavily degraded	157,297	15.34
	Slightly degraded	307,176	29.95
	Uncertain	4,583	0.45
	Well preserved	556,501	54.26
		1,025,557	100.00
Todenham	Heavily degraded	752,906	32.29
	Slightly degraded	307,400	13.18
	Uncertain	28,729	1.23
	Well preserved	1,242,924	53.30
		2,331,960	100.00

Tysoe	Heavily degraded	1,064,953	18.80
	Slightly degraded	1,295,740	22.87
	Uncertain	75,290	1.33
	Well preserved	3,229,805	57.01
		5,665,788	100.00
Warmington	Heavily degraded	273,737	15.78
	Slightly degraded	256,115	14.77
	Well preserved	1,204,619	69.45
		1,734,472	100.00
Welham	Heavily degraded	118,957	10.71
	Slightly degraded	642,881	57.87
	Well preserved	349,021	31.42
		1,110,859	100.00
Weston Subedge	Heavily degraded	895,956	26.01
	Slightly degraded	867,065	25.17
	Uncertain	9,716	0.28
	Well preserved	1,671,878	48.54
		3,444,616	100.00