The Bromesberrow Estate's Natural Capital

How this natural capital provides public goods;
and how enhancing it could form the basis for future Government support

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Executive Summary

This report has been prepared for Dr Gilbert Greenall as a first step in preparing the Bromesberrow Estate for the UK's post-Brexit agricultural policy.

Its production has been supported by the Malvern Hills Area of Outstanding Natural Beauty (AONB) Sustainable Development Fund.

Planning for future farm and environmental support

The new Environmental Land Management (ELM) scheme is due to replace the existing Basic Payment Scheme and the Environmental and Countryside Stewardship Schemes from 2024 onwards.

This will operate on the basis of 'Public Payments for Public Goods' through Land Management Plans drawn up by the farmer.

Defra has stated that the public goods that will be covered by ELM are: "*clean and plentiful water; clean air; protection from and mitigation of environmental hazards; mitigation of and adaptation to climate change; thriving plants and wildlife; and beauty, heritage and engagement*".

The Government has adopted the concept of natural capital as a way of understanding the way that the natural environment provides goods and services to society.

As a result, this report examines how the concept of natural capital can be applied to the Bromesberrow Estate, to form that basis for a future ELM Land Management Plan, recognising the many public goods that the Estate provides.

How the Bromesberrow Estate provides public goods

This study shows how the Estate's parkland and pasture, woodland, hedgerows, streams and ponds, arable land, buildings and rights of public access (its 'natural capital') provide high levels of public goods that benefit local communities and society at large.

It uses the new UK Habitat Classification to quantify different types of natural capital and it relates the condition of these natural capital assets to the provision of the public goods which the Government wishes to support and incentivise through its proposed ELM scheme.

The Estate's natural capital assets

The Estate contains a wide variety of natural capital assets within its 495 ha (1,220 acres), including:

- 88.1 ha of woodland, of which 47.8 ha is Ancient Woodland
- 82.1 ha of parkland, consisting of semi-improved permanent pasture grazed by White Park cattle and including many native and ornamental specimen trees.
- 18.9 ha of agriculturally unimproved lowland dry acid grassland, of which the 12.1 ha on Chase End Hill is part of the Malvern Hills SSSI.
- 5.4 ha of traditional orchard containing apple and cherry varieties over agriculturally unimproved (and probably flower-rich) permanent pasture
- 423 parkland and field trees and a further 153 hedgerow trees, including a number of veteran trees in Inner Park.
- 21.6 km of hedgerow and associated margins of rough grassland
- 9.2 km of watercourses and 2.1 ha of ponds and lakes
- 14.5 km of public rights of way and 29.9 ha of open access land
- One Scheduled Monument, six Listed Buildings and 54 historic environment sites or records.

Provision of public goods

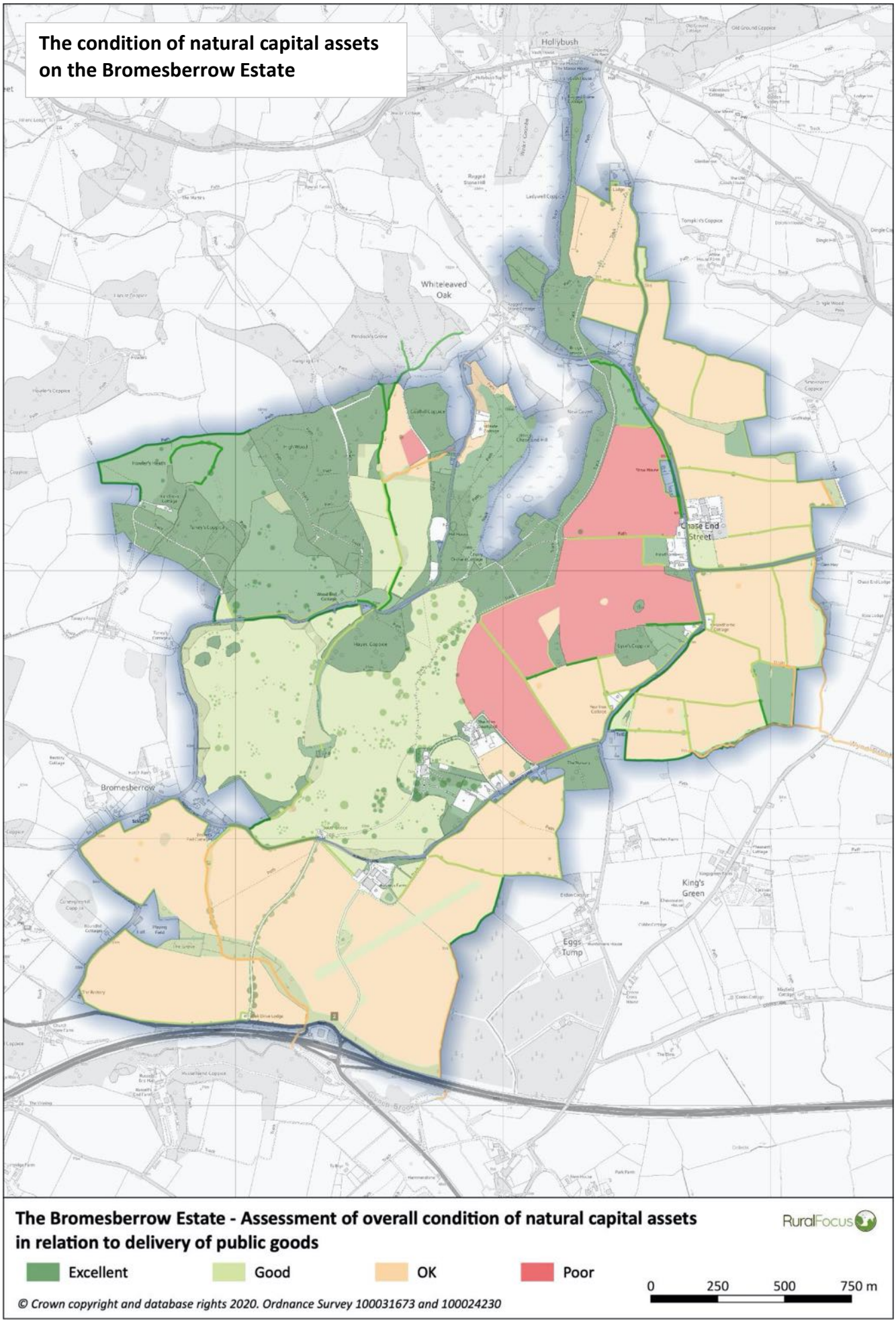
These natural capital assets provide a range of public goods which benefit society at large. Examples of the public goods derived from the Estate are:

- **Thriving wildlife** in the designated areas of Ancient and Semi-Natural Woodland and parts of the Malvern Hills SSSI, as well as in the undesignated areas of unimproved and semi-improved permanent grassland, veteran trees, hedgerows and waterbodies.
- **Natural Beauty** in the form of characteristic landscape features (e.g. woodland, parkland, orchards, hedgerows and flower-rich grassland) which contribute to the special qualities of the Malvern Hills AONB
- **Cultural heritage** at the scale of individual sites and buildings and at a landscape scale in relation to field patterns and remains of historic land use such as ridge and furrow cultivation.
- **Provision of clean and plentiful water and flood mitigation** from the filtering and slow release of rainfall through the woodland and grassland soils
- **Climate regulation** in the form of the capture and storage of atmospheric carbon in the timber and soils of the woodland and hedgerows, and the soils under permanent grassland.

Condition of natural capital and flows of public goods

The map on the following page shows how well all the natural capital assets on the Estate are meeting their potential to provide public goods, using a classification of Excellent, Good, OK and Poor condition.

- Most of the **woodland** is judged to be in excellent condition, with the exceptions being the relatively small areas of newly planted woodland and conifer woodland which are regarded as being in good condition.
- All of the **lowland dry acid grassland** is judged to be in excellent condition (although it is noted that scrub encroachment on the slopes of Chase End Hill are a threat to this).
- Most of the **parkland** and other areas of **semi-improved permanent pasture** are judged to be in good condition, with the Outer Park being in excellent condition.
- The lower levels of public goods provided by **agriculturally improved permanent grassland** means that most of these areas have been judged to be in OK condition.
- Poaching by cattle overwintered on part of the tenanted land has resulted in some of this area being classified as in poor condition. The high level of over-grazing and inadequately managed winter feeding of cattle pose a threat to the rest of this area.
- All the **hedgerows** are judged to be in excellent or good condition, with the higher classification used for the taller and larger hedgerow.
- The large area of **arable land** on the Estate (207 ha) is judged to be in OK or poor condition because of the impact of continuous arable cultivation and crop inputs on the condition of the soil – and the low levels of associated public goods such as clean water, flood mitigation and climate regulation.
- The assessment of poor condition has been given to the steeper arable fields on which gullying and erosion were observed.


The condition of natural capital assets on the Bromesberrow Estate
Hollybush
Whiteleaved Oak
Chase End Street
Bromesberrow
King's Green
Eggs Tump
The Bromesberrow Estate - Assessment of overall condition of natural capital assets in relation to delivery of public goods
RuralFocus
Excellent
Good
OK
Poor
0
250
500
750 m
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Opportunities to enhance natural capital and the provision of public goods

It remains to be seen what incentives will be provided through the ELM scheme both to reward existing provision of public goods and to encourage new practices that enhance them. However, a number of opportunities emerge from this study that could be taken forward.

A. The future of arable cropping on the Estate

The Estate's arable land is contributing least to public goods, principally because of the impact that it has on soil condition compared to soils under grassland and woodland. Taken together with the low profitability of much of this land, there are significant landscape-scale opportunities for change. These include:

- Conversion of the steep fields on the eastern flanks of Chase End Hill to permanent low input pasture / parkland.
- On other areas of arable land, establish new woodland areas, as belts or interlinking blocks.
- Where arable cropping continues, subdivide fields with new wide hedgerows and rough grass margins.

B. Hedgerow management

Hedgerow management practices are already good. Opportunities include:

- Allowing hedges to grow out laterally into the adjacent field margins.
- Adopting a long-term hedgerow tree replacement programme to plan for the decline and loss of existing trees.

C. Grassland management

The gradual process of colonisation of the low input parkland and pasture by wildflowers can be accelerated by:

- Cutting hay in late June or July and grazing the aftermath with livestock.
- Harrowing grassland in the autumn to open up the sward, revealing patches of soil, before spreading recently made hay from local flower-rich fields.
- Where it is a priority to create a wildflower meadow as a visitor attraction, soil stripping can be used create the ideal conditions before establishing new meadow mixes.

D. Woodland management

- Continuous cover forestry practices will ensure the woodlands are as resilient as possible to the impacts of climate change, maintain habitat diversity and help to protect soils.
- Encouraging structural diversity within the woodlands, particularly in a well-develop shrub layer, at woodland edges and along wide tracks and glades will maximise biodiversity.
- When the silvicultural cycle favours it, replacing the few pure stands of conifer on the Estate with mixed or pure broadleaved species, particularly on Ancient Woodland sites, will enhance natural beauty and biodiversity.

E. The Historic Environment

Future developments should take account of the Estate' rich archaeological heritage and not damage sensitive sites. Further advice should be sought before significant changes to land use are made.

F. Public access and leisure

Analysis by this study shows that some 415,000 people live within a half hour drive of the Estate and 4.3 million live within an hour's drive.

There are opportunities to broaden the recreational opportunities and services provided by the Estate, attracting staying visitors who would contribute more to the local economy and to the Estate's income.

The Estate's natural capital could have a key role to play, providing a high quality environment that enhances people's health and wellbeing and offering opportunities for outdoor leisure activities.

The Bromesberrow Estate's Natural Capital

How this natural capital provides public goods; and how enhancing it could inform management decisions and Government support

Contents

1. Introduction

This report has been prepared for Dr Gilbert Greenall as a first step in preparing for management of the Bromesberrow Estate in the context of the UK's post-Brexit agricultural policy. It mirrors similar work that is underway on Dr Gilbert's Exmoor Forest Farms. Its production has been supported by the Malvern Hills Area of Outstanding Natural Beauty (AONB) Sustainable Development Fund.

The rest of this report is split into five further sections as follows:

2. Policy context and approach
3. Public goods and how they are provided by the Bromesberrow Estate
4. The extent of natural capital on the Estate
5. Assessing the condition of natural capital
6. Conclusions for future management and enhancement of natural capital

Five appendices provide additional information on Landscape Character, Biological Recording, the Historic Environment, Agricultural Land Classification and Population Catchments.

2. Policy context and approach

Future support for farming and land management

The Government has made it clear that, following Brexit, a new Environmental Land Management (ELM) scheme will replace the existing Basic Payment Scheme and the Environmental and Countryside Stewardship Schemes. The new scheme will be rolled out nationally from 2024 following a national pilot starting in 2021. In future, all support will be paid on the basis of 'Public Payments for Public Goods'. Land Management Plans drawn up by the farmer or land manager will provide the basis for the ELM payments.

These changes to farming and countryside support schemes will be accompanied by new arrangements for the UK's trade in agricultural products. The combined effect of these changes is currently not known but industry sources such as the Agricultural and Horticulture Development Board (AHDB) are forecasting significant falls in the profitability of arable and grazing livestock farms[1].

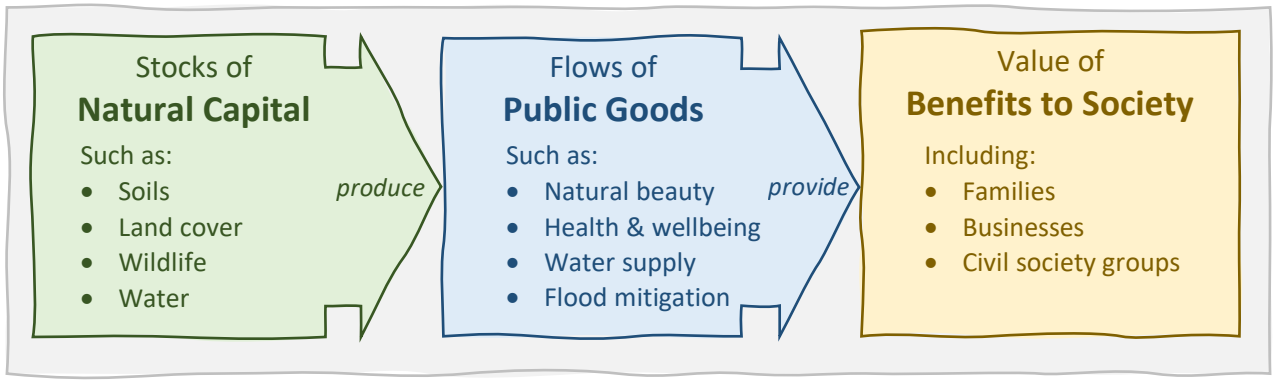
Dr Greenall and his family wish to continue to enhance the Estate's environmental quality at the same time as securing its economic future. The Estate currently receives funding from the Basic Payment Scheme, while parts of its in-hand farmland and woodland is under agreement with the Environmental Stewardship Scheme, due to expire in October 2023. In common with most livestock and arable enterprises in England, without funding from these schemes, it is understood that the Estate's agricultural enterprises would operate at a loss. The Greenall family wishes to consider options for changing land use and management.

[1] AHDB (2019). Understanding Brexit: An impact assessment for England farm types. April 2019. https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/Horizon/Understanding%20Brexit%20an%20impact%20assessment_final11April2019.pdf

The concepts: Public goods and natural capital

As stated above, the core principal behind the Government's plans for future support for land management will be 'Public Payments for Public Goods'. Economists draw a distinction between 'public goods' that are freely available and 'private goods' that are traded in markets[2]. The Government's 25 Year Environment Plan, published in 2018, describes the public goods that future policy will seek to protect and enhance[3]. Defra has stated that the public goods that will be covered by ELM are: "*clean and plentiful water; clean air; protection from and mitigation of environmental hazards; mitigation of and adaptation to climate change; thriving plants and wildlife; and beauty, heritage and engagement*"[4].

The Government's 25 Year Environment Plan, published in 2018, emphasises the concept of **natural capital** as a way of understanding the way that the natural environment provides goods and services to society. This pathway is summarised in the following diagram.



Agri-environment schemes, including the Environmental Stewardship scheme that currently applies to the in-hand farmland and woodland on the Estate, have made payments for delivering a selected number of environmental objectives such as biodiversity, landscape and cultural heritage. The Government's proposed broader public goods approach offers the potential to recognise and reward the full range of goods and services that farmers and land managers on the Malvern Hills AONB, as elsewhere in England, provide to society.

As a result, this report examines how the concept of natural capital can be applied to the Bromesberrow Estate, to form that basis for a future ELM Land Management Plan, recognising the public goods that the Estate provides. This follows the same approach being taken on Exmoor Forest Farms as part of the ELM Test and Trial administered by the Exmoor National Park Authority, with the Exmoor Hill Farming Network for Defra.

[2] In economists' jargon, public goods are by definition both 'non-excludable' and 'non-rivalrous'. This means that they must be freely available to everyone and that use by one person should not reduce availability to others. Private goods, including food, do not meet this definition, although they are often of vital importance to society.

[3] HM Government (2018). *A Green Future: Our 25 Year Plan to Improve the Environment*. The 25 Year Environment Plan. January 2018. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf

[4] Defra (2020). Environmental Land Management. Policy discussion document, February 2020. https://consult.defra.gov.uk/elm/elmpolicyconsultation/supporting_documents/elmdiscussiondocument20200225a%20002.pdf

3. Public goods and how they are provided by the Bromesberrow Estate

This report re-configures the ELM public goods so that they are relevant to the Estate's natural environment. Eight public goods are described in Table 1 on the following page, divided between those that support the special qualities of the locality and those that contribute more widely to a healthy environment.

Table 1. Public goods provided by the Bromesberrow Estate

Supporting the Special Qualities of the Malvern Hills AONB	
	The Estate lies at the southern end of the Malvern Hills AONB and its landscape contributes to the AONB's special qualities. This includes dramatic views to and from the Severn Vale and the rolling hills and valleys to the west; a distinctive combination of landscape elements that include orchards, parklands, ridgelines, quarries, hedgerows and watercourses; and a sense of remoteness and tranquillity, underpinned by dark night skies and limited noise and disturbance.
	Wildlife habitats on the Estate include ancient semi-natural woodland, unimproved acid grassland (heathland), watercourses, lakes and wetlands, veteran parkland trees and hedgerows. The northern part of the Estate contains part of the Malvern Hills Site of Special Scientific Interest (SSSI). Biological monitoring has taken place for 20 years, providing a record which is rare for an agricultural estate of this size.
	The Estate and its environs contain evidence of human activity dating back to the Iron Age (for instance Midsummer Hill Camp). The settlement of Bromsberrow was established by 1085 (being described in the Domesday Book). Most of the Estate's woodland is ancient, some of the fields show medieval patterns of ridge-and-furrow cultivation, and many of the hedges date from C18th enclosures of the medieval open fields. Bromesberrow Place was built, with its designed parkland landscape, in the late C18th. The Estate contains a range of historic sites (detailed later in this report).
	There are excellent opportunities for physical, mental and spiritual enrichment on the network of public footpaths that cross the Estate. The ridgeline walk that runs south from Hollybush to Chase End Hill is a popular route used by families and groups throughout the year, with particularly high numbers at summer weekends. Permissive public access, including riding, is permitted along some of the tracks on the Estate.
Providing a Healthy Environment	
	The majority of the Estate drains south to the Glynch Brook and onwards to the River Leadon, while the northern part of the Estate flow east into the Longdon Brook and onwards to the Severn. Severn Trent Water abstracts water for public supply from a borehole near Wood End Lane in Bromsberrow.
	Periods of severe weather, flooding and drought are increasing as a result of climate change. Whereas the higher ground on the Estate can be affected by drought, the lower areas can flood. The Estate's woodland, permanent grassland, lakes and wetlands can reduce these risks by storing and slowly releasing rainfall.
	The woodland, hedgerows and organo-mineral ('peaty') soils on the Estate are a good store of organic carbon. Appropriate management of these areas ensures that they continue to capture and store (or 'sequester') carbon from the atmosphere, reducing the causes of climate change.
	The quality of the airflow over the Estate, which is predominantly from the South West, is generally good. Woodland, lines of trees and rough vegetation can help to filter out harmful particles from traffic and industry and improve air quality in 'downstream' areas of population (i.e. the villages and towns to the north east of the Estate).

Natural capital and how it can be used to enhance public goods

Natural capital is defined as 'the parts of the natural environment that produce value to people' (UK Natural Capital Committee). Natural capital assets are a combination of both natural resources and the human resources involved in valuing or managing them.

There is no standard way of classifying different types of natural capital in the UK, but the recently published UK Habitat Classification[5] (UK Hab.) provides a reasonably comprehensive structure. In this report, 17 categories of habitat have been selected as occurring on the Estate. To these are added two categories of built land cover, two categories describing public access and two covering the historic environment. These are shown in Table 2.

Table 2. Types of natural capital recognised on the Estate

Codes in italics show the UK Hab. classification.

Woodland, trees & hedges	Broadleaved woodland	*w1*
	Mixed woodland	*w1h*
	Conifer woodland	*w2*
	Traditional orchards	*21*
	Dense scrub	*h3*
	Individual tree - parkland or field	*1170a**
	Individual tree - hedgerow	*1170b**
	Hedgerow less than 2m tall	*h2a1**
	Hedgerow more than 2m tall	*h2a2**

Grassland & crops	Lowland dry acid grassland	*g1a*
	Semi-improved permanent grassland	*g4b**
	Improved permanent grassland	*g4a**
	Rough grassland, incl arable margins	*c1a*
	Cereals and other arable crops	*c1c-d*
	Game bird mix	*c1c6*

Water	Ponds and lakes	*R1*
	Watercourses and streams	*r2b*

Heritage	Building of historic interest
	Archaeological feature
	Historic landscape / assemblage

Access	Open access land
	Public footpath
	Permissive access track or path

Other	Structure
	Curtilage or track

Note: An asterix in the UK Hab. code indicates an addition to the classification by this study to recognise different types of 'modified grassland' (g4), hedgerow (h2a) and tree (1170).

Other information is also valuable in understanding how natural capital provides public goods. This includes designations such as Sites of Special Scientific Interest and Scheduled Monuments and other classifications of land such as Ancient Semi-Natural Woodland, Landscape Character Areas and soil types. Species records may also be informative, particularly of priority and protected species.

[5] https://ecountability.co.uk/ukhabworkinggroup-ukhab/

There is an agreed methodology for determining the stock of natural capital assets, which can be used to assess the flow and value of public goods that they provide. This involves measuring the **extent** of the natural capital (how much and where it is) and its **condition** (what state it's in), as shown in **Table 3** below.

Table 3. The metrics of natural capital

Measure	What we need to know	How it is recorded
Extent of the asset	• How much of it is there? • Where is it? • How does its location fit with other natural capital assets?	• Usually a map showing the area of land covered • Sometimes a text description
Condition of the asset	• What state is it in? • How well is it providing the public goods?	• Categories (e.g. excellent, OK, poor) which are defined objectively and can be measured

4. The Extent of natural capital on the Bromesberrow Estate

Biological Monitoring 2000-2019

As noted in Table1, a programme of biological monitoring has taken place on the Estate, starting in 2000 and continuing annually since then. This continuous record provides a particularly valuable resource, tracking change in species and habitats. Appendix 2, written by Ros Willder who has undertaken the monitoring for the 20-year period, summarises the methodology and results. **Box 1**, below, draws out key findings of relevance to this study.

Box 1. Key findings from the biological recording on the Estate 2000-2020

- **Botanical change in the arable field margins**. Over the last 20 years, wider grass margins (between 2 and 6m wide) have been established around many of the arable fields. These aim to buffer the hedges from disturbance and provide a habitat for beneficial insects, small mammals and birds such as the barn owl.

  The monitoring of plant diversity along the edges of arable fields where these grass margins have been established has shown a change from a relatively large number of annual plants typical of disturbed ground (many of them considered weeds) to a smaller number of perennial species as the grass margins have become established.

  This demonstrates how the grass margins have successfully stabilised and are providing the rough margin of perennial species, dominated by grasses likely to include Yorkshire fog (*Holcus lanatus*) and false oat grass (*Arrhenatherum elatius*) that was intended.

  While the replacement of weedy field edges with stable grass margins is to be welcomed because of the network of buffering habitat it has created, it is worth noting that some arable weeds are of conservation interest. Species such as round-leaved fluellin (*Kickxia spuria*), corn spurrey (*Spergula arvensis*) and pheasant's eye (*Adonis annua*), which are all found in Worcestershire and Gloucestershire but not necessarily on the Estate, have become rare due to the use of herbicides and winter sowing. It would be interesting to know whether rare arable weeds are present on the Estate's arable fields.

- **Breeding birds, including birds of high conservation concern**. Over the 20 years, a total of 50 different bird species have been recorded during their breeding season. The number in each year has fluctuated, with recent years showing a variation between 41 (2018) and 48 (2016). These fluctuations are to be expected and are likely to be due to variations in weather and the timing of surveys.

  Of greater interest is the number of birds of high conservation concern (also called 'red list' species – see https://www.bto.org/our-science/publications/psob) recorded on the Estate. The number of these species on the Estate has been increasing in recent years, with 2019 having the most to date (cuckoo, house sparrow, mistle thrush, song thrush, linnet, skylark, starling and yellowhammer), showing an upward trend since 2000. Many of these 'red list' species were common on farmland until the late C20th but have declined dramatically since then. It is encouraging that their numbers are increasing on the Estate. Many of these species are hedgerow and field margin species (skylark being an exception to this) and their presence is likely to be due to the large hedges and wider margins that have been created in the last 20 years.

- **Small mammals**. Surveys of small mammals took place in 2001 and 2005. The results show highest numbers in woodland with few, at that time along arable margins. It is likely that the grass margins around arable fields will now support higher numbers of species such as the field vole, which is an important food source for birds such as barn owl and kestrel.

Mapping of natural capital by this study

This study has mapped the extent of natural capital on the Estate using GIS mapping software[6]. Ordnance Survey's MasterMap, provided under licence through the Malvern Hills AONB Unit, formed the framework for the mapping. The OS 1:10,000 raster maps were used as the base for the published maps shown later in this report. Three different types of data have been used.

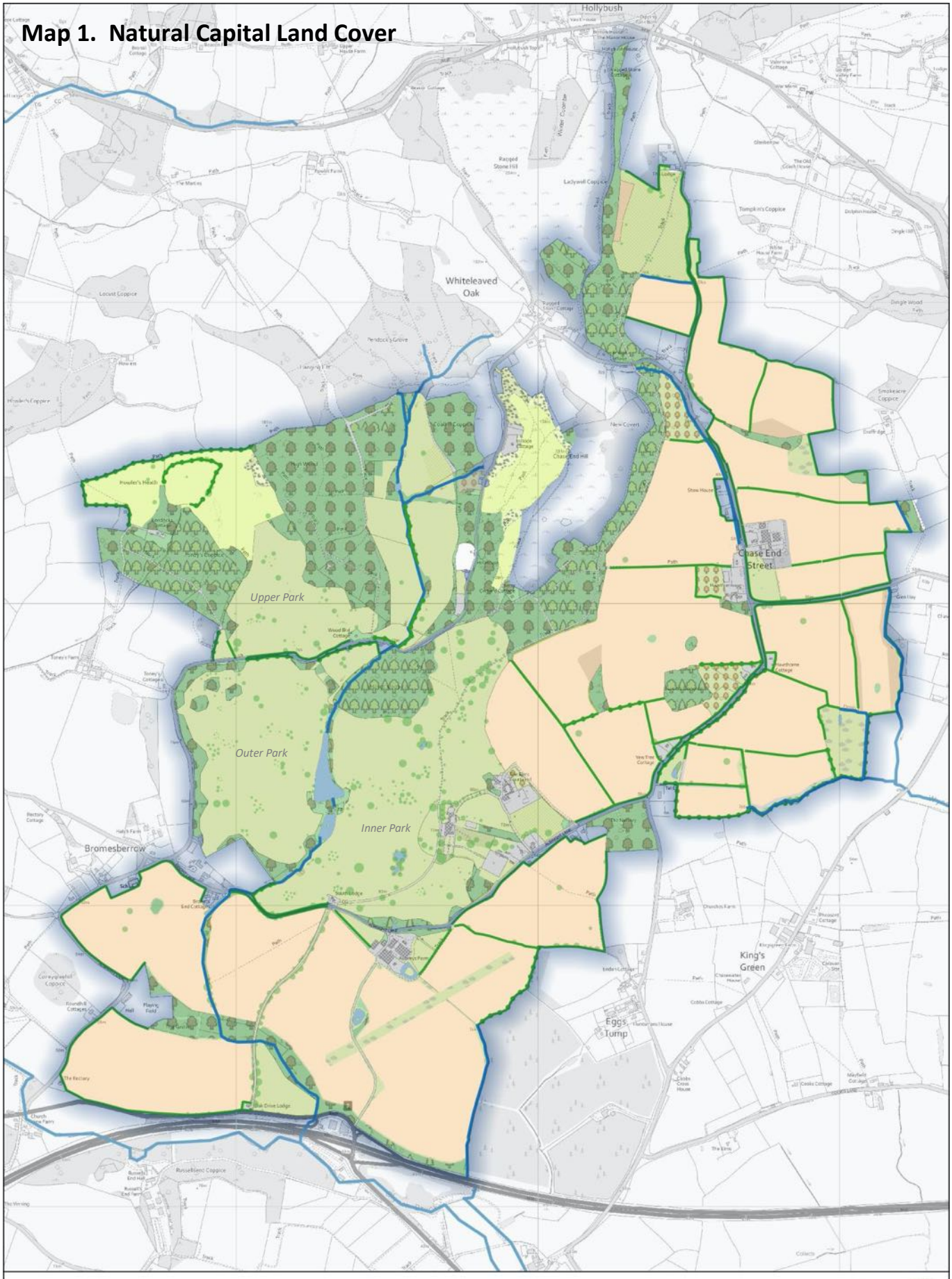
- Firstly, GIS data that are freely available on-line were used to map key habitats, designated sites, public rights of way and sites of historical interest.
    - Data for woodland was taken from the Forestry Commission's National Forestry Inventory data for other priority habitats such as unimproved acid grassland and traditional orchards was taken from Natural England's Priority Habitat Inventory.
    - Data for designated sites such as Sites of Special Scientific Interest, Scheduled Monuments and Listed Buildings and for rivers were downloaded from the Government's portal www.data.gov.uk.
    - Data on public rights of way were obtained from Gloucestershire and Worcestershire County Councils via http://www.rowmaps.com.
    - Data on areas of archaeological and other historical interest were obtained from the two County Historic Environment Records through the AONB Unit.
    - Although these existing mapped datasets are considerable, they still leaves large gaps, particularly for agricultural land and hedges. Furthermore, some of the datasets (for instance the Priority Habitat Inventory) are relatively old and need to be checked on the ground.
- Secondly, aerial photography from Google (dated 27 June 2018) was used to map hedgerows and individual trees in the parkland, fields and hedges.
- Finally, a field survey took place on 29th and 30th January to check the sources above and fill gaps such as current cropping patterns. It should be noted that distinguishing between different types of grassland (particularly between unimproved, semi-improved and improved permanent grassland) was difficult at that time of year, and the extent of these areas need confirming at a more suitable time of year (e.g. May-June). A short/limited survey at this time of year from a suitably experienced botanist should be sufficient to make up this gap in knowledge.

Map 1 on the following page shows the results of this work with a map of natural capital land cover. **Map 2** shows historic environment sites and public access and **Map 3** shows nature conservation and landscape designations and landscape character areas.

Table 4 provides the legend for Maps 1 and 2 and shows the total extent of each natural capital asset (area, length or number). This table also provides an indication of the public goods that each type of natural capital asset is potentially able to provide. Three private goods (agricultural products, woodland products and tourism) are also shown for comparison.

[6] The open-source QGIS software was used. https://qgis.org/en/site/

Map 1. Natural Capital Land Cover



The Bromesberrow Estate - Natural Capital Land Cover

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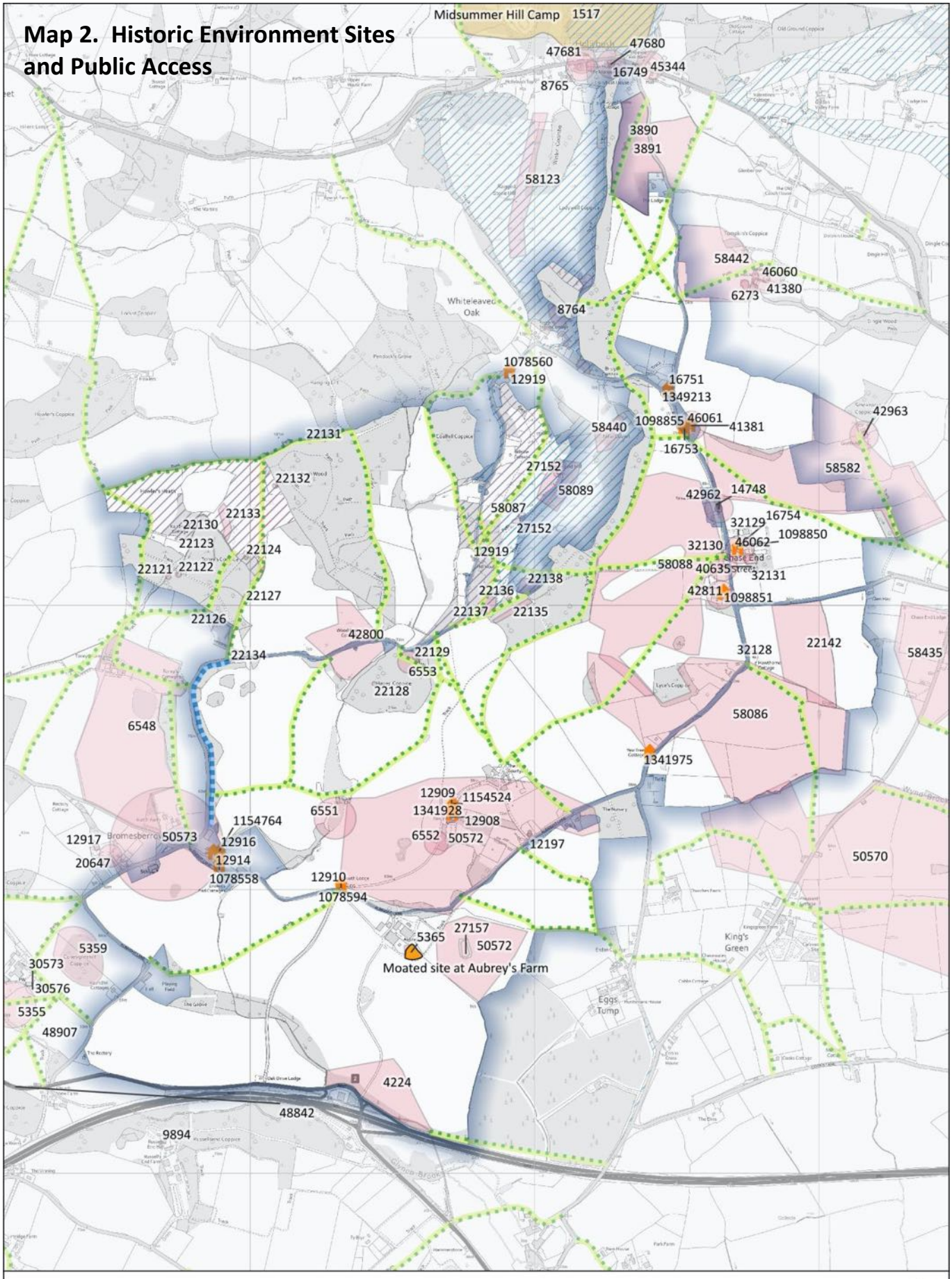
See Table 3 for legend of different types. Note: Categorisation of grassland is based on field survey in February 2020. This needs confirming at a more suitable time of year (e.g. May-June)

0 250 500 750 m

Map 2. Historic Environment Sites and Public Access



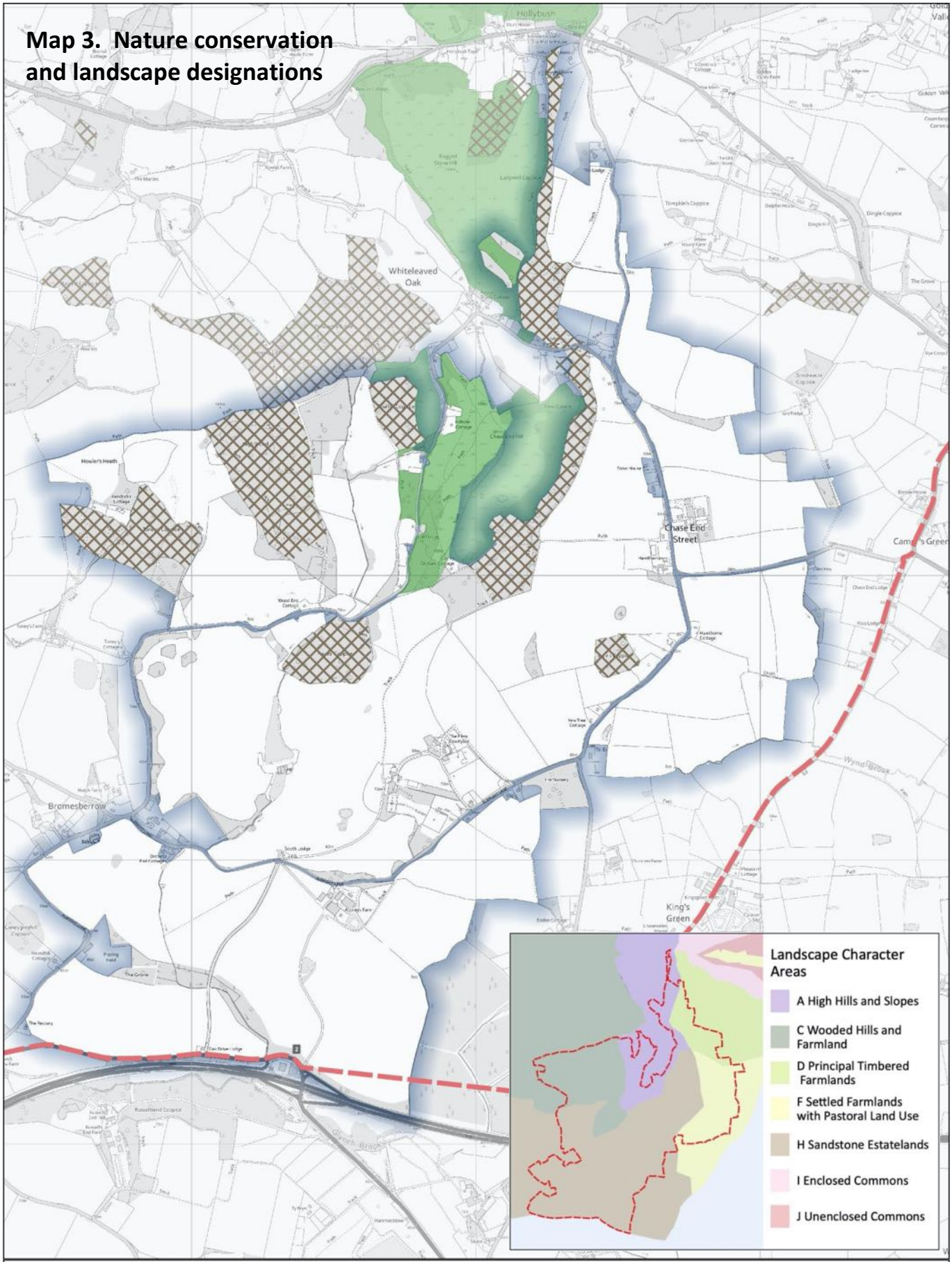
The Bromesberrow Estate - Historic Environment Sites and Public Access

RuralFocus

See separate sheet for legend

0 250 500 750 m

Map 3. Nature conservation and landscape designations



The Bromesberrow Estate - Nature Conservation and Landscape Designations

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Site of Special Scientific Interest

Ancient Woodland

Border of Malvern Hills AONB

0 250 500 750 m

Table 4.

The Bromesberrow Estate's Natural Capital Assets, with their potential delivery of public and private goods

Map key	Category	Area (ha)	Length (m)	No.	Potential provision of goods by assets: Public goods: Thriving biodiversity	Natural beauty	Cultural heritage	Engagement , H&W	Clean/plentiful water	Flood mitigation	Climate regulation	Clean air	Private goods: Agric. products	Woodland products	Tourism
	Broadleaved woodland	61.0			■	■	❖	❖	■	■	■	■		■	❖
	Mixed woodland	24.9			□	■	❖	❖	■	■	■	■		■	❖
	Conifer woodland	2.2			□	■	❖	❖	■	■	■	■		■	❖
	Traditional orchard (grazed)	5.4			■	■	■	❖	■	□	□	□	■		❖
	Dense scrub	2.6			■	□			■	■	□	□			
	Parkland / field tree			423	■	■	❖				□	□		□	
	Hedgerow tree			153	■	■					□	□		□	
	Hedgerow <2m tall		16,922		□	■	❖	❖		□	□	□		□	❖
	Hedgerow >2m tall		4,713		■	■	❖	❖		□	□	■		■	❖
	Lowland dry acid grassland	18.9			■	■	❖	❖	■	■	■		□		❖
	Semi-improved permanent grassland	103.8			□	□	❖	❖	□	□	□				❖
	Improved permanent pasture	9.6				□	❖	❖		□	□		■		❖
	Rough grassland (ungrazed)	13.7			■	■	❖	❖	■	■	■		□		❖
	Arable crop	203.7			□	□	❖	❖					■		❖
	Game crop	3.3					❖								
	Ponds and lakes	2.1			■	■		❖	■	■					❖
	Watercourse		9,231		■	■			■	■					
	Open access land	29.91						■							■
	Public footpath		14,504					■							■
	Permissive access route		657												
	Historic environment site			54			■	■							■
	Listed building of historic interest			6			■	❖							❖
	Building			98			❖	❖					❖	❖	❖
	Curtilage or track	12.8					❖	❖							❖

■ Asset potentially provides significant flow of good

□ Asset potentially provides moderate flow of good

❖ Provision depends on other characteristics - For instance the presence of archaeology or another historical record in order for an asset to provide cultural heritage, or the existence of public access for engagement, health and wellbeing or for tourism.

5. Assessing the condition of natural capital

The second metric that is used to assess the way natural capital assets deliver public goods is their condition (as shown in Table 3).

For some of the public goods there are existing published assessments of condition. For instance, the Environment Agency uses measures of ecological and chemical quality of water courses to score the condition of water bodies in England (as a requirement of the EU Water Framework Directive). Similarly, Natural England makes an assessment of the favourable condition for Sites of Special Scientific Interest showing how well each area is achieving its conservation objectives. However, for most public goods, no such published assessments exist, and it is necessary to make a judgement based on available evidence, including site survey.

For ease of comparison, a simple 4-way score of condition has been used by this study, distinguishing between:

- **Excellent**: The condition of assets provides high levels of the public or private goods, not requiring major changes in the way the assets are protected or managed.
- **Good**: The condition of assets provides good flows of the public or private goods but there is scope to improve this by targeted action to protect or enhance the condition of the asset, or by converting the land to another higher value asset.
- **OK**: The condition of assets provides some flows of the goods but there is much that can be done to improve this by better protection, management or restoration, including to other types of more valuable asset.
- **Poor**: The condition of assets provides low levels of the goods. The assets can be considered to have a low value to society as a whole and/or to the land owner or manager. There is much that can be done to address this, by avoiding damaging activities, introducing more suitable management or converting the land to other types of more beneficial assets.

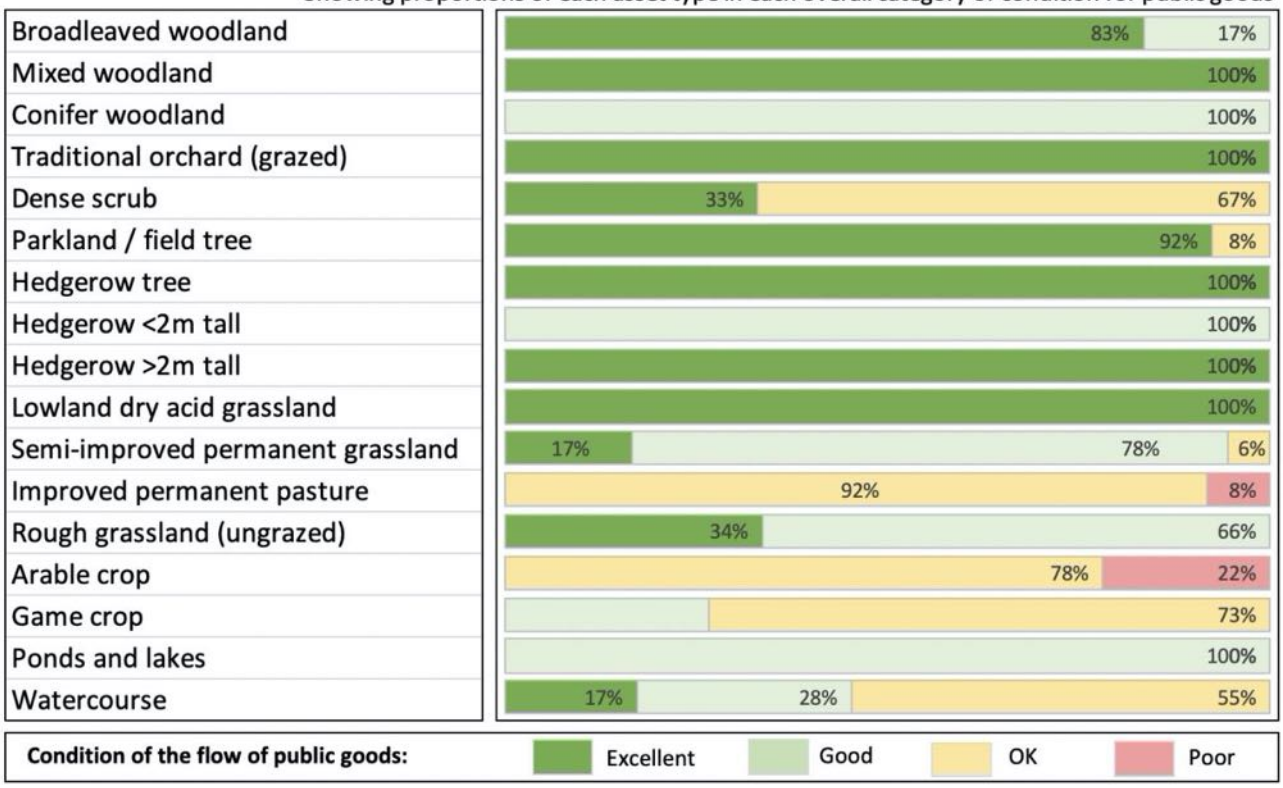
Separate assessments of condition can be made for each public good (for instance the condition of an area of broadleaved woodland can be assessed in terms of its provision of biodiversity, natural beauty, cultural heritage, public engagement, etc.). Such individual public good condition assessments are likely to be appropriate for detailed planning, particularly for the most sensitive sites, but would produce a level of detail and complexity which is not needed for making overall decisions at a farm or estate level.

Instead, in this study a single condition assessment score has been made for each parcel of land to show the way that its natural capital is delivering the flows of public goods (note: private goods have been omitted from this condition score). These assessments have been made on the basis of objective criteria, taking account of the site characteristics observed during the field survey at the end of January 2020.

The results of this analysis are shown statistically in **Table 5** and are mapped across the Estate in **Map 4**.

Table 5. **Overall condition scores on the Estate based on field assessment of each site**

Showing proportions of each asset type in each overall category of condition for public goods



Key findings arising from Table 5 and other sources of information are as follows:

Woodland

There are 88 ha of woodland on the Estate, most of it on the higher and steeper ground in the north western part. The large majority of it (86 ha) is pure broadleaved or mixed woodland. Most of the woodland is under silvicultural management which produces around 90 tonnes of woodfuel a year for use in the Estate's biomass plant.

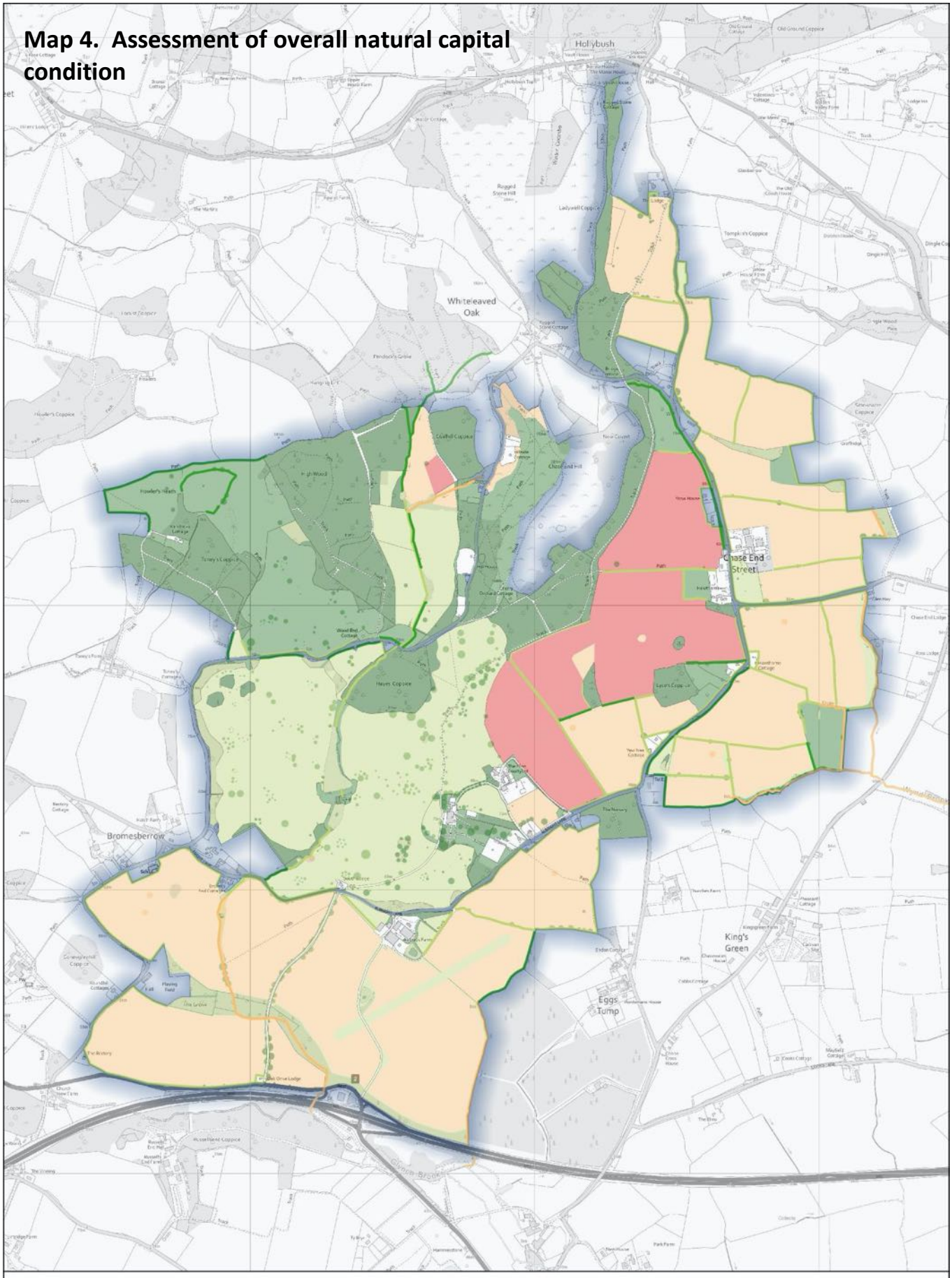
Over half of woodland on the Estate (47.8 ha or 54%) is classified as 'Ancient' (Map 3) meaning it is thought to have had a continuously wooded history since at least 1600 and giving it added historic and biological value. Most of this (31.7 ha) is classified as Ancient and Semi-Natural Woodland, meaning it contains only native tree species and is unlikely to have been planted and the remaining 16.0 ha is classified as Ancient Replanted Woodland (probably containing conifer species). An area of 2.2 ha of the Ancient and Semi-Natural Woodland on the edge of Chase End Hill is part of the Malvern Hills Site of Special Scientific Interest (SSSI).

These areas contribute strongly to the Estate's natural beauty (landscape character), support a wide range of wildlife (particularly where they have a semi-natural shrub layer and ground flora) and tend to protect buried archaeology from damage. Their soils filter rainfall, producing water that is generally free from pollutants and releasing it relatively slowly so as to reduce flood risk. The timber and soils in woodland captures and stores carbon, helping to slow climate change. Finally, woodland filters polluting particles from the air, helping to improve air quality. As a result, the majority of the broadleaved and mixed woodland is judged to be producing 'excellent' flows of public goods.

The 15 ha of newly planted broadleaved woodland (17% of the total) that have yet to develop closed canopies, shrub layers, ground flora of carbon rich soils have been scored as 'good'.

The 2 ha of conifer woodland has been scored as 'good', on the basis that it can detract from landscape character and lacks biodiversity, while still providing excellent flows of other public goods such as flood mitigation, climate regulation and clean air.

Map 4. Assessment of overall natural capital condition



The Bromesberrow Estate - Assessment of overall condition of natural capital assets in relation to delivery of public goods

RuralFocus

Excellent | Good | OK | Poor

0 250 500 750 m

Orchards

The five traditional orchards on the Estate, covering 5.4 ha, are producing excellent flows of public goods. In combination, the fruit trees (apples in four orchards and cherries in one) and the unimproved grassland underneath them contribute strongly to its natural beauty and biodiversity and provide the other public goods in a similar way to broadleaved woodland, above.

Dense scrub

The 2.6 ha of closed canopy thorn, gorse and bramble scrub that is mainly located on the slopes of Chase End Hill is split between OK and excellent condition. Scrub is an important habitat for wildlife and can be a colourful and attractive addition to the landscape. However, it is less desirable when it is encroaching over rarer and more biodiverse habitats such as acid grassland and also where it grows over buried archaeology (where its roots can break up structures such as walls). As a result, areas of long-established thorn scrub have been scored as 'excellent', whereas areas of younger scrub where it would be possible to revert back to acid grassland have been scored as 'OK'.

Parkland, field and hedgerow trees

The Estate contains some 423 individual parkland and field trees, a very considerable resource. The majority of these are found in the Inner, Outer and Upper Parks (Map 1) and are of a range of native and ornamental species (including oak, ash, sycamore, lime, fir, cedar and horse chestnut). Some of these parkland trees are veterans of the late C18th and C19th parkland design and have considerable historical interest, as well as contributing to the landscape and probably supporting uncommon lichens and deadwood insects. During the last 20 years, a large number of new parkland trees have been planted, following a plan developed by Hal Moggridge. All these parkland trees are judged to be in excellent condition because of their contribution to the historic designed parkland landscape and biodiversity as well as other public goods such as climate regulation and air quality.

There are a small number (some 43) trees growing within fields in other parts of the Estate, mostly of ash and oak. Most of these are relatively mature trees growing singly or in small groups. Where these trees are growing in permanent pasture, they are judged to be in excellent condition because of their contribution to landscape character, biodiversity and other public goods. No sign of damage from livestock grazing or compaction was observed to these groups of trees, or the single specimen trees, and it is likely that the low grazing densities in the parkland ensure this does not take place.

There are nine trees growing within arable fields. Although care is taken not to plough or cultivate under the canopy of these trees, arable cropping operations outside this immediate area (including ploughing and pesticide and fertiliser use) is likely to be reducing the contribution these trees make to biodiversity and other public goods such as clean and plentiful water. As a result they have been given a score of 'OK'.

There are 153 hedgerow trees on the Estate, again mostly of ask and oak. All are considered in excellent condition for the delivery of a range of public goods. It should be noted that ash dieback disease poses a significant threat to all the ash trees on the Estate, although at the time of the field visit (January 2020), it was not possible to identify trees that might be affected.

Hedgerows

There are around 21.6 km of hedgerow on the Estate, including roadside and boundary hedges. These delineate the field patterns on the eastern and southern parts of the estate, creating the

visual structure of the landscape and reveal its historical development through medieval and parliamentary enclosure. They provide corridors for the movement of species and in some cases buffer areas beside watercourses, helping to project water quality. Where they run across slopes they can help to reduce water run-off, erosion and flooding. Their woody growth is a store of carbon and roadside hedges help to filter and improve air quality.

Almost all the hedges consist of a mix of species with frequent hawthorn, hazel, elder, field maple, bramble and dog rose and, less frequently, common dogwood, common elm, sycamore, privet, spindle and honeysuckle. Two different management styles were recorded and these have been used to distinguish two types of hedgerow natural capital. Along most of the roadsides and between the arable fields, most hedges are cut on the sides and in an A-shape on top, creating hedges around 2m wide around 2m tall. In other areas (for instance on Howler's Heath), the hedges have been allowed to grow taller and wider. All hedges next to arable fields had a good margin of rough grassland, at least a meter wide and in many cases wider, which provides additional benefits (see below under rough grassland).

From a landscape and natural beauty perspective, the variation in these hedge sizes (both of which can be considered to be making a positive contribution to landscape character) is to be welcomed. The presence of hedgerow trees has not been taken into account is assessing the condition of the hedges and, again, from a landscape perspective, some variation in the density of trees in hedges is probably to be encouraged, helping to provide a diversity of views and visual character.

In recognition of the greater benefits of taller hedges for biodiversity (as sources of nectar and fruit, bird nesting sites, etc) and as a greater store of carbon, the latter hedges have been given a score of 'excellent' and all other hedges have been given a score of 'good'.

Grazed grassland

Around 132 ha of the Estate is permanent grassland grazed with livestock. There is no temporary (ley) grassland. For the purpose of this natural capital assessment, this grazed grassland has been split into three types of natural capital, listed below. As noted earlier (section 4 on page 5), distinguishing between these types was difficult during the field survey in January 2020 because many of the broadleaved plants were dormant. It is possible that a survey in May or June would reallocate areas between these categories on the basis of the plants present.

- Lowland dry acid grassland. Nearly 19 ha of this type of grassland has been recorded on Chase End Hill (12.1 ha) and Howlers Heath (6.8 ha). This is grassland that has never (within living memory) been reseeded or otherwise agriculturally improved and therefore contains a diverse mix of grass and wildflower species. The area of this habitat on Chase End Hill is part of the Malvern Hills Site of Special Scientific Interest (SSSI). It is likely that Howler's Heath is recorded as a County Wildlife Site, although the study did not have access to this data. Typical plant species include the grasses sheep's-fescue, common bent, wavy hair-grass and crested hair grass and the wildflowers heath bedstraw, ladies bedstraw, harebell, wild thyme and mouse-ear hawkweed. All of these areas are judged to be in excellent condition because of their contribution to natural beauty, biodiversity, clean water, flood mitigation and, where the soils are rich in organic matter, climate regulation.
- Semi-improved permanent grassland. All of Inner, Outer and Upper Park and the tenanted land north of Wood End Cottage has been placed in this category – a total of 103.8 ha. This classification was made on the basis that the swards contained many of the species that would be expected in permanent grassland that has been agricultural improved through applications of artificial fertiliser in the past, but is currently being managed with no or low inputs. These species include meadow buttercup, yarrow, common mouse-ear, plantain and

wild white clover. These species indicate a biologically rich soil with relatively high levels of organic matter which is likely to deliver public goods such as clean and plentiful water, flood mitigation and carbon storage for climate regulation. The parkland is grazed by the Estate's herd of White Park cattle (a traditional breed which is on the WatchList maintained by the Rare Breeds Survival Trust) and by sheep.

Most of the land in this category has been placed in the 'good' category. An exception to this is the 17.3 ha of Upper Park which are recorded on the Natural England Priority Habitat Inventory as 'Good Quality Semi-improved grassland' (interpreted in this study as being of 'excellent' condition for public goods). A second exception is the 5.7 ha of grassland in the tenanted land north of Wood End Cottage on which heavy grazing by over-wintered cattle and enrichment from bought-in haylage has significantly reduced sward diversity.

- Improved permanent grassland. Nearly 10 ha of pasture has been placed in this category. This includes the large field towards the northern end of the Estate (south of The Lodge) which, judging from the low numbers of broadleaved species, appears to have been reseeded relatively recently and/or to be receiving artificial fertiliser. This area is judged to be in 'OK' condition because, despite its low species diversity, it is contributing to other public goods such as flood mitigation and carbon storage (climate regulation). The area of tenanted grassland north of Wood End Cottage which has been used to out-winter and feed cattle is also placed in this category but is judged to be in poor condition because of the very high levels of poaching of the sward and damage to the soil.

Rough grassland (ungrazed)

A total at 13.7 ha of the Estate has been classified as rough grassland that is not grazed by livestock. This is widely distributed and includes the wide grass margins that surround several of the arable fields (particularly in the southern parts of the Estate). It also includes the small field in the south eastern corner of the Estate that has been allowed to develop into a wild area of rushes, reeds and developing scrub, and also the south-west facing bank to the east of Stow House that is also developing areas of scrub.

Rough grassland provides a valuable wildlife habitat, especially close to arable fields where beneficial insects (for instance natural predators of crop pests) can overwinter and which can support high populations of small mammals fed on by barn owls. It also helps to buffer sensitive habitats such as hedgerows and watercourses from cropping operations and inputs and it can reduce overland flow and erosion from water. For these reasons, most of the rough grassland has been judged to be in 'good' condition in relation to its contribution to public goods. The two larger areas of rough grassland described above and the wider strips of rough grassland adjoining watercourses have been scored as in 'excellent' condition because of their greater contribution to biodiversity.

Arable fields and game crops

There are 207 ha of the Estate down to arable crops, including, during the 2019 cropping season, winter wheat, stubble turnips, forage maize and game crops. These areas are on the lower and flatter ground on the eastern and southern parts of the Estate.

Arable land contributes to public goods in a variety of ways. It is characteristic of the landscape, particularly in the sandstone estatelands and settled farmland landscape character areas (see Appendix 2) and provides habitat diversity, supporting wildlife not found in woodland or permanent pasture. However, the frequent cultivation, soil compaction and reduction in soil organic matter and microbial activity on arable land means that it contributes relatively little to

other public goods such as cultural heritage (cultivation damages or erodes buried archaeology), clean and plentiful water, flood mitigation and climate regulation.

In recognition of these varied contributions to public goods, most of the arable land on the Estate is judged to be in 'OK' condition. However, the arable fields on the steeper land to the east of Chase End Hill, where gullying and soil erosion were observed during the field survey, are judged to be in poor condition (excepting a small area of game crops judged to be in 'good' condition).

It is worth noting that the productive quality of the arable land varies across the Estate. As shown in Appendix 4, most of the arable land is on Grade 3 land (good to moderate agricultural land capability) while the area of flat and low lying land to the east of Bromsberrow village, on fertile and easily-worked sandstone soils, is classified at Grade 2 (very good land capability).

Ponds, lakes and watercourse

There are 16 separate ponds or lakes on the Estate, covering 2 ha in total and varying in size from the 1 ha lake between the Inner and Outer Park to several small ponds of around 100m^2. There are at least 9.2 km of watercourses draining south to the Glynch Brook and onwards to the River Leadon, or east into the Longdon Brook and onwards to the Severn.

It has not been possible to do any assessment of water quality as part of this study. However, an estimate of the quality of these water bodies, and their contribution to public goods, can be made from the Environment Agency's assessment of ecological condition of main rivers for the EU Water Framework Directive (WFD). The Glynch Brook is assessed as having 'moderate' condition while the Longdon Brook is assessed as having 'poor' condition.

Taking the Environment Agency's WFD assessments into account, this study has judged that the highest reaches of the watercourses on the Estate, which rise and flow through broadleaved or mixed woodland, are in 'excellent' condition; that the ponds and lakes and the lengths of watercourse running through permanent grassland are in 'good' condition; and that the lengths of watercourse running through arable land are judged in 'OK' condition.

The Historic Environment

It has not been possible to do a detailed assessment of historic environment sites and records for this study, nor to make judgements about their condition. The Historic Environment Records (HER) obtained from the two County Archaeology Units through the AONB Unit are listed in Appendix 3 and their location is mapped in Map 2.

There is one Scheduled Monument on the Estate (the moated site at Aubrey's Farm) and one north of the Estate at Midsummer Hill Camp. There are six listed buildings on the Estate, including Bromesberrow Place (Grade II*), Hawthorns, the Stables at Bromesberrow Place, the Lodge, Gate House and Gate Cottage (all Grade II).

Many of the 54 non-designated sites listed on the HER that are located on the Estate relate to past uses and the historic development of the landscape. These include the remains of medieval ridge and furrow cultivation patterns in fields on the south eastern part of the Estate and quarries and associated holloways used to transport stone and other goods in the northern and western parts of the Estate.

The lack of recognition in the HER of the late C18th to C19th designed parkland landscape to the west of Bromesberrow Place is perhaps an omission which should be rectified, particularly as its contribution to landscape character is noted in the landscape character assessment (see Appendix 1).

Further consultation with the County Archaeological Units is recommended before any major changes of land use or management are implemented.

Public Access

The Estate lies at the southern-most end of the extremely popular walking route that runs along the ridge of the Malvern Hills. There are 14.5 km of public footpaths on the Estate and 29.9 ha of open access land (land designed as 'mountain, moor and heath' under the Countryside and Rights of Way Act 2000) – See Map 2. There are no public bridleways on the Estate but the Estate permits access on horseback to local riders on some of the tracks and cross-field paths. There is currently one signposted permissive path on the Estate running 0.6km in the belt of new woodland on the western edge of Outer Park. It is understood that another new permissive path will be created on an existing track around the arable fields west of Yew Tree Cottage.

6. Conclusions for future management and enhancement of natural capital

This study shows how the concept of natural capital, which is strongly promoted in the Government's 25 Year Environment Plan, can be applied to the Bromesberrow Estate. It uses the new UK Habitat Classification to quantify different types of natural capital and it relates each of these to the suite of public goods which the Government wishes to support and incentivise through its proposed Environmental Land Management (ELM) scheme. It makes an initial assessment of the condition of the Estate's natural capital in relation to the delivery of these public goods.

Key findings of this assessment are as follows:

I. Natural Capital Assets

The Estate contains a wide variety of natural capital assets within its 495 ha (1,220 acres), including:

- 88.1 ha of woodland, of which 47.8 ha is Ancient Woodland
- 82.1 ha of parkland, consisting of semi-improved permanent pasture grazed by White Park cattle and including many native and ornamental specimen trees.
- 18.9 ha of agriculturally unimproved lowland dry acid grassland, of which the 12.1 ha on Chase End Hill is part of the Malvern Hills SSSI.
- 5.4 ha of traditional orchard containing apple and cherry varieties over agriculturally unimproved (and probably flower-rich) permanent pasture
- 423 parkland and field trees and a further 153 hedgerow trees, including a number of veteran trees in Inner Park.
- 21.6 km of hedgerow and associated margins of rough grassland
- 9.2 km of watercourses and 2.1 ha of ponds and lakes
- 14.5 km of public rights of way and 29.9 ha of open access land
- One Scheduled Monument, six Listed Buildings and 54 historic environment sites or records.

II. Provision of public goods

These natural capital assets provide a range of public goods which benefit society at large. Examples of the public goods derived from the Estate are:

- **Thriving wildlife** in the designated areas of Ancient and Semi-Natural Woodland and parts of the Malvern Hills SSSI, as well as in the undesignated areas of unimproved and semi-improved permanent grassland, veteran trees, hedgerows and waterbodies.
- **Natural Beauty** in the form of characteristic landscape features (e.g. woodland, parkland, orchards, hedgerows and flower-rich grassland) which contribute to the special qualities of the Malvern Hills AONB
- **Cultural heritage** at the scale of individual sites and buildings and at a landscape scale in relation to field patterns and remains of historic land use such as ridge and furrow cultivation.

- **Provision of clean and plentiful water and flood mitigation** from the filtering and slow release of rainfall through the woodland and grassland soils
- **Climate regulation** in the form of the capture and storage of atmospheric carbon in the timber and soils of the woodland and hedgerows, and the soils under permanent grassland.

III. Condition of natural capital and flows of public goods

This study has made an assessment of how well each of the natural capital assets are meeting their potential to provide public goods, using a classification of Excellent, Good, OK and Poor condition.

- Most of the **woodland** is judged to be in excellent condition, with the exceptions being the relatively small areas of newly planted woodland and conifer woodland which are regarded as being in good condition.
- All of the **lowland dry acid grassland** is judged to be in excellent condition (although it is noted that scrub encroachment on the slopes of Chase End Hill are a threat to this).
- Most of the **parkland** and other areas of **semi-improved permanent pasture** are judged to be in good condition, with the Outer Park being in excellent condition.
- The lower levels of public goods provided by **agriculturally improved permanent grassland** means that most of these areas have been judged to be in OK condition. Poaching by cattle overwintered on part of the tenanted land has resulted in some of this area being classified as in poor condition. The high level of over-grazing and inadequately managed winter feeding of cattle pose a threat to the rest of this area.
- All the **hedgerows** are judged to be in excellent or good condition, with the higher classification used for the taller and larger hedgerow.
- The large area of **arable land** on the Estate (207 ha) is judged to be in OK or poor condition because of the impact of continuous arable cultivation and crop inputs on the condition of the soil – and the low levels of associated public goods such as clean water, flood mitigation and climate regulation. The assessment of poor condition has been given to the steeper fields on which gullying and erosion were observed.

IV. Opportunities to enhance natural capital and the provision of public goods

The gradual withdrawal by Government of the Basic Payment Scheme between 2021 and 2028 and its replacement by the ELM scheme will provide a stimulus for reviews of management objectives and sources of income by many farms and estates in England. It is hoped that this study will provide a good starting point for a discussion by the Greenall family and their advisers.

It remains to be seen what incentives will be provided through the ELM scheme both to reward existing provision of public goods and also to encourage new land uses and management practices that enhance them. However, a number of opportunities emerge from this study. These could be considered by the Greenall family alongside other changes they are considering.

A. The future of arable cropping on the Estate

It is clear from this study that the Estate's arable land is contributing least to public goods, principally because of the impact that it has on soil condition compared to soils under grassland and woodland. It is understood that the economic viability of arable cropping on the poorer quality land (i.e. the Grade 3 agricultural land – see Appendix 4) is also under consideration by the Estate.

This suggests that there are significant landscape-scale opportunities for changing land use in the large parts of the Estate (mainly on the eastern side) currently under arable cropping. Options include:

- **Convert the steep fields on the eastern flanks of Chase End Hill from arable cropping to permanent and low input pasture**, potentially extending the parkland landscape north from Inner Park. This would quickly have a strong positive visual impact and, over time, would lead to significant improvements in soil quality and associated public goods. It would also safeguard the future of existing field trees in these areas.
- **On other areas of arable land, establish new areas of woodland, either as belts connecting existing habitats or as extensions to ancient woodland sites**. Over time, this would deliver the wide range of benefits provided by other woodland on the Estate and could have the added benefit of adding woodland cover into the lower lying areas of the Estate where there is currently little.
- Where it is decided that arable cropping should continue (such as on the Grade 2 land), there are opportunities to **subdivide fields with new wide hedgerows and rough grass margins** to create a stronger network of field boundaries for landscape and wildlife and other public benefits such as flood mitigation and air quality. This could include the reinstatement of historic field boundaries that were removed during the C20th, with reference to the boundaries shown on the first edition (County Series) Ordnance Survey map or the 1840s tithe map.

B. Hedgerow management

Hedgerow management practices on the Estate are already good. However, an option to extend their value to wildlife and to carbon storage would be to all them to grow out latterly into the adjacent field margins. This could be done both by letting existing shrubs to grow bigger and also allowing self sown shrubs to become established. Over time, hedges that are currently 2m wide by 2m tall could become 4m or more wide and tall. Where arable land is converted to pasture, the width of the hedges can be established by the position of the new stock fencing that will be required.

Earlier, it was noted that differences in the density and ages of hedgerow trees helps to create variation in landscape character. While there may be no immediate need to increase the numbers of hedgerow trees (although this could be considered along with other land use changes under consideration, especially given the contribution that trees make to biodiversity and carbon sequestration), it is important to plan for the future, as existing trees get older. A long-term hedgerow tree establishment programme could therefore be drawn up.

C. Grassland management

Most of the grassland on the Estate is already managed with low or no inputs of artificial fertiliser or pesticides. The slow process of the colonisation by wildflowers can be accelerated by adopting a mixture of traditional meadow management and more interventionist measures.

- Cutting hay in late June or July and grazing the aftermath with livestock allows flowers to set seed and gradually reduces soil fertility, favouring less dominant species.
- Harrowing grassland in the autumn to open up the sward, revealing patches of soil, before spreading recently made hay from local flower-rich fields is a way of encouraging the spread of species locally. Livestock should be allowed to feed on the hay, with their trampling encouraging seeds to establish.
- Soil testing for areas of low fertility can be used to select the fields where wildflowers would be most likely to thrive and spread.
- Additionally, where it is a priority to create a wildflower meadow as a visitor attraction, soil stripping can be used create the ideal conditions (providing there is nothing of value already growing in the soil that would be removed)[7] before establishing new meadow mixes from flower-rich hay, bought in seeds or plant plugs. Seed or plant plugs must be bought from reputable suppliers who can demonstrate a local provenance (ideally from meadows in nearby counties to the Estate).

The large number of parkland trees on the Estate is one of its most characteristic features. There is no evidence of damage from soil compaction by livestock but this can be a risk if large numbers of stock shelter under trees, causing root damage and reducing water infiltration and tree health. It is something that should be watched, particularly during prolonged periods of hot weather, and animals moved to new areas if necessary.

As noted above (A. The future of arable cropping), the conversion of arable to permanent pasture would create opportunities for new parkland tree planting, with all the public good benefits that would bring.

D. Woodland management

The existing forestry management is producing an annual supply of 90 tonnes of woodfuel that is sufficient to supply the Estate's biomass plant and continue on a sustainable basis. In addition, it is likely that some of the woodland blocks (particularly High Wood and Toney's Coppice) have oak trees suitable for structural timber and other high value uses.

These productive uses can continue while at the same time enhancing the public goods produced by the woodland. Management using continuous cover forestry practices will ensure the woodlands are as resilient as possible to the impacts of climate change, maintain habitat diversity and help to protect soils. Encouraging structural diversity within the woodlands, particularly in a well-develop shrub layer, at woodland edges and along wide tracks and glades will maximise biodiversity. When the silvicultural cycle favours it, replacing the few pure stands of conifer on the Estate with mixed or pure broadleaved species, particularly on Ancient Woodland sites, will enhance natural beauty and biodiversity.

[7] See http://www.magnificentmeadows.org.uk/assets/pdfs/Soil_Nutrient_Stripping.pdf for guidance on soil nutrient stripping.

E. The Historic Environment

The long history of human activity that has taken place from the Iron Age to the present day is preserved in the landscape patterns, archaeology and buildings on the Estate. It is important that future developments take account of this historic interest and do not damage sensitive sites. It is recommended that further advice is sought from staff in the County Archaeological Units before significant changes to land use are made. Conservation Officers in the Local Planning Departments should be consulted about changes to listed buildings.

F. Public access and leisure

The Estate provides outstanding opportunities for public recreation and enjoyment of nature and heritage. There are already high numbers of people walking on the Estate's footpaths, most of them using the ridge top route from Hollybush to Chase End Hill, and the Estate services these users by providing car parking and keeping routes accessible. One permissive path has already been opened up by the Estate and there are plans for a second. It is likely that the overwhelming majority of people walking on the Estate are local people or day visitors to the Malvern Hills. Analysis by this study (Appendix 5) shows that some 415,000 people live within a half hour drive of the Estate and 4.3 million live within an hour's drive.

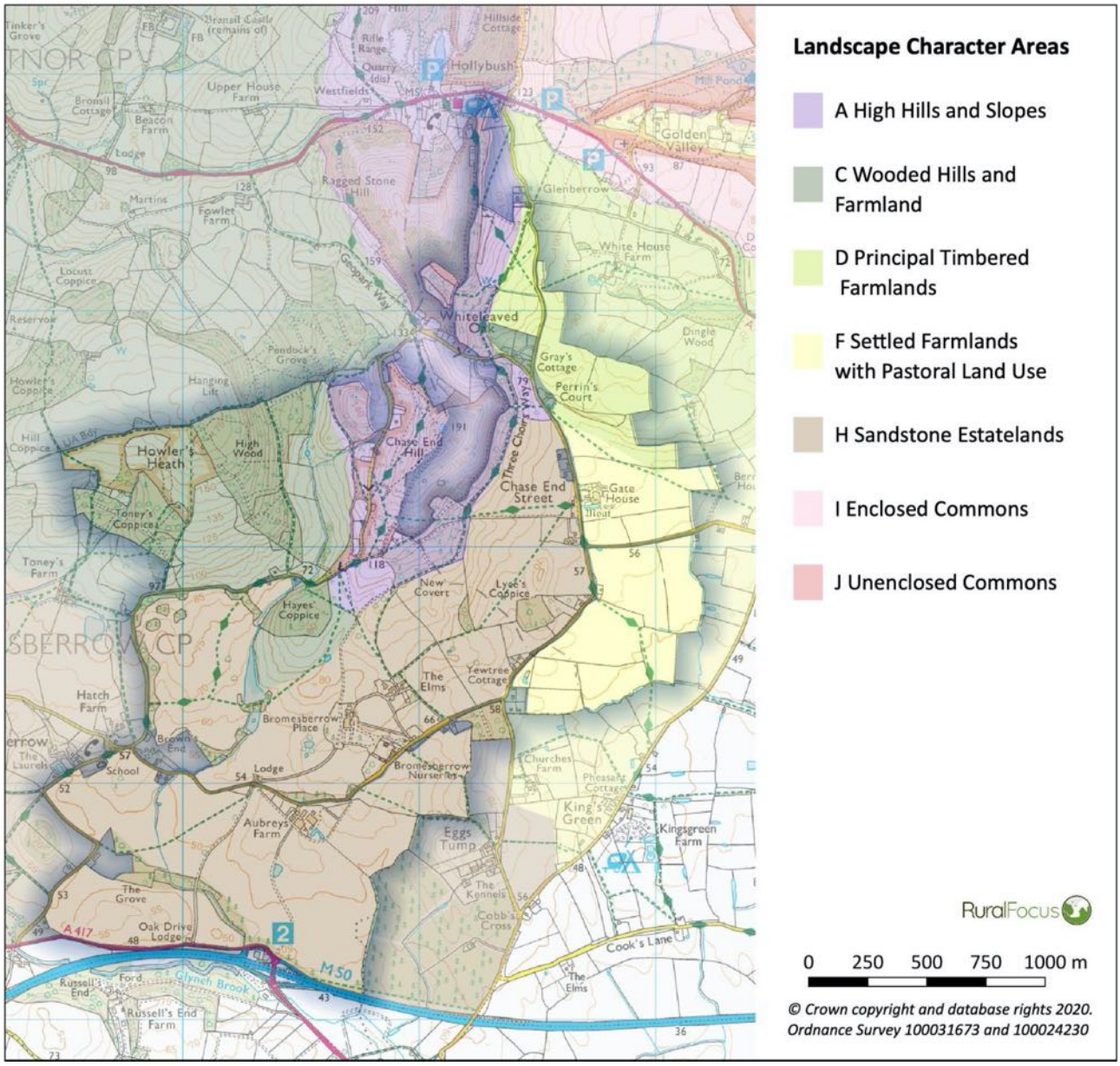
There are opportunities to broaden the recreational opportunities and services provided by the Estate, attracting staying visitors who would contribute more to the local economy and to the Estate's income. It is beyond the scope of this report to assess the investment in buildings and infrastructure needed for this. However, the Estate's natural capital could have a key role to play, providing a high quality environment that enhances people's health and wellbeing and offering opportunities for outdoor leisure activities. These activities could be structured around a series of routes and destinations on the Estate, providing different leisure opportunities such as challenging exercise, inspiring views, wildlife watching, education, conservation activities and arts/crafts.

Next steps – Summary of suggested actions

Theme	Action	Timing	Resources needed
A. Arable cropping	Soil testing to identify most productive fields and plan for conversion of low productivity fields to low-input pasture	Autumn 2020	£10-20 per soil sample or £20-30 per ha for soil scanning
	Start to map opportunities for new woodland belts on low productivity fields. Contact Forestry Commission about grants	Autumn – Winter 2020	No additional costs for examining opportunities
B. Hedges	Instruct hedge cutting contractor on new cutting regime	August 2020	No additional costs. Over time, there should be significant reductions in annual hedge cutting costs
	Use Tithe map to identify potential for reinstatement of historic field boundaries as new hedgerows	Winter 2020	No additional costs for examining opportunities
	Draw up map and schedule for phased planting of new hedgerow trees. Investigate sources of grant aid.	Summer 2020	No additional financial cost for mapping / drawing up schedule
C. Grassland management	Survey of botanical interest in Inner, Outer and Upper Park	Booked for end of June 2020	Survey cost to be met by Malvern Hills AONB
	Soil testing to identify grassland soil condition, especially compaction. Highlight areas of low fertility as potential for increasing botanical interest (e.g. from hay cutting)	Autumn 2020	As above
D. Woodland management	Discuss implications of continuous cover forestry with Estate's forestry contractor	Autumn 2020	No additional costs
E. Historic Env.	Maintain watching brief on sites of historic interest	Continuing	No additional costs
F. Public access and leisure	Investigate grant aid for completion of restoration of Hawthorns Barn	Summer 2020	No additional costs
	Develop further plans for permissive recreational routes, car parking and visitor destinations; and scope for charging	Summer – Autumn 2020	No additional costs

Appendix 1. Landscape Character

The Estate lies principally within four of the landscape character areas described in the Malvern Hills AONB Landscape Strategy And Guidelines (2011). These areas are shown in the Figure below. This Appendix contains relevant extracts from this document.



Sandstone Estatelands

Character

The Sandstone Estatelands is an open rolling landscape characterised by red, sandy soils which developed on the underlying Permian sandstone, and a regular pattern of large arable fields with localised blocks of woodland. Isolated hummocks are remnants of glacial boulder clay and fluvioglacial sand and gravel. On these hillocks, there are patches of relic heathy vegetation. Elsewhere the presence of gorse and bracken in verges reflects the sandy nature of the underlying soils. Overall, this is a planned landscape with a strong estate character, reflected in the isolated brick farmsteads and clusters of wayside dwellings with accompanying country houses. Parkland and its associated ornamental planting, together with stone built estate dwellings, contribute to the diversity of this landscape. The irregular pattern of narrow, rural lanes is a key feature and,

together with the strong field layout, plays a dominant structural role in this landscape. Field boundaries are often defined by thorn/ elm hedges, with taller, mixed species hedges along rural lanes. Mature hedgerow oak trees are only sparsely scattered and rather than blocking views, or creating a sense of enclosure, the tree cover generally frames wide, open views.

Key Characteristics

- Planned landscape of large arable fields
- Sandy soils with patches of relic heathy vegetation
- Discrete estate plantations and groups of trees
- Hedgerow field boundaries with scattered mature trees
- Dispersed pattern of brick and stone farmsteads and clusters of wayside dwellings
- Parklands with associated ornamental planting

Future landscape opportunities

In places, opportunities still exist to restore, or create new field boundaries, to provide valuable wildlife habitats and to help sustain the visual unity of the landscape. Elsewhere the focus should be on maintaining management of field boundaries to the benefit of landscape and wildlife.

Opportunities should be sought to re-create patches of heathland vegetation, particularly on sandy knolls/ hillocks outside of established parkland areas. Opportunities may also exist to encourage multi-age planting and a greater variety of native species in any woodlands which are of plantation origin. This would increase their ecological value. Much replacement planting for old and veteran specimen trees has been undertaken in the last 20 years and this should continue as appropriate.

Historic buildings should be managed to ensure that any redevelopment complements the existing settlement character of the Sandstone Estatelands and enhances the social and economic opportunities of the landscape.

Overall landscape strategy

The Sandstone Estatelands have a moderately strong cultural character with a variable condition. In many places the landscape has benefitted significantly from recent management practices. In some other areas past changes, such as a decline in hedgerow pattern, remain evident. There is potential to continue to enhance the landscape through positive management, especially in those areas which have not been a focus for recent activity. The overall strategy for the Sandstone Estatelands, therefore, should be: **Strengthen and maintain the overall structure of the landscape by conserving and enhancing the network of lanes, field boundaries and other primary features, such as the hedgerow trees and ornamental planting associated with parkland.**

Wooded Hills and Farmland

Character

A wooded landscape with a varied undulating, in places steeply sloping, topography, associated with an outcrop of ancient, mixed sedimentary rocks, comprising limestones and sandstones separated by softer mudstones and siltstones. This is a landscape of discrete, irregularly shaped ancient woods framing larger areas of enclosed farmland. The hedgerow structure and streamside tree cover is particularly important in providing visual unity to the area, linking the woodland blocks and integrating them with the areas of farmland. These features help to create an important ecological resource with moderate to strong interconnection of habitats and good ecological networks. Sparse settlement is usually associated with these areas, often in the form of small estate villages with older properties constructed from limestone, or clusters of settlement

around former commons. Large, isolated historic farmsteads, most of which have a regular courtyard plan, are scattered throughout the area.

Key Characteristics

- Prominent undulating topography
- Ancient mixed hard rock geology, including areas of harder limestone and sandstone
- Large, discrete woodland blocks of ancient woodland
- Network of primary hedge lines often derived from woodland assarting
- Medium distance framed views
- Mixed farming land use
- Sparsely settled pattern of farmsteads and small estate villages

Future landscape opportunities

There are opportunities to increase individual tree and woodland cover in this landscape, both as a sustainable energy source and to help to reduce atmospheric carbon. Similarly, where woodland occurs along water courses, it can help to regulate water flow, reducing run off and alleviating flood risk. Managing some plantation woodlands for local woodfuel schemes may provide a purpose and economic benefit for woodland management, whilst helping to reduce reliance on traditional carbon based energy. This may create a force for change in terms of the amount of woodland and types of woodlands within this landscape. Opportunities should be sought to enhance the ecological value of agricultural land and to reinforce local distinctiveness and strength of character, for example, through the continued management of historic parkland.

Overall landscape strategy

This is a landscape where both the agricultural land and the woodlands are managed at a fairly high level of intensity. The overall structure and ecological diversity of parts of the landscape are in relatively poor condition. However, this landscape also contains habitats, species and landscape features which are of great importance. The overall strategy for the Wooded Hills and Farmland, therefore, should be to: **Conserve the overall unity of this estate landscape and seek opportunities to enhance the ancient wooded character**.

High Hills and Slopes

Character

The High Hills and Slopes landscape is a steeply sloping, unenclosed landscape associated with a high ridge of ancient igneous and metamorphic rocks. These hard rocks have been pushed up by earth movements along a line of weakness in the Earth's crust, which has produced the spectacular scenery we see today.

This landscape is characterised by prominent summits, shallow mineral soils and extensive tracts of rough grassland/ heath graduating into a more heavily wooded land cover on the lower slopes. The exposed character, with its distant panoramic views, is heightened by the dramatic form of the topography creating a wild, invigorating quality. The steeply sloping topography means that roads and settlements are sparse. Path and trackways, mainly Victorian in creation, cross the slopes and reflect the cultural heritage of the area as a spa resort. The summit of the ridge, however, is marked by a series of prominent historic earthworks, including Iron Age Forts.

The High Hills and Slopes is a simple, yet visually distinctive landscape, not least for the contrast that it provides with the surrounding settled and gentler, enclosed agricultural landscapes.

Key Characteristics

- Dominant, steeply sloping 'highland' topography

- Exposed character, with panoramic views over surrounding lower lying land
- Ancient Precambrian hard rock geology with numerous accessible rock outcrops
- Water spouts and springs at the boundary between granite and impervious, sedimentary and volcanic rocks
- Shallow mineral soils supporting acid grassland and heath
- Unenclosed rough grazing land with few signs of human habitation
- Heavily wooded lower slopes

Future landscape opportunities

Encroachment of scrub and secondary woodland is affecting the open character of this landscape. Managing scrub growth on the lower slopes will help to provide visual continuity with the Principal Wooded Hills landscape, grading to a more open grassland character on the higher slopes and summits. To maintain the panoramic views and open character of the ridge, the management of bracken and scrub could be more rigorous on the higher slopes and summits. Opportunities to encourage higher stocking rates on the summits to manage the landscape in a traditional manner, rather than using manual cutting methods, should be sought.

Increasing visitor numbers has contributed to the erosion of grassland. There is an opportunity to develop an access strategy related to signage and other forms of media. This will help to manage and direct visitors to appropriate paths and tracks, limiting the damage to the grassland. This should be coupled with appropriate footpath management and maintenance.

Overall landscape strategy

The High Hills and Slopes have a strong character which is very much associated with the expanse of open land along the higher parts of the ridge. The decline of open land has become an issue and the priority for management should be to manage the bracken and scrub to conserve and expand the open character of the landscape. There is scope to retain some woodland cover on the lower slopes to maintain the visual continuity with other Landscape Character Types, such as the Principal Wooded Hills. The overall strategy for the High Hills and Slopes, therefore, should be to: **Conserve and restore a balance between the open character of the high ridge and the more wooded nature of the lower slopes**.

Settled Farmlands with Pastoral Land Use

Character

The Settled Farmlands with Pastoral Land Use is a small to medium scale settled agricultural landscape characterised by scattered farms, relic commons and clusters of wayside dwellings. The clustered settlement is linked by a network of narrow winding lanes, nestling within a matrix of small hedged fields where the heavy/ poorly drained soils support a predominantly pastoral land use. Tree cover is largely restricted to scattered hedgerow trees, groups of trees around dwellings and lines of trees along stream sides. This is a landscape with a notably domestic character, defined chiefly by the scale of its field pattern, the nature and density of its settlement and its traditional land uses, which include grazed pastures, orchards and some arable fields. A large number of the historic farmsteads in this landscape, dating mainly from the 19th century, are clustered around the common edge. Older farmsteads, dating from the 14th to 18th century, are more often located in hamlets, villages, or scattered throughout the landscape.

Key Characteristics

- Small-scale landscape defined by a prominent pattern of hedged fields
- Pastoral land use on heavy clay soils
- Clustered settlement pattern of farmsteads and wayside dwellings

- Filtered views through scattered trees within hedgerows and along watercourses
- Rolling lowland with occasional steep sided hills and valleys

Future landscape opportunities

Agricultural landscapes may change as a result of many factors, particularly the economy. Changing markets and the introduction of new crop types, such as energy crops, could impact upon the character of this landscape, creating new textures and altering the visual character. However, such crops may provide opportunities to enhance the economic strength of the sector. These two factors may require balancing.

Tree planting or natural regeneration along watercourses can enhance the habitat value of this landscape. This may also enhance sustainable flood risk management, by helping to regulate flow and reduce run off, thus alleviating flood risk.

Renewable energy and changing energy infrastructure may be required for settlement within this landscape. New structures or features to support energy generation should be retained within existing parcels of development, close to existing buildings in order to respect and maintain the existing rural character of the landscape.

Overall landscape strategy

This is a landscape that is relatively intact and generally in good condition, although in places there is evidence of change and degradation of the cultural pattern. The overall strategy for the Settled Farmlands with Pastoral Land Use, therefore, should be: **Conserve the diversity and function of this small scale, settled agricultural landscape and seek opportunities to restore/ enhance the character of degraded areas.**

Appendix 2

BROMESBERROW ESTATE BIOLOGICAL MONITORING by Ros Willder of Willder Ecology 22/04/2020

1.1 INTRODUCTION

The purpose of the biological monitoring of the flora and fauna on Bromesberrow Estate was carried out in order to assess the effects a variety of proposed conservation works will have on the range and diversity of the flora and fauna. The first year of the biological monitoring began over twenty years ago in the year 2000 and it still carries on to this day. All the monitoring has been carried out by Ros Willder with help from Mary Palfrey, Gordon Avery, Stuart Davies, Tim & Brian Willder & Juliet Bailey.

2. METHODOLOGY

In order to try to assess the diversity and range of flora and fauna on the estate, three types of surveys were initial carried out: -

1. Botanical survey (annually)
2. Ornithological survey (annually)
3. Invertebrate sampling (bi-annually from 2000 to 2006)
4. Mammal survey (2001 & 2005)

The Botanical and Ornithological surveys being repeat surveys carried out annually from 2000 to 2009, and the invertebrate surveys being normally carried out every two years from 2000 to 2006. In addition to these surveys two mammal surveys were carried out between 2000 to 2009 in 2001 & 2005.

For the second tranche of Biological Monitoring surveys these were carried out from 2011 to this year (2020) and two types of surveys were carried out:-

5. Botanical survey (tri-annually)
6. Ornithological survey (annually)

Ornithological surveys

In order to assess the diversity of bird life on the farm, a Breeding Bird (BB) Survey was carried out in April & May of each year between 6.30 & 9.30am. These dates were chosen as the best time to get a good representation of the birds using the estate for breeding.

The first BB survey was carried out across Aubrey's Farm following a specific route, from Point 1A to Point 8A. All birds seen and heard were then recorded from in-between each point. The second BB survey was carried out across Hawthorns Farm following a specific route from Point 1H to Point 5H.

All the birds which were seen and heard were recorded at each point, in order to highlight the exact location of each species.

Botanical transect surveys

In order to assess the existing vegetation, botanical surveys were carried out at six different sites across Bromesberrow estate. The transect approach was used at all of the sites. A transect is a line along which samples of vegetation are taken. All transects were 10m long & 1m wide. All the vegetation was recorded using the **D-A-F-O-R** scale. This stands for **D**ominant, **A**bundant, **F**requent, **Occasional,** and **R**are.
The results can then be translated into percentages at a later date for further data analysis.

An example of one transect is shown below in figure one to show how a new block of planted woodland and its adjacent new field margin were developing.

Figure one – Botanical transect

Invertebrate sampling

A total of twenty-five pitfall traps were set at five different locations across the estate. Each individual pitfall trap was set by placing a glass jar in the ground with the neck of the jar exactly level with the earth. Each jar was filled with between 1-2 fluid oz of preserving fluid and three hazel sticks or stones placed an inch away from the neck of the jar and a ceramic tile placed on top. All traps were marked with a florescent orange-topped cane. All traps were set in May and checked every week and collected every alternate week until the beginning of September. The invertebrate sampling was carried out in 2000, 2002, 2004 & 2006.

Mammal surveys

Three separate sites were chosen across the estate the first being an area of set-a-side, the second site was on the edge of an arable field and the third site was at the edge of a young mixed woodland. A total of 16 Longworth mammal traps were placed with a distance of 10- 15m (between the two sets of 8 traps) in each area. The traps were monitored daily for a period seven days recording capture and resetting the traps with bait in 2001 & 2005.

3. Results of the Biological Monitoring at Bromesberrow Estate

3.1 Botanical Transects

If the diversity of the transects is looked at over the last nineteen years in all transects a common trend can be seen of an initial reduction of species from years 2001 to 2003 and 2004 then an increase in species developing from years 2006 and 2007 and then a slight reduction in 2008 and 2009 (as shown in figure two below) in the majority of transects followed by a stabilization of numbers between 2010 to 2017.

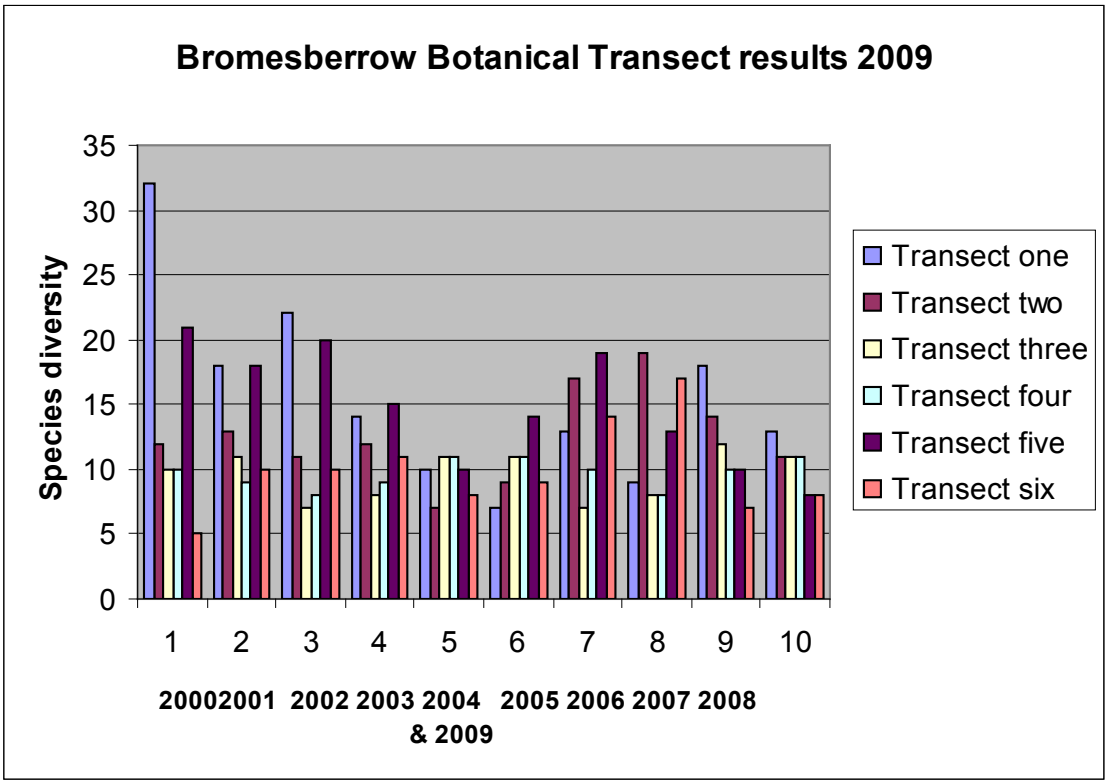


Figure 2: Botanical transect Graph of results 2000- 2009

The transects which were located where field margins have been developed i.e. one, two, fifth and sixth it is to be expected that there will be a loss of a wider range of the species indicative of disturbed ground until the field margin establishes itself.

This is shown to be true as over the first four to five years the species diversity has generally decreased but is now as the field margins establish there is an initial improvement and then stabilization as the weed species are reduced and the grasses begin to dominant. This trait has continued over the years between 2011 & 2017 and the management of the field margins was shown to be key to the diversity results.

3.2 Ornithological Results

The results showed that the highest diversity of breeding birds between 2000 and 2019 were recorded around Aubrey's Farm and Hawthorns Farm in 2009 as a total of 50 were recorded this included 13 birds of medium concern and five species of high conservation concern as shown in figure three below.

However, whilst the breeding bird diversity of species has fluctuated between 2000 to 2019 what is particularly important to note is that one of the highest number of birds of High Conservation concern was the most recent survey carried out last year in 2019 when eight different species of birds of high conservation concern were recorded in the breeding bird survey as shown in figure four over the page.

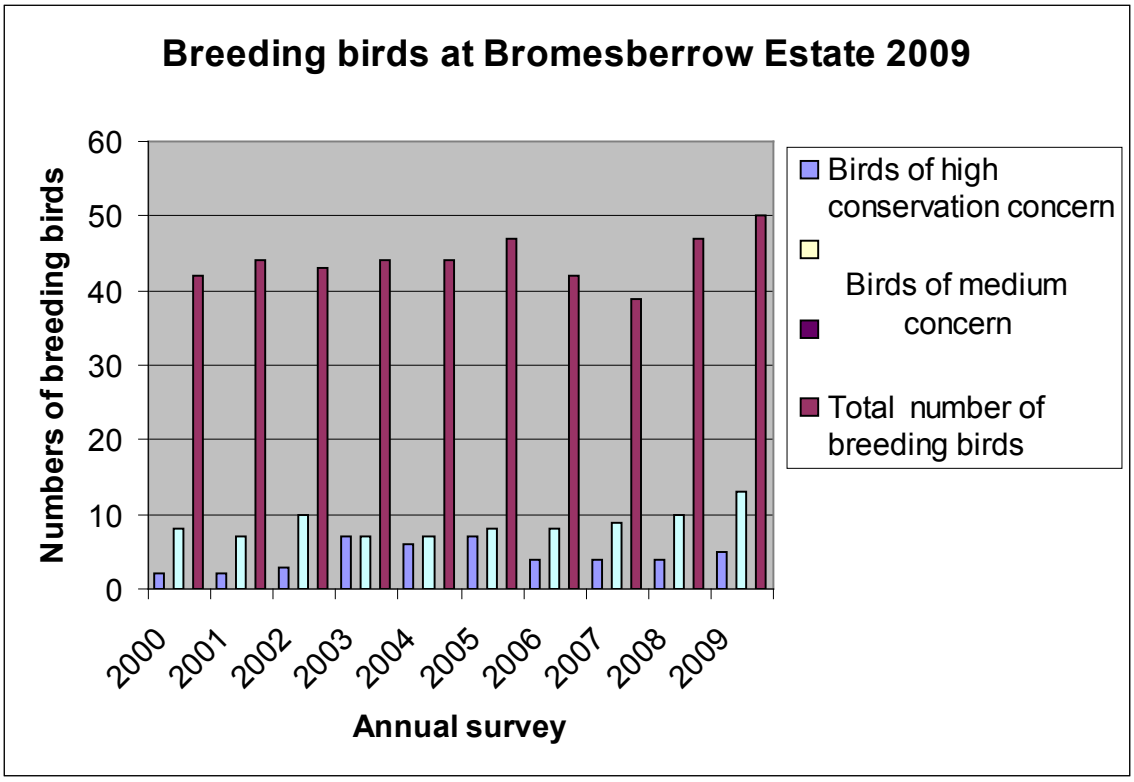


Figure 3: A graph to show breeding birds between 2000-2009

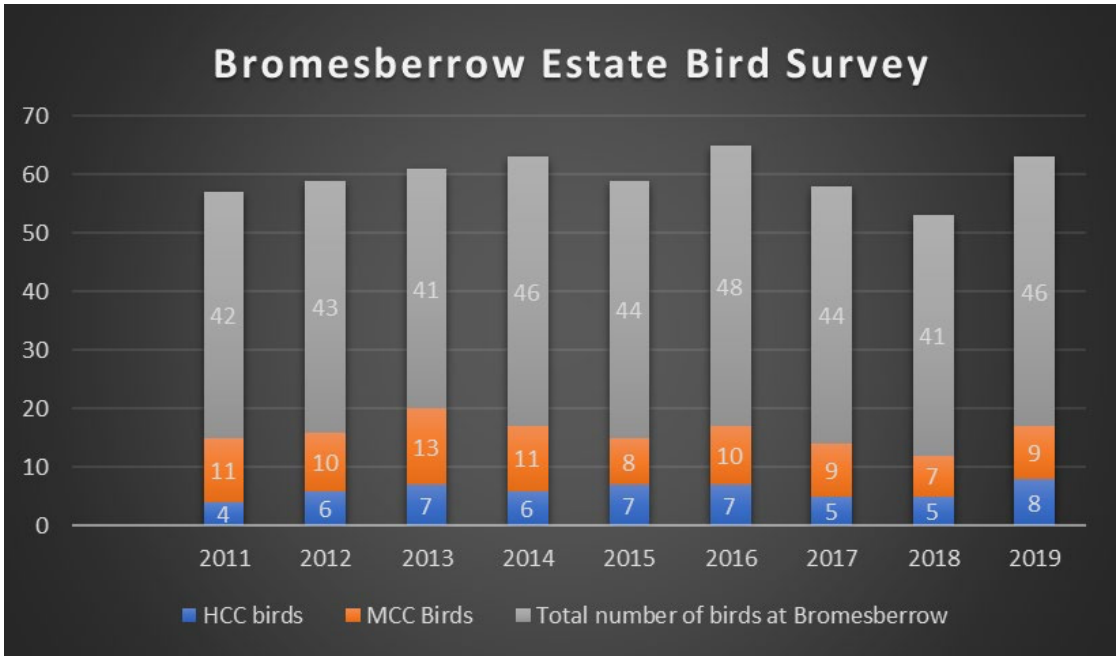


Figure 4: A graph to show breeding birds recorded between 2011 to 2019

3.4 Mammal trapping results

Over the five nights of trapping, a total of 35 captures were made, 26 different individuals were identified. Across all areas studied, the species found in the greatest numbers was Yellow-Necked Mouse, 65% of individuals trapped. A total of 19% of individuals were Wood Mice and 12% of individuals were Bank Voles and the smallest numbers were Shrews, 4% of individuals as shown in figure five.

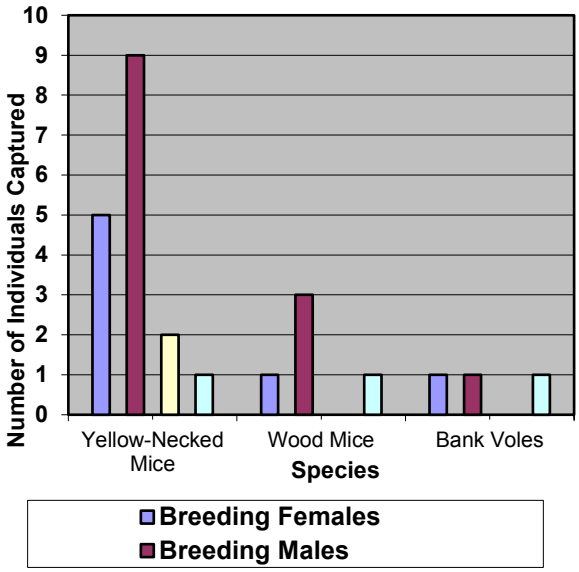


Figure 5: Mammal trapping results

4. Conclusions of the Biological Monitoring at Bromesberrow Estate

In conclusion the **Botanical transect** surveys show that if the field margins are to maintain the optimum structural and species diversity, they must receive the appropriate management to encourage this. It can be seen that the management of the field margins is effective and there are far less dominance of weeds in any of the margin transects recorded in the last year of the botanical surveys in 2017.

It also shows where the hedge and newly planted trees have developed and the grasses are dominating, the species diversity is remaining much more stable and the weeds suppressed to the point of exclusion.

In conclusion the species diversity has reduced as the areas have established themselves over the last nineteen years but often the losses are weed species as the field margins become better managed and grasses and wildflowers become better established and the microhabitat becomes stabilized.

The management of these marginal areas is key to their benefit for conservation and it would be worth considering some cutting trials to encourage greater diversity of species to develop.

In conclusion the results of the **breeding bird surveys** showed that a total of 46 different birds species were recorded at Bromesberrow Estate in 2019 this is not the highest and the numbers have fluctuated from 39 to 50 over the last nineteen years. However, it is important to note that the number of bird species of **High Conservation Concern** (HCC) recorded has increased and included Cuckoo, House Sparrow, Mistle thrush, Linnets, Skylark, Song thrush, Starling and Yellow hammers. Which is the highest numbers of birds of HCC ever recorded since the monitoring began in 2000.

The bird species of **Medium Conservation Concern** has also fluctuated with numbers being their highest in 2009 & 2013 at over 13 different bird species of MCC.

The total number of breeding birds recorded on the estate has increased from 42 in 2000 to 46 in 2019. It is also important to note that the estate remains an increasingly important area for farmland birds and birds of both medium conservation concern currently total nine and more importantly birds of high conservation concern most at risk currently total nine.

In conclusion the **mammal surveys** indicated that the farm woodlands support large numbers of small mammals, arable land was found to support the lowest numbers of small mammals with only the field margins on the arable land supporting more small mammals indicating that field margins on arable land

and set-a-side help to improve the value of the habitat and so are beneficial to the farmland biodiversity.

As far as the **invertebrate sampling** it can therefore be concluded that the invertebrate species are increasing as the habitats develop across the farm as the field margins establish and become more densely vegetated they provide good cover and habitat as well as buffering existing habitats from farming operations. In future years the field margins will need careful management in order to maintain their floral diversity and encourage greater insect diversity.

CONCLUSION SUMMARY AND RECOMMENDATIONS

- The botanical transects located by the field margins are generally showing a decrease in species as the field margins have now established and there is a reduction in weed species.

- This shows that after nineteen years the margins are finally established and the importance of the management of these key farmland habitats for invertebrates, small mammals, plants & birds should not be underestimated.

- The breeding bird survey showed the diversity of breeding birds can fluctuate over nineteen years from as low as 39 to as high as 50 different species.

- It is equally important to note that the birds of medium conservation concern can also fluctuate from as low as four to as high as thirteen different species.

- The bird of high conservation concern can also fluctuate but the survey shows a steady increase from three in 2000 to nine different species in 2019 which shows that the habitats are improving for these important at-risk bird species on Bromesberrow Estate.

- It would be worth examining the cropping plan for the last nineteen years to see if this may have caused any of the reduction in bird diversity numbers and to see what crops have caused the increase of numbers over the different years.

- Habitat biodiversity across the estate is key to encouraging wildlife but the management of all those habitats is also equally important.

Appendix 3: Historic Environment

This Appendix provides details of the archaeological and other historic environment records that have been identified on the Estate. These include Scheduled Monuments, Listed Buildings and records from the Historic Environment Record (HER) held by Gloucestershire and Worcestershire County Councils.

Each of the records can be cross-referenced with ID codes shown on Map 2 in the main report (Historic Environment Sites).

Scheduled Monuments

There is one Scheduled Monument on the Estate: The moated site at Aubrey's Farm. The scheduling description from Historic England is as follows: "*The monument includes a moated site set on low lying ground to the south of the Malvern Hills. The moated site includes a trapeziodal four-armed moat enclosing an island aligned north west to south east, measuring 24m by 24m narrowing to 14m on the south east. The moat would have originally been 28m wide at its northwestern point, although this has been reduced generally to 16m, and 7m at its narrowest through the dumping of rubble into the moat during the 1980s and 1990s. It is water-filled and over 3m in depth. The moat was originally fed by a stream which runs into its south western corner, but has since been dammed. Although not visible at ground level, the buried remains of buildings will survive on the island. Although the present farmhouse is comparatively modern, Aubrey's Place is first mentioned in a document of 1424, and the moat itself is recorded in a conveyance of about 1600 when a plot of land is described as `being encompassed with a mote or pool of water'. It is likely, however, that a moat was first constructed on the site between 1250 and 1350. The Dutch barn and its concrete flooring where they impinge on the moat's protective margin are excluded from the scheduling, although the ground beneath is included.*"

Just to the north of the Estate, lies the Midsummer Hill Camp. This monument includes the remains of a large multivallate hillfort, defensive Appendix, dyke and pillow mound situated in a commanding position on Midsummer and Hollybush Hills, west of the River Severn.

Listed Buildings

At least six buildings on the Estate are listed (the precise extent of ownership is not known to the author), as follows:

ID code	Name	Grade
1341928	BROMSBERROW PLACE	II*
1098851	HAWTHORNS	II
1154524	STABLES AND KITCHEN END OF HOUSE, BROMSBERROW PLACE	II
1078594	LODGE, CIRCA 430 METRES SOUTH WEST OF BROMSBERROW PLACE	II
1098850	GATE HOUSE FARMHOUSE	II
1341975	GATE COTTAGE	II

A further seven buildings in close proximity to the Estate are listed as follows:

ID code	Name	Grade
1078558	BARN AND SHELTER SHED AT BROWN'S END	II
1078560	YEWTREE COTTAGE	II
1098855	OUTBUILDING APPROXIMATELY 20 METRES SOUTH-WEST OF PERRIN'S COURT	II
1154753	BROWN'S END	II
1154764	BAKEHOUSE, BROWN'S END	II
1156330	PERRIN'S COURT AND OUTBUILDING ADJOINING TO SOUTH-EAST IN SAME RANGE	II
1349213	GRAY'S COTTAGE	II

Sites on the Estate from the Worcestershire Historic Environment Record

ID code	Type	Name	Period
22142	Place name	Field-Name; Black Dole, Berrow	Roman 1st Century AD to Pre Conquest
29178	Building	Traditional Farm Buildings, The Whitehouse Farm, Berrow	Post Medieval to 21st Century
32128	Building	Hawthorne Cottage, Chase End Street, Berrow	16th to 21st Century
41380	Building	White House Farm (White House), Berrow	19th to 21st Century
41381	Building	Perrin's Court, Berrow	17th to 21st Century
41382	Building	Gate House, Berrow	17th to 21st Century
42811	Building	Hawthorns, Berrow	19th to 21st Century
32130	Building	Timber Framed Threashing Barn, Gate House, Chase End Street, Berrow	15th to 21st Century
32131	Building	Ladder Store, Gate House, Chase End Street, Berrow	19th to 21st Century
46062	Landscape	Gate House, Berrow	17th to 21st Century
47491	Landscape	Hawthorns, Berrow	19th to 21st Century
47642	Landscape	Border Cottage, Berrow	17th to 21st Century
47643	Landscape	Graffridge Farm, Berrow	19th to 21st Century
47680	Landscape	Manor House and Manor Cottage, Berrow	18th to 21st Century
47681	Landscape	Vault House, Castlemorton	19th to 21st Century
47682	Landscape	Berrow House, Berrow	19th to 21st Century
14748	Building	Timber framed cottage and outbuildings, Berrow.	Post Medieval
16749	Building	The Manor House, Hollybush, Berrow	18th to 21st Century
16750	Building	Manor Cottage, Hollybush, Berrow	18th to 21st Century
16751	Building	Gray's Cottage, Chase End Street, Berrow	17th to 21st Century
16752	Building	Perrin's Court & Attached Outbuilding, Berrow	17th to 21st Century
16753	Building	Outbuilding 20m South-West of Perrin's Court, Berrow	17th to 21st Century
16754	Building	Gate House Farmhouse, Berrow	17th to 21st Century
16755	Building	Hawthorns, Berrow	19th to 21st Century
32129	Building	Privy, Gate House, Chase End Street, Berrow	19th to 21st Century
40635	Building	Outfarm south west of Gate House, Berrow	19th to 21st Century
45344	Landscape	Dripping Tank Barn, Castlemorton	19th to 21st Century
46060	Landscape	White House Farm (White House), Berrow	19th to 21st Century
42962	Building	Border Cottage, Berrow	17th to 21st Century
42963	Building	Graffridge Farm, Berrow	19th to 21st Century
43000	Building	Manor House and Manor Cottage, Berrow	18th to 21st Century
43002	Building	Berrow House, Berrow	19th to 21st Century
45315	Landscape	Outfarm south west of Gate House, Berrow	19th to 21st Century
46061	Landscape	Perrin's Court, Berrow	17th to 21st Century
58086	Monument	Ridge and Furrow, Lyce's Coppice, Berrow	Late 11th to 21st Century
58087	Monument	Quarries, Chase End Hill, Berrow	Unknown
58088	Monument	Field System, Hawthorns, Berrow	Late 11th to 20th Century
58089	Monument	Ditches, Chase End Hill, Berrow	Unknown
58123	Monument	Red Earl's Dyke/Shire Ditch, Ragged Stone Hill, Berrow	12th to 13th Century
58435	Monument	Ridge and Furrow, Camer's Green, Berrow	Late 11th to 19th Century
58440	Monument	Ditch and Bank, South of Bridge Cottage, Berrow	Late 11th to 19th Century
58442	Monument	Ridge and Furrow, White House Farm, Berrow	Late 11th to 19th Century
58523	Landscape	Defence of Britain defended locality, Hollybush, Malvern Hills	World War Two
58582	Monument	Ridge and Furrow, Chase End Street, Berrow	Late 11th to 19th Century

Sites on the Estate from the Gloucestershire Historic Environment Record

ID code	Type	Name
22128	General	Charcoal hearth, Hayes' Coppice, Bromsberrow.
22136	General	Ruined house/building, New Covert, Bromsberrow.
22138	General	Disused quarry, north of New Covert, Bromsberrow.
22132	General	Ruined building, High Wood, Bromsberrow.
22135	General	Possible lynchet, New Covert, Bromsberrow.

ID code	Type	Name
27152	General	Two possible quarries of unknown date visible as earthworks on the scarp edge of Chase End Hill, Bromsberrow.
22121	General	Water management feature, Toney's Coppice, Bromsberrow.
20647	General	Site of substantial rectangular water feature - possibly a moat at The Laurels/ The Rectory, Bromsberrow.
22123	General	Possible trackway, Toney's Coppice, Bromsberrow.
22126	General	Ditched platform, Toney's Coppice, Bromsberrow.
22122	General	Charcoal burning hearth, Toney's Coppice, Bromsberrow.
22124	General	Ruined building, Toney's Coppice, Bromsberrow.
22130	General	Woodbank, Toney's Coppice, Bromsberrow.
22129	General	Possible trackway, Hayes' Coppice, Bromsberrow.
27152	General	Two possible quarries of unknown date visible as earthworks on the scarp edge of Chase End Hill, Bromsberrow.
22127	General	Holloway, Toney's Coppice, Bromsberrow.
22134	General	Holloway, Toney's Coppice, Bromsberrow.
27157	General	A double ditched subcircular enclosure and pits visible as cropmarks on aerial photographs, Redmarley D'Abitot.
22133	General	Quarry on Howler's Heath, near Toney's Coppice, Bromsberrow.
22137	General	Disused quarry, north of New Covert, Bromsberrow.
22131	General	Woodbank, High Wood, Bromsberrow.
42800	General	Series of shrunken village earthworks recorded through aerial photography of the Bromesberrow area, Bromesberrow.
48842	Turnpike	Route of the 1721 Ledbury Turnpike in Gloucestershire.
50572	Ridge and Furrow	Medieval and/or Post Medieval ridge and furrow and possibly associated boundaries are visible as earthworks, surrounding Bromsberrow Place, Bromsberrow.
48907	General	General HER number for milestones recorded by the Milestone Society in the Forest of Dean.
50570	Ridge and Furrow	Medieval and/or post-medieval ridge and furrow is visible as earthworks in the north of Redmarley D'Abitot parish.
50572	Ridge and Furrow	Medieval and/or Post Medieval ridge and furrow and possibly associated boundaries are visible as earthworks, surrounding Bromsberrow Place, Bromsberrow.
50573	General	Possible 10th century burh at "Bremesbyrig" or "Brunnesburgh", said to have been founded 912 or 915 AD by Aethelflaed of Mercia.

Sites close to the Estate from the Worcestershire Historic Environment Record

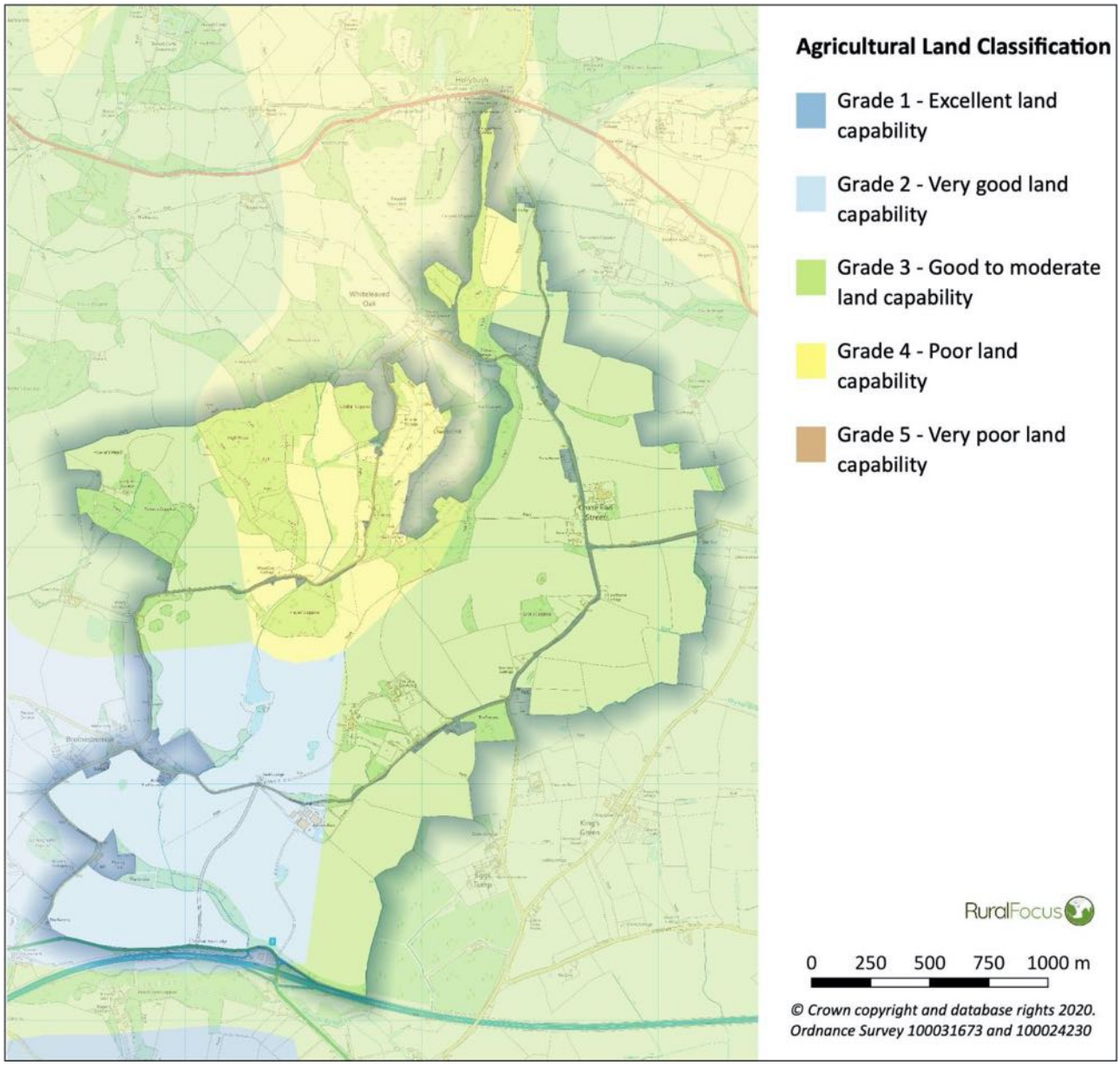
ID code	Type	Name	Period
1497	Monument	Moat, Gatehouse, Chase End Street, Berrow	Medieval
1517	Monument	The Shire Ditch, Malvern Hills	Late Bronze Age to Medieval
2245	Monument	Site of Moat Pond & island, W of White House, Berrow	Post Medieval
3890	Monument	Ridge and Furrow East of Ladywell Coppice, Berrow	Medieval
3891	Monument	Ridge and Furrow, East of Ladywell Coppice	Medieval
6273	Monument	Moat, White House Farm, Hollybush	Late 11th to 16th Century
8764	Monument	Old Quarries, east of Whiteleaved Oak, Berrow	18th to 19th Century
8765	Monument	Old Quarry, south east of the Old Post Office, Berrow	18th to 19th Century

Sites close to the Estate from the Gloucestershire Historic Environment Record

ID code	Type	Name
5355	General	Possible Moat and DMV at Bromesberrow Court, Bromsberrow, with further possible interpretation as the remains of an undated formal garden.
6552	General	Circular enclosure: Possible Moat
4224	General	Enclosure? adjacent M50
6553	General	Site of Moat?
5359	General	Conigree Hill probably 18C mound
6551	General	Possible Mill Site
5365	General	The medieval moated site at Aubrey's Farm is a scheduled monument, Bromsberrow.
6548	General	Probable DMV at Brownsend Farm

Appendix 4: Agricultural Land Classification

The Figure below shows the classification of land into different grades according to its capability for agricultural production. The Classification, prepared in the 1970s and 1980s by the Ministry of Agriculture, Fisheries and Food (now Defra) is concerned with the inherent potential of land under a range of farming systems. Factors affecting the grade are climate, site and soil characteristics, and the important interactions between them. The current agricultural use, or intensity of use, does not affect the ALC grade.

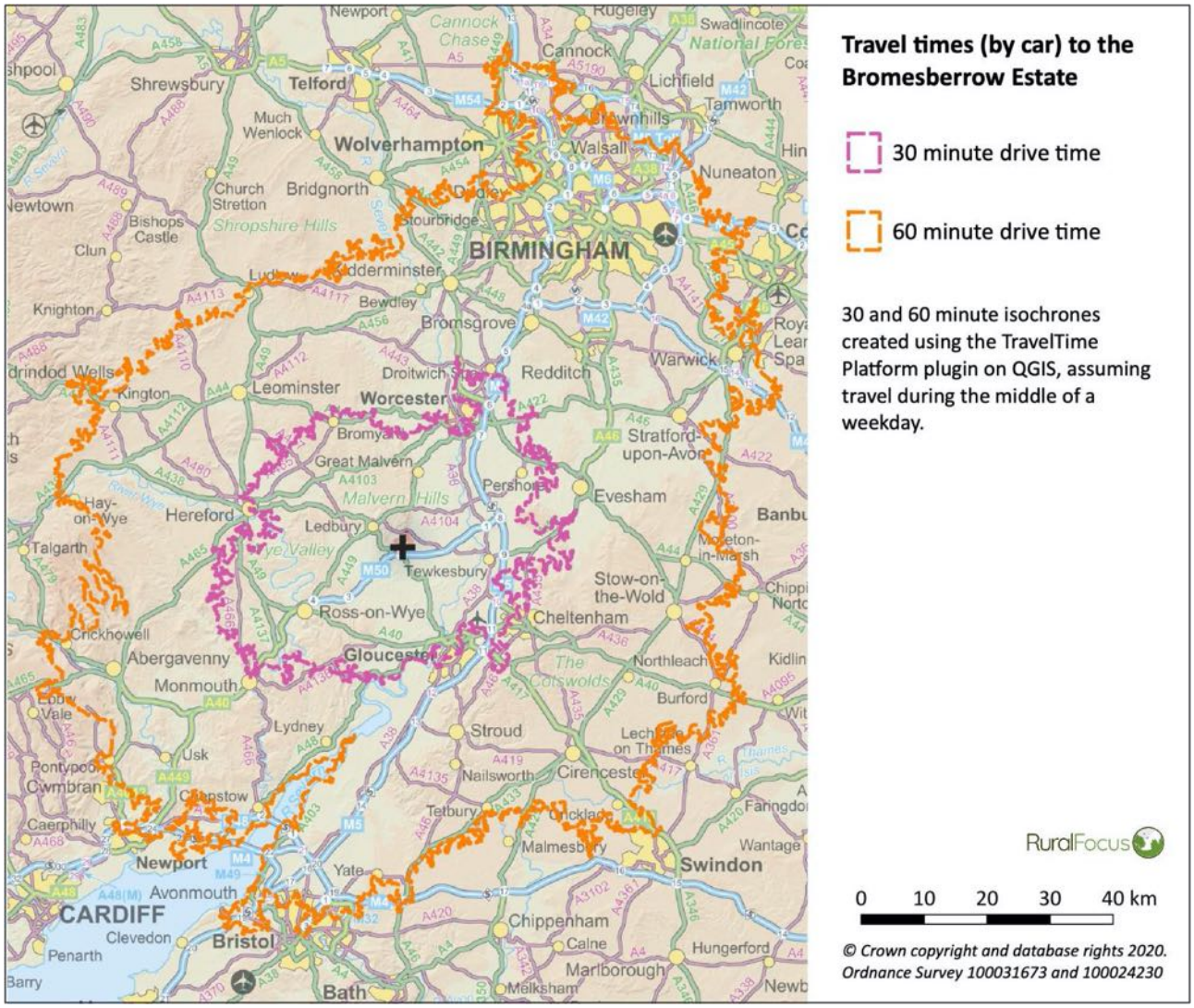


The Figure shows that the majority of the Estate is classified at Grade 3 (good to moderate land capability). The higher ground and steeper slopes between High Wood and Chase End Hill, which overlays the igneous and metamorphic rocks that form the spine of the Malvern Hills is Grade 4 (poor land capability), while the flatter and lower south western part of the Estate closest to Bromsberrow Village, on the fertile and easily worked sandstone soils, is Grade 2 (very good land capability). An area of Grade 1 land (excellent land capability) lies south of the Estate.

Appendix 5: Populations accessible to Bromesberrow

Spatial analysis by this study of the population living within easy driving distances of the Estate reveals the following:

- A 30 minute drive by car encompasses people living in towns such as Great Malvern, Ledbury, Ross-on-Wye and Pershore, extending to the edge of Worcester, Gloucester, Cheltenham and Hereford. In total, 414,627 people, in 175,471 households[8] live in this area.
- A 60 minute drive by car extends the larger urban areas including Birmingham, Warwick, Stratford-upon-Avon, Cirencester, the edge of Bristol and Leominster. In total, 4.3 million people, in 1.7 million households live in this area.



[8] Population and household data based on the 2011 Population Census using ONS Census Output Areas.

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