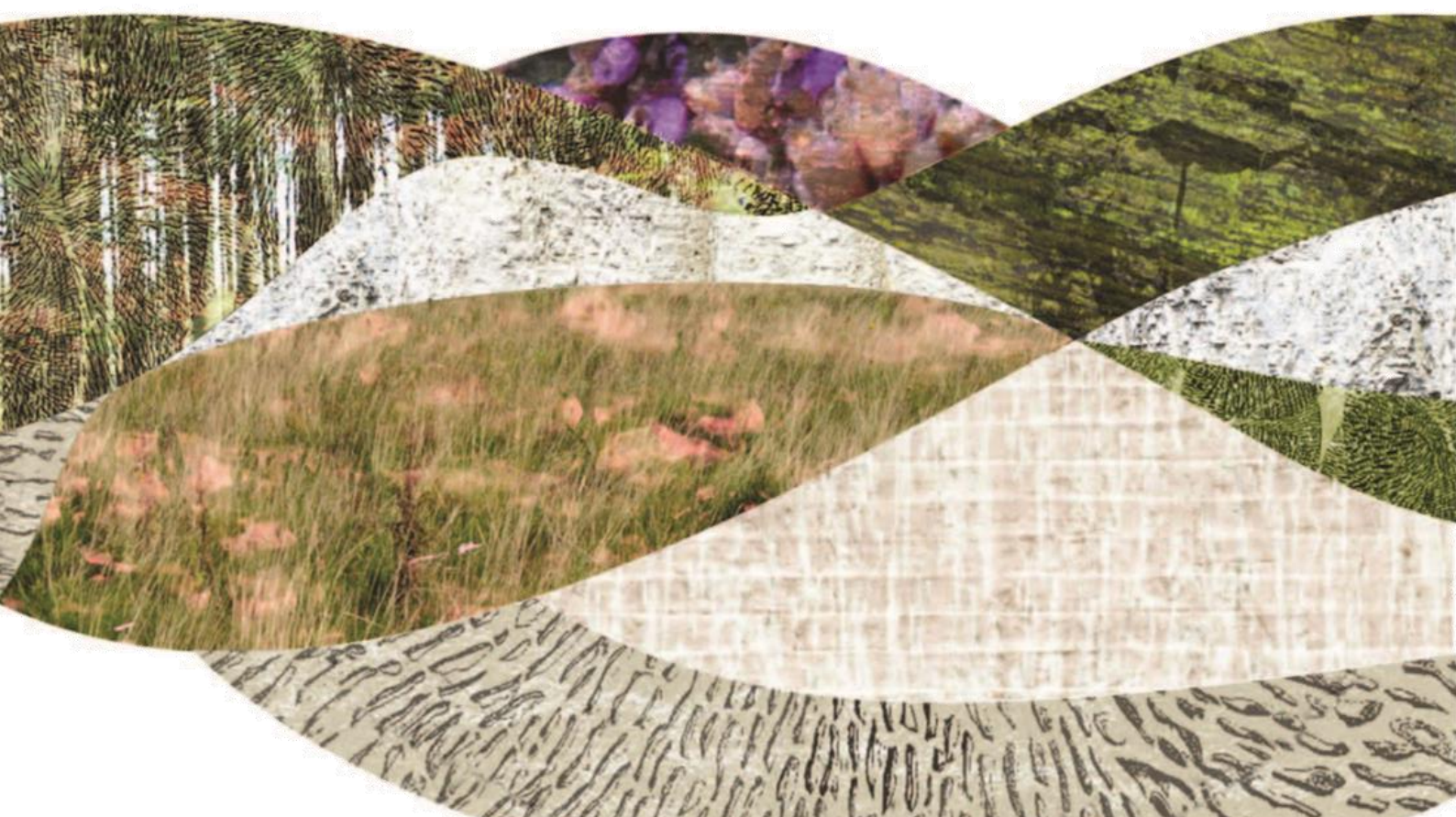


Guidelines for the stewardship of heritage assets in forestry management

SECRETS — OF THE — HIGH WOODS

SOUTH DOWNS NATIONAL PARK



Secrets of the High Woods project, South Downs National Park: Guidelines for the stewardship of heritage assets in forestry management

Landward Research Ltd for the South Downs National Park Authority

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1 EXECUTIVE SUMMARY

These guidelines have been produced as a consequence of an idea which developed during the *Secrets of the High Woods* project, as described by Ian McConnell in the recently published *Secrets of the High Woods* project book (McConnell in Manley 2016). That is, to engage with local foresters and land managers to make them aware of the newly discovered archaeological resources within their estates so that the potential impacts of forestry activities on those resources could be mitigated in practical ways. These guidelines are the result of consultation with those foresters and land managers of the wooded estates.

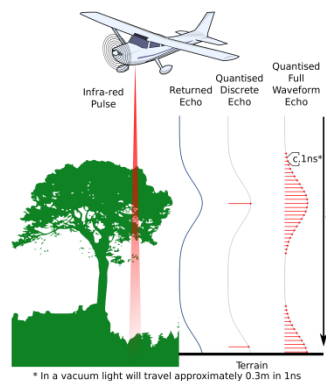
The document briefly reviews the *Secrets of the High Woods* project, legislation, standards and guidance surrounding forestry management and the archaeology of the area. The appendices cover these topics in greater depth. The heart of the guidelines covers how to obtain archaeological advice and how resources, like Historic Environment Records, are available to support the protection of heritage assets. Furthermore, it presents several case studies from the South Downs that highlight best practice being undertaken in forestry work to avoid damaging cultural heritage assets.



2 INTRODUCTION

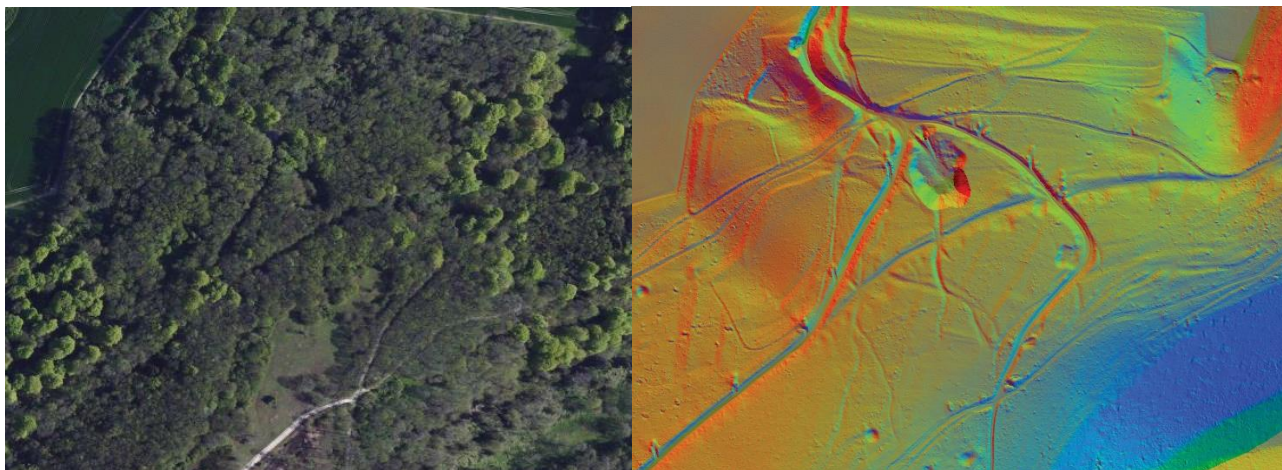
A bird's eye view of the landscape hidden under the trees, that's what the LiDAR survey as part of the 'Secrets of the High Woods' project has given us.

LiDAR uses airborne laser beams that can travel through the canopy to bounce off the land surface below, recording even the slightest undulations. The LiDAR survey has revealed an extraordinarily rich archaeological landscape within the wooded estates of the South Downs, a landscape which we did not know existed but which we have discovered retains entire systems of land-use and settlement from the prehistoric era onwards.



*Example of how LiDAR works.. CC-BY-SA
Anthony Beck*

Image (below left) illustrates dense woodland that is nearly impossible for archaeologists to map resources in; the tree cover obstructs aerial photography and the dense vegetation makes it hard, often impossible, to recognise features during walk over surveys. However, image (below right) shows how a LiDAR scan of that area has penetrated the forest canopy and stripped away the vegetation to reveal many previously unknown features such as field systems and hollows.



Bignor Tail Wood Aerial Photograph

Bignor Tail Wood LiDAR view

Because forestry work is capable of damaging or destroying this hidden archaeology unless managed carefully (McConnell in Manley 2016) these guidelines have been prepared by the South Downs National Park Authority in consultation with local foresters, land managers and archaeologists, to assist foresters and other custodians of the land with the stewardship of the historic environment in the wooded estates of the South Downs, especially in light of the hundreds of newly discovered archaeological sites.

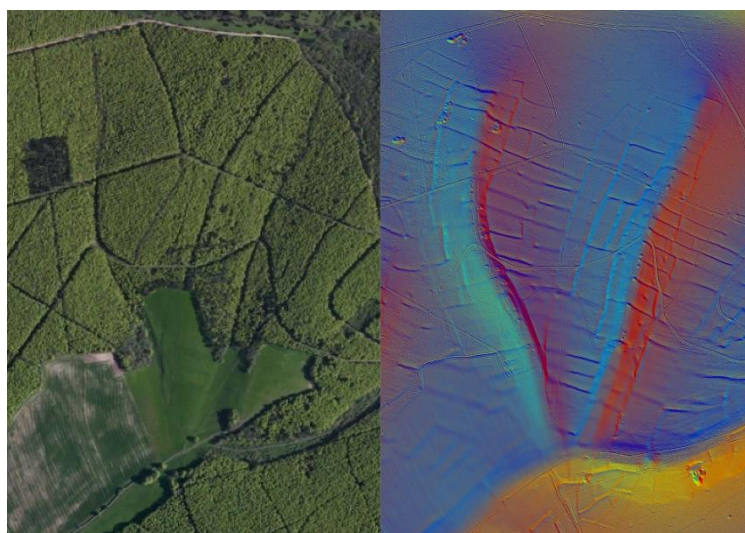
3 THE SECRETS OF THE HIGH WOODS PROJECT OVERVIEW

The formation of the South Downs National Park Authority (SDNPA) in 2010 provided the opportunity to consider the region's historic environment on a landscape scale, and the desirability of a LiDAR survey of its wooded parts soon became evident. The Heritage Lottery Fund (HLF) provided support to develop the idea in 2012, and in 2013 funding for the Secrets of the High Woods project was secured from HLF and the SDNPA, and was planned to take three years. It would involve not only LiDAR survey, and its analysis, but also three supporting volunteer strands of ground-truthing fieldwork, documentary history and oral history recording.



LiDAR Survey

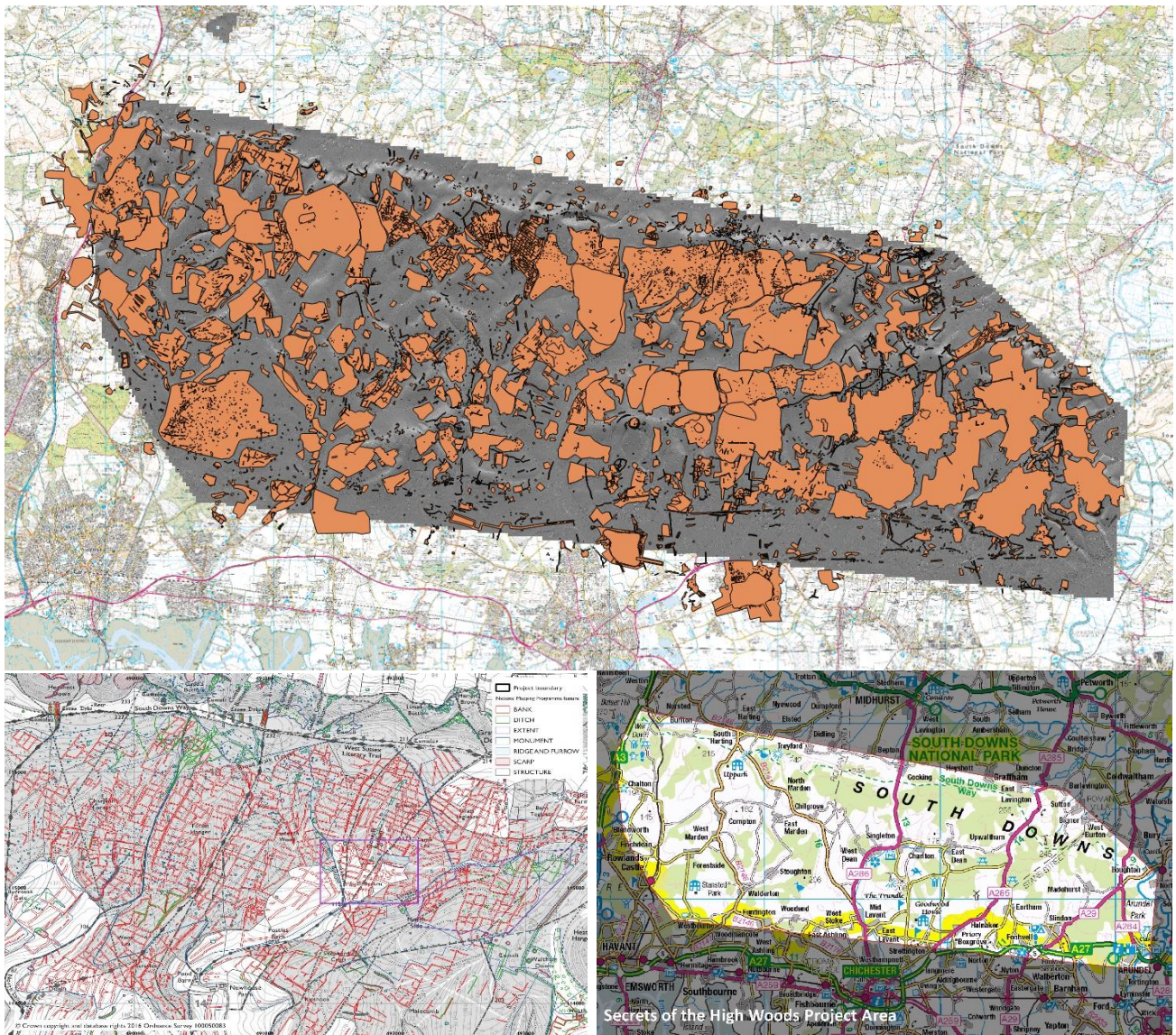
Before the Secrets of the High Woods (SoHW) other projects, for example in the High Weald (Weald Forest Ridge, Landscape Partnership Scheme 2013), the Forest of Dean (Lennon 2010) and the New Forest (New Forest National Park Authority 2015), showed just how valuable a tool LiDAR could be in mapping the otherwise unmappable; extensive archaeological features within the woods. Local archaeologists had realised that many archaeological sites continued into the forests of the study area but, masked by woodland and dense undergrowth, they were usually too difficult to map on the ground.



Aerial photo and LiDAR scan showing hidden archaeological features below the canopy at Lamb Lea, near Charlton

The LiDAR results have been a boon to the record of the archaeology in the project area with the discovery of hundreds of new archaeological sites- 1646 newly recorded sites in the National Mapping Programme alone. These records have been made available to the various Historic Environment Records (HERs) in the Counties and Districts of the project area, and to the estates in

that area. The survey results have been analysed and reported in a National Mapping Programme (NMP, Carpenter et al. 2016) and synthesised for a book about the project (Manley 2016), although works to research and interpret the remains fully will be ongoing for many years to come. The image below shows some of the new sites discovered from the LiDAR and added to local HERs as part of NMP. As you can see there are hundreds of archaeological features newly discovered in the South Downs.



Top: Area covered by the LiDAR with highlighted archaeological resources in the National Mapping Programme. Bottom left: detailed entry in the NMP. Bottom right: is the project area inside the South Downs. © Crown copyright and database rights 2017 Ordnance Survey 100050083

In Section 5 the reader can find out more about the archaeology of the Secrets of the High Woods project area. But, before that, we consider the frameworks within which foresters operate and contribute to the conservation of the historic environment in and of the woods.

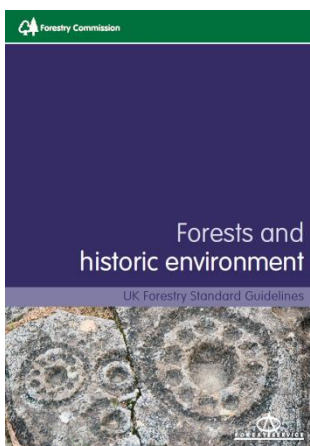
4 LEGISLATION, STANDARDS & GUIDANCE FOR FORESTRY MANAGEMENT

Woodland in the South Downs is managed for quite a variety of objectives, including wood fuel, timber, coppice, shooting, conservation and amenity, all to be balanced with the inherent responsibilities towards economy, environment, landscape and society. Not an easy job. However, legislation and guidance exists to provide a framework for forestry planning and operations in England and the UK. Principal amongst these is the UK Forestry Standard. This is summarised here, and explored in greater depth in Appendix 1, which also covers UKWAS, wider forestry and historic environment guidance, heritage designations and issues, and the implications of the National Park designation.



UK Forestry Standard (UKFS)

The UK Forestry Standard (FC 2011a) applies to all forests and woodlands in the UK and is the reference standard for sustainable forest management. Furthermore, the payment of Forestry Commission grants is conditional on meeting UKFS Requirements. Together with England's national forestry policies and strategies, the UKFS provides a framework for the delivery of international agreements on sustainable forest management, alongside policies on implementation. Its 3rd edition was developed in 2011 by the Forestry Commission. An update is in preparation at the time of writing and the most recent edition should always be used. The UKFS and its supporting Guidelines are available from the Forestry Commission website at www.forestry.gov.uk/ukfs



The UKFS Historic Environment Guidelines

The UKFS identifies two levels of compliance: legal requirements and good forestry practice requirements. A series of 'Guidelines' publications provide both the legal requirements and good practice requirements particular to seven specific aspects: Biodiversity, Climate Change, Historic Environment, Landscape, People, Soil, and Water. Of course, the Historic Environment Guidelines (FC 2011b) are most relevant here, but they cross over with aspects of the others, especially the Landscape Guidelines (FC 2011c). The UKFS Historic Environment Guidelines are available at www.forestry.gov.uk/ukfs/historicenvironment

There is also a handy UKFS checklist available free from the Forestry Commission website, for use on smartphones and tablets, which summarises the requirements for each aspect of the UKFS guidelines.

The UKFS defines the historic environment as 'all tangible evidence of past interactions between humans and their environment, incorporating archaeological sites, historic landscapes and natural heritage' (FC 2011b: 62). There are three legal requirements given in the UKFS for the Historic Environment (Table 1), reflecting wider legislation which is applicable in the UK. The

UKFS uses the word ‘must’ in the expression of the legal requirements (Table 1) and the word ‘should’ in the expression of best practice requirements (Table 2).

UKFS LEGAL REQUIREMENTS FOR HISTORIC ENVIRONMENT		RELEVANT AUTHORITY
1	Scheduled Monuments must not be damaged and consent must be obtained from the relevant historic environment authority for any works that have the potential to damage the monument.	Historic England www.historicengland.org.uk
2	The historic environment authority must be informed if objects are found that come within the scope of the law covering archaeological finds. Metal detectors must not be used where legally restricted or on a Scheduled Monument Site.	Finds: Portable Antiquities Scheme: locate your Finds Liaison Officer at finds.org.uk/contacts Scheduled Monuments & Metal detecting: Historic England
3	Listed building consent must be obtained from the local authority or relevant historic environment authority to demolish a listed building or structure or any part of it, or alter in any way which would affect its character, inside or out.	Local planning authority. Contact SDNPA www.southdowns.gov.uk

Table 1 Legal requirements in UKFS Historic Environment Guidelines (FC 2011b)

The three legal requirements (Table 1) refer to the protection warranted for *designated* heritage assets, although, as stressed by the Forestry Commission, the absence of an asset’s designation should not be taken as an indication of a lack of its significance (FC 2011b: 9). An asset’s importance may be recorded on a local heritage list (See Section 5 of this document on local Historic Environment Records), or may yet to have been discovered, recorded, or fully investigated. As forested areas are often poorly recorded due to their tree cover it is important that possibly significant heritage assets within woodlands are identifiable by those working near them to prevent their loss (Crutchley and Crow 2010). These comments are especially relevant to the SoHW project area where the LiDAR survey has mapped many new discoveries but the process of evaluating them is still in its early stages.

The UKFS Guidelines also describe five best practice requirements for the Historic Environment (Table 2) and give more information on the context of these requirements. Points 1 and 2 refer to historic landscape character while Points 3, 4 and 5 refer to historic features.

BEST PRACTICE REQUIREMENTS IN UKFS HISTORIC ENVIRONMENT GUIDELINES	
1	Forests should be designed and managed to take account of the historical character and cultural values of the landscape.
2	Forests should be designed and managed to take account of policies associated with historic landscapes, battlefield sites, historic parks and gardens, and designed landscapes of historic interest.
3	Steps should be taken to ensure that historic features, which may be adversely affected by forestry, are known and evaluated on an individual site basis, taking advice from the local historic environment services.
4	Forest management plans and operational plans should set out how important historic environment features, including veteran trees, are to be protected and managed.
5	Where existing forests do not meet the UKFS Requirements for Forests and Historic Environment, improvements should be made when management opportunities arise.

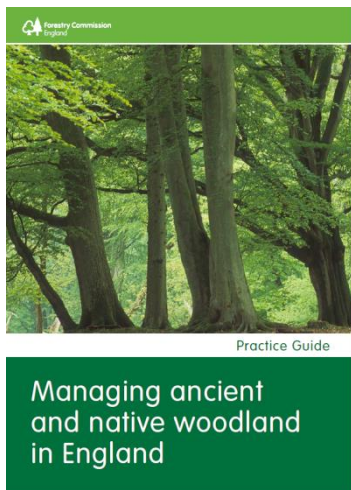
Table 2 Best practice requirements in UKFS Historic Environment Guidelines (FC 2011b)

An important aspect to note in Table 2 is the requirement to consider the Historic Environment both when (a) preparing, and reviewing, Forest Design Plans and (b) when planning and implementing Operations. The more comprehensive the planning, the less likely that historic features will be encountered unexpectedly or damaged accidentally during the course of operations. Similarly, effective communications within forestry teams, and with contractors, are fundamental for successful conservation management during operations.

Detailed guidelines on meeting the UKFS Requirements for Historic Environment are set out in Section 6 of the Forests and Historic Environment document (FC 2011b: 15). That section lists eight generic factors about the Historic Environment which are addressed by 30 Sustainable Forest Management guidelines, grouped by the factor headings (Appendix 1 Tables A and B). More information about UKFS and other relevant legislation and guidance is given in Appendix 1. The practical measures for implementing the UKFS Forests and Historic Environment Guidelines are considered further in Section 6 of this document.

Ancient Woodland and other historic woods

The term 'heritage assets in woodland' covers more than historic monuments, i.e. built heritage, because of course the woods and trees themselves may be of historic interest. The most obvious form of woodland with historic interest must be Ancient Woodland.



In England, Ancient Woodland is defined as a woodland which has been under continuous wooded cover since at least AD1600. An Inventory of Ancient Woodland in England is maintained by Natural England. Natural England is also a statutory consultee for proposals that affect any Site of Special Scientific Interest (SSSI), a number of which occur in the project area.

(see designatedsites.naturalengland.org.uk)

The Forestry Commission in England have issued a Practice Guide for 'Managing Ancient and Native Woodland in England', which chimes with the objectives of the UKFS and can be downloaded from their website (Forestry Commission England 2010).

Veteran Trees

'Veteran trees' are trees which, because of their age, size or condition are of cultural, historical, landscape and nature conservation value. They can be found as individuals or groups within ancient wood pastures, historic parkland, hedgerows, orchards, parks or other areas. Usually, veteran trees have no formal protected status unless they happen to be within an area protected by another designation, such as an SSSI, a Scheduled Monument, a listed park or garden, or a Tree Preservation Order. However, the protection and appropriate management of veteran trees is a best practice requirement of the UKFS (Table 2).

Since 2004 the Woodland Trust has been leading the compilation of an Ancient Tree Inventory, a register of veteran trees (see www.ancient-tree-hunt.org.uk) and there are already a sizeable number of trees registered in the project area. Their records can be viewed on a zoomable map on the Woodland Trust Ancient Tree Hunt web pages. The intention is to highlight the importance of veteran trees, promote their value and encourage their conservation.



Veteran beech on bank at West Dean Estate

5 ARCHAEOLOGICAL ADVICE AND THE HISTORIC ENVIRONMENT RECORDS

Foresters and land managers generally know that Historic England (formerly English Heritage) are the body they must consult on managing woodland on scheduled archaeological sites. For non-scheduled heritage assets the requirements of the UK Forestry Standard (UKFS) are that ‘historic features, which may be adversely affected by forestry, are known and evaluated on an individual site basis, taking advice from local historic environment services’. They also make clear that stewardship of the historic environment is inclusive of all important historic environment features, including veteran trees, requiring their protection and appropriate management.

Although not discussed in the guidance document, evaluating what is ‘important’ should be a process involving professional archaeological advice and cognisance of the local Historic Environment Records (HERs). The local HERs are usually held and maintained by the local planning authority. Despite the role of the South Downs National Park Authority in planning, they do not hold the Historic Environment Records for the Park area and it is the various district and county planning authorities within the South Downs National Park area that should be consulted (Table 3). It is their role to maintain the Historic Environment Records, and they have all been offered the LiDAR survey results to incorporate into their records.

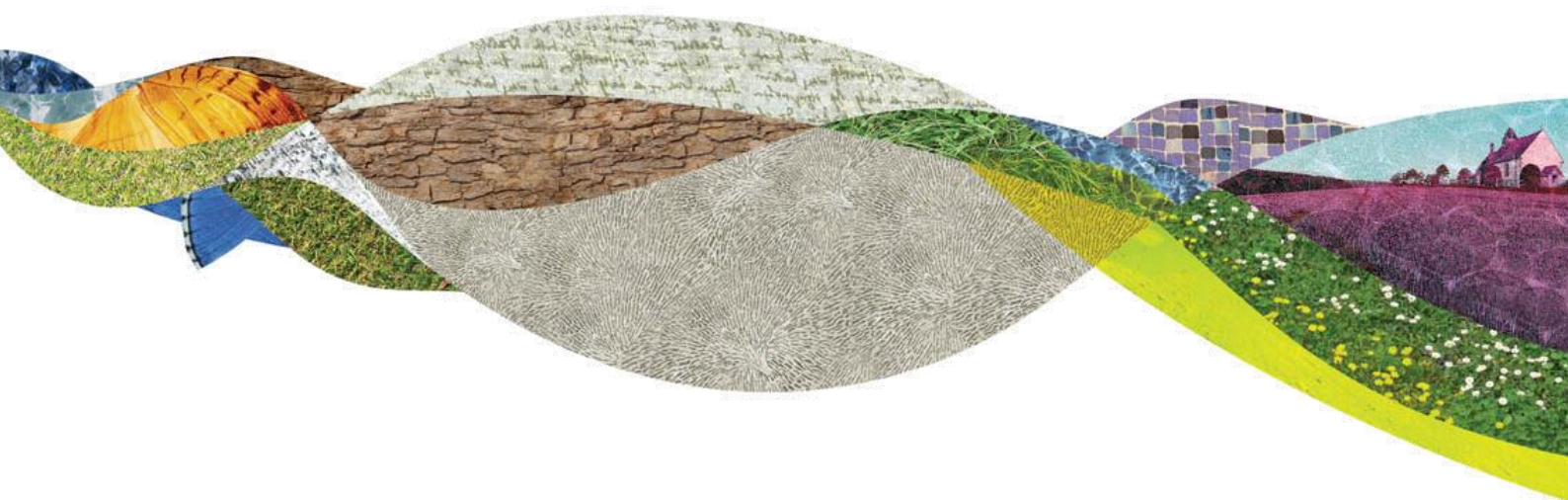
PLANNING AUTHORITY	CONTACT DETAIL
Chichester District Council (and for Arun District)	Email: her@chichester.gov.uk Tel: 01243 534800 Web: www.chichester.gov.uk/article/25424/Archaeology
Hampshire County Council	Email: historic.environment@hants.gov.uk Tel: 01962 832339 Web: www.hants.gov.uk/landscape-and-heritage/historic-environment.htm
West Sussex County Council	Email: environment.heritage@westsussex.gov.uk Tel: 0330 2226450 Web: www.westsussex.gov.uk/leisure/explore_west_sussex/history_of_west_sussex/archaeology.aspx

Table 3 Historic Environment Records contact information for the project area

Information on which of these planning authorities you should contact or if this list is updated can be found on the SDNPA website at: www.southdowns.gov.uk

KEY TAKE AWAY

The Secrets of the High Woods LiDAR survey has revealed extensive archaeology beneath the tree canopy, much of which was previously unknown. Reading and evaluating this complex layered archaeological landscape is a specialist task and professional archaeological advice should be sought to interpret the significance of archaeological features before forestry work begins. These HERs should be the first stop to either obtain this advice or recommendations of archaeologists who can provide this advice.



6 THE ARCHAEOLOGY AND CULTURAL HERITAGE OF THE HIGH WOODS

The LiDAR survey with the help of aerial photography and volunteer surveys (Image below) has helped us to discover and identify over 1600 hundred new archaeological sites. The High Woods is truly rich in archaeological resources. This section will help you understand what features you are likely to encounter during your work. This review will not make you an expert but will give you a basic overview of sites likely to be encountered.



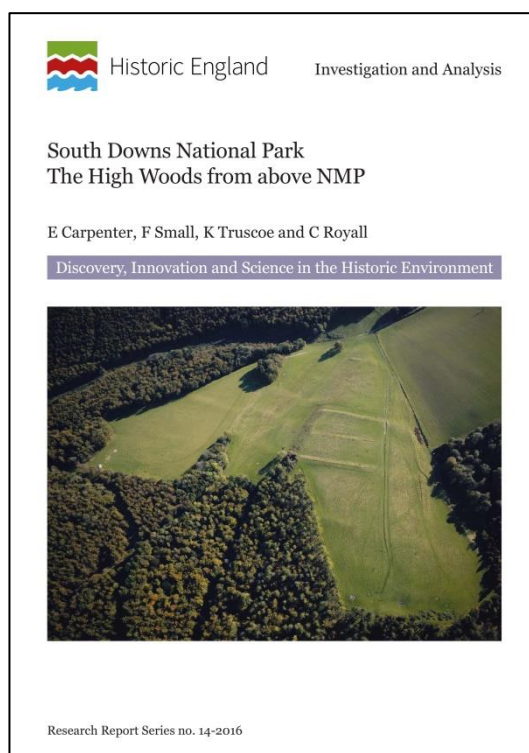
Volunteers survey archaeological resources in the South Downs.

The National Mapping Programme identified over 100 different types of archaeological sites in the High Woods. These are broad types and could easily be divided into several hundred sub-types. Therefore, this review will cover general categories with a few specific examples to give an understanding what exists in the High Woods. The general categories are:

- Ancient woodland and other historic woods
- Mounds and banks
- Ditches and pits
- Buildings
- Artefacts
- Sub-surface

Some archaeological features will be a combination of these.

This is only a brief review of the archaeology. If you would like to know more about the history of the South Downs please read Appendix 2. If you would like to know more about archaeological sites please read the publication - *South Downs National Park: The High Woods from above NMP*. This can be found online.



Ancient Woodland and other historic woods

The forests and trees themselves are considered part of the historic environment. Ancient Woodland and veteran trees were discussed in the previous section but from the point of view of the project area, Ancient Woodlands are not the only types of woods with historic interest. Many of the woods in the project area have originated as plantations since AD1600 or have been created as parts of designed landscapes since then, as is discussed further in Appendix 2. The Ancient Woodland Inventory only includes woods above a certain density of tree cover. Therefore, ancient wood pastures are not usually included because their woodland cover is sparse. However, they can be amongst the oldest and most interesting forms of historic woodland.

Mounds and banks

Throughout the South Downs humans have created earthen features out of stone and earth. In each of the following general categories will be one or two examples of site types.

Archaeological site type: Barrows

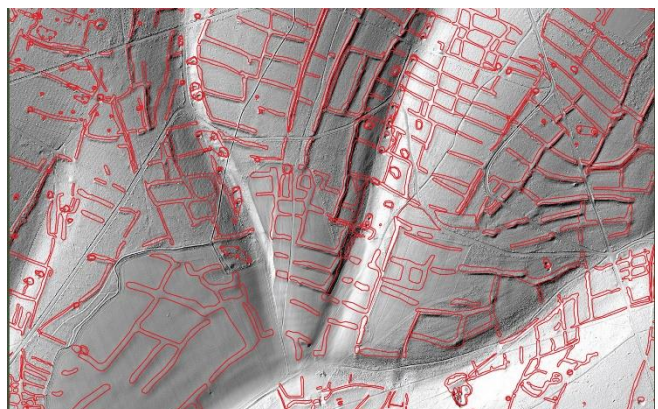
A round or elongated mound of earth or stones that was sometimes used to cover a burial(s). These are prehistoric features. They can come in all sorts of shapes and sizes. Bevis's Thumb, a Long Barrow near the village of Compton is unmissable in the landscape. It is likely to be over 5,000 years old and covers the burials of some of the first downland farmers.



The Bevis's Thumb Long Barrow © Shazz Attribution-ShareAlike 2.0

Archaeological site type: Field system

From the prehistoric to medieval times much of the South Downs area was farmed and this activity has left field boundaries- raised earthen banks.



Field systems as revealed by LiDAR and enhanced in GIS.

Occurrence of mound and bank type sites: There are hundreds of mound like features throughout the South Downs. There are over 200 Bronze Age ones alone. There are over 100 identified Field Systems.

Number of Identified Bronze Age (2200BC-800BC) mound type sites

Bell Barrow	13
Bowl Barrow	83
Disc Barrow	2
Platform Barrow	2
Pond Barrow	3
Saucer Barrow	1
Round Barrow	122
Cross Dyke	43

Ditches and pits

These are features formed from pits, ditches, tunnels, etc.

Archaeological site type: Flint/Chalk Mines

From the earliest times to more recent times people have mined both flint and chalk from the South Downs. This activity has left depressions in the surface that can be quite large, like the Cissbury flint mine, or more subtle such as this possible chalk mine found with LiDAR.



Cissbury flint mine



Possible chalk mine.

Occurrence of ditches and pits: There are over 925 Chalk Pit/Clay Pit/Extractive Pit/Gravel Pit/Quarry/Sand Pits identified in the High Woods. Ditches/pits and mounds/banks are the most common features in the area.

Ditches, mounds and banks

Many archaeological features you will encounter will be a combination of ditches and banks, usually recorded as the catch all term of Earthwork.

Archaeological site type: Cross-dykes

These are a type of boundary which usually consists of a ditch and a raised bank.



Example of several cross-ridge dykes on Pen Hill- comprises a bank and a ditch. Creative Commons Attribution-Share Alike 2.0 © Chris Gunns

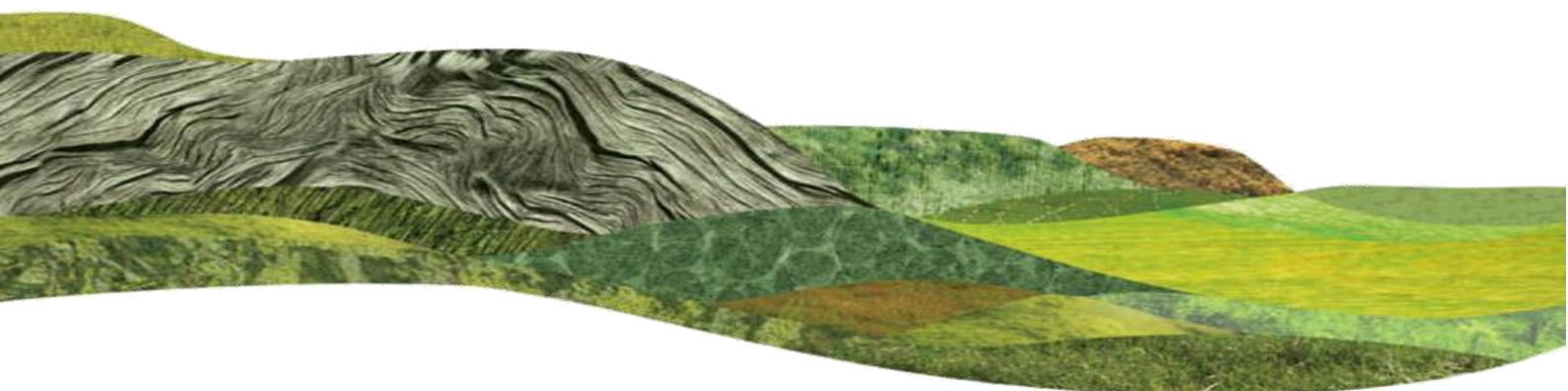
Archaeological site type: Hillfort

Especially typical of the Iron Age these are prestige sites and usually consist of a series of ditches and banks surrounding the top of a hill. The hillfort of Chanctonbury Ring, above Washington, is one of the most celebrated monuments in the South Downs National Park.



Chanctonbury Ring © John Manley

Occurrence of mixed features: Earthworks are the most common feature that you will encounter in the high woods. 80% of all features identified during the national mapping programme were earthworks. Most of what you will encounter will be 'lumps, bumps and dips' in the earth.



Buildings and structures

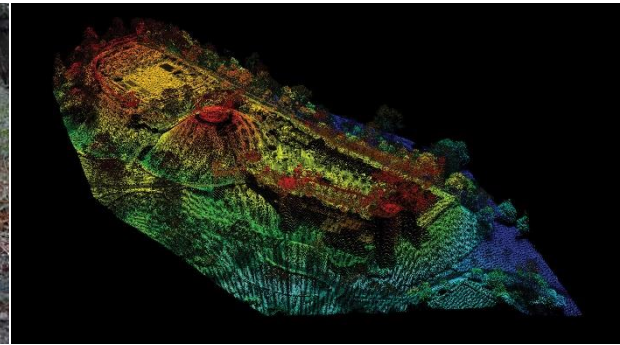
More modern structures will be much easier to identify in various stages of preservation. The downs were used as a military training ground during the first and second world wars, leaving traces such as zig-zag trenches and firing ranges. Some defensive wartime structures such as pillboxes also survive (left image), although in some cases only the foundations of a structure will remain (centre image). Even older structures will sometimes be present in the landscape, for example the medieval Arundel Castle is still upstanding (right image).



Example of a pillbox



WW2 Hut base used by Canadians or Free French prior to D-day.



LiDAR point cloud image, Arundel Castle

Occurrence of buildings: There are not many structures that are considered archaeological resources. The National Mapping Programme only identified five standing and nine demolished structures of archaeological interest. Most structures you will encounter will still be in use and not archaeological.

Artefacts

These are individual objects created by humans, other than structures. They may be present on the surface but will more often be found during root and stump removal in the disturbed soil. LiDAR survey is not usually able to identify artefact scatters except in rare circumstances. If you come across artefacts you should note the location and report it to the nearest Portable Antiquities officer. They will record the find and tell you more about it. See their website at: www.finds.org.uk

Archaeological site type: Flint scatter

The earliest people of the South Downs were hunter gatherers leaving little trace. Scatters of flint artefacts (stone tools) are the most common site type they have left behind. This will be a cluster of stones that look like they have been smashed up to create sharp cutting tools.



Image of lithics. Photo by The Portable Antiquities Scheme, Adam Daubney, CC-BY-SA

Archaeological site type: Middens

These are rubbish dumps. They will contain broken artefacts, possibly pottery, stone tools or, if more recent, metal tools. They typically also contain marine shells e.g. oyster shells. If you find oyster shells away from the ocean or estuary, then you have probably found a midden. Middens may be visible in LiDAR if people have piled up enough refuse to create a mound.

Occurrence of artefacts: The Portable Antiquities Scheme has only a few hundred finds listed in the South Downs area. Most were found by metal detectorists. It is unlikely that you will come across many artefacts in your work.

Sub-surface

For centuries the High Woods were farmed and under the plough. This agricultural work has flattened many of the archaeological features so that nothing above the plough level remains identifiably but they can be seen through aerial photography as soil/crop marks. 15% of sites recorded in the area are these soil/crop marks and a further 4% are a mixture of cropmark and some earthworks still remaining.



Buried remains of the ditches associated with large mounds or enclosures, probably Neolithic or Bronze Age barrows or ceremonial monuments. Revealed as cropmarks south-east of Lordington. 15386/19 21-AUG-1995 © Historic England.

General Type	Occurrence	Identifying
Mounds and banks + Ditches and pits	80-85%	<p>Mounds and banks tend to have regular and consistent shapes whereas natural features will be irregular in shape. Straight lines, especially ones that do not follow the contour of the landscape, are a dead giveaway that the feature is human-made. Hollows and ditches cut below the normal soil level will retain their form even when largely silted up. However, when a feature has been mostly infilled it will be difficult to determine if it is natural, e.g. a tree throw, or human-made.</p> <p>If you notice such features during operations report them to your local HER and they will be able to better advise you as to whether the feature is natural or archaeological.</p>
Buildings	Rare	Self-explanatory
Artefacts	Rare	Self-explanatory
Sub-surface	15-20%	You will not be able to identify such features during operations. Only aerial photography can do this. Check with your local HER to see if any soil/crop marks have been identified in your work area.

More Information

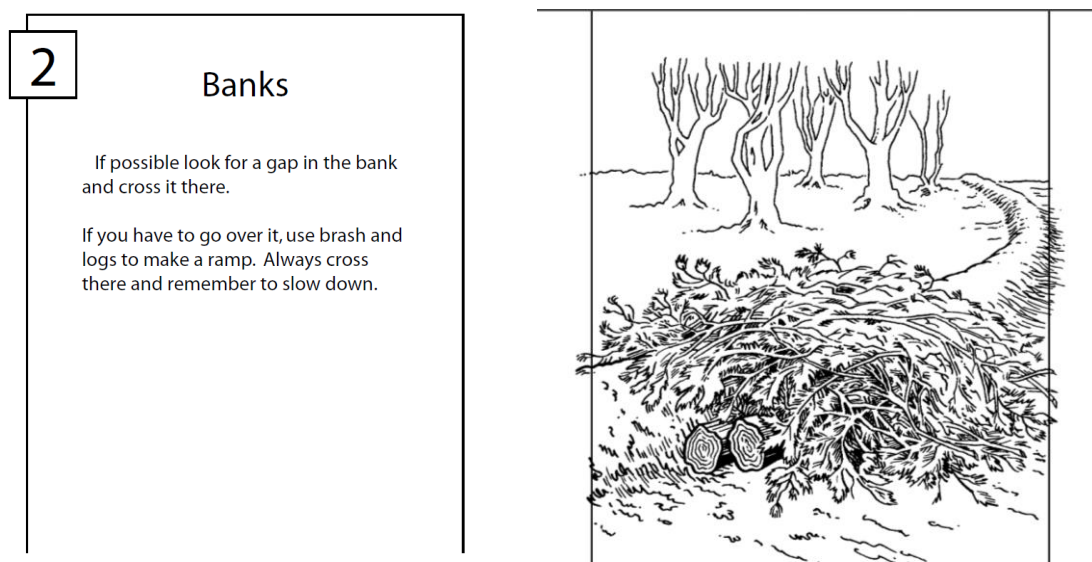
Anyone wishing to read more about the evolution of the High Woods archaeological landscape is directed to Appendix 2 where a more detailed account is given about the history and archaeology of the South Downs.

7 GUIDELINES AND FORESTRY MANAGEMENT EXAMPLES FROM THE HIGH WOODS

This section outlines some practical advice (Table 4) and a number of local case studies on how to avoid damaging the historic environment assets in the wooded parts of the South Downs.

Landscape scale LiDAR surveys in other wooded areas have worked with foresters to develop mitigation measures. One of the most practical outputs was a set of Cab-Cards from the High Weald project, aimed at machine operators to help them recognise and protect archaeological features. The Cab Cards can be found here:

www.highweald.org/downloads/publications/land-management-guidance/woodland-1/369-limiting-damage-to-woodland-archaeology/file.html.



Example of Cab Cards

However, they are no substitute for advance planning, and foresters want to plan ahead in both strategic and operational planning. Knowing in advance what you have on your land is the best possible starting position for both the forester and the archaeological resource. The following table outlines good practice guidelines to follow when planning forestry work so as not to damage or destroy archaeological and historical features.

TABLE 4 NOTES ON BEST PRACTICE INFORMED FROM CONSULTATION

IN STRATEGIC PLANNING	
KNOW WHAT'S THERE	Use your own knowledge of the land, archaeological advice, the Historic Environment Records and the LiDAR mapping to find out what is there before designing woodlands and operations.
CONSULT GIS MAPPING & HISTORIC ENVIRONMENT SERVICES	Use of GIS shapefile layers with LiDAR survey data included provides a quick visual survey of features against the backdrop of the woodland, which can be checked by forest managers and inform strategic and operational planning. It is also important to seek professional archaeological advice because the LiDAR data may require interpretation and is not the only mapped heritage information. Local Historic Environment Records (HERs) have comprehensive records. Consulting local historic environment services is a requirement of the UKFS.
PRE-OPERATIONAL SURVEYS	A desk-based GIS/HER exercise alone may be insufficient to identify and evaluate the historic features. Archaeological survey may be appropriate to inform both strategic and operational planning. It can identify and evaluate the significance of features. Contact your local council archaeologist to discuss the need.
INCLUDE VETERAN TREES	Remember to include any veteran trees as historic features when planning ahead. They may not be represented in Historic Environment Records or in archaeological surveys. They may appear on the Woodland Trust's Ancient Tree Inventory, although this is not comprehensive. Veteran trees will likely have specific management prescriptions attributed to them, such as halo thinning, and so careful thought should be given to their management.
RE-ALIGN LINEAR WORKS	Extraction racks, fence-lines etc. should be designed to run around features where possible rather than 'cut them in half' or run over them.
WOODLAND DESIGN & OPEN AREAS	In planning the design of new woodlands or in re-stocking consider avoiding planting on the archaeological features if possible. Where natural regeneration of a wood is intended, consider keeping archaeological areas open and free of trees and scrub. However, this is only practicable where resources exist to continue to maintain them as open areas, for example by mowing, cutting or grazing.

IN PRE-OPERATIONAL PLANNING

KNOW WHAT IS THERE	Make use of the available historic environment information, which usually is gathered as part of strategic planning (see above). Conduct Operational Site Assessments of each compartment to be worked, to check on desk based study of features, and to check for any additional features on the ground. Also record locations of any veteran trees and note any management prescriptions that may be required.
CONTRACTORS	Particularly on sensitive sites, use contractors who are switched on to looking for features and reporting any findings to the forest works manager.
HAZARD AND CONSTRAINTS MAPS	Production of Hazard and Constraints maps or similar documentation to walk contractors or other site workers through any known issues on a worksite ensures that all information is communicated to them before operations begin.
SITE MARKING	Where features are difficult to identify or particularly sensitive to disturbance they should be physically marked out with hazard tape prior to operations commencing to create non-intervention zones.

DURING OPERATIONS

COMMUNICATIONS	Maintain good communications between land managers, foresters and operators, whether in-house or contractors.
TIMING OF OPERATIONS	Clay soils become very heavy when wet and are susceptible to excessive damage and deep rutting. Timing operations away from periods of heavy rain prevents unnecessary damage to the ground and any archaeological features which may be under the surface. Flexibility needs to be built into the harvesting programme where possible so that contractors can be moved to less sensitive sites during wet periods.
MACHINERY CHOICE	The ground bearing pressure of a machine has far more impact on a site than merely its weight. Heavy machines with good ground bearing capacity can cause far less ground damage than lighter machinery with traditional narrow tyres. Band tracks should be avoided where possible.
BRASH MATS	In crops where there is sufficient brash the creation of brash mats on particularly vulnerable sections of working sites can provide protection from heavy machinery. Brash mats should be maintained throughout the operation by utilising brash and small roundwood from less sensitive areas of the site.

RE-ALIGN LINEAR WORKS	As work progresses, continue to monitor extraction racks, which wherever possible should be re-aligned around features rather than run over them. Do not run machinery along the tops of banks.
SINGLE CROSSING POINTS	If crossing an archaeological feature is unavoidable, such as in a closed field system, then always use the same crossing point and protect with brash matting.
CLEARING UP	Avoid impacts on the archaeology during clearing up phase of the job. Do not remove stumps of felled trees.
REPORT FINDS	Any artefactual finds should be reported to the relevant Finds Liaison Officer (see Table 1). Newly discovered archaeological sites should be reported to the local HER officer (see Section 5).
AFTER OPERATIONS	
REVIEW AND UPDATE PLANS IF NECESSARY	If new archaeological finds, sites or approaches to conserving the archaeology have arisen during operations, review and update the strategic plan and future operational plans as necessary.
FOLLOW SITE MAINTENANCE PLAN	Refer to the strategic plan regarding the longer term maintenance requirements of the site, for example regular mowing or strimming to keep a site open. Incorporate these maintenance requirements into forward planning of estate work.
SITE CONDITION MONITORING	Monitor the condition of the archaeological sites regularly to ensure the maintenance regime is working, and to identify and respond to any unexpected threats.
IMPROVEMENT OPPORTUNITIES	Be mindful of the possibility of improving site condition and setting where the opportunity arises, and adjust plans accordingly.

INTRODUCTION TO LOCAL CASE STUDIES

The case studies presented over the next few pages are real life examples brought to our attention by the foresters of the High Woods themselves. Some of them highlight solutions to the challenges raised by the rich archaeological landscape under the trees, while others flag up forestry impacts on the archaeology which happened before the LiDAR survey was undertaken, giving the opportunity to consider how better solutions could be found for the future.



Hazel coppice with oak standards over a linear bank (unknown age) at West Dean Estate





Case Study A: Charlton Forest, Forestry Commission

BACKGROUND

Charlton Forest is on long term lease from the Goodwood Estate to the Forestry Commission. The woodland is predominantly young beech with some evidence of a previous coppice system in places. There are extensive archaeological remains within the woods, including newly discovered barrows and many field systems, some of probable Romano-British date. Many of these features have been recorded for the first time within the SoHW LiDAR data.

BEST PRACTICE IN STRATEGIC PLANNING

The forestry managers undertook the correct best practices when planning for work. They consulted their local Historic Environment Records and local historic environment services as required by the UKFS. Using GIS shapefile layers provided by the HERs they conducted a visual survey of features against the backdrop of the woodland.

The results of these investigations found that there were no known historical environment assets in their project area. This was because the LiDAR survey had yet to be conducted and none of the field systems were known. This resulted in forestry machinery running over a field system bank during thinning operations (image right), and leaving ruts in the feature, probably worsened by crossing in wet weather.

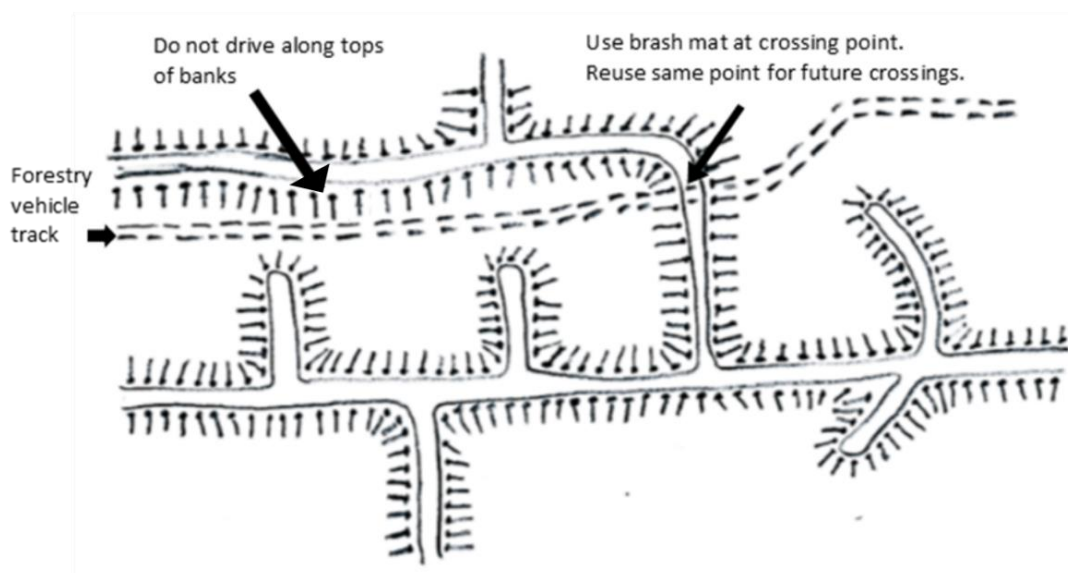


KEY TAKE AWAY #1

This can and does happen, following all the best practices does not guarantee that the historical environment will not be damaged. HERs consist of known archaeological sites and are only as good as the data inside them. The Forestry Commission could not have known the features were there and undertook their best efforts to mitigate damage.

Following best practice when a new thinning operation was planned the forestry managers undertook a new review of the HER data and resources. At this point the LiDAR data was available which showed that the thinning area actually contained a field system of an unknown age. This caused a re-evaluation of the methods being used.

Case Study A



KEY TAKE AWAY #2

Historic Environment Records are constantly being updated with new information. Every forestry project should run through the recommended workflow even if the area has been previously worked, even recently. New information could have come to light between projects.

BEST PRACTICE DURING OPERATIONS

Discussion by the project team revolved around the desirability of avoiding running over banks or lynchets where at all possible. Given that the field system was closed and that to conduct the thinning the banks would have to be crossed at some point it was decided to cross at the same

location that earlier machinery had impacted the bank. Brash mats were used to protect this area. The LiDAR data will assist in planning future access routes to minimise damage to the field system.

KEY TAKE AWAY #3

Where the layout of a field system means a bank has to be crossed, i.e. in a closed system, then re-using the same crossing point rather than using multiple crossing points is to be preferred, to minimise damage overall. Furthermore, running lengthwise along the tops and edges of banks and lynchets should also be avoided.

Case Study B: Hacking Copse, Cowdray Estate

BACKGROUND

A previously unrecorded barrow is present in a mid-rotation commercial conifer stand. Previous clearfelling operations, more than 10 years ago, extracted timber over the barrow. This has left track marks over the edge of the barrow. At that time the estate was unaware of the barrow and the issues surrounding the track damage to it. The estate operates with a full in-house forestry team and is UKWAS certified.

The image on the left shows the barrow mound. The image on the right shows the track running along the side of the barrow.

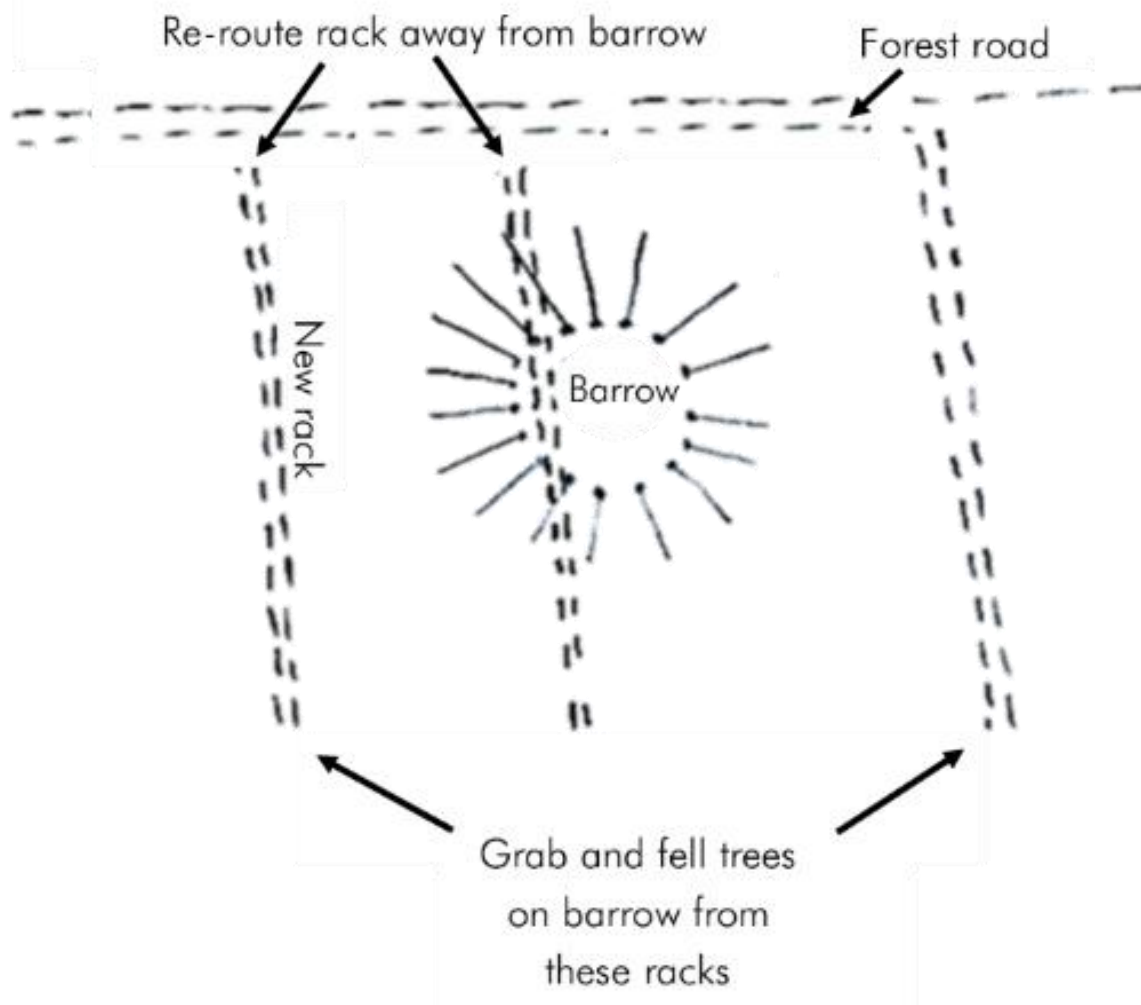


BEST PRACTICE IN STRATEGIC PLANNING

A desk-based assessment of the Historic Environment Record discovered the barrow and project planning found that the machine tracks intersected the barrow. The estate managers have devised a plan to address these issues. Following best practices, the management plan action points are:

- to fell the trees off the site using a harvester grab that would prevent the trees falling on the feature. Careful removal of the trees will improve the setting for the barrow within the woodland, and the site will be kept open by regular mowing;
- to re-align the existing extraction rack 2-3 rows away from the barrow to prevent further damage;
- to use appropriate means of re-instating the barrow profile, where the tracks have impinged on it. The methods are under discussion, and might either use brash to build up the profile, or add rubble stone over a layer of terram to distinguish new material from old;
- that the estate will factor in the archaeology in their new 10-year forestry plan.

Case Study B



KEY TAKE AWAY

Managing archaeological resources is not only about minimising damage to resources but also about repairing damage to and stabilising the condition of sites. In this case damage was caused by previous forestry work but it could have easily been caused by erosion or some other natural process. The estate has done the right thing to minimise future damage by moving the track and removing the trees but not the stumps and roots. They are also examining options to repair the damage previously done.





Case Study C: Rewell Wood, Norfolk Estates

BACKGROUND

The site is a sweet chestnut coppice which is worked on a 21-year rotation. Like many areas surveyed with LiDAR it was found to lie over an ancient field system. There were also Scheduled Monuments on the estate that had been managed for years.

BEST PRACTICE IN PRE-OPERATIONAL PLANNING

The estate has taken great care to protect both their newly discovered and older heritage assets. They have implemented several strategies to minimise the risk to the heritage during the chestnut felling. One of the strategies is to create hazard and constraints maps of the areas to be harvested. These are easily created using GIS by importing a map layer of the heritage assets and then colour coding those on the map to alert their contractors about the locations to avoid or that need additional mitigation work. Importantly the estate then uses those maps to walk sites with the contractor and to point out features on the ground. This clear method of communication ensures that no mis-interpretation occurs.

KEY TAKE AWAY #1

Using hazard and constraint maps can help ensure all of the heritage assets are appropriately flagged up to contractors.

BEST PRACTICE DURING OPERATIONS

The operation was timed to happen in the summer when the area was dryer to prevent ground damage. Moreover, the schedule took into account legislation protecting flora and fauna. While

this was mainly done for the wildlife such an action had the double benefit of protecting both the natural and cultural heritage of the area.

Heavy brash resulting from coppicing operations was gathered and used to form dense protective brash mats to cross linear features at pinch points during extraction of harvested material.

The estate uses the same contractors for most of their work which builds up site knowledge and positive working practices.



Elsewhere in Rewell Woods, we visited an example of a recent thinning operation around a Scheduled Monument (SM). The operation was timed to happen in the summer to prevent ground damage and to take into account legislation protecting flora and fauna.

SCHEDULED MONUMENT

The estate has a Scheduled Monument which had previously carried a conifer crop. After felling, weeds and scrub began to grow on it. Because this site had statutory protection the estate followed both best practice and the law and consulted with Historic England.

The discussions with Historic England focused on how best to maintain the site. Best practice would dictate that the area be left free of trees and maintained as an open area. However, in these circumstances the best protection for the monument was to plant another commercial crop over the features given budget constraints which would not permit maintenance as an open space.

KEY TAKE AWAY #2

Maintaining a Scheduled Monument or any heritage asset is not always a difficult task. In some cases, continuing the same practices as before will be what is best for your heritage assets.



Case Study D: Northwood, Slindon Estate, National Trust



BACKGROUND

'The Rise of Northwood' is a National Trust project to restore native woodland on an area which has been farmland until recently but which was formerly woodland until about 100 years ago. The former woodland was mostly clear-felled during the first world war (Sloan in Manley 2016) but some small pockets of woodland were not cut down and remain as ancient woodland today; however, these areas are small and disconnected from each other. Natural regeneration of trees in the area would have gradually increased the size of the woods but this project will help this process further through seed dispersal and tree planting.

There are several reasons that the National Trust are planning to restore the native woodland. The current isolation of woodland patches means much of the wildlife in these wooded areas is unable to join up without having to leave the safety of cover, an example being the harvest mouse. The land is registered as Grade 4 Agriculture under the Agricultural Land Classification (ALC) which indicates that the fields had poor agricultural productivity. The woodland would create a buffer between two of the Slindon Estates farms, reducing the risk of flooding by soaking up surface runoff. Finally, restoring the woodland will allow the Trust to open up Northwood to the public and create permissive paths where access was once impossible.

BEST PRACTICE IN STRATEGIC PLANNING

The layout of the new woodland is being designed around the many archaeological features present, and the NT will leave them as open areas. The extent and character of these sites have been surveyed and investigated by volunteers under the direction of the NT's own archaeologist, Tom Dommett. You can learn more about these efforts from the project website

www.riseofnorthwoodnt.wordpress.com

KEY TAKE AWAY #1

The National Trust used their own knowledge of the land, archaeological advice and the Historic Environment Records to find out what is there before designing woodlands and operations. This allowed them to design the woodland around the archaeological features.

KEY TAKE AWAY #2

A desk-based GIS/HER exercise is not always sufficient to identify and evaluate the historic features. The NT conducted a survey using volunteers to find and evaluate the archaeology that may have been missed in the records. While not always practical or within the goals of project the use of volunteers helped them build community buy-in for the project.

BEST PRACTICE IN OPERATIONS AND POST-OPERATION WORK

The Slindon Estate is working to a 10-year strategic management plan and is UKWAS certified. Forestry operations are done through a combination of direct employees, contractors, volunteers and fire wood merchants (standing sale). In addition to the woods, the Estate also manage around 550 veteran trees. Operations are carefully managed and site conditions regularly monitored during and after operations, as set out in the Strategic Plan.

KEY TAKE AWAY #3

Operations are one off events but they fit into the longer term management of the woodlands. Having a long term plan will reduce costs by not having to repeat all of the same steps e.g. strategic creation planning, for every operation.

Case Study E: Fencing re-alignment, Stansted Estate



BACKGROUND

Stansted Estate is managed by a Charitable Trust for the benefit of the nation. Forestry on the estate aims to balance timber production, landscape, conservation and public access interests. Standing sales are used for large commercial felling. On the estate there is a woodbank that crosses an area that has been planned for re-stocking.

BEST PRACTICE IN STRATEGIC PLANNING

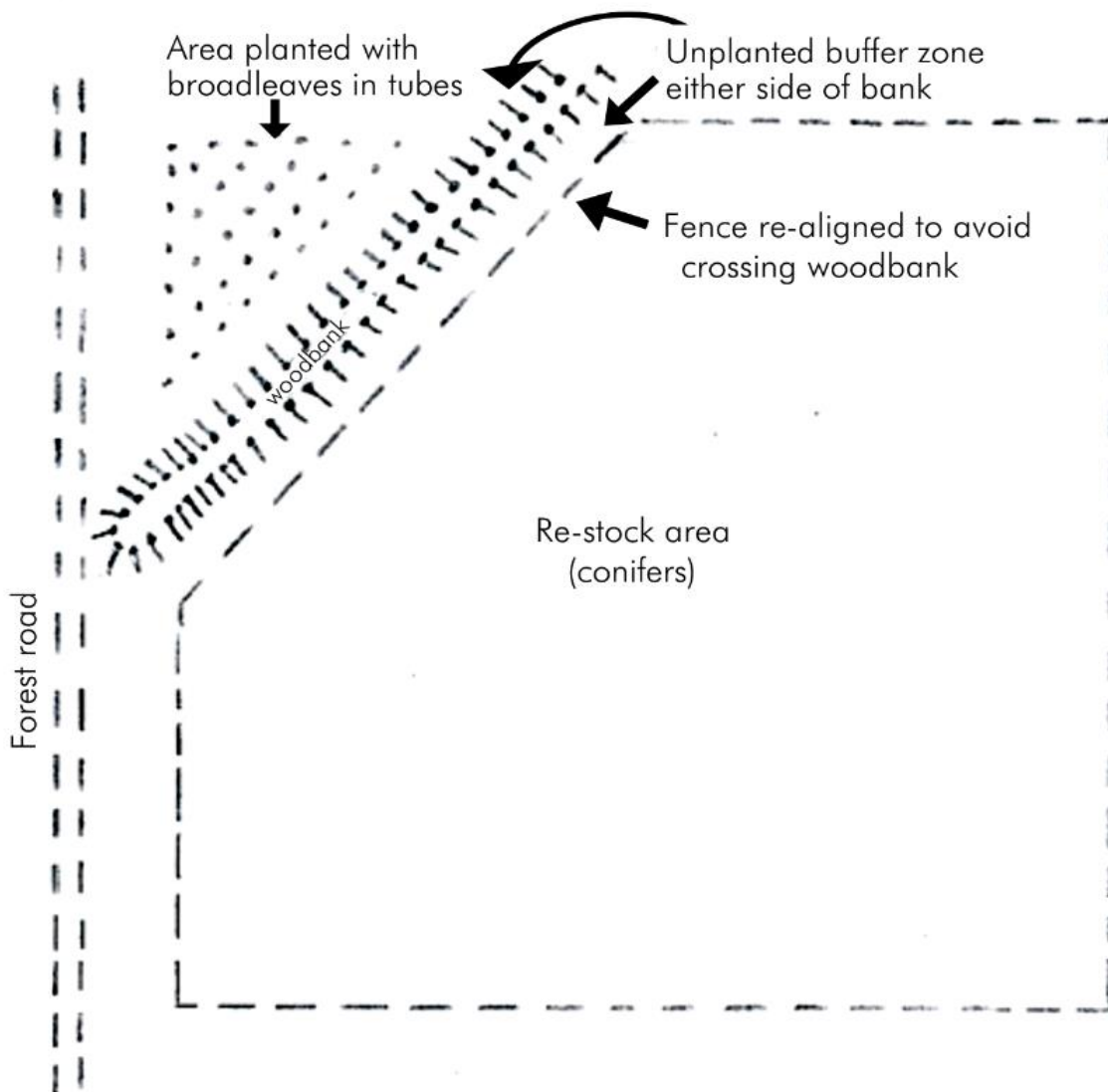
During the planning phase the re-stock fencing route was re-aligned to avoid cutting across the woodbank feature. Broadleaves are being planted in tubes in the area between the woodbank and the forest road, while the main re-stock area is being planted with conifers. A two metre buffer zone is being left unplanted either side of the woodbank.

KEY TAKE AWAY #1

Where possible work with the alignment of features to run fence-lines and access routes alongside them rather than 'cut them in half' or run over them. Leave a buffer zone around the feature.



Case Study E



BEST PRACTICE IN OPERATIONAL WORK

Work is largely done by an in-house team, with contractors well-known to the estate used on bigger jobs. The estate is working to a long term forest plan. Pre-site surveys, site marking and operational documentation are all used as required prior to and during operational work.

KEY TAKE AWAY #2

Using trusted contractors and ensuring that they are informed of the location of the features through site marking and operational documents is a great example of good communication. The estate has provided the contractors with all the information they need so as to avoid mistakes.

Case Study F: Devil's Jumps, Treyford, West Dean Estate

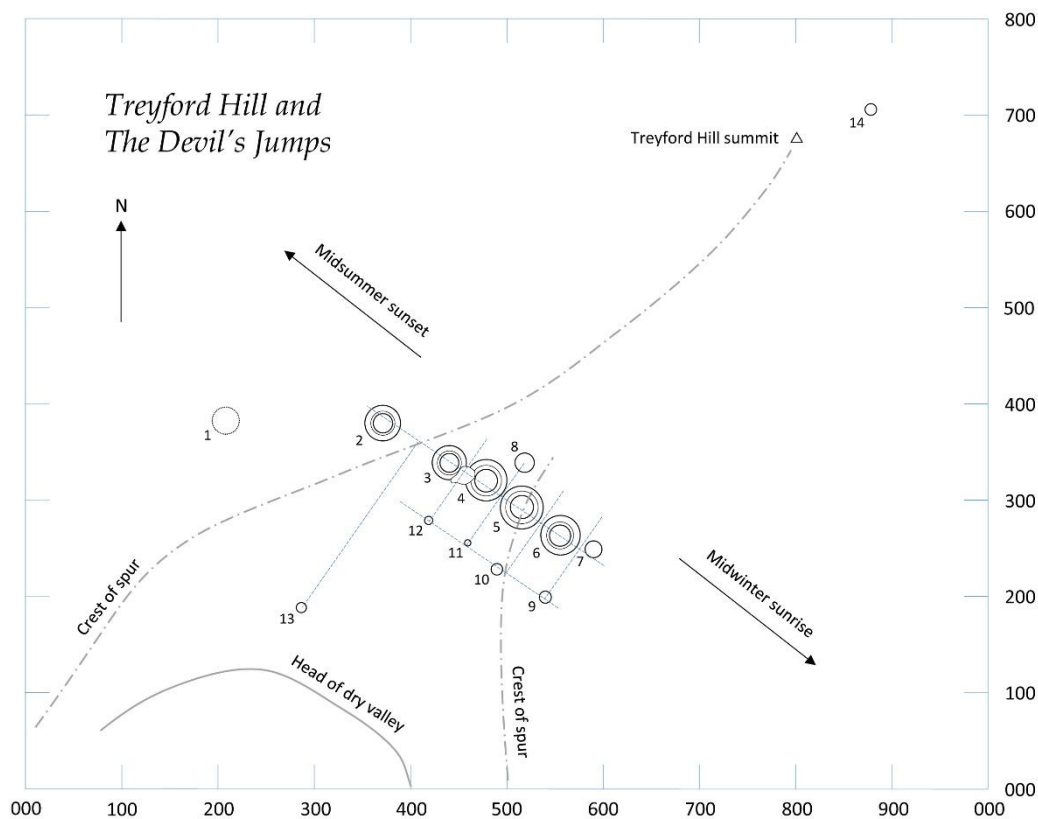
BACKGROUND

This is a long established example of woodland clearance from the series of barrows known as the Devil's Jumps. The site is a Scheduled Monument. The case presents an excellent example of land managers, authorities and volunteers working together for the good of the site. In this case the standard trees were removed from the barrows to prevent damage, and the conifer plantation adjacent to the site was also removed, revealing more barrows.



BEST PRACTICE IN STRATEGIC PLANNING

Before the South Downs National Park was established there was a site meeting of interested parties including West Dean Estate, English Heritage, Area of Outstanding Natural Beauty representatives, the local authority and the Murray Downland Trust to discuss the management of the Devil's Jumps. It was agreed that the estate would remove the trees and move the woodland boundary away from the barrows.



Plan of barrows and small mounds at the Devil's Jumps as revealed by the People of the Heath survey. The regular lay-out is picked out by the drawn orthogonal lines. © Stuart Needham.



BEST PRACTICE IN PRE-OPERATIONAL PLANNING

The block of woodland was examined by Chichester & District Archaeology Society members under the direction of the local authority archaeologist prior to felling to identify potential heritage assets and mitigate impact on them.



BEST PRACTICE IN POST-OPERATIONAL WORK

The Murray Downland Trust agreed to take on the maintenance of the site as an open area. More information about the Murray Downland Trust is available here:

www.murraydownlandtrust.blogspot.co.uk

KEY TAKE AWAY



As shown in the photos, there is now some return of scrub and this underlines the issue of the considerable maintenance work needed to keep areas open. This ongoing commitment has been made possible by the contribution of various organisations and highlights management of the natural and cultural landscapes is a team effort.



8 CONCLUSION & ACKNOWLEDGEMENTS

The Secret of the High Woods project celebrates the character of the South Downs woods and forests as essential components of the area's working and cultural landscapes. The project's LiDAR survey has enabled us to look through the canopy to see the archaeological landscapes preserved within the woods. The mapping of these earlier landscape features complements the existing records of built heritage and historic woodland, to create a much more holistic view of what is there. This in turn is assisting foresters and land managers with the ongoing stewardship of the land under their care.

These Guidelines have been developed with the invaluable input of local foresters, land managers and archaeologists, presenting their knowledge and experiences within the framework of the legal and best practice requirements of the forestry sector. Several case studies have been included, presenting some real life scenarios to illustrate how best practice is being implemented locally. Already the benefits of the additional information from the LiDAR survey are being seen, and going forward strategic plans and practical operational approaches are being reviewed in the light of these new findings. This will ensure the long term survival of the rich heritage assets of the wooded South Downs under careful local stewardship.

The authors are extremely grateful to the foresters, land managers and archaeologists of the project area who have been so generous with their input and their time. These include Mark Aldridge, Billie-Jo Blackett, Tom Dommett, Richard Everett, Kerry Hill, David Hopkins, James Kenny, Philip Kirk, Darren Norris, Ian Odin, Michael Prior, Mark Roberts, Mark Taylor, Rob Thurlow, Mark Wardle and Tim Yarnell. We also wish to thank the staff of the SDNPA who have shared their expertise and information so extensively, including Anne Bone, Andy Player, Ian McConnell and Abigail Rice. This report is founded upon the excellent work of many other people, staff and volunteers, who undertook the various Secrets of the High Woods reports and field investigations.



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APPENDIX 1 LEGISLATION, STANDARDS & GUIDANCE

Legislation and guidance exists to provide a framework for forestry planning and operations in England and the UK as a whole. Principal amongst the frameworks for legislation and guidance is the UK Forestry Standard. The UKFS is an umbrella which encapsulates the most relevant legislation and guidance. Because it is the over-arching forestry standard the framework provided by UKFS is introduced in Section 3, and explored in greater depth, along with other aspects of legislation and guidance, in this Appendix.

The UKFS and its supporting Guidelines are available from the Forestry Commission website at <http://www.forestry.gov.uk/ukfs> The UKFS Historic Environment Guidelines are available at <http://www.forestry.gov.uk/ukfs/historicenvironment>

There is also a handy UKFS checklist available free from the Forestry Commission website, for use on smartphones and tablets, which summarises the requirements for each aspect of the UKFS guidelines.

Detailed guidelines on meeting the UKFS Requirements for Historic Environment are set out in Section 6 of the Forests and Historic Environment document (FC 2011b: 15). That section lists eight generic factors about the Historic Environment (Table A) which are addressed by 30 Sustainable Forest Management guidelines, grouped by the factor headings (Table B). Reading through this section of the original document is highly recommended, as it gives more context for each of the factors and all the related guidelines. The practical measures for implementing the UKFS Forests and Historic Environment Guidelines are considered further in Section 6 of this document.

FACTOR	IMPORTANCE FOR HISTORIC ENVIRONMENT	HEG numbers (see Table B)
Historic context	All landscapes have intrinsic historical value and many have special cultural significance, as can the individual elements within them. The historic context provides the starting point in forest planning for the historic environment.	HEG 1, 2 & 3
Evidence of the historic environment	Assessing the evidence is vital in establishing the historic environment value of a site.	HEG 4, 5, 6, 7, 8 & 9
Forest planning	Consideration of the historic environment forms part of the forest planning process in both new woodlands and the redesign of existing woodland.	HEG 10, 11, 12, 13 & 14
Woodland heritage	Woodlands in their own right are often of significant historical interest, and historic environment features may have been preserved within them.	HEG 15, 16 & 17
Open space	Open space is often the most appropriate setting for historic environment features; open areas may have to be managed to minimise erosion or inappropriate woodland regeneration.	HEG 18 & 19
Forest operations	Forest operations, ground disturbance and heavy machinery involved in earthworks all have the potential to seriously damage historic environmental features.	HEG 20, 21, 22, 23 & 24
Site hydrology	Many buried archaeological features have survived well in waterlogged soils and altering the hydrology can affect their preservation.	HEG 25, 26 & 27
Access and interpretation	The historic environment provides considerable public benefit and enjoyment. Interpretation can provide a site focus and enhance the visitor experience.	HEG 28, 29 & 30

Table A Factors important for forests and historic environment (FC 2011b). HEG numbers refer to specific practical Historic Environment Guidelines for meeting the requirements for the eight historic environment factors, given in full in Section 6 of <http://www.forestry.gov.uk/ukfs/historicenvironment> and summarised in Table B below.

The UK Woodland Assurance Standard

The UK Woodland Assurance Standard (UKWAS) is an independent certification standard which sets out the requirements that woodland owners, managers and certification bodies can use to certify sustainable woodland management in the United Kingdom.

Primarily, the certification standard is designed to reflect the requirements set out in the governmental UK Forestry Standard (UKFS). In response to the demand from the UK forestry and forest products sector, the certification standard is also designed to reflect the requirements of the two leading global forest certification schemes - the Forest Stewardship Council (FSC) and Programme for the Endorsement of Forest Certification schemes (PEFC). Products certified through these schemes are in demand in the UK and global timber markets as they provide a widely recognised way to inform customers that timber products come from responsibly managed sources.



Forestry practice ancient and modern. Public Domain



To receive certification, there must be compliance with a wide range of requirements including several concerning the historic environment. Compliance is assessed as part of an annual UKWAS audit process. The UKWAS is at time of writing being updated from the current to its 4th version – available to the public in final draft form from the UKWAS website (UKWAS 2016). Where before sites of cultural significance were required to be ‘identified and discussed with interested local people, the relevant authorities and interest groups’ and measures taken for protection (UKWAS 2012: 45), the updated requirement (UKWAS 2016) focuses more on active and precautionary management taken by the landowner. It states that through engagement with the relevant statutory historical environment agencies, local people and other interested parties, and using other relevant sources of information, the owner/manager shall:

- Identify sites and features of special cultural and historical significance;
- Assess their condition; and
- Adopting a precautionary approach, devise and implement measures to maintain and/or enhance them (UKWAS, 2016: 20)

It is also notable that operations will cease or relocate if they damage features of significance or reveal previously unknown features (UKWAS 2016: 16). The potential pitfalls of being unaware of the historic environment within forests are highlighted in this current update: relevant bodies should be consulted before work takes place to ensure damage to archaeology is mitigated against.

Governmental Guidance for Forestry and the Historic Environment

Each country of the UK is subject to the legal requirements of UKFS, but as forest management is a devolved issue, each national government of the UK, and their relevant governmental bodies, produce individual policies, strategies and projects to manage forests and the historic environment.

The UK Government’s forestry and historic environment undertakings in England are run by the non-ministerial government department Forestry Commission England and by the non-departmental public body Historic England. Both have produced guidance around managing the historic environment and on LiDAR as a tool to fulfil this task.



Forestry Commission England

As a child agency of the Forestry Commission, Forestry Commission England's main guidance output is in the form of the UK Forestry Standard (UKFS) and its Guidelines documents. Forestry Commission England has set out its individual aims within its most recent Corporate Plan to continue to maintain, improve, and preserve the historic fabric and extensive range of archaeological sites within its forests, whilst also increasing the extent of restored Planted Ancient Woodland Sites (FCE 2015).

These aims are in line with the UK Government's Forestry and Woodlands Policy Statement released by the Department for Environment, Food and Rural Affairs in 2013, which targeted increasing woodland cover and putting more woodland into active management, two thirds of England's total by 2018 (DEFRA 2013). This document also highlighted the need to increase the skill-sets of forestry experts and form better networks of expertise. LiDAR, in its form as a management resource and as a new form of expertise, could have a role in fulfilling these targets.

The research agency of the Forest Commission, Forest Research, provides a guidance document for the use of LiDAR to achieve Historic Environment Surveys of woodland, and for other uses (Crow 2008). The document is broadly identical to the section encompassing woodland management in English Heritage's 'The Light Fantastic', sharing the same author, with perhaps more emphasis on LiDAR's possible application in Forest Design Planning, and that LiDAR survey allows important sites to be identified to workers prior to commencement of operations (Crow 2008, 9).



*Aerial photo of woodland and hidden features being revealed by LiDAR.
Lamb Lea, near Charlton*

Forest Research has also undertaken research into the attitude of landowners to woodland management in the UK, highlighting the strong ethic of custodianship and the sense of an obligation to protect woodland heritage among many landowners (Lawrence et al. 2010; Lawrence and Dandy 2014). Forest landowners' natural proclivity to custodianship over the historic environment is a promising trend for developing woodland management strategies, as well as perhaps for informing the public of the culture and history within these areas.

Governmental Guidance – Forestry in the rest of the UK

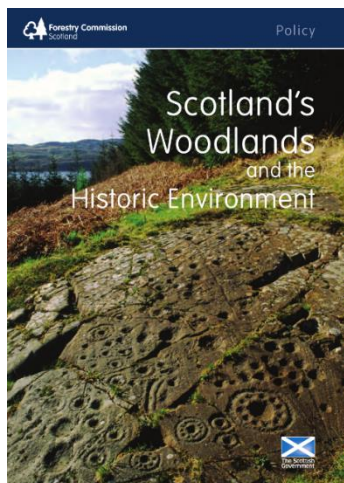
The relationship between the management of the historic environment and forestry for the rest of the UK is similar to that in England, due to all countries of the UK being obliged to follow the requirements of the UKFS and its related Guidelines. However, due to the different executive governments interpreting these guidelines within their own unique landscapes, there are a number of national strategies and projects from which to take inspiration.

All executive governments and their respective bodies in the UK share in concepts which include increasing the area of forests under active management; increasing overall tree cover; and improving forestry skill-sets (NI Forest Service 2006; Scottish Executive 2006; Welsh Assembly 2009; DEFRA 2013). In Wales, forestry guidance comes through the UKFS. However, the Welsh Assembly's policies for forestry also champion public involvement with woodland owners and the improvement of existing mechanisms to manage archaeological sites (Welsh Assembly 2009).

Within the past 10 years, Scotland has perhaps, out of all the countries of the UK, produced the leading response to managing the historic environment within forests. In 2006, the Scottish Executive classified heritage as an environmental quality, placing the identification of significant evidence of the historic environment through the process of forest design as a priority (Scottish Executive 2006). Subsequently, several excellent resources have been developed by Forestry Commission Scotland, including:

- An on-line training course for foresters which promotes best practice in the identification, protection and conservation management of the historic environment in Scotland. The course has been developed to help develop forest management plans with respect to the UKFS Forests and Historic Environment Guidelines, and as such has wider UK relevance. Available at <http://scotland.forestry.gov.uk/supporting/strategy-policy-guidance/historic-environment/training-course>
- 'Scotland's woodlands and the historic environment', a policy document outlining how the forestry sector can manage woodland to enhance stewardship of the historic environment (FCS 2008);
- Guidelines for identifying archaeological features, focusing on the most common types found in Scottish woods, in the form of a pdf booklet (FCS 2010);
- Detailed guidelines on heritage designations and legislation, forestry operations, information sources and methods for gathering new information (FCS 2011a);
- A practice guide for stewardship of trees and woodlands within a landscape context (FCS 2011b);
- A collection of case studies for promoting best practice, detailing forestry and historic environment interactions within a variety of landscapes (FCS 2013);
- A guidance note on obtaining archaeological information in line with UKFS guidance, that is to consult professional services where they may be required (FCS 2016).

This suite of resources, aimed at those working within the forestry sector, is given by the Scottish Government to champion sustainable conservation management of the historic environment (Scottish Government 2014: 12). Many of the principles and practices are transferable to other parts of the UK.



Scotland: (L) cover of the Scottish guidance document 'Scotland's woodlands and the historic environment'; (R) Scottish case study, Balgownie Wood, Fife, a combination of a PAWS and a LEPO site. A 16th century plantation created over medieval rig field system. In the photo a late 18th century improvement era beech hedge on a field bank has been allowed to grow on to form a magnificent edge to the newest part of the plantation created in the early 19th century when the field was absorbed into the wood's expanding footprint (Mills and Quelch 2011, FCS 2013, Quelch and Mills 2016).

Ancient Woodland, other historic woods and Veteran Trees

The term 'heritage assets in woodland' covers more than historic monuments, i.e. built heritage, because of course the woods and trees themselves may be of historic interest. The most obvious form of woodland with historic interest must be Ancient Woodland. Ancient woodland takes many hundreds of years to establish and is considered important for its wildlife, soils, recreation, cultural value, history and contribution to landscapes. Similarly, Veteran Trees are important survivors of past forestry and land cover. The issues around Ancient Woodland and Veteran Trees are explored further in Section 3 of the main text.



South Downs National Park designation

The project area lies within the South Downs National Park. As a National Park, the area is subject to protection under the terms of the National Parks and Access to the Countryside Act 1949. Several other acts regarding conservation and countryside access relate to this act, including the Environmental Protection Act 1990 (control of emissions), the Environment Act 1995 (standards for environmental management), the Countryside and Rights of Way Act 2000 (countryside access) and the Natural Environment and Rural Communities Act 2006.

The Environment Act 1995 set out two statutory purposes for national parks in England and Wales:

1. Conserve and enhance the natural beauty, wildlife and cultural heritage
2. Promote opportunities for the understanding and enjoyment of the special qualities of national parks by the public

When undertaking these statutory purposes, the parks also have a duty to seek to foster the social and economic wellbeing of the local communities within the National Park in pursuit of their purposes. To enable the National Park Authorities (NPA) to meet these goals the Government has made the NPAs the sole planning authorities for their areas, including plan-making, enforcement, development control and minerals and waste planning responsibilities.

There are currently (2017) fifteen national parks in the UK. Every national park authority is required to produce a National Park Management Plan. Local communities, landowners and other organisations are asked for their opinions and help in achieving the plan. As well as preparing the statutory management plan for the whole of the National Park, the Authority has responsibility, under the Localism Act 2011, of working with local communities on Neighbourhood Plans.

Historic England (formerly English Heritage)

Historic England is the public body that looks after England's historic environment. It champions and protects historic places, helping people to understand, value and care for them. Listing is the term given by Historic England to the practice of listing buildings, scheduling monuments, registering parks, gardens and battlefields, and protecting wreck sites. Listing allows Historic England to highlight what is significant about a building or site, and helps to make sure that any future changes to it do not result in the loss of its significance.

Scheduling is the process through which nationally important sites and monuments are given legal protection, and is the most relevant aspect of Historic England's remit with respect to the Secrets of the High Woods project. However, the lack of a designation for a particular monument should not be interpreted as a lack of significance. Newly discovered monuments will probably not have been considered yet for scheduling or they may be of regional or local significance, even if not viewed as of national significance, the criterion on which scheduling is conferred.

Historic England does not explicitly address management of cultural heritage in woodland. However, methods from its document *Conservation Principles* (English Heritage 2008) are useful tools for all those working within the historic environment. Intended for Historic England staff making decisions concerning the historic environment, *Conservation Principles* is particularly useful for evaluating the 'importance' or 'significance' of a heritage asset, which is made more objective by assessing four contributing values: historic, communal, aesthetic, and evidential.

This method is inspired by the tenets of Planning Policy Statement 5: Planning for the Historic Environment (Historic England 2010) – which demonstrates that heritage assets are a non-renewable resource, and that change to them must be proportional to their importance. Significance appears throughout the UKFS, but without a given definition. The task of explaining decisions concerning the historic environment to different stakeholders may be easier through this tested framework for describing significance.



Devil's Jumps- ancient Bronze Age barrows near Treyford



South Downs 'The Trundle'

Historic England's guidelines for management concerning LiDAR datasets are contained within a document called 'The Light Fantastic' (Crutchley and Crow 2010). The document introduces LiDAR and provides guidance for its archaeological use under the four outputs of visualisation, interpretation, mapping and field use. The document includes amongst its case studies the examples of the Forest of Dean and Savernake Forest and one of its five parts is devoted to LiDAR for woodland survey, authored by Forest Research landscape scientist Peter Crow. Crow echoes the UKFS guidance in noting that LiDAR provides an opportunity to learn about the historic environment under woodland cover on a dramatic scale (Crutchley and Crow 2010: 33). However, LiDAR results must be considered carefully, especially within managed forests, as some forestry attributes may appear like archaeological sites, for example timber stacks or dense plant growth giving the appearance of earthworks (Crutchley and Crow 2010: 34). Ground-truthing is an important aspect of the follow up process after LiDAR survey.

The Light Fantastic, much like the UKFS, warns that the biggest risk for the historic environment is accidental. Therefore, knowledge proliferation and early warning are key. LiDAR survey's greatest strength is in allowing the location of otherwise unmapped or unknown sites and monuments to be identified, and therefore allowing mitigation to be planned in advance. For example, it permits a more sensitive approach to designing access routes or re-setting a historic asset (Crutchley and Crow 2010: 36).

There are other benefits to LiDAR beyond the heritage applications. LiDAR also allows for better mapping of forestry operations and plans. Wider research into the application of LiDAR within management reflects these sentiments: Petersen et al. (2005) confirm the successful application of LiDAR in recovering forest structure characteristics, while Wulder et al. (2008) see the greatest opportunities within 'engineering purposes' such as harvest planning.

Historic England published its Introduction to Heritage Assets (Archaeology) series, before its rebrand from the name English Heritage. Guides in this series touch upon some of the features that LiDAR has uncovered in the South Downs, such as Field Systems (McOmish 2011) and Barrows and Burial Mounds (Field 2011). These guides serve as a good introduction to the different types of archaeology present in England but do not address conservation and management issues.



APPENDIX 2 A HISTORY OF THE ARCHAEOLOGICAL LANDSCAPE IN THE HIGH WOODS

The Secrets of the High Woods LiDAR survey has revealed extensive archaeology beneath the tree canopy, much of which was previously unknown. The survey area may reasonably be described as an archaeological landscape, not frozen in time from one particular period but with successive layers of land-use overlying, inter-cutting or even removing earlier evidence. Reading this complex layered archaeological landscape is a specialist task, and has been the subject of a 'National Mapping Programme' (NMP) report (Carpenter et al. 2016), a research agenda to guide future studies in the area (Thorne & Bennett 2015; Bone forthcoming) and a popular book (Manley 2016).

These reports consider not only the LiDAR survey, but also the evidence from aerial photographs, field investigations, historic mapping and ground-truthing work. It is possible only to give a summary of the findings here, and the reader is referred to the published reports for the fuller picture. They largely follow a chronological structure, describing the archaeology from each successive period through time. Experience allows the archaeologists to make informed judgements about the age and typology of the various remains revealed by the project, and this is the foundation for starting to evaluate their importance. However, only a small amount of archaeological field investigation and ground-truthing has so far occurred, and the work of checking and evaluating what has been revealed by the airborne survey has really only just started.

The Palaeolithic and Mesolithic periods (before 4300 BC)

The earliest people of the South Downs were hunter-gatherers who left only ephemeral traces of their activities, and therefore the LiDAR survey is not able to detect their remains. Their presence is primarily known from chance finds of stone tools. However, several important discoveries of hominid remains of Lower Palaeolithic date have been made from the raised beach deposits at the foot of the dip-slope of the Downs, just outside the National Park boundary (Thorne and Bennett 2015).



*Recreation of Mesolithic dugout boats. Public Domain.
https://commons.wikimedia.org/wiki/File:Dugout_boats_Kierikki_Centre_Oulu_20130526.JPG*

These include the internationally important site at Boxgrove, with deposits and artefacts dated to about 500,000 BC (Pitts & Roberts 1998). Further evidence from this period was uncovered in fieldwork ahead of an extension of the gravel quarry to the south of the Valdoe (Pope et al. 2009).



Skull of Homo heidelbergensis who would have produced the artefacts at Boxgrove. © Gerbil. Free Art License

After the last Ice Age, from about 10,000 BC, the Mesolithic period saw the return of people to the South Downs in response to an improving climate which gradually led to the spread of woodland. This developed into a mixed broad-leaved forest dominated by oak and including elm, ash, alder, lime and hazel. Humans were attracted by the resources of the woods and the river valleys, and effected small scale clearances. Their settlements were temporary structures or seasonal camps and evidence for them is scarce. Most of the evidence for the Mesolithic comes from flint scatters, and therefore is not detectable from the LiDAR survey (Thorne and Bennett 2015).



The Neolithic (c.4300BC-2200 BC)

The Neolithic, the time of the first farmers, is the earliest period for which the LiDAR survey can detect man-made sites in the project area. These earliest sites are represented by flint mines, causewayed enclosures and long or oval barrows, while Neolithic settlements are elusive and field systems almost unknown. Some woodland clearance took place in this period, leading to a mosaic of woods and open areas in what was predominantly a pastoral landscape (Thorne & Bennett 2015).



Photo flint mine(s)

Examples of flint mines (Whittle et al 2011: 257) in the study area include Long Down, Eartham, Nore Down and Robin Wood, Compton and Stoke Clump, Funtington, with other possible mines also noted at Court Hill, Singleton and Bow Hill, Stoughton. The four causewayed enclosures in the High Woods are of special note, being among the oldest and rarest type of archaeological monument in Britain (Oswald 2011). They are thought to date from between about 3,800 BC and 3,500 BC and only a few survive across the country as upstanding earthworks, some 15 out of 80 examples (Oswald et al. 2001). Most of them survive as cropmarks only, and so the four causewayed enclosures in the High Woods area, Barkhale, Court Hill, Halnaker Hill and the Trundle, represent a significant group of monuments.

A fifth enclosure on Bury Hill has a continuous bank and ditch, so is different from the causewayed enclosures but is still thought to be Neolithic in date (Oswald et al. 2001, 156). Bury Hill was identified as cropmarks on aerial photographs, but the High Woods LiDAR data suggests that in places the bank survives as a very slight earthwork (Thorne and Bennett 2015).

The third major category of monuments of the Neolithic period are long mounds or long barrows. These also represent rare and nationally significant evidence of past communities and had a ceremonial and funerary function. They usually comprise a large mound of material up to about 50m in length and up to 25m wide, generally flanked by ditches. The SoHW project has identified three possible long barrows, seen as cropmarks, at Main Down, Harting, The Valdoe, Lavant and The Warren, Harting. Other notable monuments with possible Neolithic or early Bronze Age dates include oval barrows and pit circles identified by the National Mapping Project survey near Lordington (Thorne and Bennett 2015).

Late Neolithic-Early Bronze Age (c.2200–1400 BC)

A new burial rite emerges in southern England from the late 3rd millennium BC, at the beginning of what is known as the Beaker period, with inhumation of single individuals under round barrows (Field 2008, 71). In our study area these are mostly concentrated along the chalk escarpment. The National Mapping Programme (Carpenter et al. 2016) recorded a substantial number of round barrows (226 in total) representing a range of forms in the High Woods area. These included the most common bowl barrow type (simply a mound surrounded by a ditch) and more complex forms with multiple ditches, berms and mounds.

Isolated barrows are occasionally seen but they are generally found in groups, and sometimes in alignment. Within each cemetery there may be a variety of types of barrow, for example in the Devil's Jumps, Treyford, the Devil's Humps, Stoughton and Heyshott Down. The barrows were mostly positioned on higher ground along the crests of ridges and hilltops. They sometimes seem to have associations with probably later linear boundaries and cross ridge dykes. Similarly, there are possible relationships between Bronze Age round barrows and Neolithic enclosures (Rudling 2003: 60) although this could be down to them happening to share elevated positions (Thorne and Bennett 2015).



View of round barrow. © Jim Champion CC BY-SA 2.0

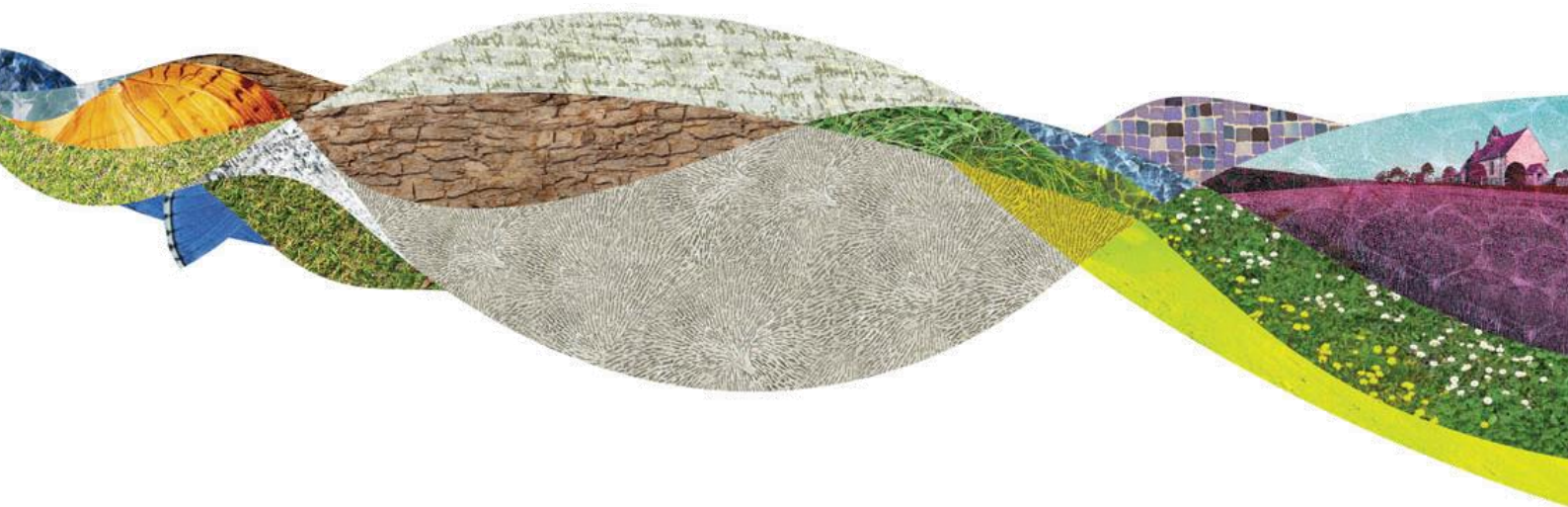
The high proportion of barrows in readily visible upland locations supports the idea that they acted as territorial markers designed to be seen widely in the landscape (Woodward 2000, 51-5). The smaller numbers situated in more hidden locations, in dry valleys and on lower slopes, may have played a different role, perhaps marking or guarding significant places along important traditional ceremonial route ways (Thorne and Bennett 2015).

Evidence for settlement in this period is rare, perhaps because domestic buildings were rather slight (Bradley et al 2014) or perhaps because settlement was focused in valley bottoms where it has been buried beneath later deposits of hill wash. More field research on this issue is desirable within the project area.

Environmentally, the Bronze Age is regarded as a period of extensive woodland clearance in the face of expanding agricultural activity. In the wider region, excavation in advance of the Brighton bypass construction identified colluvial (hill wash) deposits dating to the early Bronze Age. It is often supposed that barrows indicate an open environment at the time they were constructed, as many buried soils beneath barrows from across the southern downland have shown (Allen in Walker and Farwell 2000:159). However, an example from Twyford Down of Early Bronze Age to Middle Bronze Age date has been proven to have been constructed in a locally cleared area of woodland (Walker and Farwell 2000: 17) and there may have been substantial areas of the chalk downland still remaining under woodland cover (Thorne and Bennett 2015).



Twyford Down



Middle and Late Bronze Age (c.1400 - 700 BC)

Much more widespread clearance of woodland is evident in the project area in the middle to late Bronze Age, going hand in hand with the development of extensive field systems which are well represented in the LiDAR data (Thorne and Bennett 2015).

Thus there is a shift away from the predominantly ceremonial monuments typifying the Neolithic and Early Bronze Age record, to more of the evidence of everyday life, in which both pastoral and arable agriculture featured. However, the field systems can be difficult to date on morphology alone, and many of them are likely to have great longevity, with evidence of some being maintained well into the Iron



Bronze Age bell barrows now known as the Devil's Jumps, near Treyford. Attribution-ShareAlike 2.0 © Generic Dave Spicer

Age, as appears to be the case for the so-called co-axial systems (Bradley and Yates 2007: 96).

The environmental impact of later Bronze Age agriculture is evident from excavations in dry valleys in the eastern Downs where datable episodes of sedimentation point to extensive woodland clearance followed by cultivation (Rudling 2003: 236, Wilkinson 2003: 747). Much more research and excavation is needed to tease out the chronology of the evolving farming landscape over the Bronze and Iron Ages in the area. Such evidence has been more forthcoming from the coastal plain than from the South Downs where development-led excavation is rare. For example, recent excavation at Peacehaven at the east end of the South Downs identified Middle Bronze Age field systems together with cremation burials and roundhouse settlement (Thorne and Bennett 2015).

Settlements of this period are usually small, with between two and five round houses, and can be enclosed or unenclosed. In the wider Downs area, settlements often have house platforms set within field systems or small enclosures, with such an example excavated at Black Patch (Drewett et al. 1988: 97). The settlements are interpreted as housing single family groups practising mixed farming. However, only one such settlement complex is known in the project area, at Kingley Vale, and much more investigation of the archaeological record is needed to locate and understand the organisation of settlement in this period.

Towards the end of the Bronze Age a new and impressive type of monument appears, the 'Hillfort', now more often referred to as a 'hilltop enclosure' as current thinking sees it as unlikely that all such enclosures had a common function. Some may be settlements while others may be animal corrals (Rudling 2002: 257). The inter-visibility of such sites seems to be an important characteristic, and they are often located at the edge of the downland, commanding views out over the landscape (Hamilton and Manley 1997: 100) as, for example, at Beacon Hill, Harting (Thorne and Bennett 2015).

The 'cross ridge' dyke is another monument type typifying the Late Bronze Age here, with eighteen of these linear features currently recorded in the Historic Environment Record for the project area, and the discovery of more to be expected through new research (Thorne and Bennett 2015). They have been interpreted as land divisions developed through increased territoriality and perhaps linked to increased pressure on the land and a greater emphasis on animal husbandry above cereal production (Cunliffe 2005: 421-423).

As the hilltop enclosures emerge, during the Late Bronze Age, there is less evidence for other settlement at the Late Bronze Age to Iron Age transition, a phenomenon which is difficult to explain when agriculture appears to be intensifying (Bradley and Yates 2007: 97). More research and excavation may eventually yield more evidence of settlement at this time.



The Iron Age (c.700 BC – AD 43)

In general, the Iron Age has left a larger and more varied archaeological record than the Bronze Age. However, early Iron Age farmsteads, which must have been the main social and economic unit of that time, are difficult to identify in the project area. The reason is unclear but could be due to a shift away from defining house plots with permanent enclosures and perhaps hedges or slight fences were used, leaving no permanent trace. Such features would not show up on the LiDAR survey. Early Iron Age settlement is largely represented by plough soil pottery finds, for example at Barlavington, Harting Down, Stoke Clump and Compton (Thorne and Bennett 2015). However, there are so far too few known sites to characterise the nature of earlier Iron Age settlement within the study area, and more research and excavation is needed to better understand this period.



Recreated Iron Age Roundhouses

The knowledge of Middle Iron Age settlement is better, with both enclosed and unenclosed examples known, mainly through excavation, for example of a hillslope enclosure at Rummages Barn (Kenny 1985) and of unenclosed roundhouses and post-built structures at Chalkpit Lane, Lavant (Kenny 1993:28). These sites had no upstanding remains, only sub-surface features, and so sites like these would not show up on the LiDAR survey. Middle Iron Age enclosures have also been located at Selhurstpark Farm, Boxgrove, Goosehill Camp, West Dean, and Carne's Seat, Westhampnett (Thorne and Bennett 2015).

The hillfort is surely the most well-known site type of the Iron Age in the south of England. While some hillforts originated in the hilltop enclosures of the later Bronze Age, a new form of enclosure, known as a 'developed hillfort' characterises the Middle Iron Age (Thorne and Bennett 2015). These are seen as important centralised places, often with defensive features and evidence of settlement and substantial storage pits, most probably for grain (Hamilton and Manley 1997). These hillforts have been interpreted as defended elite residences, controlling the surrounding territory and its commodities, and they might also have had religious significance (Cunliffe 2005: 309). Opinions differ on whether the impressive ramparts have a primarily defensive role or act as symbols of power in the landscape. Of course, a dual role is possible.

As we move into the later Iron Age, there is increased evidence of settlement in the region, especially on the coastal plain, evidence which is interpreted as reflecting population expansion and more intensive use of the landscape, alongside possible loss of fertility of the downland soils (Drewett et al. 1988: 129). Characteristics of settlement of the period include individual enclosed or unenclosed farmsteads set within permanent agricultural systems of rectilinear fields and trackways. Small enclosures at Carne's Seat and Selhurst Park are rare excavated examples in the area (Thorne and Bennett 2015). Many field systems are thought to date to the late Iron Age with

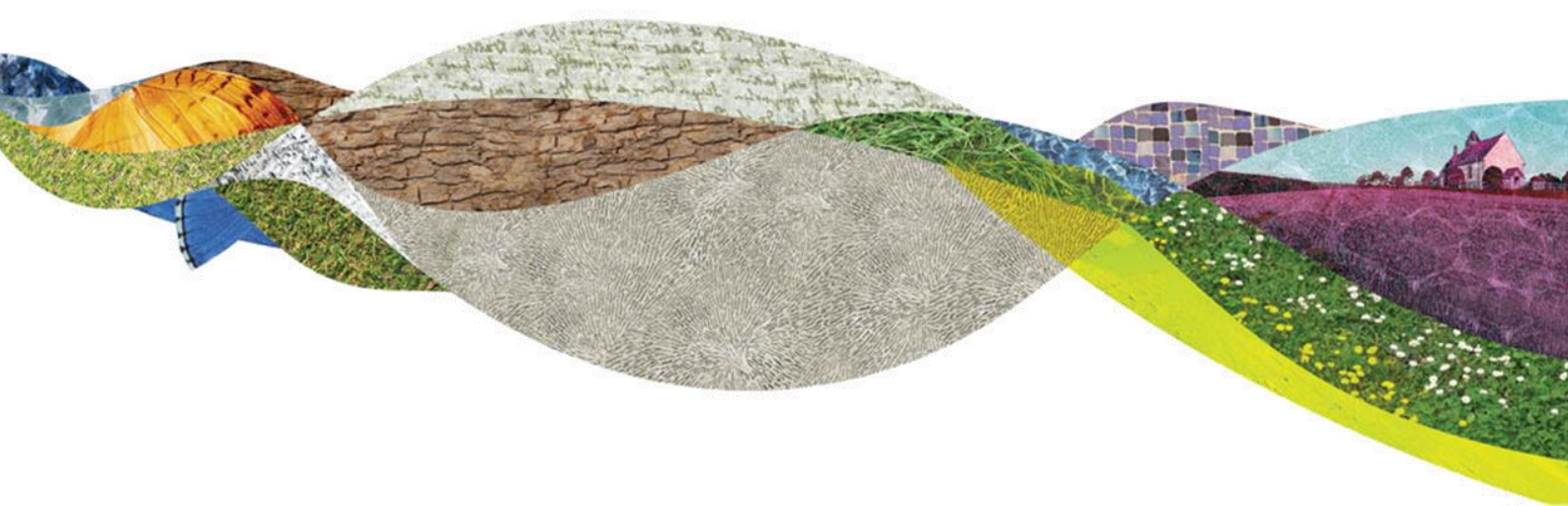
lynchets, banks of earth accumulated at the downslope end of a ploughed field, being a common feature.

However, dating lynchets is very difficult, not least due to their potential longevity, and many can only be ascribed a very broad multi-period date. A well-known example of a field monument in the project area with a probable later Iron Age date is the Devil's Ditch, a long section of which was recorded in recent fieldwork for the SoHW project at the Valdoe on the Goodwood Estate (Pengelly and Thorne 2015). This is a massive bank and ditch feature, which in places has been re-cut and modified, probably in the medieval period and which is well-preserved in its 1 km stretch through the woodland of the Valdoe. In places it cuts lynchets which are therefore regarded as earlier than the Devil's Ditch (Pengelly and Thorne 2015), although excavation would be required to tease out more specific dating.



Excavation as part of the Secret of the Highwood project.

Political and cultural change is viewed as a characteristic of the late Iron Age, for example as seen in the abandonment of the western Sussex hillforts in the last century AD. At the same time coins with Romanised inscriptions were being produced. Pro-Roman sympathies may have been developing locally (Cunliffe 2005) so that, after the Roman invasion of AD54 under Emperor Claudius, favourable trading arrangements may have been readily created with pro-Roman tribes in the region (Drewett et al 1988: 176) such as the Atrebates who are thought to have inhabited the project area (Thorne and Bennett 2015).



The Roman Period (AD 43 – c.410)

After the Roman 'conquest', which might well have been welcomed by pro-Roman tribes like the Atrebates, the region was ruled as a client kingdom and later subsumed into the Roman province of Britannia. The impressive palace complex at Fishbourne implies an international importance for the project area, perhaps reflecting the success of the Atrebates in negotiating their relationship with the Roman world (Thorne and Bennett 2015).

Many other villas were established locally, usually in the more productive agricultural areas including the southern fringes of the South Downs. Some villas may have developed out of previous late Iron Age settlements (Rudling 2003: 118) while others were newly established in the Roman period.

The LiDAR data provide an opportunity to investigate these sites within their landscape context, and may allow a better understanding of the extent and the economy of the villa estates (Thorne and Bennett 2015).



Roman Villa at Butser Ancient Farm, interior view

Forms of non-villa rural Romano-British settlement are expected to be common in the project area, but they are not well understood because historically most excavation has focussed on villa sites. An exception is seen at Chalton Down, a rural settlement site which was excavated by Cunliffe in the 1960s (Cunliffe 1973 and 1976). Such sites could include the remains of traditional roundhouses, along with house platforms, long rectangular fields and trackways in particular arrangements.

Other rural settlements of this era have been recognised by the presence of corn dryers and threshing floors next to ditched enclosures. The relationship between the villas and the non-villa settlements is poorly understood, and the LiDAR data offers great potential for investigating the Romano-British rural landscape further (Thorne and Bennett 2015). Following the LiDAR survey, one of the linked field investigations was undertaken at Queen Elizabeth Country Park, to check the extent and character of archaeology around the scheduled Romano British settlements at Holt Down and Chalton Down (Thorne and Webber 2015). This confirmed the indications from the LiDAR data that the archaeological remains of probable Romano-British date, mostly under woodland cover, extended well beyond the limits of the scheduled areas.



Samianware found at an excavation at Goblestubby

Environmental evidence from excavations in the eastern South Downs have demonstrated the intensive use of the landscape during the Romano-British period. The huge depth of colluvium (hill-wash) observed in the Brighton bypass excavations indicates cultivation on a much greater scale than had so far occurred in any period (Wilkinson 2003: 748). The picture in the western downland is less clear, due to a lack of field investigation (Thorne and Bennett 2015).

Other evidence of Roman impact on the landscape is represented by the road network, with Stane Street and the Chichester–Silchester road running through the project area. Industrial remains are also known, for example the pottery kilns at Rowland's Castle, just west of the project area, and in the Arun valley, just to the east (Thorne and Bennett 2015). Surface pottery collections at terraced features on steep slopes in Markwells Wood, on the Hampshire/West Sussex border, proved to be diagnostic of Rowland's Castle ware of 1st century AD date which indicated an early Roman date for these terraces (Thorne and Doherty 2016).

Physical evidence of the religious life of the Romano-British people in this region is best known from the shrine at Hayling Island, where a Roman temple was built over the site of a circular Iron Age structure. A possible temple site at Bow Hill, in the project area, was excavated in the 1920s, unfortunately leaving few records. It seems to have been a square building, and amongst the finds were roof tiles, plaster and coins, some from the 1st century but most from the 4th century AD (Rudling 2008: 110). Nearby, a Roman coin and pottery were found at a barrow, and such evidence of the apparent veneration of Bronze Age barrows by the Romano-British is quite widespread in the south of England (Drewett et al. 1988: 212).

Raiding along the south coast became a destabilising force from the 3rd century AD, and led to the development of forts along the shore and the fortification of urban centres (Drewett et al. 1988: 201). By the late 3rd century AD many villas in the region are in decline or abandoned (Drewett et al. 1988; 216), and at this time Fishbourne Palace burnt down. However, some villas in the project area continued to operate, for example the villa at Bignor which was one of a number which developed into 'super villas' during the 4th century. In time, commerce waned and by the later 4th and early 5th century the remaining villas could no longer survive (Thorne and Bennett 2015).

The Early Medieval Period (c.AD 410 - 1066)

Invasion theories have dominated thinking on the transition between the Romano-British and Early Medieval period, with Anglo-Saxon migration seen as filling the void created by the collapse of the Roman economy. The reality was probably rather more nuanced, with intermarriage and cultural assimilation effecting a blurring of ethnic identities (Thorne and Bennett 2015).

Archaeologically, the material culture of the early Saxon period is far less visible than that of the Romano-British period, due to a return to a dispersed rural settlement pattern and a model of local production and use of organic materials. Early Saxon cemeteries yield the most evidence of the material culture, with a local example at Apple Down and possible other examples at East Marden and Walderton Down, Stoughton. Interestingly, the secondary use of barrow cemeteries is again seen, just as occurred in the Roman period, for example at West Copse, Funtingdon and Halnaker (Thorne and Bennett 2015).

The villas on the Downs were in terminal decline before the end of the Roman era, and apparently not re-used thereafter. Settlement of the early Saxon period is difficult to identify because buildings seem to have been short-lived (Drewett et al. 1988: 294) and usually left no upstanding remains. Therefore they are more likely to be identified through air photographs than LiDAR. A local example has been found at Chalton (Addyman and Leigh 1973) and sunken floored buildings of middle-Saxon date have been excavated at Marden and Upwaltham (Thorne and Bennett 2015). However, there is rather more evidence of early Saxon settlement at the eastern end of the South Downs, outside the project area, and perhaps this is a significant pattern in that it is away from the earlier area of Roman settlement at the west end of the South Downs (White 1999: 28). The apparent absence of early Saxon settlements from the valleys may be in part due to them being masked by colluvium (hill-wash) or by later Medieval settlement (Thorne and Bennett 2015).



Anglo-Saxon sword and scabbard mount (6th century) from Grave 76 at the cemetery of Chessel Down (Isle of Wight). British Museum in London. Public Domain



Hoard of Anglo-Saxon rings. CC-BY Licence. Author: Portable Antiquities Scheme

In the later Saxon period, settlement is thought to have become more centralised into villages within estates (Brandon 1999: 56), and the development of estates during the Early Medieval period is likely to be of particular interest given how it shapes land ownership and estate boundaries into the present-day. More research and field investigation is needed to reveal the changing patterns and character of Saxon settlement and land management, although the role of the LiDAR data may be limited by the lack of upstanding settlement remains and perhaps is more useful in tracing estate boundaries (Thorne and Bennett 2015).

More environmental research is desirable to investigate the changing balance of woodland, arable and pasture in the post-Roman landscape, but placename evidence does indicate the presence of woodland on the South Downs (Gardiner 2008: 59). Of course, wood and timber would have been vital resources to the Anglo-Saxon way of life and surely must have been an important element of the emerging estates. As Sussex is finally converted to Christianity in the late 7th century, written records begin in the form of land charters, witnessing the granting of land to various noblemen. Minster churches were also established around this time on some estates. The pattern of landed estates evolves so that by the time of Domesday there is a concentration of estates in the South Downs, held by the Crown, the Church and a number of powerful families (Thorne and Bennett 2015).

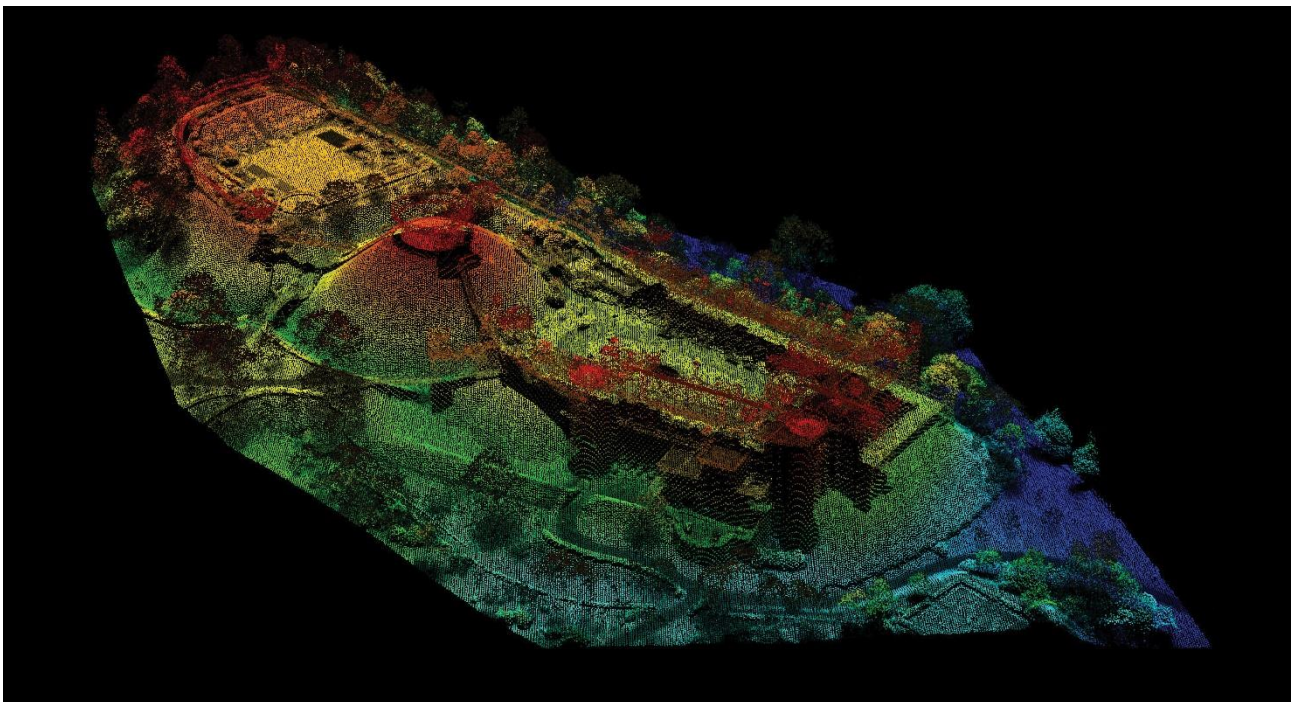
Elements of the Anglo-Saxon landscape which may sometimes be visible in the LiDAR data include manorial and parish boundaries, and hundred meeting places. On occasion they re-use earlier features, for example at the 'Moot Mound' in Barkhale Wood where a Bronze Age bowl barrow is used as an Anglo-Saxon meeting place. Significantly, this site is located at the junction of the boundaries of four parishes, Bignor, Bury, Houghton and Madehurst, presumed to be the parishes over which the moot court held sway (Thorne & Bennett 2015).



The Medieval Period (AD 1066 – 1540)

The administrative systems developed during Anglo-Saxon times, with parishes, hundreds, and probably also Sussex's Rapal system (made up of groups of hundreds), were already well-developed by the time of the Norman Conquest and were retained thereafter (Gardiner in Rudling 2003:159). Under the ruling Norman elite, a feudal land-ownership model was pursued, whereby all land belonged to the king and parts of it were gifted to loyal followers. In this way, powerful families built up their landholdings, and in Sussex for example, by the 14th century, the Earls of Arundel estates comprised 64 manors, 12 hunting forests, 13 deer parks and all together 13,000 arable acres and 10,000 woodland acres (Brandon and Short 1990: 118). Hunting, farming and forestry interests must have co-existed, as they do today.

Most people lived in hamlets or villages, which would have had common fields nearby. As the villages grew, common land expanded through reclamation of downland, woodland or heath (Thorne and Bennett 2015). As before some differences in land-use are apparent between the eastern and western South Downs. In the east, land-use was predominantly the classic sheep-corn system while in the west there was a more complex mix of sheep walks, pasture, parks and wood pasture (Brandon 1999: 61, Thorne and Bennett 2015).



LiDAR point cloud image, Arundel Castle

In medieval times, forest law was a hugely important instrument of power. Forests were primarily hunting grounds and were not necessarily wooded. While most forests were retained by the crown some were granted to the nobility or the church. Ordinary people also lived and worked within them, in tightly controlled ways, and peasants could have common rights within them, for example, as was the case in the Forest of Arundel (Brandon 1999: 65, Thorne and Bennett 2015). The Forest of Arundel is otherwise known as Arundel Chase, the massive unfenced

hunting ground of the Earls of Arundel, and although its exact boundaries are not known it must have occupied most of the project area (Carpenter et al. 2016: 88).

Deer Parks are a particularly characteristic feature of the medieval landscape in this part of England, and while some may have origins in the Early Medieval period, it was the Norman introduction of fallow deer and deer husbandry practices which brought them to the fore, with the deer park soon becoming the hallmark of a gentleman (Brandon and Short 1990:70). In fact deer parks were not just for deer but were usually multi-purpose; rabbit warrens and fish ponds were often established within parks, and grazing of farm animals was permitted at certain seasons. Sheep and goats, however, were usually prohibited because their grazing habits interfered with those of the deer (Brandon and Short 1990: 72). Other resources obtained from deer parks included timber, wood fuel and bracken, and most deer parks would have had areas of woodland as well as more open areas within them. Most parks would be enclosed by a park pale, classically with a bank and ditch earthwork, with the ditch inside the bank and with a hedge or fencing on top of the bank (Fletcher 2011: 146).



East Dean Deer Park

The LiDAR survey offers a great opportunity to research the boundaries and internal layout of the medieval parks in the project areas (Thorne and Bennett 2015) and this is discussed in greater detail in the National Mapping Programme report (Carpenter et al. 2016, 88-98). Deer park boundaries are not usually influenced by the layout of pre-existing earthworks such as early field systems. They often cut through such features, emphasising their medieval or later origins (Carpenter et al 2016, 90).

The boom and bust cycle of population dynamics in the medieval period has left traces in the landscape which might be explored through the LiDAR survey. There was population growth in the 12th and 13th centuries, with accompanying expansion of arable land around the villages and some enclosure of upland areas for grazing, for example the regular fields laid out on the tops of the South Downs around Gumber above Slindon (Thorne and Bennett 2015). Woodland may have come under pressure from these competing land uses at the time (Brandon 1999: 65). The rapid decline in population in the mid 14th century caused by the Black Death, famine and a climatic downturn, would also have left its mark on the landscape, most obviously in the form of deserted or contracted Medieval villages, Monkton being a good example in the project area (Thorne and Bennett 2015).

The Post-Medieval Period (AD 1540 – 1900 AD)

The 16th and 17th centuries saw social and economic changes which have left their traces in the landscape of the South Downs. Population numbers were rising again, and agriculture and trade were evolving under their demands. Early industrialisation was also happening in the region. On the coastal plain, farming produced large quantities of wheat and barley, alongside the sheep-corn system. Elsewhere, including on the downland commons, mixed grazing was important. Under an increasing demand for wool, the tops of the eastern South Downs were given over to sheep walks and common grazing. However, a more mixed land-use characterised the western end of the downs, with management of woodland for timber and other needs being run alongside grazing interests (Thorne and Bennett 2015). Specialist 'hogg commons' are known to have existed at Singleton and East Dean, while sheep grazing was permitted in some woods in the area (Brandon and Short 1990: 175).

This period was characterised by the enclosure of commons and waste land throughout England, a process which started especially early in the western downs (Brandon 1999). Both landowners and tenants could be involved in enclosing land, often to prevent overstocking. Open field systems and strip fields were also frequently enclosed in this period (Thorne and Bennett 2015). Church records known as 'glebe terriers' for the Diocese of Chichester demonstrate that within the project area, at Harting and Treyford, the enclosure of common fields was completed pretty early, by 1635 (Brandon 1999: 94). The process of enclosure also extended to woodland, as industrial demands for fuel developed in the region. This saw, for example, enclosure of large tracts of woodland at East Dean, Singleton forest and Charlton forest. Records indicate that this led to fuel poverty for ordinary people in the area, who had formerly enjoyed common rights to wood (Brandon 1999: 100-101). Many of the boundaries created in this period persist in the landscape, and may be usefully studied through the LiDAR survey results. The deer parks which had epitomised the medieval period began to fall out of use towards the end of the medieval period and especially during the 16th and 17th centuries (Rackham 1986, 126) when they reverted to woodland, became farmland, or were converted into landscape parks (Carpenter et al 2016, 90).

The 18th century witnessed development of the great landed estates, and shaped the character of much of the landscape we enjoy today, albeit most of the estates evolved from their medieval predecessors. Wealthy landowners consolidated their land holdings and commissioned landscaping works, firstly with formal geometric woodland designs and then from the mid-18th century with a softer, more naturalistic character. Many of these landscaped woods would have had economic uses too. Valdoe Wood on the Goodwood estate, now under sweet chestnut and hazel coppice, retains much of its formal 18th century layout with avenues and vistas still traceable (Pengelly and Thorne 2015). Field verification at Stansted Wood recorded rectilinear systems of banks and ditches, thought to be woodland compartment divisions, which pre-dated some of the 18th century rides, and which might therefore have a 17th to earlier 18th century date (Thorne and Perkins 2015).



Goodwood Racecourse as it currently looks. Creative Commons Attribution-Share Alike 2.0 Generic. Peter Trimming

Many parishes at this time comprised a single estate owned by a single family, known as a ‘close’ parish, although of course most ordinary people living locally grew up on, and worked in, these great estates. Two of the largest landholdings in the project area were Goodwood Park, owned by the Dukes of Richmond, and the Arundel estate, belonging to the Dukes of Norfolk (Thorne and Bennett 2015).

The industrial revolution was mirrored by a revolution in agriculture over the 18th and 19th centuries which fed the demand from a growing population, both in the towns and the country. These forces were especially evident after the Napoleonic wars of the early 19th centuries, which led on to a booming domestic economy and an intensification of agriculture especially from the 1840s to the 1870s (Brandon and Short 1990: 322). During this period, there was massive encroachment of arable agriculture onto the downland, particularly in the eastern South Downs, where arable land was at its maximum extent, with even more land being under the plough than in the later peak of the war effort in the 1940s (Thorne and Bennett 2015).

The situation in the western end of the South Downs is less well understood, but a more diverse economic base is indicated with forestry being an important element, and with extensive beech plantations being established from the 18th century onwards. These took in former agricultural land, especially in areas of sheep pasture for example at Up Marden, Cocking Downs and Woolavington (Thorne and Bennett 2015). This process is important to note, because these historic plantation woods were originally planted and harvested by hand, and it is this which allowed earlier landscapes to be preserved fantastically well under the new tree cover.

The economic drivers shifted in the mid-19th century, with the acceleration of rural depopulation, as people were sucked into the increasingly industrialised towns, a process fostered by the poor wages given for agricultural work in the south east at the time. Cheap imports of grain from abroad in the latter part of the 19th century contributed to a deep agricultural depression which saw the end of the traditional sheep-corn system. Many upland areas went out of agricultural use at this time, and some of the estates in the wider region struggled, selling off farms and land, not least to pay death duties.

However, the western end of the South Downs was different because of its more diverse rural economic base, and the move towards fragmentation of landholding did not occur here; the landed estates survived largely intact. Archaeological evidence of the use of the woods, such as saw-pits and charcoal platforms would be expected to survive in the woods from this and earlier periods, but the latter have been surprisingly hard to find and do not seem to present well on the LiDAR survey (Blandford in Manley 2016). Saw-pits were noted in a SoHW field investigation at Bepton New Farm, in woods at Cocking Down on the Cowdray Estate (Blandford in Manley 2016). The wooded estates, then as now, made for an attractive landscape and, in the wider picture, new tourism by people temporarily escaping the squalid towns and cities was another boost to the broader economic base in the western South Downs in the later part of the 19th century (Thorne and Bennett 2015).



Charcoal burning platform. Creative Commons Attribution-Share Alike 2.0 Generic. Richard Webb

Investigation into the evolving post-medieval landscape using multiple strands of evidence including the LiDAR survey, historic maps and documentation like estate records, will be an especially rewarding avenue of future research. Studies focussing on tracing the origin and development of the woodlands in the project area, especially those sites evolved from Ancient Woodland and early plantations, would be particularly revealing in unwrapping the layers in the post-medieval landscape.

The Twentieth Century

The agricultural depression of the later 19th century was temporarily reversed by the impacts of the two world wars in the 20th century, with much downland put back into cultivation. In the Great War, large areas of woodland were cleared for the war effort, for example there was almost total clearance at Slindon Estate by the Canadian Forestry Corps. Across Britain, the efforts at supplying the wartime demand for timber, for lining trenches and for pit props, highlighted the fragile nature of the domestic timber supply, and led directly to the establishment of the Forestry Commission (FC) in 1919 and the wide-scale planting of commercial coniferous woods in the 1920s, both by the FC and by private estates. Long term leases entered into by the FC with many estates at various points through the 20th century continue to this day, and originated in this desire to secure the domestic timber supply. There were also great demands on the domestic timber supply in the second world war, followed by the establishment of more commercial plantations in the 1950s. A consequent drop in the price of timber caused by abundant cheap Scandinavian imports in the late 20th century has meant that many of these earlier 20th century commercial plantations have survived (Thorne and Bennett 2015), although now more of them are being thinned and harvested, mostly for fuel wood.

The world wars had other impacts, and in the wider region many of the great estates were requisitioned and never really returned to their pre-war state. However, the estates in the project area survived largely intact, despite seeing some intensive use for war time activities.

Parts of the South Downs were used as training grounds and firing ranges during both wars, and prior to D-Day many hundreds of troops were housed in temporary camps hidden in the woods (Thorne and Bennett 2015). Similarly, the area was



A World War II Pillbox

used as a springboard for the allied assault of 1944, and this had some infrastructural benefits in bringing electricity, mains water and new roadways to country areas (Brandon and Short 1990: 363). The area also housed the home guard, where local men, selected for their knowledge of the countryside, were trained in the use of weapons and in effecting resistance should there be an invasion. Some zig-zag trenching and various pits recorded at the Valdoe on Goodwood Estate may originate from such WWII activities (Pengelly and Thorne 2015). Such activities also contribute to colourful oral histories of the area, some of which have been recorded through the Secrets of the High Woods project.

