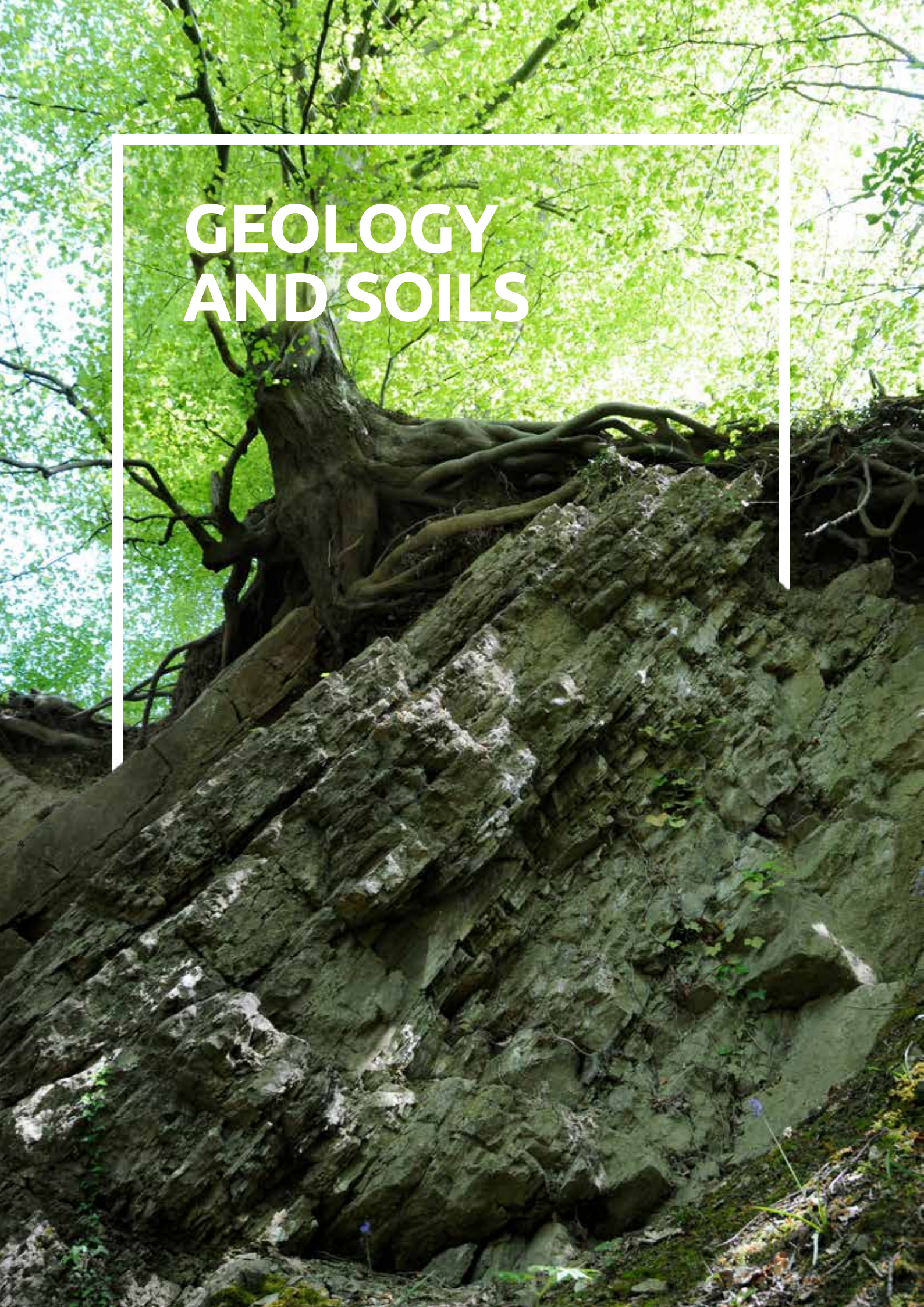

GEOLOGY AND SOILS

WHERE ARE WE NOW?

The distinctive and diverse landscape of the Forest of Dean is determined by the nature of the rocks that lie beneath the surface and the processes that have formed them. In turn the Forest soils are closely related to the rocks from which they are derived.

Everything we see on the surface of the Forest of Dean – the changing topography, varied natural habitats and vegetation, the patterns of human settlement, culture and even the buildings – is shaped by the underlying geology. An understanding of the geology of the Forest of Dean and how it influences the character of the area is of fundamental importance if we are to retain the distinctive and diverse landscape.

The geology of the Forest is exceptionally diverse, with significant change across a small area. At its most basic, the Forest can be thought of as sitting upon the Old Red Sandstone.

To the west and north, the high ground is made up of the Carboniferous limestones. These are freely draining rocks, as the rock is cracked and fissured. Surface water percolates down these cracks and fissures, eroding out the limestone to form complex cavern systems.

In the core of the Forest is the 'coal basin'. The rocks outcropping at the surface in the coal basin are the younger Carboniferous coal measures. These include sandstones, the coal seams and associated clays.

To the east of the 'coal basin' is a series of ridges and valleys. These ridges and valleys can be thought of as a crumple zone where all the rocks so far mentioned outcrop at the surface, having been pushed upwards by huge forces. These outcrops are in a broadly linear fashion, although this can be hidden in places by alluvial deposits (most likely glacial in origin) that are essentially 'dumps' of other rock material upon the surface; mainly sands and gravels.

The richness and complexity of the Forest's geology is represented in the relatively high number of geological SSSIs, and the plethora of current, mothballed and long-closed mineral extraction sites – stone quarries, iron and coal mines.

Soil formation can also be incredibly complex, and is directly linked to the underlying geology, as soil derives from rock as well as deposited organic matter. As rock breaks down through weathering and erosion, the resulting particles form the basis for soil. Soil evolves as a result of physical and chemical processes, and biological activity. It can vary from a very thin cover, or none, to deep soils and peat. The underlying geology is important in determining the chemical and physical nature of the developing soil and the habitats and vegetation types it supports. In turn, the nature of the vegetation, cycles of vegetation decay, activity of earthworms and fungi also enrich and improve soil fertility and structure.

In the Dean, the differences in geology, and therefore soils, can easily be observed, often over only short distances as you move through the Forest.

Limestones lead to alkaline, well-drained and often quite shallow soils. The climax vegetation upon limestone is dominated by ash, beech, field maple woodland with pockets of lime and an understorey of blackthorn, hawthorn, yew, privet and spindle. The ground layer consists of an assemblage of characteristic species including dog's mercury (Mercuralis perennis), enchanter's nightshade

(Circaea lutetiana) and wood sedge (Carex sylvatica). Where suitable conditions exist on remnant pockets of outcropping limestone, calcareous grassland supports uncommon and interesting plants such as bloody cranesbill (Geranium sanguisorba), common rock-rose (Helianthemum nummularium) and soft-leaved sedge (Carex montana). Species such as the Carboniferous hawkweed (Hieracium pachyphylloides) and a variety of whitebeam hybrids are endemic to the Wye Valley due to the unique geological conditions it provides.

Sandstones, sands and gravels lead to more acidic, well-drained brown, podzolic soils – more typical of the central basin of the Forest of Dean. The natural climax vegetation of the Forest of Dean is sessile oak (Quercus petraea), pedunculate oak (Quercus robur), and birch (Betula pendula), with rowan (Sorbus aucuparia) and holly (Ilex aquifolium) in the understorey. When the climax vegetation is removed, as

was the case when areas of the original wild wood were felled, the resulting acid grasslands and lowland heaths support bramble (Rubus fruticosus), bracken (Pteridium aquifolium) and, on the most acidic soils, light demanding ericaceous shrubs such as ling (Calluna vulgaris), bell heather (Erica ciliaris), bilberry (Vaccinium myrtillis) and tormentil (Potentilla erecta).

Fine-grained rocks, such as the coal measure clays, mudstones and shales, lead to poorly-drained soils – and it is these soils that underlay the wetter areas of the Forest of Dean. Where drainage is impeded, the climax vegetation that would naturally exist is pockets of wet woodland supporting species such as alder (Alnus glutinosa) and willow (Salix spp.) with rain-fed mires which proliferated where the ground is too wet to support trees. This creates unique assemblages of wet heath and mire plants such as sundew (Drosera rotundifolia), bog myrtle (Myrica gale) and Sphagnum species. These wetlands not only provide habitat for diverse and severely declining wetland plants and invertebrates, they also store carbon in the peat that gradually forms over millennia as sphagnum is compacted. Very little of the original wetland/mire communities still exist within the Forest of Dean, as the groundwaters feeding them have been impacted through drainage for forestry or industry.

Many of our former mineral extraction sites have areas of minimal or no soil cover where the soil forming process is in its infancy after disturbance. These areas are nationally rare and have a value in their own right.

In comparison to the highly disturbed, ploughed and fertilised soils of much of the surrounding agricultural landscape, Forest soils remain relatively intact in terms of their composition and structure. Within some agricultural landscapes, the annual damage done by arable cropping is destroying the soil's structure and fertility faster than natural soil forming processes can replenish it. There is growing recognition in agriculture that active soil conservation has to become part of modern farming to maintain productivity.

The same is true of forestry and timber cropping – but with significantly different time horizons. Over time, repeated timber cropping will have a negative impact on many of the natural

processes that underpin a healthy functioning surface and soil ecosystem in co-existence with the underlying geology. Through disruption to these processes, the soil's ability to support vegetation and tree growth is reduced, and its ability to support beneficial soil organisms, and the free movement of soil water are negatively affected. Healthy, aerated and well-structured soil is thus vital for woodland resilience.

WHERE DO WE WANT TO GET TO?

In 100 years, we want to have retained or enhanced the distinctive diversity of habitats and species of wildlife that are thriving within the Forest. We will have realised the ecological and productive potential of the Forest, and maintained or increased its carbon storage capacity.

We will have provided functional ecological linkages to have reduced the negative implications of 'island sites' for species conservation, which reflect the underlying soils and geology. We will be actively managing dynamic, site-appropriate habitats to maintain a range of ecosystems, linked to healthy soil regime.

We will have a resilient Forest, where extremes of climate may have an impact on the diverse woodlands and other habitats, but the natural and managed resilience ensures that no single climatic event has a devastating impact. Restoring natural processes is an important long-term aim to improve the Forest's resilience, and its ability to adapt in the face of climate change.

This means we will give time and space for nature and natural processes, with greater shared understanding of the objectives in place for each area or compartment. Site by site decision making and based upon sound objectives and professional judgment, coupled with patience, will be promoted over our current silvicultural philosophy of making artificial interventions every few years. We will have the right tree, in the right place for the right reason.

We wish to reduce soil damage through compaction, erosion or pollution to an absolute minimum through good site management and greater use of permanent extraction / access routes (which themselves will inevitably be more degraded as a result).

We also wish to increase awareness of the Forest's geological diversity, and how that diversity has influenced the natural, built and cultural heritage of the Forest.

WHAT ARE WE GOING TO DO?

Our commitments:

1 Identify optimum sites for lowland heath, mire and other wetlands and link these to open spaces

2 Move away from felling blocks of trees to reduce the impact on soil qualities

3 Improve extraction and access routes for forest operations to reduce soil compaction by machines

4 Promote the story of our geological sites of interest

1 Identify optimum sites for lowland heath, mire and other wetlands and link these to open spaces

We will critically examine the Forest as a whole, and determine where the optimum sites are for lowland heath, mire and other wetlands, as directed by the underlying geology and potential of the soils and landform. We will look to link those areas with ecologically functional corridors of open space and riparian woodlands. Open habitats will be sufficiently extensive and connected to allow a more naturalistic approach to their management, using grazing ponies, cattle and sheep. Wooded habitats will also be matched to soil type and land form, recognising that different tree species have different soil preferences for nutrient and soil moisture regimes, for example.

2 Move away from felling blocks of trees to reduce the impact on soil qualities

We will evolve our approach away from the plantation system of clear-fell/restock towards more continuous cover systems, to preserve woodland cover and reduce the negative impact of large scale clearances on soil processes, such as soil moisture regimes and soil micro-organisms.

3 Improve extraction and access routes for forest operations to reduce soil compaction by machines

We will refine our operational planning systems to take account of the increasing need for more detailed site by site assessments, and encourage greater use of natural processes to achieve the required objectives. We will

strengthen the link between operational plans and execution of those plans, with more robust monitoring post-operation to assess whether the objectives were met.

We will steadily raise the standard we expect in the Forest, surpassing the application of the existing Forestry Standards, as we set our ambitions to reach exemplary standards of woodland management.

We will ensure extraction and access plans are included for all forest operations to reduce soil compaction by machines, and ensure that additional focus is given to control of erosion and sedimentation. This will include greater support for suspending works when control of sedimentation cannot be guaranteed due to ground or prevailing weather conditions.

4 Promote the story of our geological sites of interest

We will maintain our suite of geological SSSIs in favourable condition, and maintain access to them, where it is safe to do so. We will endeavour to understand the relevance of each site to the story of our landscape so that appropriate sites can feature in the interpretation programme.

These are our principles of land management to celebrate our geological heritage and safeguard our soils.