NATURAL ENGLAND

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Geodiversity and Nature Recovery in the High Weald.

Ashdown Forest and the High Weald from the air above Maresfield, East Sussex. © Cuesta, 2015

Final Report

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Cuesta

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Contents

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Executive Summary

This Case Study has been commissioned by Natural England to illustrate **the benefits and value of integrating geodiversity into nature recovery**, using the High Weald of Sussex and Kent as an example. The study covers the whole of the High Weald but, in order to provide a more detailed analysis, focuses in particular on a local study area between Ashdown Forest and Uckfield, in East Sussex.

Nature recovery forms the centrepiece of the Government's approach to improving the quality of the natural environment, as part of the Environmental Improvement Plan (EIP23). The plan includes the establishment of a **Nature Recovery Network** (NRN) and a series of **Local Nature Recovery Strategies** (LNRS) throughout the country.

This case study seeks to assess the extent to which geodiversity can support nature recovery in each of its aims and how the establishment of LNRSs can, in turn, help to promote 'geodiversity value' (i.e. the overall benefits to be gained from existing geodiversity features and geological conservation). The study has demonstrated how geodiversity is frequently linked to biodiversity, though the influence of rocks, sediments, landforms and active geomorphological processes on soil types, topography, hydrological and hydrogeological conditions, hydromorphology in river channels and many different natural habitats. Throughout the High Weald, these various connections have greatly influenced the extent to which Ancient Woodlands, narrow floodplains, small-scale Medieval field patterns and areas of open heathland have survived the threat of intensive agriculture.

The study has also shown how the same geodiversity factors can contribute, just as well, to nature recovery initiatives in areas which have experienced biodiversity decline and fragmentation. Most importantly, it has shown that **geodiversity factors not only underpin existing biodiversity; they also provide the groundwork for enhancing and rebuilding it**.

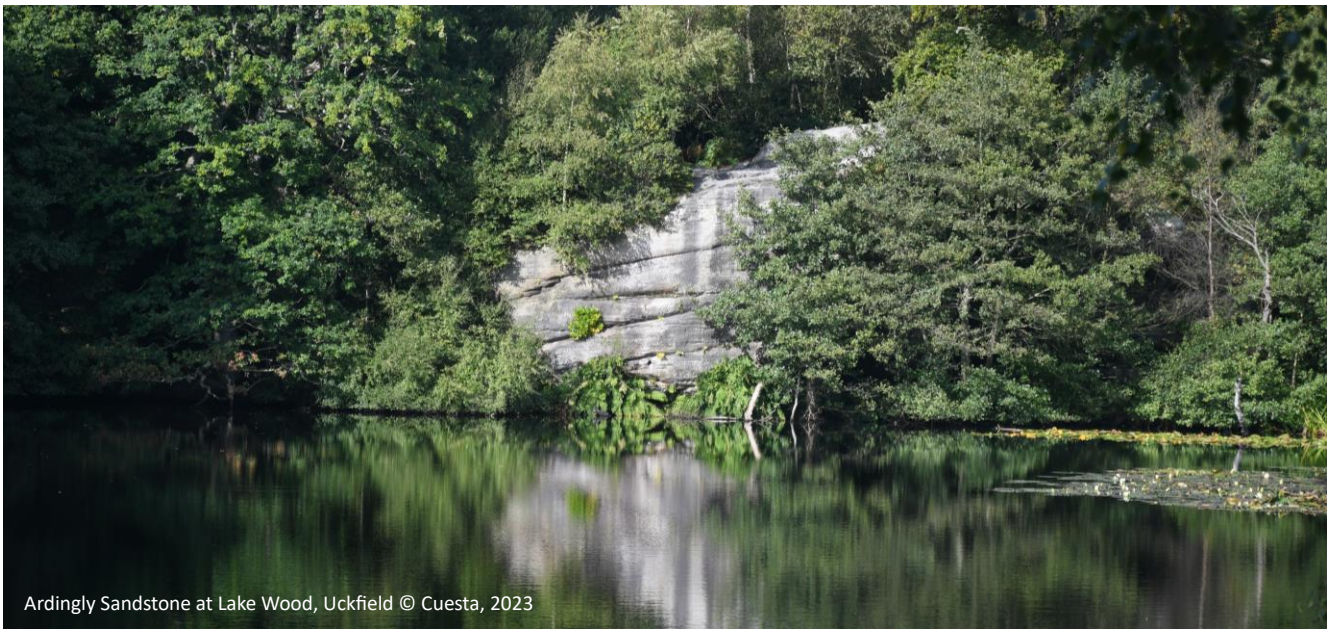
Overall, the study has demonstrated that various geological and geomorphological factors frequently underpin and reinforce the natural characteristics and conservation value of designated sites, priority habitats and aspects of cultural heritage. It has also shown that they can be important in their own right, for example in providing connections between individual sites along undesignated river floodplains and geological outcrops. Understanding these connections can help us to harness and improve the landscape's natural resilience to climate change – for example by maintaining natural ecosystems and wildlife corridors rather than disrupting and fragmenting them, and by 'rewilding' natural floodplains and headwater areas to control flooding.

The case study has illustrated how geodiversity can be integrated with and make positive contributions to all four of the main themes of nature recovery. It can **enhance** the value of existing designated sites and the level of interest in them. Understanding the ways in which geodiversity factors underpin biodiversity can help us to harness and **improve** the landscape's natural resilience to climate change, by maintaining and expanding natural ecosystems and wildlife corridors. An understanding of geodiversity can also help to **reinforce** awareness of the natural, geological and cultural diversity of the area, demonstrating important links between geology, landscape and the historical evolution of the area. Bringing all of these aspects together and presenting them to the wider public will help local people **enjoy** and **connect with** these important aspects of their natural, local environment. In each of these cases there are also benefits for geodiversity itself, by virtue of geoconservation work (e.g. to re-expose geological outcrops whilst creating or extending important habitats), as well as through increased awareness and appreciation of its role in nature recovery projects.

By looking in detail at the local study area between Uckfield and Ashdown Forest, the study has demonstrated how joining-up existing designations, habitats and other natural features could enable wildlife corridors to be established, enhanced or extended. It illustrates what could be achieved by adopting a **holistic approach to nature recovery – one that benefits from (and provides reciprocal benefits to) geodiversity**.

Introduction

This Case Study has been commissioned by Natural England to illustrate **the benefits and value of integrating geodiversity into nature recovery**, using the High Weald of Sussex and Kent as an example. The first part of the study covers the whole of the High Weald but, in order to provide a more detailed analysis, the second part focuses in particular on a local study area between Ashdown Forest and Uckfield, in East Sussex.



Ardingly Sandstone at Lake Wood, Uckfield © Cuesta, 2023

Geodiversity is the natural range (diversity) of geological, geomorphological, soil and hydrological features, including their contributions to the landscape. Geodiversity is an integral part of nature and an essential aspect of nature conservation. It often underpins ecological networks, landscape character and landscape heritage. Since the aim of 'Nature Recovery' is to recover 'nature', it follows that geodiversity should be able both to contribute to and benefit from nature recovery initiatives.

Nature recovery forms the centrepiece of the Government's approach to improving the quality of the natural environment in the UK, as part of the **Environmental Improvement Plan** (EIP23). The plan includes targets to protect 30% of our land and sea for nature by 2030 through the establishment of a **Nature Recovery Network** (NRN) and a series of **Local Nature Recovery Strategies** (LNRS) throughout the country. More specifically, it seeks to restore or create more than 500,000 hectares of wildlife-rich habitats outside protected sites by 2042. It also seeks to halt the decline in species abundance by the end of 2030 increasing it above 2022 levels by 2042, and to increase connectivity between habitats.

In order to achieve those targets, the NRN has four main themes:

1. to **enhance** sites designated for nature conservation and other wildlife-rich places - newly created and restored wildlife-rich habitats, corridors and stepping-stones will help wildlife populations to grow and move;
2. to **improve** the landscape's resilience to climate change, providing natural solutions to reduce carbon and manage flood risk, and sustaining vital ecosystems such as improved soil, clean water and clean air;
3. to **reinforce** the natural, geological and cultural diversity of our landscapes, and protect our historic natural environment; and
4. to enable us to **enjoy and connect with nature** where we live, work and play - benefiting our health and well-being.

This case study seeks to assess the extent to which geodiversity can support nature recovery in each of these areas and how the establishment of nature recovery strategies can, in turn, help to enhance and promote 'geodiversity value' (i.e. the overall benefits to be gained from existing geodiversity features and geological conservation). It aims to do so at two levels: firstly by looking at the importance of geodiversity across the whole of the High Weald area, with some examples of how it provides opportunities for nature recovery; and secondly by examining the relationships between geodiversity, biodiversity and other nature recovery factors in more detail, within a local study area to the north of Uckfield.

The Nature of the High Weald

The High Weald is a distinctive part of the English landscape (***National Character Area 122: High Weald***, as defined by Natural England[1]). It encompasses the ridged and faulted sandstone core of the Kent and Sussex Weald and is therefore fundamentally defined by its geology and landforms. It is also an area of ancient countryside and one of the best surviving medieval landscapes in northern Europe, consisting of a mixture of small fields, woodlands and farmsteads connected by historic routeways, tracks and paths. These characteristics are directly associated with the intricate topography of the area and the generally poor quality of its soils, both of which have precluded large scale agricultural transformation and have allowed ancient woodlands, hedgerows and small field patterns to survive. The same characteristics provide a flourishing, accessible landscape for wildlife. Exposed sandstone outcrops and steep, wooded headwater streams, known as ghylls, provide nationally rare habitats and support an array of ferns, bryophytes and lichens. The area also has very strong historical and cultural associations, from widespread relicts of the 16th and 17th Century iron industry (including charcoal hearths, ironstone pits, hammer ponds and pond bays) and numerous historic buildings, to recreational activities including climbing on the exposed sandstone crags.

Ashdown Forest and the High Weald from the air above Maresfield, East Sussex. © Cuesta, 2015

Some 78% of the NCA also falls within the High Weald National Landscape (formerly known, and still designated as an Area of Outstanding Natural Beauty). Such areas are defined by their intrinsic natural beauty and landscape quality, as well as their distinctive character. The word 'weald' comes from an Old English word meaning 'forest', though this did not simply equate to woodland – it also included areas of open heathland such as Ashdown Forest, which became hunting grounds for royalty. Trees and woodland are, nevertheless a particularly distinctive feature of the High Weald landscape, covering nearly a third of the AONB – much of it being defined

[1] https://publications.naturalengland.org.uk/publication/4706903212949504

as precious Ancient Woodland. Geology, landforms and river systems are recognised as key components of the High Weald's natural beauty and they are major features of the area's Management Plan[2].

The Geological Story and Structure

The **High Weald** comprises the oldest of the exposed rocks in **South East England** at the centre of a complex geological structure - a folded, elongated dome that has subsequently been stripped of the younger, overlying sediments. But the story of the formation of the High Weald is much older than the rocks which now remain, dating back to more than 250 million years ago. At that time, a basement of much older rocks was compressed and broken - **faulted** - as continents collided together in what is known as the 'Variscan' mountain-building event. Later, from about 200 million years ago, during the ***Jurassic age***, the area was submerged beneath the sea. **Marine sediments** built up into thicknesses of more than 1500 metres. The great weight of these sediments loaded the underlying rocks and reactivated the existing faults causing further differential movements. Only the uppermost and youngest of these sediments – the **Purbeck Group** – are now exposed, within the 'core' of the Wealden Dome, near Heathfield, Brightling and Mountfield. The others remain deeply buried.

Around 145 million years ago, during the ***Lower Cretaceous age***, the sea began to retreat, and a lagoonal, **freshwater** environment emerged, fed by rivers, sometimes from the north, sometimes from the west. depending on which 'blocks' of adjoining land were uplifting at the time. These rivers created great fans of sediment with meandering and braided waterways, feeding into the lagoons. When the blocks of adjoining land which supplied the sediment subsided, and runoff and sediment load decreased, lakes predominated, becoming gradually infilled with finer-grained clays. These sediments, up to around 450m in overall thickness, are characterised by rhythmic repetitions of clays, silts and sands known as cyclothems. Early plants colonised the land and the environment was inhabited by invertebrates of many kinds, dinosaurs and other reptiles, amphibians, birds, and early mammals. The remains of these plants and animals are often found as fossils, whilst fossil footprints and burrows may be found on the surfaces of specific geological beds. These sediments now make up the sandier rocks of the High Weald (including the **Ashdown Formation** and the **Tunbridge Wells Sand Formation**) but also the **Wadhurst Clay Formation** and the more predominantly clayey strata of the Low Weald (including the **Weald Clay Formation**).

Around 100 million years ago, during the ***Lower to Upper Cretaceous age*** this area, along with much of England, was again flooded by the sea. Sandy marine sediments of the 'Greensand', and clayey marine sediments of the 'Gault Clay', and then the Chalk, laid down in a shallower tropical sea, accumulated to depths of more than 400m. The build-up of these sediments again caused the land to sink, reactivating those ancient faults.

Around 65 million years ago, as the mid-Atlantic ridge continued to open to the north-west of the UK, and as the Alpine mountains began to form in Europe to the south and east, the associated Earth movements caused the whole sequence of rocks, in what is now SE England, to become **compressed and folded-up** into an elongated **dome**. In Sussex, the main fold axis trends roughly WNW – ESE, but it is not a simple structure. Many other folds were formed 'en echelon' - overlapping and parallel to - the main fold, and the weaker lines of the ancient faults operated in a reverse direction leading not only to folding of the rocks, but also to the formation of many **faulted blocks** which are particularly well

Reverse Fault within the Hastings to Pett Beach SSSI. © Idris 2024

[2] https://highweald.org/aonb-management-plan/

developed in the relatively hard rocks of the High Weald. This gives complexity to the outcrops of sediments with great variability over short distances.

The final piece of the story was the area's '**unroofing**' which, in the High Weald, comprised the stripping away of all the overlying Chalk, Gault Clay, Greensand and Weald Clay deposits, leaving the Lower Cretaceous sediments exposed at the surface (and the underlying Purbeck Group strata in the centre of the fold). This process has taken place very gradually, over the last 65 million years.

Within the last 2 million years, England has experienced a number of glaciations or 'ice-ages', although glaciers did not extend as far south as the Weald. Instead, there were alternations of warmer climatic periods and colder 'periglacial' conditions, with more-or-less permanently frozen ground ('permafrost'). **Powerful rivers and substantial hill slope processes** during such periods had a **greater erosive ability**, completing the removal of the overlying sediments and shaping the location of the valleys, slopes, and rock outcrops that we see today, but **the underlying 'blueprint' of the structural, folded, and faulted basement** can still be seen.

The resulting **outcrop pattern** of the 'bedrock' within the Weald as a whole is shown on Figure 1, below, along with the more recent 'superficial' deposits and the boundaries of the High Weald National Character Area. Although the outcrop pattern is complex in detail, due primarily to faulting, this is also a consequence of the intricate dissection of the landscape that has resulted from the erosion by down-cutting river systems. The main rivers are shown on the inset diagram, but a much larger number of minor streams and headwater valleys have also contributed to the shape of the modern land surface. These are indicated, in part, by the distribution of alluvial deposits, as shown on the map.

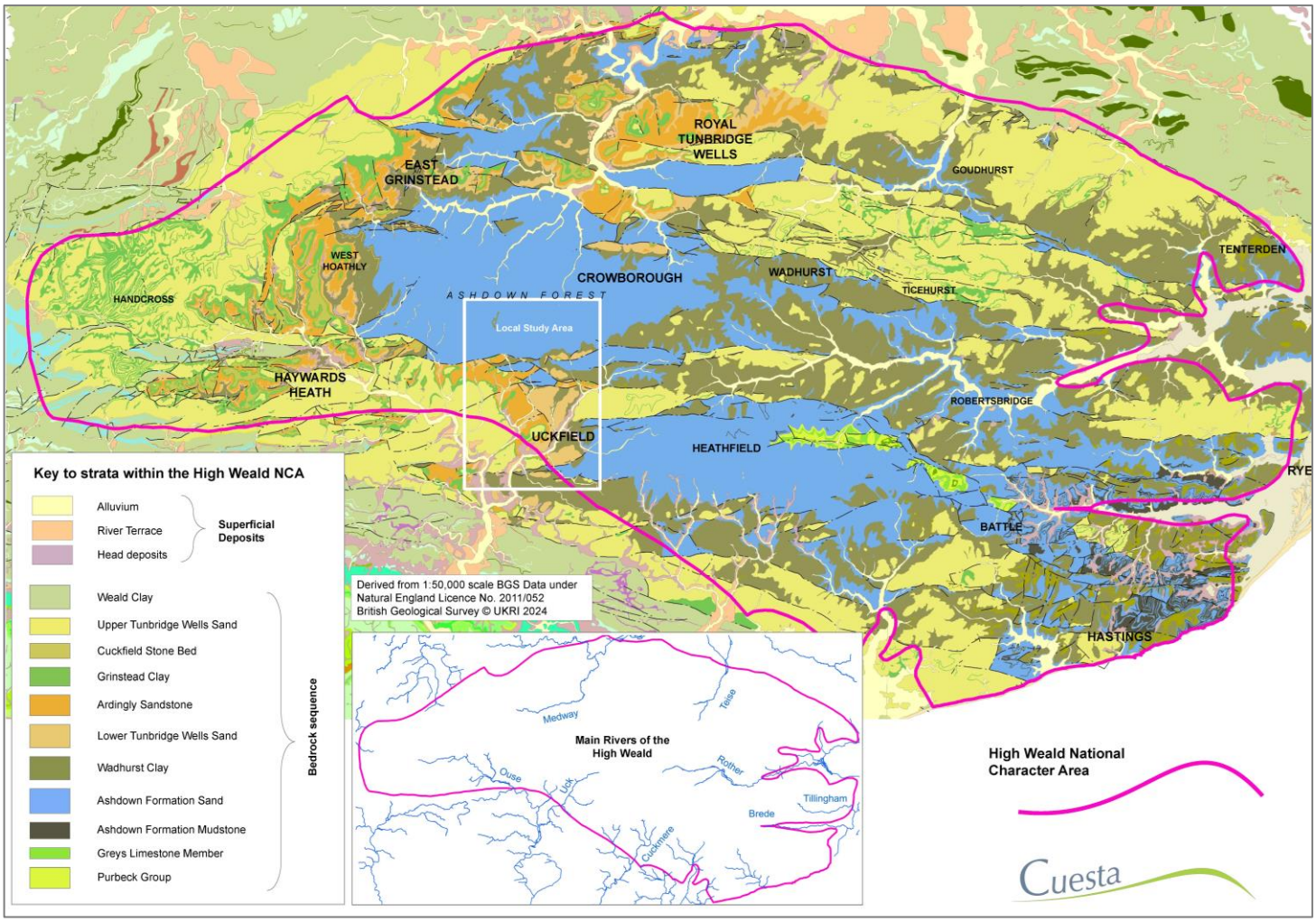


Figure 1: The Geology and River Systems of the High Weald National Character Area (SOURCE: British Geological Survey)

To some extent, the complex pattern is also a consequence of differences between the western part of the High Weald, where the Tunbridge Wells Sand Formation incorporates two important sandstone units – the Ardingly Sandstone and the Cuckfield Stone – and the areas further east where those divisions are not present. The Ardingly Sandstone, in particular, has proved to be of major significance, on account of its association with very distinctive rock outcrops which, in turn, are important features of the natural and cultural landscape and intimately associated with the characteristic 'ghyll' valleys and woodlands seen throughout these areas.

Also shown on Figure 1, for reference, is the extent of the more detailed Local Study Area, between Uckfield and Ashdown Forest.

Figure 2, below, shows the distribution of the broad soil types or '**Soilscapes**' found within the High Weald area. This is effectively a simplified version of the National Soil Map and has been produced by the National Soil Resources Institute (NSRI) of Cranfield University with support from Defra. It shows, in simple terms, what the likely soil conditions are at any point in the landscape by reference to one of 27 different broad types of soil (only six of which are found within this area). White areas pick out the main areas of built development. Comparison of the map with Figure 1, above, shows a broadly similar overall pattern, illustrating the relationship between soils, rock types and geological structure.

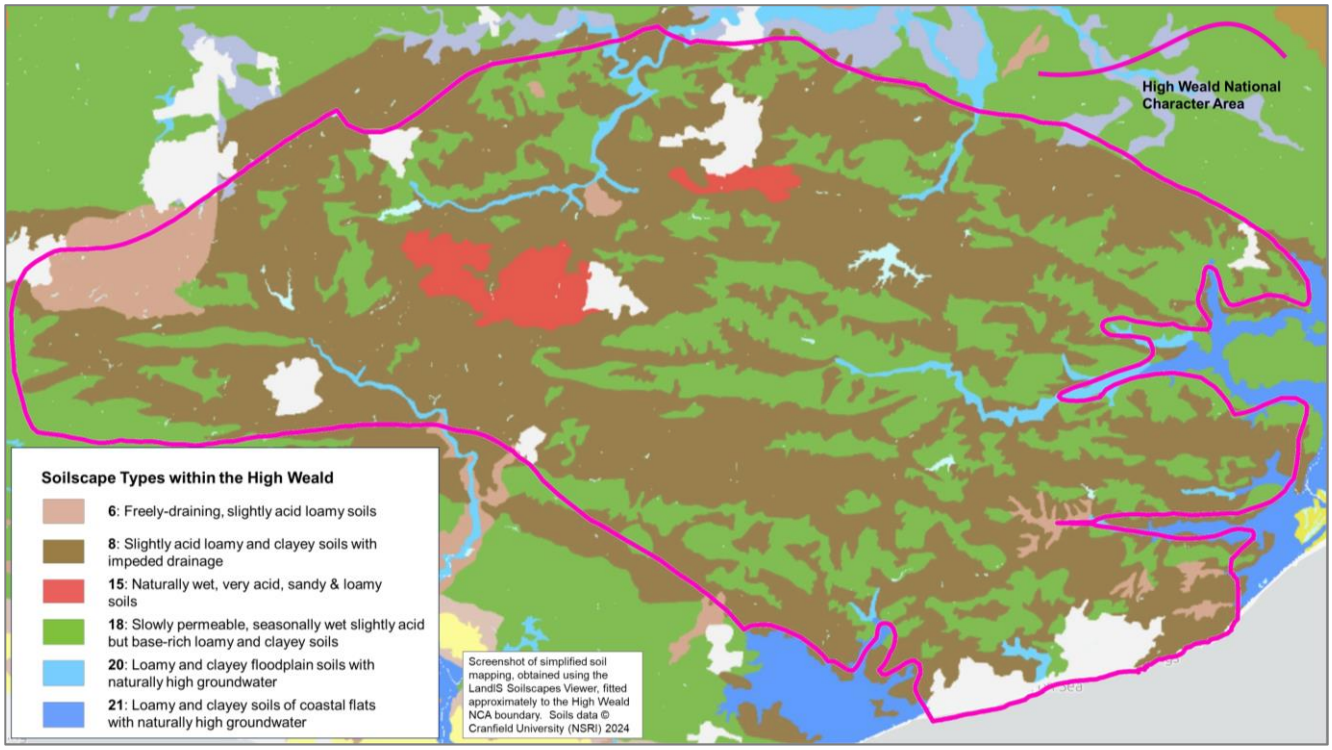


Figure 2: Soilscapes of the High Weald (SOURCE: Cranfield University)

Geodiversity Connections in the High Weald

Each of the different geological formations exposed at the surface within the High Weald is described below, with associated influences on landform, landscape, biodiversity & soils, and resilience to climate change. The historical, cultural, and natural environment connections are also explored. For each formation, some suggestions are made for how understanding the geodiversity can contribute to the Nature Recovery Network (NRN) and what corresponding benefits there might be for geodiversity. These suggestions are by no means definitive or exhaustive, they are merely examples. In each case they are cross-referenced to one or more of the four main themes of the NRN (1 to 4, as listed on page 1, above). Additional and more specific opportunities are identified in later sections of the report, focusing in more detail on the Local Study Area.

Information on the geology of the High Weald is usefully held on the Sussex Geodiversity Partnership's website, which includes detailed site reports of designated Local Geological Sites and geological Sites of Special Scientific Interest[3]. These geological sites, along with SSSIs designated for their biodiversity, are identified for each geological formation within this chapter and the management and promotion of these sites could form a useful starting point for enhancing and promoting nature conservation within the High Weald. Perhaps most prominently in relation to the distinctive sandrock outcrops of the Ardingly Sandstone (see pp 14 - 17, below) where there are many designated sites for both geodiversity and biodiversity.

The Purbeck Group

Geological Description

The small outcrops of **Purbeck Group** sediments in the High Weald comprise blueish-grey calcareous mudstones with limestones and some sandstones and ironstones. The limestones include finer-grained grey-blue limestones, informally known as the 'Blues' and relatively younger coarser-grained shelly grey limestones, known as the **Greys Limestone Member**. Evaporite sediments of gypsum and anhydrite lie beneath the surface and are mined at Brightling.

Associated Landforms and Geomorphological Processes

As shown on Figure 1 above, the Purbeck Group sediments outcrop in three discrete areas within raised, faulted blocks ('horsts') and underlie the typically wooded upper valleys of streams flowing north-east away from a ridge of higher ground underlain by the Ashdown Formation to the east of Heathfield. Small landslips within the mudstones are seen in places on valley sides. Tufa is actively precipitating around some of the springs and streams where groundwater flowing through the limestone has become super-saturated with calcium carbonate.

Influence on Landscape, Soils, Biodiversity and Resilience to Climate Change

The influence of the relatively small outcrop of Purbeck Group sediments on landform is limited. The typical broad soil type is a slowly permeable, seasonally wet, slightly acid, base rich, loamy and clayey soil (Soilscape Type No. 18) associated with seasonally wet pastures and woodlands. However, the calcareous influence of the underlying limestones gives rise to a sporadic, locally more lime-rich, alkaline soil than is present elsewhere in the Weald, supporting lime-loving species such as orchid, ash and hazel.

Historical, Cultural and Natural Environment Connections

The limestones were worked as a source of agricultural lime and in a more limited way as a local building stone, primarily rubblestone, although the Blues Limestone has been used for polished paving slabs. The Greys Limestone Member, typically located nearer the ground surface, was predominantly worked using bell-pits together with ironstones to a more limited extent. The deeper Blues Limestone was extracted using levels and

[3] https://geodiversitysussex.org.uk/geodiversity/SussexGeology.php

larger pits. These different methods of working provide a useful tool in identifying the underlying geology in the absence of exposures within woodland.

Gypsum mining began in the late 19th Century at Mountfield after the drilling of an exploratory borehole looking for coal identified the workable resource. Mining continues today at Brightling, with an almost 5km long conveyor belt linking the new mine to the processing plant which is located adjacent to the railway network. The Gypsum reserves here are considered the most extensive in Britain.

Designated Sites

Within the banks of the upper reaches of the River Line at Netherfield, the complete exposed sequence is shown, from the Blues Limestones through Plant and Bone Beds, the Cinder Bed, Sandstones, Shales-with-Ironstone to the Greys Limestone Member. This forms the only SSSI in the High Weald designated for geodiversity interest within the Purbeck Group. One other stream section, the Darwell Stream at Cackle Street is designated a LGS and shows the junction of the Purbeck Group with the overlying Ashdown Sand Formation. Three SSSIs designated for their biodiversity: Darwell Wood, Binglett's Wood and Willingford Meadows are, in part, underlain by the Purbeck Group. Both Darwell Wood and Willingford Meadows support a mosaic of woodland and grassland plant communities respectively due to the presence of locally calcareous alkaline soils amongst the more typical High Weald acidic soils. The influence of this varied underlying geology is noted in both citations. The interest at Binglett's Wood is an Atlantic plant community within deep headwater ghylls underlain by both the Ashdown Formation and Purbeck Group.

Exposures of Pubeck Group limestones and shaly mudstone within the River Line geological SSSI

Potential Contribution to the Nature Recovery Network

- Mosaic of Habitats: Except for the infrastructure associated with the Gypsum mine, this area is a predominantly rural location of small settlements, woodlands, and stream meadows. The unusual (for the High Weald) **presence of alkaline soils** influenced by the limestones of the Purbeck Group, alongside the **typical acidic soils** and the **ghyll woodland** associated with the Ashdown Formation, provides a superb opportunity to create a **rich mosaic of habitats**. The Rother, Brede, and Tillingham Woods Biodiversity Opportunity Area (BOA) includes much of this area and could usefully be extended to include the complete outcrop of the Purbeck Group. In Sussex, Biodiversity Opportunity Areas are currently viewed as a broad concept but their relevance to land use planning is yet to be realised[4]. Also, whilst the influence of the underlying geology is noted in individual SSSI citations, this has not yet been fully or accurately described within the BOA. By including a greater recognition of the important role of the geodiversity of this area in shaping the soils and associated habitats within the BOA, it may be possible to identify unique policy and specific actions for biodiversity in these areas. Such actions would contribute to **Theme 1** of the NRN.

[4] Sussex Nature Partnership and Sussex Biodiversity Record Centre (2021) *Mapping a Nature Recovery Network in Sussex at the District Level*, Final Report - to accompany Executive Summary, p5

The Ashdown Formation

Geological Description

The Ashdown Formation is dominated by yellowish-brown to pale grey siltstones and silty fine-grained sandstones with only subordinate amounts of shale and mudstone, arranged in rhythmic units divided by thin pebble beds. Mudstone units are mapped separately around Hastings where they are more prevalent and include the 'Fairlight Clays', dark grey mudstones, and shales, patchily red stained and with abundant siderite (iron carbonate) pellets.

Above: The cliffs immediately east of Hastings, where the sandstones, siltstones and clays of the Ashdown Formation are spectacularly displayed. One of several deep, hanging valleys, Ecclesbourne Glen, is clearly shown, similar in form to the deep ghylls that are typical of the inland outcrop of this geological formation.

Left: an outcrop of wavy, lenticular bedded fine sandstone of the Ashdown Formation at the Waldron Cutting SSSI.

Associated Landforms and Geomorphological Processes

The main folded, fault-bound ridges which form the highest ground of the High Weald are underlain by the relatively resistant sandstones of the Ashdown Formation. As can be seen on Figure 1, on page 4, the central ridge runs from Ashdown Forest to Wadhurst, with Crowborough Beacon as the high point at 225m. Broken northern ridges run around Tunbridge Wells. A broken southern ridge runs from the eastern side of Uckfield to Heathfield and from Battle to the coast between Hastings and Fairlight**,** where high cliffs show excellent exposures of the rocks that make up this geological formation.

The wider middle reaches of the main eastern rivers: Rother, Tillingham and Brede flow between these fault-bounded ridges and their headwaters (as well as those of the Medway, Adur, Ouse, and Cuckmere Rivers) originate from them, giving a clear radial drainage pattern (see inset on Figure 1).

Streams within these upper reaches of the catchments, which often originate from springs, commonly form steep, wooded 'ghyll' valleys as they erode into the relatively soft bedrock. At the coast, glens form 'hanging valleys' as stream erosion has not kept pace with falling base levels caused by coastal cliff retreat. Also at the

coast, deep-seated rotational landslips and mudflows occur where Fairlight Clays crop out at the base of cliffs, beneath more competent Ashdown sandstones.

Influence on Landscape, Soils, Biodiversity and Resilience to Climate Change

The Ashdown Formation is a **minor aquifer** and considered the most important aquifer within the High Weald (Jones *et al*, 2000).

Soils are generally of a poor quality, i.e. low fertility. The typical soil type is a slightly acid, loamy, and clayey soil with impeded drainage (Soilscape Type No 8). The few occurrences within the High Weald of a more acid, particularly poor-quality soil (Soilscape Type 15) and the limited existing **Lowland Heath Priority Habitat** within the Ashdown Forest and south of Tunbridge Wells occurs on the outcrop of the Ashdown Formation.

The steep sided nature of the **ghylls** has ensured that many woodlands in these valleys have remained undisturbed by human activity. They have an unusual '**Atlantic**' **micro-climate** and are often rich in **bryophytes** (mosses and liverworts), ferns, and other moisture-loving plants which are a good bioindicator for air quality assessments.

Sunken Lanes are a typical feature of the lasting medieval landscape of the High Weald. They are often associated with the north-south orientated drover's routes from the Chalk Downs into the High Weald, where commoners' rights – pannage - allowed local communities to bring pigs to feed on acorns in the late summer. Year on year they would return to the same patches - dens - of woodland and over time the erosion of the sandy soils from this transhumance led to the formation of linear hollows. Some of these sunken lanes are also understood to be the direct result of the continual movements of materials to and from medieval iron furnaces. Many of the now-metalled roads in Sussex follow these ancient routes, provide inland exposures of the geodiversity, and are, or have potential as, species-rich sources of grassland and woodland wildflower verges due to the longevity of the seedbanks in the banks of the sunken lanes.

Historical, Cultural and Natural Environment Connections

The high ground of the Ashdown Formation provided the location of the earliest east to west transport routes, the '**Ridgeways**'.

Several of the former **hammer ponds** and **'pond bay' dams** associated with the medieval iron industry are located within the upper tributaries of streams cut into the Ashdown Formation. Along with the topography and poor-quality soils, the development of the iron industry also contributed to the survival of ancient woodland in patches, which was managed and coppiced for use as a fuel source, rather than being felled wholescale for agriculture.

The more competent sandstones within the formation had a **limited historical building stone** use and were formerly quarried around Horsted Keynes and Sharpthorne. The stone was only used locally in walls as rough-cut blocks and coursed rubble. At Fairlight the sand was quarried for use as a **moulding sand** in glass production, particularly during the war for military optical items.

The **Cretaceous plant fossil sites** of greatest importance in Britain are found within the Fairlight Clays of the Ashdown Formation and the eroding cliffs east of Hastings provide the most abundant and diverse range of early Cretaceous plant fossils in Europe. These are typically found in lenses of sandstone and ironstone and include a range of algae, mosses, horsetails, cycad and now extinct bennettites.

The coastal glens proved popular for recreation. The Victorians developed a fondness for these damp, romantic valleys, and for fern-collecting. This craze (which became known as *Pteridomania*) would draw day-trippers from London and fern motifs became common in art and pottery.

Designated Sites

Seven SSSIs are recognised for geodiversity interest within the Ashdown Formation. These are the West Hoathly Clay Pit which exposed just the Top Ashdown Pebble Bed below worked Wadhurst Clay, three road cuttings (Hastingford, Winchelsea and Waldron), one small building stone quarry and associated road cutting at Brede and several sections at the coast within the Hastings to Pett Beach SSSI which also has a varied biodiversity interest. The junction between the Ashdown Formation and Wadhurst Clay Formation is identified at Winchelsea Cutting. In addition, one LGS, the Marline Valley Woods in Hastings, which is also a SSSI for biodiversity interest, shows exposures of massive Ashdown sand within a typical ghyll. Cliffs at Little Galley Hill LGS, Bexhill show further exposures at the coast.

There are many SSSIs recognised for their biodiversity located on the Ashdown Formation. In addition to the two sites mentioned above a further eleven SSSIs are recognised primarily for ghyll woodland or ancient woodland, four SSSIs are recognised for grassland or meadows and one major site - Ashdown Forest – is noted primarily for lowland heath, developed on low fertility sandy soils.

Potential Contributions to the Nature Recovery Network

- Biodiversity Opportunity Areas (BOAs): As noted earlier, in Sussex, Biodiversity Opportunity Areas are currently viewed as a broad concept and its relevance to land use planning has yet to be realised[5]. However, given the stakeholder engagement process in distinguishing these areas, there is continuing interest in using BOAs to connect and restore wildlife-rich corridors. The majority of four of the largest BOAs in Sussex and Kent are located within the outcrop of the Ashdown Formation, in the upper catchments of the main rivers[6]. These are the **Medway Ouse Watershed**, the **River Uck & Headwaters**, the **Western Ouse Streams & Ashdown Forest** and the **Pevensey, Rother, and Cuckmere Watershed**. Recognising these four BOAs as a much wider-connected group first and foremost by merit of their similar geological and geomorphological setting could provide the means of targeting appropriate policy and action. They are characterised by headwater streams on relatively higher ground, and on the interfluves between the valleys they already contain some areas of Lowland Heath priority habitat. In recognition of these factors, preferred actions within the BOAs could therefore include the creation of conditions suitable for Lowland Heath and / or for the development of 'leaky dams' and the creation and conservation of upstream wetlands and wet woodland areas, utilising the cascading pond design of medieval times (as explored more fully in the local study area, later in this report). These actions would have the multiple potential to **restore wildlife-rich habitats**, **sequester carbon** and **alleviate flooding downstream** within areas already identified as opportunistic for biodiversity. Such actions would make important contributions to **Themes 1 and 2** of the NRN.

- Sunken Lanes: Whilst not specifically protected, the sunken lanes of Sussex are a recognised and distinguishable part of the High Weald's beauty and provide an obvious linear exposed geological feature for the development of wildlife corridors. They are discussed in literature as a man-made geomorphological landform (Jones, 2020; Boardman, 2022), and the High Weald National Landscape team has produced guidance on their management and some verges have been designated wildflower verges by the County Councils.[7] These features are an ideal location for targeting areas of **Biodiversity Net Gain**, as they are managed by national or local authorities rather than being on privately owned land and are ubiquitous across the Weald, so can offset habitat

[5] Sussex Nature Partnership and Sussex Biodiversity Record Centre (2021) *Mapping a Nature Recovery Network in Sussex at the District Level*, Final Report - to accompany Executive Summary, p5

[6] https://sussexlnp.org.uk/boa/

[7] https://highweald.org/guidance/community-spaces/roadside-verges/

destruction very close to any new development. These features could add to - or could even help to refine - the B-Lines[8] identified within the High Weald of Sussex as they provide an obvious rather than modelled 'insect pathway' for pollinators. Targeting Biodiversity Net Gain in this way could also aid conservation of the geodiversity, by ensuring some areas of the lanes remain exposed, aiding access to the sediments. Such actions would contribute to **Theme 1** of the NRN.

- Plant Fossils: The Cretaceous Wealden fossil plants are globally significant for understanding the environment and climate of that time. Kew at Wakehurst Place is within the High Weald and houses one of the most diverse botanical collections in the world. It has pledged land as part of the Weald-to-Waves nature recovery corridor, is committed to halting biodiversity loss and developing nature-based solutions and has a high visitor usage. One of their interactive, creative exhibitions could be used to inform and explore the biodiversity of the High Weald's geological past, the Victorian interest in both Wealden fossil and Holocene-age plants, alongside present challenges and future opportunities for the biodiversity of this area. This would contribute to **Themes 3 and 4** of the NRN.

[8] https://www.buglife.org.uk/our-work/b-lines/

The Wadhurst Clay Formation

Geological Description

The Wadhurst Clay Formation comprises mainly **dark grey shales** and **mudstones** with subordinate beds of pale grey siltstone, **fine-grained, sometimes calcareous sandstone, shelly limestone** and in the lower part of the succession distinctive **sideritic ironstone**, a carbonate of iron. The top metre or so often comprises stiff clay stained red from weathering occurring on an earlier land surface after deposition.

Left: An exposure of the Wadhurst Clay Formation at the Northiam SSSI showing sandy clays with iron nodules and weathered, red, iron-enriched sandstone.

Right: The Cliff End Sandstone and overlying shaly, clayey sediments including the Cliff End Bone Bed, all forming part of the Wadhurst Clay Formation exposed at Cliff End, within the Hastings to Pett Beach SSSI.

Associated Landforms and Geomorphological Processes

The Wadhurst Clay typically underlies more gentle terrain on valley slopes. Rotational landslips and translational mudflows may occur. These are more common in connection with the overlying Tunbridge Wells Sand Formation, where the weight of the overlying rocks, the relatively steeper slopes, and seepage at the junction of the two formations exacerbates instability.

Influence on Landscape, Soils, Biodiversity and Resilience to Climate Change

The limited permeability of the Wadhurst Clay typically creates wetter, more water-logged soils. A slowly permeable, seasonally wet, slightly acid, base rich, loamy and clayey soil (Soilscape Type No. 18) associated with seasonally wet pastures and woodlands is identified with this formation.

Historical, Cultural and Natural Environment Connections

The majority of the sideritic iron ore which formed the basis of the Wealden iron industry was obtained from the Wadhurst Clay Formation, in which it occurs both as nodules and in tabular masses. The most important and consistent ironstone horizon occurs near the base of the formation. This resource was exploited in prehistoric, Roman, and most significantly during Medieval times, where it formed the basis for a very extensive iron industry during the 15th and 16th Centuries.

Ponds and hollows resulting from shallow bell pits, dug for ironstone, marl or building materials are common.

The generated wealth from the iron industry enabled the development of the grand houses and estates of the High Weald.

Around Hastings, where rhythms of alternating sandstone and mudstone are more typical of the formation, the hard, calcareous sandstone beds - known as Tilgate Stone or 'Hastings Granite' were used locally as a general walling and building stone. Other competent impersistent beds including the Cliff End Sandstone, Hog Hill Sandstone, Northiam Sandstone, and the Rye Ironstone have also been worked and used in this way.

Most recently, modern brick pits have extracted the clay, providing characteristic bricks and tiles that are widely used as local building materials throughout the High Weald. Tile-hung elevations are a distinctive feature of many traditional buildings in the area, providing a means of weather-proofing houses built of the rather porous local stone. The clay pits also facilitate the examination and study of the otherwise limited exposure of this formation (see below).

Designated Sites

Nine SSSIs are identified for geodiversity interest within the Wadhurst Clay Formation. Three SSSIs are located within former brick pits (Southborough Pit, West Hoathly and Freshfield Lane) as well as one LGS (Ashdown Brickworks, Bexhill). Three SSSIs in the east are located within former small building stone quarries (Brede Pit and associated Cutting, Blackhorse Quarry and Northiam), two SSSIs are within road cuttings, (Hastingford and Winchelsea) and one, Houghton Greencliff, is a former sea cliff, now located inland. In addition, various places at the coast within the Hastings to Pett Beach SSSI are recognised for both geodiversity and biodiversity interest and include exposures of the Cliff End Sandstone and overlying shaly sediments at Cliff End, within the Fairlight Quarries, and within the uppermost part of the cliff east of Hastings. Another former sea cliff (now inland) Cadborough Cliff is also designated an LGS. As well as being important for the sedimentary record, the fossil interest is significant and includes the bones and teeth of reptiles and early mammals as well as plants, particularly horsetails.

One LGS at West Hoathly is recognised for a landslip in Wadhurst Clay at the junction with overlying Tunbridge Wells Sand.

There are also a further eleven SSSIs recognised for their biodiversity interest which are located on the Wadhurst Clay Formation. These are overwhelmingly designated for ancient woodland or ghyll woodland, only Stockland Farm Meadows is designated primarily for grassland.

Potential Contribution to the Nature Recovery Network

- Ponds: Early work on mapping a nature recovery network for Sussex has identified that different approaches are needed for discrete and dispersed priority habitats such as ponds. The Wadhurst Estate – with land pledged to the Weald-to-Waves nature recovery initiative – is located primarily on the Wadhurst Clay Formation and has used historical mapping to identify former ponds and hollows, including places where the geological resource was previously exploited. This work has been used as the basis for reinstating these as wetland areas within their estate. This approach could be replicated within other areas underlain by the Wadhurst Clay Formation where these features are prevalent, and where the underlying geology and soils are suited to the development of wetland habitats. This would contribute to **Themes 1 and 2** of the NRN

The Tunbridge Wells Sand Formation

Geological Description

The **Tunbridge Wells Sand Formation** is a predominantly **fine- to medium-grained sandstone, siltstone and silty sand** arranged in rhythmic units with finely bedded mudstones and thin limestones. In the western High Weald, between Haywards Head and Tunbridge Wells, the **Grinstead Clay Member**, - **a grey mudstone**, with thin beds of siltstone, nodular clay ironstone and shelly limestone with common rootlet horizons and plant-rich beds - divides the formation into informally named upper and lower beds. In places, the Grinstead Clay Member is itself divided by the **Cuckfield Stone Bed**, a fine grained, calcareous in part, pale yellow brown, fissile sandstone. A distinctive, massive, fine to medium grained, quartzose Sandstone, the **Ardingly Sandstone Member** lies immediately beneath the Grinstead Clay Member and is of particular interest in terms of its geodiversity and its influence on the landscape.

Above and Bottom Left: Outcrops of the massive Ardingly Sandstone within the Wakehurst & Chiddinlye Woods SSSI showing overhangs, honeycomb weathering, deep gulls and weathering along bedding planes. Also showing the problematic, invasive Rhododendron that requires mangement for the benefit of both biodiversity and geodiversity.

Bottom Right: Outcrop of more thinly bedded sandstone of the lower part of the Tunbridge Wells Sand Formation within the Rock Wood SSSI.

Associated Landforms and Geomorphological Processes

The Tunbridge Wells Sand Formation typically shapes the outer rim of the High Weald, and the presence of the massive Ardingly Sandstone and, to a lesser extent the Cuckfield Stone Bed and other sufficiently persistent sandstone beds in the west, has contributed to the formation of numerous sandstone outcrops and subsidiary ridges in this area. These ridges are at a relatively lower elevation, rising to over 100m, compared to the highest ridges underlain by the Ashdown Formation which rise to over 200m. The overall result is that the western part of the High Weald has a much greater sense of elevation and undulation, with many ridges, valleys, deep ghylls and sunken lanes. In the east, the Rother, Tillingham and Brede Rivers shape a landform of lower relief, and the influence of the Tunbridge Wells Sandstone Formation in those areas is more limited.

The **inland cliffs and crags** of the massive **Ardingly Sandstone** form the most distinctive **natural outcrops** of the High Weald. They are often described as '**sandrock**' in accounts relating to biodiversity interest and as '**Southern Sandstone**' by the climbing community. There are around 100 natural outcrops, with the largest being continuous cliff lines over half a kilometre long and more than 10m high, typically within the upper section of valley sides and associated with particularly **steep and deep, wooded ghylls**. The cliff faces are generally covered with a dark grey, weathered crust which helps to protect the underlying sandstone from erosion. When exposed, the fresh sandstone is a light honey colour.

Periglacial **cambering** - the tilting of sandstone blocks into the valleys during previous cold climatic periods - can produce a complex system of 'gulls' (deep, open fissures) where the blocks have moved apart. The sandstone crags are often deeply undercut at their base and weathered along bedding places and discontinuities aided by the action of percolating groundwater. They are also distinguished by a wealth of micro-weathering features, such as honeycomb weathering, polygonal cracking of the surface and broken, weathered angular blocks of sandstone are typical at the base of the cliffs and within ghyll slopes.

Influence on Landscape, Soils, Biodiversity and Resilience to Climate Change

The Tunbridge Wells Sand Formation is a minor aquifer but of more limited importance in the region compared to the Ashdown Sand Formation (Jones et al, 2000). However, the **chalybeate** (iron-enriched) **springs** which are common throughout the area, and on which the 17th Century spa town of Royal Tunbridge Wells was developed, emanate from the base of this formation, at the point where the underlying Wadhurst Clay Formation provides a more impermeable barrier.

The presence of the Grinstead Clay Member locally influences the formation of a more slowly permeable, seasonally wet, slightly acid, but base-rich loamy and clayey soil (Soilscape No. 18). Elsewhere, the soils are predominantly slightly acid, loamy, and clayey with impeded drainage (Soilscape No. 8) although two areas: St Leonards Forest, east of Horsham and an area south-west of Groombridge, are mapped as freely draining, slightly acid loamy soils (Soilscape No. 6).

The **'Atlantic' plant community of bryophytes, ferns and lichens** is commonly associated with tall, often overhanging outcrops of the Ardingly Sandstone – particularly, but not only, within the many deeply-incised ghylls, as these retain a micro-climate quite different to that found elsewhere in the south-east. The Tunbridge Filmy Fern is a particularly rare species, unique to this area.

Sunken lanes formed in the softer sediments beneath outcrops of Ardingly Sandstone are particularly distinctive, deep, and shady.

Historical, Cultural and Natural Environment Connections

Discoveries of microlithic flint points within natural overhangs, or rock-shelters, in the Ardingly Sandstone provide convincing evidence of Mesolithic hunting activity within the High Weald.

Sideritic ironstone was locally worked from the Grinstead Clay, though to a lesser extent than from the Wadhurst Clay Formation.

Ardingly Sandstone is the most widely used building stone of the High Weald and it is often the sole building stone employed. It is used for high-quality ashlar, walls, and fine decorative and ornamental work as it is readily carved. Many churches within the area of outcrop and stately homes, such as Gravetye Manor, Wakehurst Place and Bateman's, Kipling's home at Burwash, are built of Ardingly sandstone. This rock is still worked today at Philpotts Quarry near West Hoathly.

Cuckfield Stone and other sandstones within the formation have a more limited use as rough ashlar and coursed rubble. The particularly flaggy, thin sandstone units within the Cuckfield Sandstone Bed (also known as 'Tilgate Stone') are used in paving, roadstone and roofing, locally around Cuckfield.

The Ardingly Sandstone forms the only location of inland outcrops suitable for climbing in southern England. This makes them extremely popular. Out of the many outcrops, just twelve locations are promoted for climbing[9] although these areas include two geological SSSIs at Stone Farm and High Rocks: and two biological SSSIs at Eridge Green and Rusthall Common. A code of conduct has been developed that promotes the avoidance of moving ropes cutting into the soft rock and the need to preserve the thin outer crust to reduce erosion[10].

In addition to those mentioned above, two other inland outcrops are designated geological SSSIs for the Ardingly Sandstone interest at Wakehurst & Chiddingly Woods and Turner's Hill and one cutting & small former pit at Pembury. The quarries at Philpotts & Hook and Freshfield Lane are designated for interest in the Tunbridge Wells Sandstone Formation including the Ardingly Sandstone Member and Grinstead Clay Member.

Designated Sites

In addition to Stone Farm and High Rocks mentioned above, there is one other geological SSSIs designated for interest within Ardingly Sandstone outcrops at Chiddingly Woods, one cutting & small former pit at Pembury and a small former pit at Turner's Hill. The quarries at Philpotts & Hook and Freshfield Lane are designated for interest in the Tunbridge Wells Sandstone Formation including the Ardingly Sandstone and Grinstead Clay.

In addition to Eridge Green (also an LGS) and Rusthall Common noted above, Penn's Rocks and Mills Rocks (also known as The Rocks, Ashurst Wood) are designated as SSSIs for the biodiversity interest within outcrops of Ardingly Sandstone, the latter is also designated an LGS. Wakehurst and Chiddingly Woods SSSI also has biodiversity interest and the Rocks Walk and Rock View at Wakehurst Place are designated as two separate LGS. The local geological importance of the sandstone outcrops is recognised by a further six LGS: Harrison's Rock, Rocks Wood at Groombridge, Cow Wood at Handcross, Lake Wood Rocks and Rocks Park at Uckfield and The Hermitage at High Hurstwood.

Galley Hill LGS at Bexhill and a road cutting at Founthill LGS at Newick show further exposures of the Tunbridge Wells Sand Formation and Whitemans Green LGS is the site of a former quarry that extracted Cuckfield Stone and includes a commemorative plaque recognising Gideon Mantell's work in first identifying dinosaurs here in the early 1800s.

Seventeen other SSSIs designated for their biodiversity are located on the Tunbridge Wells Sand Formation and reflect the more varied sediments of this geological formation by a range of interests including ponds, hammer ponds, ancient woodland, ghyll woodland, grassland, and meadows.

[9] https://www.southernsandstoneclimbs.co.uk/p/climbing-areas.html

[10] https://www.southernsandstoneclimbs.co.uk/p/code-of-practice.html

Potential Contribution to the Nature Recovery Network

- Sandstone. The Ardingly Sandstone outcrops provide opportunities to grow the Nature Recovery Network in a variety of different ways. The craggy outcrops are a recognised and distinguishable landform of the High Weald appreciated by geomorphologists, ecologists, the climbing community, active youngsters who like to scramble through the gulls and over the lower rocks, and the interested public. Several thousand years ago they provided shelters for early inhabitants of the Weald. They are also discussed in literature, feature in mythology and art, and the High Weald National Landscape team has produced informative leaflets and guidance on their management. Whilst the outcrops do not appear to have been overly worked, the same Ardingly Sandstone has also been quarried and used as a building stone across the High Weald, further linking this important natural environment feature to the historical and cultural landscape. The sandstone outcrops are also widely associated with the formation of natural ghylls and deep sunken lanes and together these features provide a **network of linear connections for biodiversity opportunities** in the **western High Weald**, particularly for the important and **rare 'Atlantic' plant communities**. Quite separately, the **removal of invasive bracken and rhododendron** from sandstone outcrops has **benefits for both geodiversity and biodiversity**, enabling better viewing of the interesting geomorphological features and providing conditions suitable for localised heathland communities and specialised invertebrates to establish and thrive. Through connecting newly emerging networks such as the 'Weald-to-Waves' initiative, and existing groups, such as the Sussex Geodiversity Partnership and Wildlife Trusts, landowners with outcrops of Ardingly Sandstone within their landholdings, particularly those with designated sites, could be invited to establish a particular 'Sandrock Group' where advice could be shared on conserving, managing and monitoring these geological and geomorphological features and their associated biodiversity as well as promoting their heritage. This could include workshops, engaging experts, and interested volunteer groups and, most importantly, considering these features holistically as a unique opportunity for recovering both the geodiversity and biodiversity of the High Weald and making better connections to the natural environment. These various suggestions could contribute to **Themes 1, 3 and 4** of the NRN.

Superficial Deposits and River Systems

Geological Description

Superficial deposits are those which have been laid down within the last 2.6 million years, during the 'Quaternary' period of Earth history. As the name suggests, where they occur, these deposits overlie the older ('bedrock') strata, cutting across their boundaries and creating landscape-scale connections between the different outcrops. Throughout the High Weald they are associated, either directly or indirectly, with the formation of incised river valleys and the consequent movement and redeposition of sediment.

Alluvium: is present within all of the major river valleys and many of the smaller headwater streams. It represents the most recent phase of deposition by the river systems during the current (ongoing) 'Holocene' epoch, which began when the climate began to improve, some 11,700 years ago, following the last ice age. Within the High Weald, alluvium is generally confined to narrow headwater valleys and is composed of fine sands, silts and clays, laid down by periodic flood waters, usually underlain by gravel of local origin. In some areas, the deposits incorporate organic clays and peat, reflecting the presence of localised former wetland habitats within the floodplains. Further downstream, in all of the major rivers, the alluvial deposits widen out across broader floodplains. For the Rivers Ouse, Uck and Cuckmere, this transition occurs as the rivers descend to the lower ground and more gentle slopes of the Low Weald. For the others, including the Medway, Teise and Rother, it occurs within the High Weald NCA itself.

Above: Alluvium of the small floodplain of the Shortbridge Stream within the Butcher's Wood LWS, Uckfield

Above: Detail of the cohesive, silty alluvium exposed in the banks of the Shortbridge Stream within the Rock Wood SSSI.

River Terrace Deposits: these represent the remnants of former floodplains, which were established at slightly higher levels by more powerful river systems, prior to the Holocene epoch. At that time, the area experienced a colder and harsher climatic regime, particularly during periods of glaciation further north, with periglacial tundra-like conditions prevailing for much of the time, with limited vegetation cover and with much more intense weathering of the landscape. This, combined with periods of more intensive surface runoff due to impermeable frozen ground and subsequently from melting permafrost, delivered much larger quantities of sediment into the rivers, causing them to deposit extensive spreads of material in the valley bottoms. Such deposits are of most significance within the valleys of the Medway, Ouse, Uck and Cuckmere, though primarily downstream of the High Weald NCA boundary. They are more limited within the eastern valleys of the Rother, Tillingham and Brede rivers. Where they occur within the High Weald, the deposits are composed of fragments of locally-derived sandstones, siltstones, and ironstones in sandy matrix.

Head: Silty loams, typically dark brown in colour and mixed with locally-derived sub-angular gravel in places, are present on the lower slopes of some valleys, above (and often merging into) the river terraces. They result from hillslope (rather than fluvial) processes during former periglacial conditions, including 'solifluction' – the downslope movement of water-saturated sediment, but also from more recent hillwash processes, particularly generated at spring-lines, such as those at the base of the Tunbridge Wells Sand. The deposits appear to be more prevalent on the southern side of the High Weald, notably within the Ouse, Uck, Cuckmere and Brede catchments.

Associated Landforms and Geomorphological Processes

The ongoing geomorphological processes of river erosion, spring sapping (where groundwater undermines slopes leading to the headward growth of valleys) and hillwash are continuing to shape the landforms of the High Weald today. It is this ongoing natural erosion, over several thousand years, that has exposed the crags associated with more resistant beds of sandstone and which has formed the steep ghylls so characteristic of the area.

The upper reaches of all the river catchments are steep and short. With most areas having only limited permeability at the surface, due to the predominance of fine-grained sandstones, siltstones and clays, this gives rise to a 'flashy' discharge regime, with a rapid response to rainfall events and frequent flooding downstream. Fluvial activity, in terms of the lateral erosion of river banks and changes in channel pattern are very limited, however, due largely to the resistant, cohesive nature of the silty and clayey alluvium which forms the banks.

Influence on Landscape, Soils, Biodiversity and Resilience to Climate Change

The presence of alluvium influences the formation of loamy and clayey floodplain soils with naturally high groundwater levels (Soilscape No. 20). These are naturally associated with wet meadows and wet woodland habitats. Historically, however, these have often been 'improved' (i.e. drained artificially, cleared of trees and fertilised) to create more productive pasture. In many cases they have also been protected from inundation by artificial flood defences and are no longer capable of functioning as they should, to store and convey floodwater. Natural Flood Management schemes, where they have been implemented, seek to reverse this effect, making space for river flooding and reconnecting the rivers to their floodplains.

Where terrace gravel deposits or weathered head deposits are particularly extensive, such as the headwaters of the River Ouse and River Uck in the vicinity of Uckfield, the headwaters of the Cuckmere River, north of Hailsham and the headwaters of the River Brede, east of Battle, this influences the development of more freely draining, slightly acid loamy soils (Soilscape Type No. 6).

Historical, Cultural and Natural Environment Connections

The superficial deposits are generally limited in extent and are not significant as an economic resource, although river terrace gravels have occasionally been exploited, very locally, for use as aggregate.

More generally, there are some connections between the main rivers of the area and historical settlement patterns (e.g. Uckfield, Robertsbridge, Groombridge), but most of the towns and larger villages (East Grinstead, Crowborough, Tunbridge Wells, Heathfield, Wadhurst, Battle) are located on interfluves or higher ground.

Historically, most of the major rivers in Sussex have been straightened within artificial embankments, deepened, and realigned, in their mid and lower reaches to aid transportation and to provide land for agriculture.

Designated Sites

Within the High Weald, there are no SSSIs designated specifically for geodiversity interest in the superficial deposits. However, five SSSIs designated for biodiversity are located, in part, on alluvium and/or river terrace deposits. These include Hedgecourt Lake, a dammed millpond within the upper tributary of the River Medway; Scotney Castle, also within an upper tributary of the Medway; Buxted Park which includes part of the River Uck floodplain; St Dunstan's Farm Meadows within a tributary of the Cuckmere River; and Combe Haven, within a small river catchment between Bexhill and Hastings. Alluvial meadows and woodland habitats are important at these sites.

Potential Contribution to the Nature Recovery Network

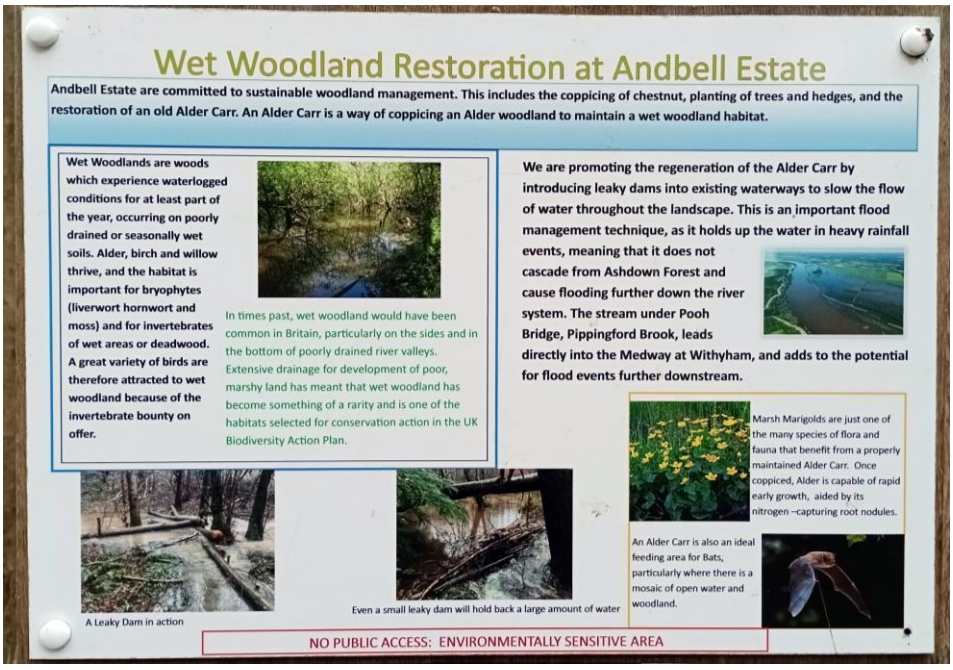
- Floodplains. Alluvium is generally coincident with river floodplains, and it is the rivers and floodplains themselves (as functional landforms and areas of habitat), rather than the alluvial deposits, which provide the main opportunities for nature recovery in these areas. Encouraging landowners and land-mangers to recognise these opportunities can help to **reduce the potential of damaging floods**, **improve water quality** and **create**, **enhance** or **reconnect important wildlife corridors**. There are several nature recovery projects already promoting restoration of the Sussex Rivers along these lines and providing a network of advice and support. These include the Sussex Wildlife Trust's Wilder Ouse[11] , the Ouse and Adur River Trust (OART)[12] and the farmer and land-manager-led 'Weald to Waves'[13] initiatives. Their work includes re-establishing natural floodplain storage capacity, removing river embankments in places where people and property won't be affected, and **allowing rivers to meander**, through the operation of **natural fluvial processes**,

[11] https://sussexwildlifetrust.org.uk/get-involved/projects/wilder-ouse

[12] https://oart.org.uk/

[13] https://www.wealdtowaves.co.uk/

thereby reducing the speed of flow. It also includes the re-establishment of natural wetland vegetation and wet woodland together with species-rich alluvial meadows, aided in some cases by the unfettered introduction of domestic animals or the re-introduction of **beavers**[14] to speed up the transformation and further reduce the rate of flow, as used on the Knepp Estate in Sussex. As well as attenuating floodwaters, a study by the University of Exeter (Puttock *et al*, 2017) has shown that beaver dams are effective at capturing soil that has eroded from intensively managed fields during heavy rain, and at neutralising artificial nitrogen, phosphorous and other pollutants. Carbon is also locked up in the sediment. Beavers are seen, in that study, as one of the most powerful tools available for mitigating the effects of climate change. Similar benefits might be envisaged within the lower reaches of other rivers draining from the High Weald and, locally, within the High Weald itself, where the floodplains are generally narrower and steeper, and where woodlands are frequently more characteristic natural habitats than wetlands. One such example is seen within a small tributary of the River Medway near to Hartfield, on the northern side of Ashdown Forest – the site of the famous 'Pooh Sticks Bridge', where 'leaky dams' have been used to help restore wet woodland habitats within an old Alder Carr (see below). Many of the foregoing initiatives would also benefit geodiversity by allowing geomorphological processes to operate naturally and effectively. All of these activities would contribute to **Themes 1 and 2** of the NRN



Alder Carr wet woodland restoration through the construction of leaky dams, near Hartfield, West Sussex.

[14] https://knepp.co.uk/2020/02/bringing-beavers-back-to-sussex/

Characteristics of the Local Study Area

In order to examine the connections between geodiversity and biodiversity in more detail, and to explore more specific opportunities for integration with nature recovery, this case study has focused on one particular part of the High Weald, between the Ashdown Forest and the town of Uckfield, in East Sussex.

As detailed within this Chapter, this is an area characterised by multiple environmental designations and priority habitats. It is also characterised by high levels of pressure for built development, particularly for much-needed housing. For both of these reasons, it is an area that has previously been identified as being in need of positive action on Nature Recovery, in order to reverse the decline in biodiversity associated with the fragmentation of habitats that has taken place in the past. The LNRS for East Sussex, which will incorporate the study area, is currently being developed. Its main purpose will be to identify locations to create or improve habitat that are most likely to provide the greatest benefit for nature and the wider environment. It is hoped that this case study will contribute to that strategy, both in terms of providing baseline information (on geodiversity as well as wildlife) and making suggestions for biodiversity and geodiversity enhancement.

This Chapter examines the main characteristics of this area, in terms of existing landscape and nature conservation designations, priority habitats and other features, relating each of these to the underlying geology. The features are listed in descending levels of protection from national (and international) designations down to locally-designated sites and individual types of priority habitat. In each case, the information is drawn partly from the published citations for individual designations, partly from other published sources and partly from existing personal knowledge and field observations.

Local Geology

With the exception of the Purbeck Group strata (which remain deeply buried beneath the surface, in this area), all of the geological Formations seen within the rest of the High Weald are represented. Descriptions of these are given in the previous section and so are not repeated here.

In terms of their distribution within the local area, the Ashdown Formation sandstones underlie the highest areas on Ashdown Forest, at the centre of the High Weald, and are also exposed within a fault-bounded ridge to the east of Uckfield. The Wadhurst Clay is also found, overlying the Ashdown Sandstones in those areas, and to the south of Uckfield. The Tunbridge Wells Sand Formation, which in this area is clearly split into its Upper and Lower divisions, separated by the Grinstead Clay and the Ardingly Sandstone, occupies the central part of the area, within and to the west of both Uckfield and Maresfield. The Ardingly Sandstone, in particular, is a feature of considerable geodiversity interest, making significant contributions in terms of both local landforms and associated biodiversity (see also Figure 13, on page 43, for detailed mapping of this in the area around Uckfield). Modern alluvial deposits are present beneath the narrow floodplains of all the main rivers and most of the tributary streams. Older river terrace deposits are preserved alongside the alluvium within parts of the Ouse and Uck valleys, in the south-west. Periglacial Head deposits are also well-developed along the sides of those valleys and some of the tributaries.

Figure 3, on the next page, illustrates the geology of this area, including bedrock, superficial deposits and geological faults. The legend to the colours shown on Figure 3 (slightly modified from those on Figure 1, for greater clarity) are as follows:

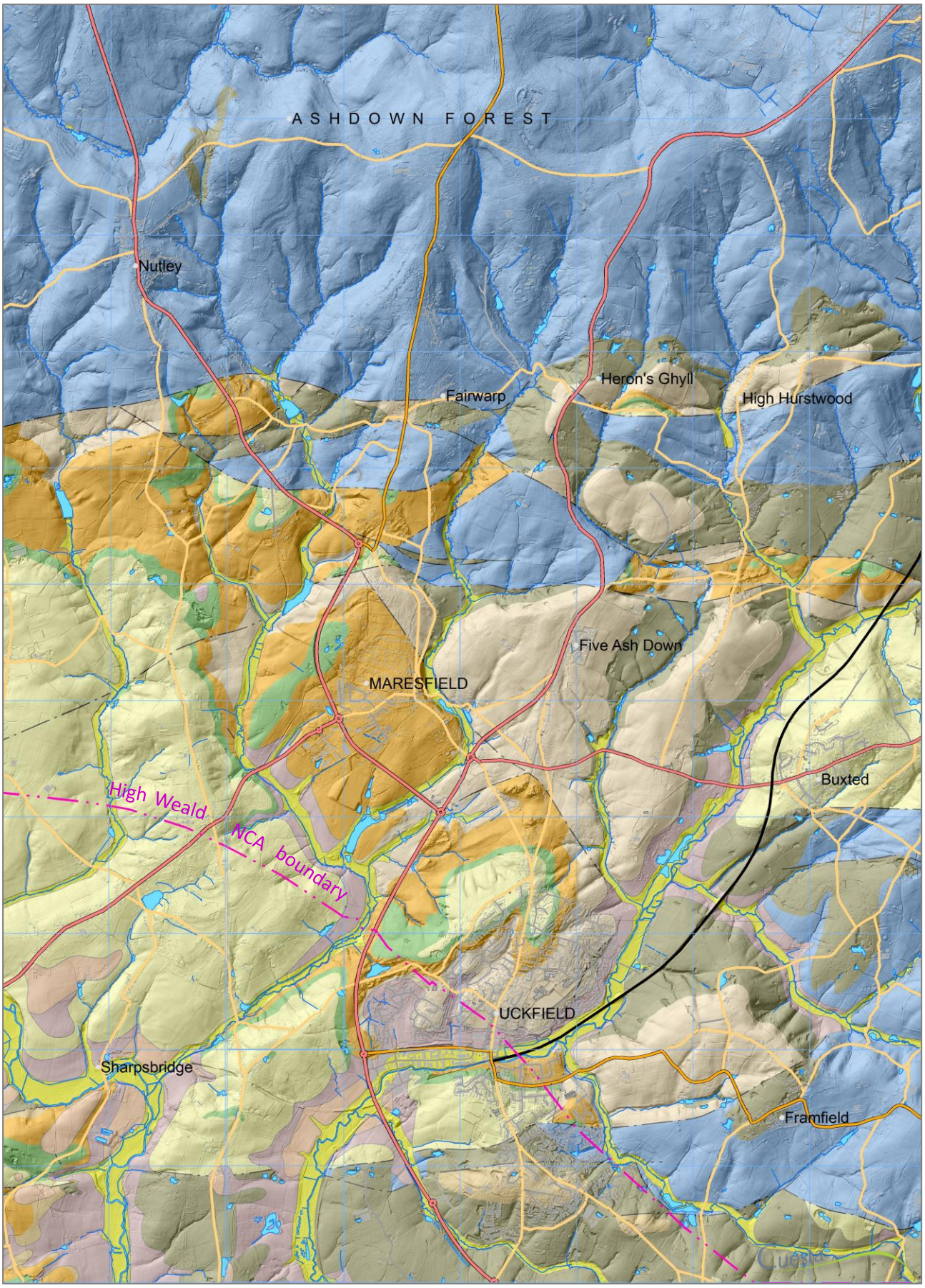
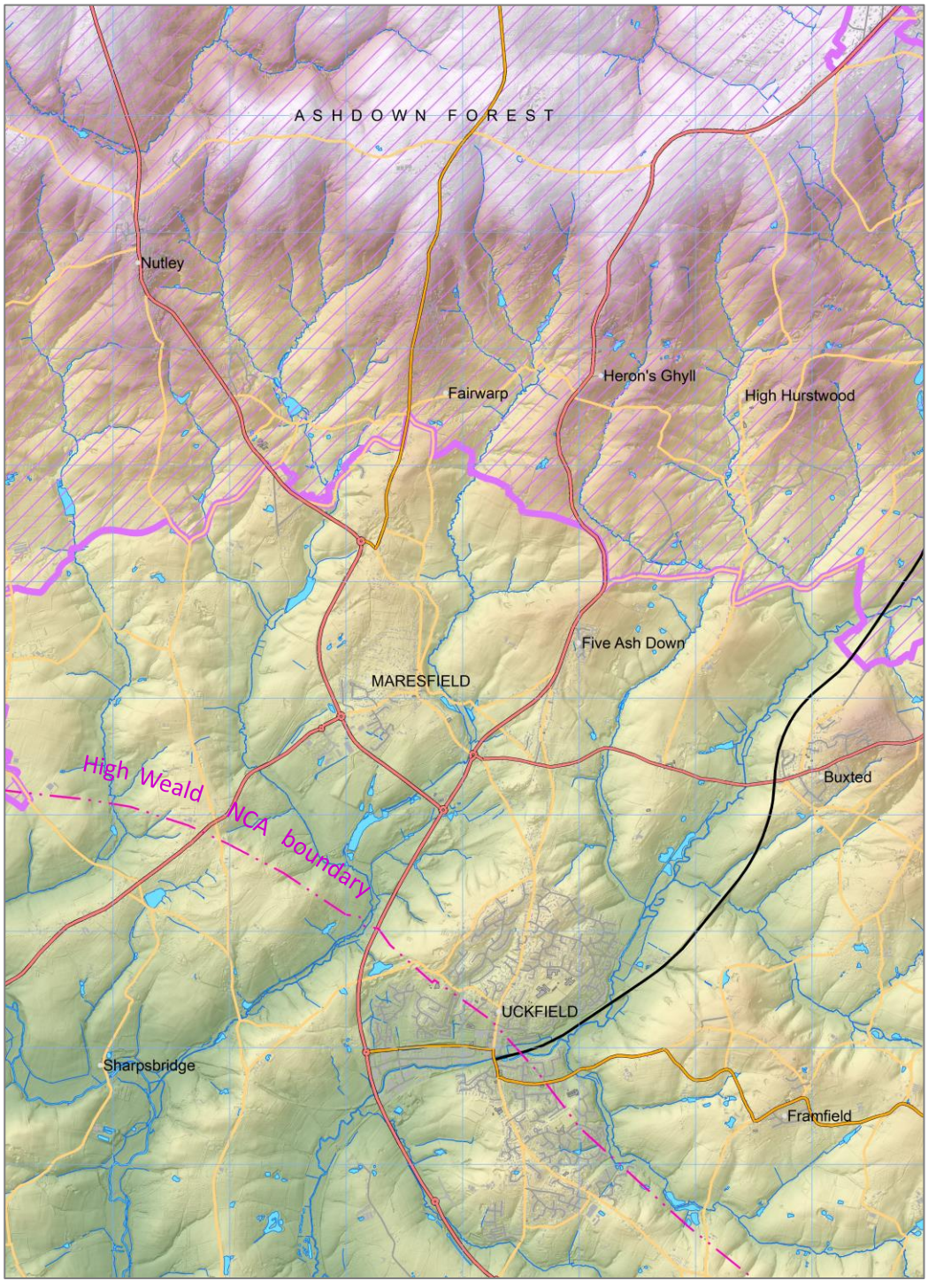


Figure 3: The Bedrock and Superficial Geology of the Local Study Area *(see previous page for legend)*.

The High Weald National Landscape

Formerly known as the High Weald Area of Outstanding Natural Beauty (AONB), this covers some 78% of the High Weald National Character Area and most of the northern half of the study area (Fig 4). In common with all National Landscapes, its designation relates not only to landscape character but also to landscape quality and 'Natural Beauty'. The landscape is described, (on page 17 of the AONB Management Plan[15]), as "*a deeply incised, ridged and faulted landform of clays and sandstone. The ridges tend east-west, and from them spring numerous ghyll streams that form the headwaters of rivers*". Geology, landform and water systems are thus recognised as key components of the High Weald's natural beauty and provide a focus for nature conservation within the area.



Within that part of the National Landscape which falls within the local study area, Ancient Woodlands are particularly abundant (compare Figure 4, here with Figure 7, below). The key to their survival lies partly in their former importance to the local iron industry, but also to the nature of the landscape itself. The intricate topography of the area, steeply dissected by numerous headwater streams, and the generally poor quality of its soils have combined to preclude large scale agricultural transformation and have allowed many woodlands to survive.

Figure 4: The extent of the High Weald National Landscape (shaded) and the southern boundary of the High Weald National Character Area (dashed line) within the local study area.

[15] https://highweald.org/aonb-management-plan/

Sites of Special Scientific Interest

Three SSSIs are located partly or wholly within the local study area. All of these are primarily designated for their biological characteristics, but all three have clear relationships with geodiversity factors. They comprise:

Ashdown Forest © Cuesta, 2009

Ashdown Forest SSSI, which is also a Special Area of Conservation (SAC) and a Special Protection Area (SPA) for wild birds, is an extensive, historical area of common land, occupying the high ground in the centre of the High Weald. Its soils are derived predominantly from the interbedded sandstones and siltstones of the Ashdown Formation strata. It is one of the largest single continuous blocks of heath, semi-natural woodland and valley bog in south-east England. The heath and bracken communities form a mosaic with acid grassland dominated by purple moor-grass. Wet areas provide suitable conditions for several species of Sphagnum moss, together with bog asphodel, common cotton grass, marsh gentian and ivy-leaved bell flower among others. Gorse, silver birch, pedunculate oak and Scots pine are scattered across the heath, and in some areas form extensive secondary woodland and scrub. Within the study area, the forest is drained by the headwater streams of the River Uck and the River Ouse. These cut down through the soft sandstone in many places, forming steep sided valleys (ghylls) which are sheltered from winter frosts and remain humid in summer. A range of bryophytes, including liverworts and mosses together with a variety of ferns thrive in this

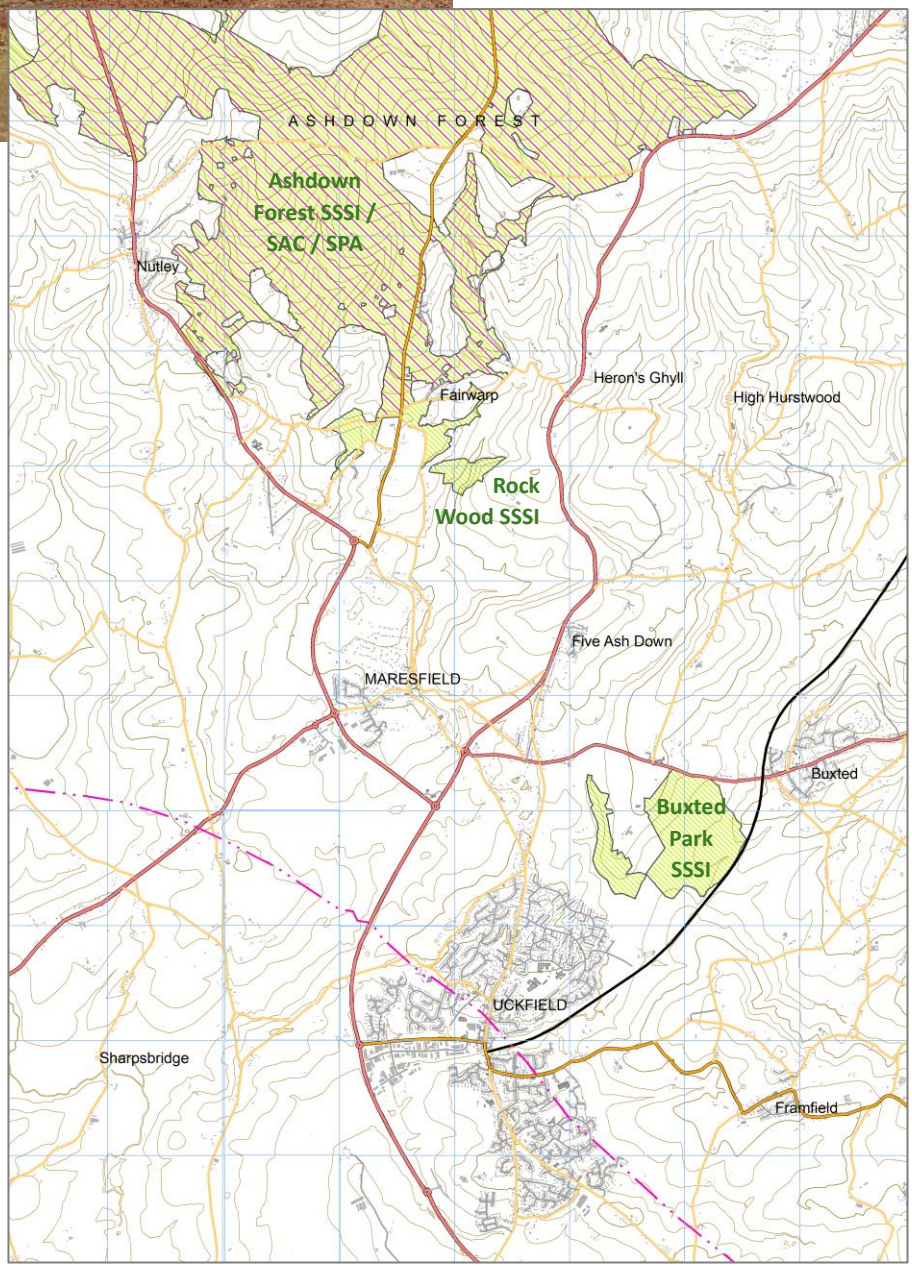


Figure 5: Sites of Special Scientific Interest within the local study area.

'Atlantic' microclimate. The damming of streams, digging for marl, and localised quarrying for sandstone have produced several large ponds in a number of areas of the forest. The aquatic habitats support a diverse fauna, including a range of water beetles and a diversity of dragonfly and damselfly species. Large populations of reptiles, including the viviparous lizard and the adder occur on the open habitats. Notable heath nesting birds include the Dartford Warbler, nightjar, hobby and (formerly, at least) Curlew. Scrub, woodlands and coppice together support a wide range of breeding woodland birds, and provide a refuge for the dormouse.

Buxted Park SSSI, an old, Medieval deer park consisting of a variety of unimproved grassland communities with parkland trees and areas of woodland which, as a whole, support a large invertebrate population These are found primarily on the marshlands and riverbanks, but also in association with over-mature trees and dead wood. Areas of marshy grassland, often dominated by tufted hair grass and fen communities *occupy land close to the river* and in one area a fine greater tussock sedge swamp has developed. The site has been found to be of exceptional importance for conservation of invertebrates, especially beetles such as *Ptenidium gressneri* and nationally scarce flies including the hoverfly of fen and marshes (*Orthonevra brevicornis)* and the large-headed fly of woodland in southern England, (*Nephrocerus flavicornis*). The acidic grassland east of the River Uck, developed over Tunbridge Wells Sandstone and Wadhurst Clay, is of a type very scarce in south east England. Whilst designated only for its biodiversity, the site incorporates a relatively natural part of the River Uck floodplain – modified in places by the excavation of large angling lakes, but unaffected by built development or artificial flood defences.


River Uck floodplain in Buxted Park SSSI © Cuesta,

Rock Wood SSSI, a small area of Ancient Woodland lying (in part) on Ardingly Sandstone which crops out in lines of high crags (estimated to be up to 10m in height) in several places within the wood. The Shortbridge Stream flows though the site and a minor, right bank tributary spills over the crags in one location, forming a waterfall within a steep-sided ghyll. In common with similar features elsewhere in the study area, this has a moist, mild microclimate which is suitable for a number of 'Atlantic' plant species uncommon in south-east England, including bryophytes (mosses and liverworts) and ferns. The latter include the scented buckler fern and Tunbridge filmy fern which, although rare, are characteristic of the ghyll woodlands seen in many parts of the High Weald.


Rock Wood SSSI © Cuesta, 2024

Though not relevant to the SSSI citation, a Scheduled Monument (Hendall Furnace) is located within the SSSI. This relates to a 16th Century blast furnace with its associated 'pond bay' earth dam, water system and slag heaps. The location of the furnace, directly below the dam, is clearly influenced by the need for water and power (and hence is linked to the geomorphology of the steep-sided valley). It is also linked to the proximity to sources of iron (within the adjoining outcrop of Wadhurst Clay) and to charcoal (from the aptly-named Furnace Wood, directly upstream of the site and largely within the Wadhurst Clay outcrop).

Local Designations

Local nature conservation designations within the study area are shown in Figure 6 and are described in detail within Appendix A. They comprise two Statutorily-protected **Local Nature Reserves**, together with three **Local Geological Sites** and sixteen **Local Wildlife Sites**. The Local Nature Reserves are both linked to geodiversity factors – the River Uck floodplain in the case of Hempstead Meadows LNR, and Ardingly Sandstone outcrops with evidence of Mesolithic occupation, in the case of West Park. All three LGS contain notable outcrops of Ardingly Sandstone, with associated bryophytes, ferns and lichens, as do five of the Local Wildlife Sites (two of which overlap with LGS designations). The LWS also include a former brick clay pit and a section of floodplain meadow on the Shortbridge Stream. In all of these cases there are opportunities to consider the role of geodiversity in supporting and helping to understand the biodiversity features that are present. There is also a need for geodiversity issues to be considered when routine condition monitoring and maintenance work is carried out.

For the nine remaining LWS, geodiversity factors are less obvious but generally still relevant, in terms of the influence of parent materials on soil type and vegetation cover.

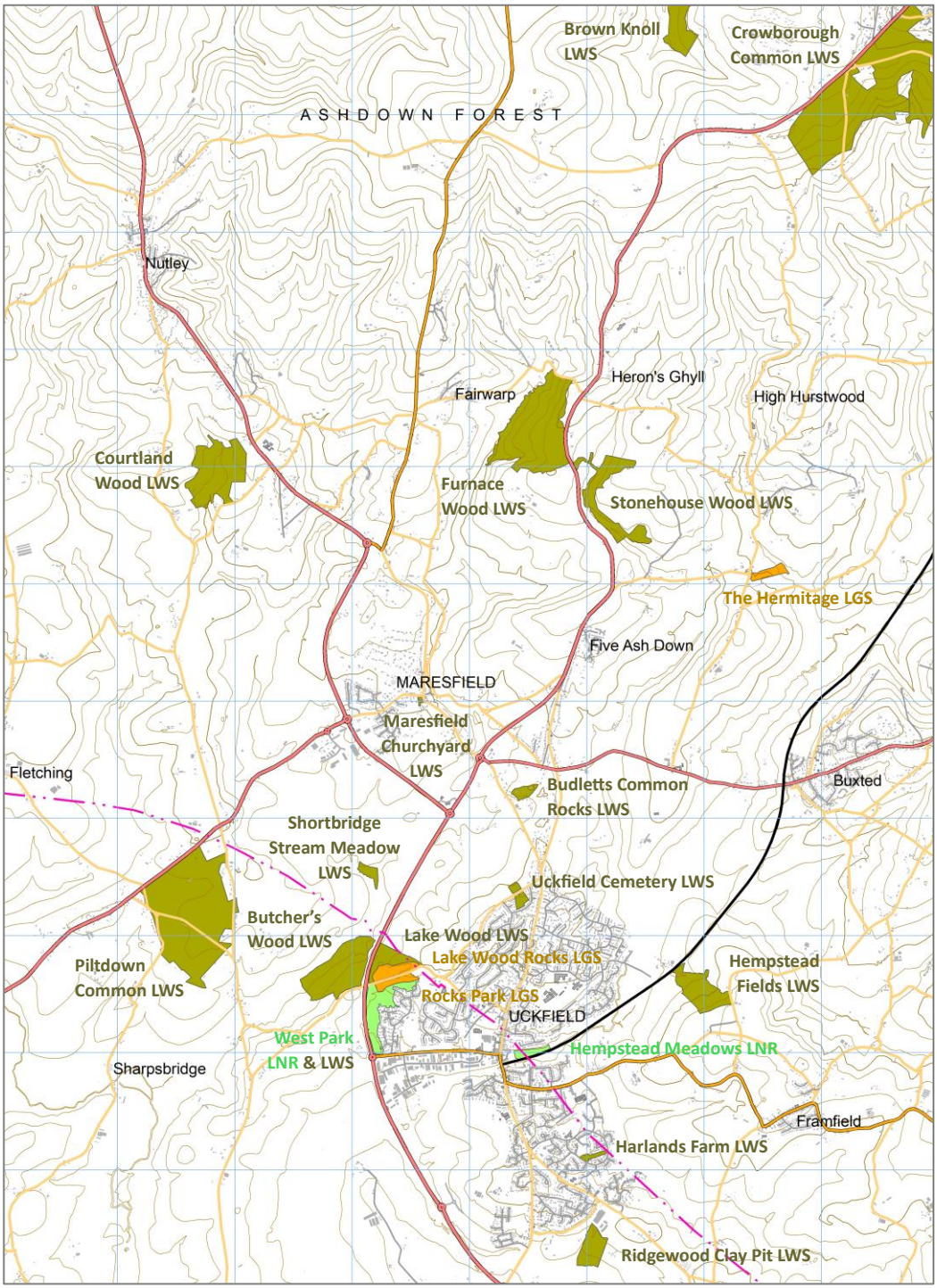
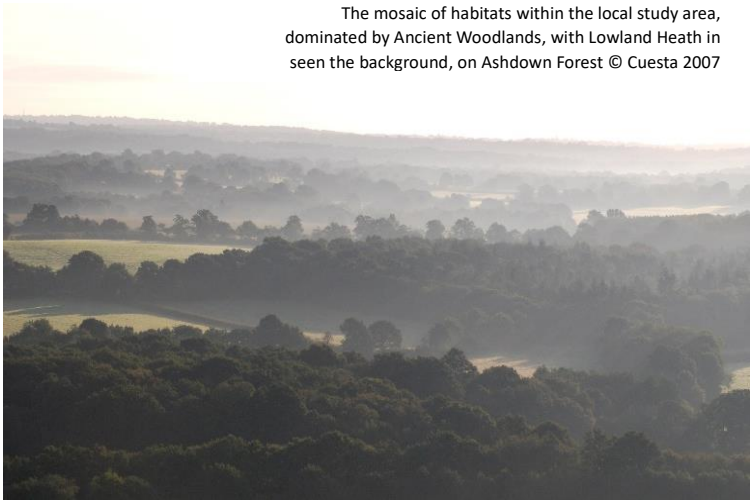


Figure 6: Local nature conservation designations within the study area, including Statutory Local Nature Reserves *(green shading)****, Local Geological Sites*** *(orange shading)* ***and Local Wildlife Sites*** *(olive shading)*

Priority Habitats



The mosaic of habitats within the local study area, dominated by Ancient Woodlands, with Lowland Heath in seen the background, on Ashdown Forest © Cuesta 2007

In addition to the various designated sites, described above, areas mapped as priority habitats, under Section 41 of the Natural Environment and Rural Communities (NERC) Act provide a further means of recognising important features of the natural environment. These were first identified in the UK Biodiversity Action Plan (UK BAP).

Priority habitats found within the local study area comprise:

- **Ancient Woodland** including:
  - **ancient semi-natural woodland** mainly made up of trees and shrubs native to the site, usually arising from natural regeneration; and
  - **plantations on ancient woodland sites**, where the original woodland has been replanted with conifer or broadleaved trees on sites that retain ancient woodland features, such as undisturbed soil, ground flora and fungi.

Both types have equal protection under paragraph 186 of the NPPF[16], and both are extensive across the High Weald landscape as well as within the local study area (Fig.7). Ancient woodlands take hundreds of years to establish and are defined by the UK Government as an ***irreplaceable habitat***. They are valuable natural assets that are important for wildlife, soils, carbon capture and storage, contributing to the seed bank and genetic diversity, as well as recreation, health and wellbeing, cultural, historical and landscape value.

Figure 7: The extent of woodlands within the local study area. *Dark green areas are* ***deciduous woodland priority habitat.*** *Vertical shading indicates* ***Ancient Semi-Natural Woodland;*** *horizontal shading indicates* ***Plantations on Ancient Woodland Sites;*** *and diagonal shading indicates* ***Wood Pasture and Parkland.***

[16] National Planning Policy Framework (NPPF), December 2023 edition.

Ancient Woodland is defined as any area that's been wooded continuously since at least 1600 AD. This does not mean there's been continuous tree cover across the whole site throughout that period, since woodland management will periodically involve felling or at least coppicing of the trees. Moreover, not all trees in the woodland have to be old. Open ground, both temporary and permanent, is an important component of ancient woodlands.

Ancient Woodland within the Lake Wood LWS © Cuesta 2023

Ancient Woodlands are frequently found within the headwater valleys draining south from the high ground of Ashdown Forest, but continue south of the AONB boundary, both within wooded valleys and across broader areas on the interfluves between the main streams and rivers. The latter continue beyond the High Weald NCA boundary, particularly on the interfluve between the River Ouse and the River Uck. One particularly important category of Ancient Woodland is that which occurs within the deeply-incised ghyll valleys, where they are commonly associated with steep sandstone outcrops and assemblages of rare bryophytes and ferns.

- **Wood Pasture and Parkland**, associated either with large tracts of land within and at the edges of Ashdown Forest or with remnants of smaller parkland areas in Maresfield Park, Buxted Park, West Park in Uckfield and Framfield Place.

Buxted Park SSSI © Cuesta 2024

- **Deciduous Woodland**. Deciduous (broadleaved) woodland, in general, has a similar distribution to Ancient Woodlands, as described above – and for the same reasons. The distributions overlap significantly (since all Semi-Natural Ancient Woodlands and many replanted Ancient Woodlands are deciduous) but additional, younger deciduous woodlands also occur in places.
- **Lowland Heathland**. This is found primarily on the high ground of Ashdown Forest, covering extensive areas of land (see front cover photograph), but also on and around Piltdown Common in the south of the local study area (see purple -shaded areas in Figure 8, below for distribution). In both cases, these are areas of low fertility, acidic, thin sandy soils underlain by the interbedded sandstones and siltstones of either the Ashdown Formation or the Upper Tunbridge Wells Sand.

Lowland Heathland on Ashdown Forest © Cuesta, 2009

- **Other Priority Habitats** – Whilst woodlands (shown on Figure 7 above) and lowland heath (shown on Figure 8, below, *in pale purple*) are by far the most extensively preserved priority habitats within the study area, a number of others are present to a lesser extent. These include:

  - **Good Quality Semi-improved Grassland** (*magenta shading on Figure 8*), found in several areas, often adjacent to areas of Ancient Woodland.

  - **Traditional Orchards** (*shaded dark green*) - just eleven examples, scattered throughout the area.

  - **Coastal and Floodplain Grazing Marsh** (shown separately on Figure 9), comprise seven areas, within the floodplain of the River Ouse and the Shortbridge Stream Meadow LWS.

  - **Lowland Dry Acid Grassland** (*salmon coloured on Figure 8*) - comprising just four areas, all within the Buxted Park SSSI, associated with acidic-neutral soils developed over Tunbridge Wells Sandstone and Wadhurst Clay.

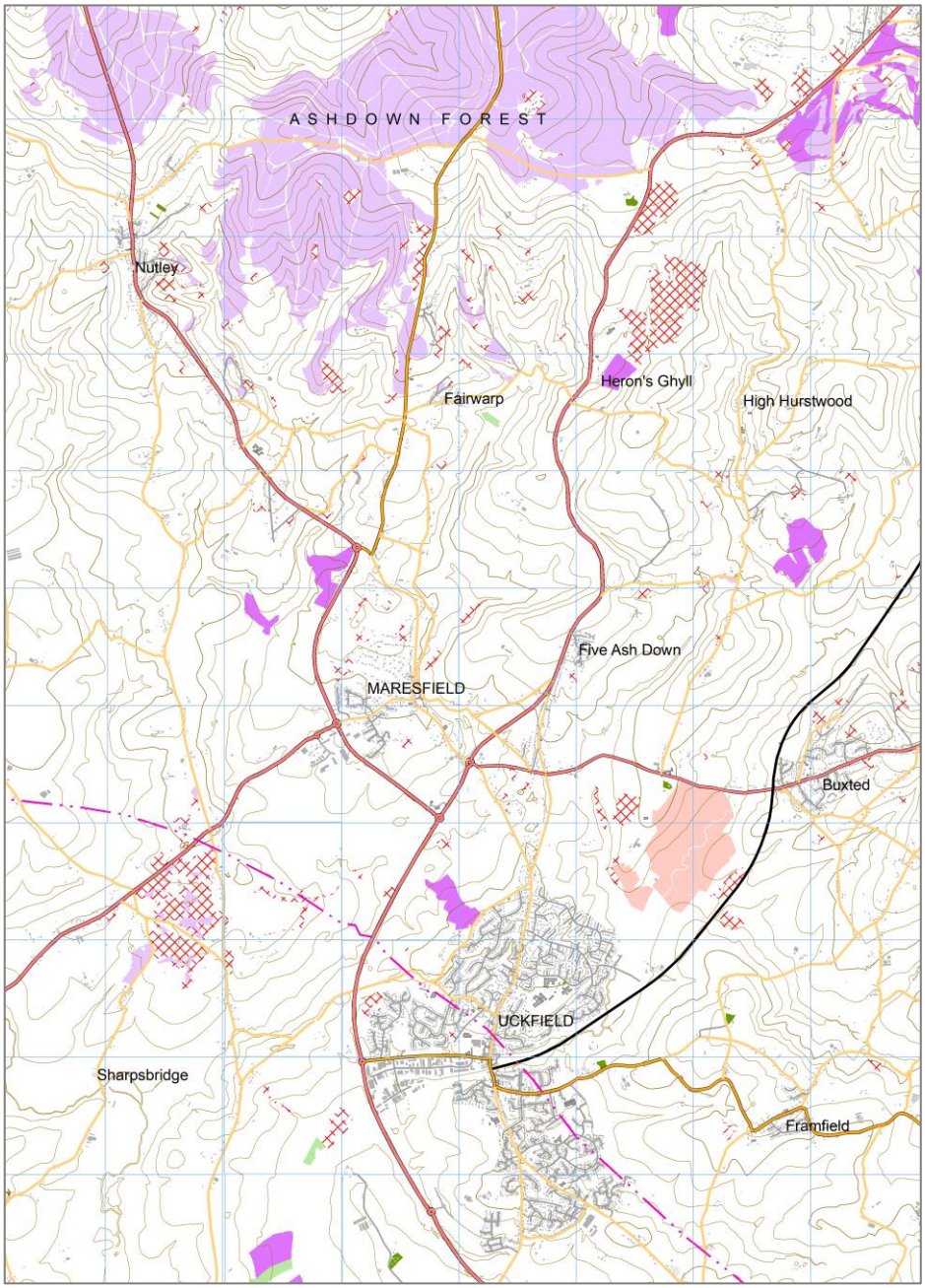


Figure 8: Non-woodland Priority Habitats within the local study area.
(See accompanying text for explanation of colours)

  - **Lowland Meadows** (*pale green*) - only four sites, two in the lower part of the River Uck valley and two in the headwaters of the Shortbridge Stream, near Fairwarp village.

  - **No main habitat but additional habitats present** (*red cross-hatching*). This category is also recognised under Section 41 and is mapped in many parts of the study area, particularly (but not only) on the steeper upland slopes and (alongside lowland heath and woodland) on Piltdown Common. Its characteristic feature is often a mosaic of small areas of different habitat, reflecting the very nature of the High Weald landscape, with its pattern of small fields and steep terrain.

All Priority Habitat information, as portrayed on Figures 7, 8 and 9, is readily available as 'Open Data' on the UK Government's 'Magic' website (https://magic.defra.gov.uk) where it can be either viewed online or downloaded for use within Geographic Information Systems (as used here).

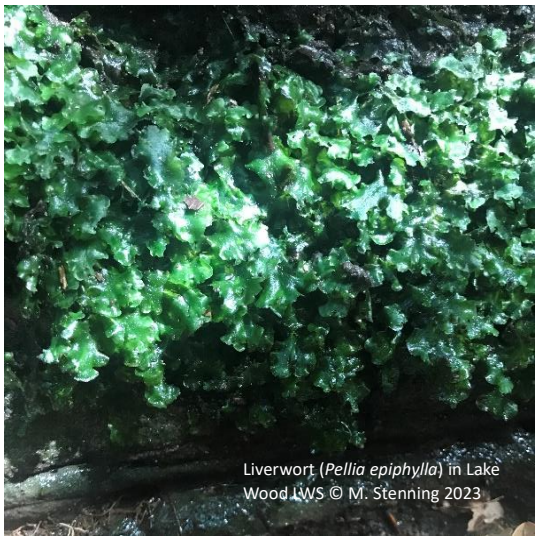
Other Natural Features

In addition to the various designations and protected habitats outlined above, a number of specific natural features are characteristic of the local study area and demonstrate very detailed relationships between geodiversity and biodiversity. These include:

- **Ghyll Woodland** – As already noted, ghylls (or gills) are very characteristic features of the High Weald landscape and are well-represented within the local study area. They provide a classic example of the integration of biodiversity, geodiversity and landscape. They occur where streams have cut down through more resistant layers of rock to form deeply-incised, steep sided and steep gradient valleys. They include short ghylls produced by minor tributaries (such as Shermanreed Ghyll, Longwood Gill and Lake Wood, directly to the west and north-west of Uckfield) as well as short sections of larger streams and rivers where these cut through individual sandstone outcrops along their course – as seen, for example, in the case of the Shortbridge Stream within the Rock Wood SSSI, near Fairwarp.


Longwood Ghyll in winter © Cuesta 2002

Within the central and southern parts of the High Weald character area, such features are most commonly associated with the Ardingly Sandstone, but sandstones within the slightly older Ashdown Formation produce the same effect on higher ground to the north. In each case, it is the erosive power of the steeply-flowing streams and the contrasting resistance of the sandstones and weaker rock types above and below the ghylls which is responsible for their formation. The resulting landforms and associated vegetation frequently have a primeval feel about them.

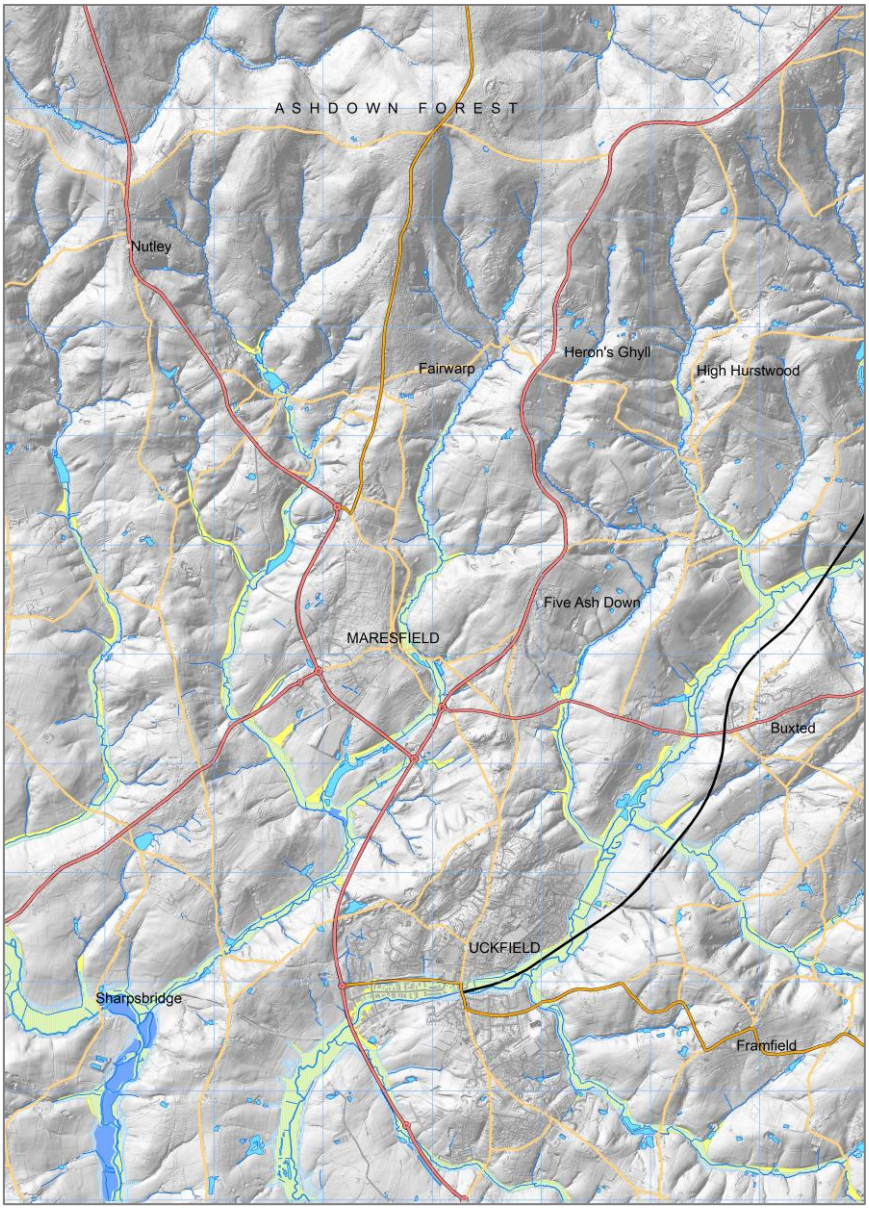

Liverwort (*Pellia epiphylla*) in Lake Wood LWS © M. Stenning 2023

Many are likely to be primary woodland sites, potentially dating from the mid-Holocene period (Sansum, 2014). They have a higher humidity all year round, being slightly cooler in the summer than the surroundings and milder in the winter. Because they have a more constant physical environment and are rarely disturbed by humans, they provide a good habitat and refuge for animals and plants at all levels. They also provide a source of fresh water which seeps out of the sandstone aquifers for much of the year. Together with the shading provided by the associated woodlands, these provide perfect microclimatic conditions for an 'Atlantic' assemblage of bryophytes (mosses and liverworts), ferns and lichens which are otherwise rare in south-east England. Ghyll woodlands help to capture and slow down rainfall and overland run-off which would otherwise have a high capacity for erosion in these steep areas. They also provide shade and protection from sunlight, which provides a kind of 'thermostatic regulation' to downstream areas of the rivers by cooling down water temperatures, which can be important for the reproduction of a number of fish species.

The restoration of ghyll woodlands that may have been damaged – for example by the uncontrolled spread of invasive, non-native plants such as Rhododendron – would also be beneficial, contributing significantly to **Themes 1 to 3 of the NRN**. To some extent, this has already been carried out – very successfully – by local conservation volunteers around Lake Wood in Uckfield (see Appendix A, page 60), but there is scope for similar work to be undertaken within other ghyll valleys elsewhere in the study area.

- **River Floodplains** – the middle and lower reaches of both the River Ouse and the River Uck, as well as their main tributary streams, are characterised by well-developed and frequently inundated floodplains. The extent of these is shown on Figure 9, below, with the outlines being derived from a combination of sources: direct observations and mapping of flooding within the Uck catchment on 12th October 2000; historical flood mapping, as recorded by the Environment Agency; the latest available flood modelling outlines, issued by the Environment Agency; and the outlines of river alluvium as mapped by the British Geological Survey.

The River Uck floodplain upstream of Uckfield, at the height of the October 2000 floods © Cuesta 2000



Flooding is known to be a major issue on both of the main rivers and their tributaries[17], reflecting the steep upland nature of the catchment headwaters and the limited permeability of the fine-grained sandstones, siltstones and clays in those areas, which promotes rapid runoff. This has been exacerbated by widespread agricultural land drainage during the middle part of the 20th Century and by localised urban development in the late 20th / early 21st Centuries, both of which have accelerated the flow of water into the rivers. In the case of Uckfield, these problems were compounded further by artificially raising the level of the floodplain and building over it, during the 1970s and 80s.

Figure 9: The locations of river floodplains and watercourses within the local study area, including areas of Coastal and Floodplain Grazing Marsh priority habitat *(shown in darker blue shading)*.

[17] East Sussex Local Flood Risk Management Strategy 2016 – 2026.

Despite the presence of an engineered flood channel through this development, the reduction in storage capacity appears to have increased the level of flood hazard and the introduction of extensive commercial development has put more properties at risk (those within the industrial estate and residential properties upstream). It has also had consequences for the natural environment, fragmenting the once continuous floodplain and greatly diminishing the connectivity of habitats above and below the town.

For all of these reasons, there is clearly a need, in this area, for nature recovery solutions to be developed. Re-establishing the pre-existing wildlife corridors would be a major challenge, due to the costs involved in relocating the areas of existing built development. However, the prospect has been examined, as discussed in the 'opportunities' section of this report (page 40), and innovative alternatives relating to the identification of a 'Nature Recovery Corridor' as a focus for future action are discussed in the subsequent section on 'Growing the Network' (see page 50).

- **Water Quality** – Three of the main rivers within the local study area – The River Ouse, the River Uck and the Shortbridge Stream – were designated under the EU Water Framework Directive as important freshwater fish habitats (Cyprinid and/or Salmonid species). Whilst there are ongoing problems relating to certain aspects of water quality, the 'hydromorphological' characteristics, which comprise both the hydrological regime and the morphology of the river channel, are classified as 'supporting good status' in all of the sub-catchments. From a wider geodiversity perspective, consideration also needs to be given to the role of sandstone aquifers in filtering and storing groundwater. Within the study area, the most significant aquifer is the Ardingly Sandstone. This is of little importance in terms of supplying drinking water and is classed only as a secondary aquifer by the Environment Agency. It does, however, have much greater ecological importance in terms of sustaining base flow to ghyll streams and bryophyte vegetation between periods of rainfall.


The Shortbridge Stream © Cuesta 2024

- **Soils** – Over the higher parts of the local study area, the geology of the Ashdown Formation gives rise to relatively poor quality, light silty loam and sandy loam soils which are generally unfit for any intensive agricultural purpose. Such soils are naturally wet, very acidic, warm and infertile. They are characteristically associated with heathland and scrub. The small areas of farmland in these areas are graded 4 ('poor') in the agricultural land classification, but this should not be taken to infer that they are of little importance: low fertility soils are generally advantageous for biodiversity including natural acidic grassland and heathland species. This is because the lack of nutrients reduces competition between 'hungry' vigorous species and the lesser vigorous smaller species which would otherwise be out-competed. Soils derived from outcrops of the Wadhurst Clay tend to be colder, wetter and more fertile. These and the silty soils associated with the


Ancient Woodland ground flora within Lake Wood, Uckfield. M. Stenning 2024

Tunbridge Wells Sands, which predominate over most of the remaining part of the study area, support mixed woodland and pasture, grazed by sheep and horses, with some larger arable fields. Special consideration should be given to the soils associated with existing and former areas of Ancient Woodland, as these retain an important seedbank for future natural regeneration, both of AW trees and the associated, specialised ground flora. In some parts of the study area, such soils (evidenced by characteristic AW ground flora in areas that were previously wooded) are known to exist beyond the boundaries that are identified in the Ancient Woodland Inventory and are in need of formal recognition.

Sandier horizons within the Tunbridge Wells Sand are sometimes associated with areas of heathland and acidic grassland (as seen, for example, at Piltdown Common and Buxted Park, respectively). The same can be true for some of the Ardingly Sandstone outcrops, although these are often hidden within areas of Ancient Woodland which has developed on silts and clays found immediately above and below the sandstone and which has survived because of the steep terrain created by the rock outcrops.

The Historic Environment

There is evidence, throughout the study area, of the relationships between geological factors and the historic environment. These range from Mesolithic rock shelters to retained medieval landscapes (small field patterns and larger deer parks), relics of the Wealden iron industry and vernacular architecture, including the use of local sandstone (primarily seen within historic parish churches) and, more commonly, red bricks and tiles produced from the local Wadhurst Clay. Of these, the most significant links between geodiversity and biodiversity within the local study area are found in relation to the former iron industry, dating from the 16th and 17th Centuries, and the local, small-scale quarrying of brick clay, which continued into the mid-20th Century.

- **The Wealden Iron Industry** – Relics of the former iron industry include furnace hearths, hammer ponds (constructed to power forge hammers), their associated 'Pond Bay' dams and coppiced woodlands used for the production of charcoal. In most cases, these features are linked to geodiversity by virtue of their proximity to sources of iron ore, particularly within the Wadhurst Clay and Grinstead Clay, and also by their proximity to watercourses and (in most cases) steep sided valleys capable of being easily dammed. Their association with biodiversity is primarily linked to their location within deciduous, often Ancient Woodland. The site of Hendall iron furnace, located by the Shortbridge Stream within the Rock Wood SSSI, and designated as a Scheduled Monument, is a perfect example of this, as are the sites of Oldlands Furnace, further upstream, and Iron Plat Furnace, located on the River Uck, north of Buxted. Many other pond bay structures – most of them breached but some still holding water, are present throughout the area. Ironstone clay pits are also common and, in most cases, have naturally regenerated into deciduous woodlands around ponds.

Abandoned pond bay structure associated with the Hendall Furnace Scheduled Monument within the Rock Wood SSSI © Cuesta 2024

- **Building Stone Quarries and Clay Pits** – The former extraction of brick clay and, to a far lesser extent, local sandstone, have also given rise to natural regeneration within former pits – notably the Ridgewood Clay Pit, south-east of Uckfield, which has become adopted as a Local Wildlife Site and now forms part of Uckfield's Millennium Green. Other former clay pits, either for brick clay or ironstone, are abundant on the Wadhurst Clay outcrop around Five Ash Down and on the Grinstead Clay around Downlands Farm, north Uckfield. Many of these are clearly evident on Figure 3 (on page 23, above), either as topographic depressions and/or as ponds.

Biodiversity Opportunity Areas

Biodiversity Opportunity Areas are spatial planning tools which have emerged in a rather piecemeal fashion in different parts of the country, from national policy requirements to halt the overall decline in biodiversity. The most recent expression of this requirement is found in paragraph 185 of the National Planning Policy Framework (NPPF, December 2023), which states that:

> "To protect and enhance biodiversity and geodiversity, plans should:
>
> a) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation; and
>
> b) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity".

Within Sussex, the response has been to identify a series of Biodiversity Opportunity Areas (BOAs), which present the best opportunities for enhancing bio- and geodiversity, often being buffers around existing reserves or linkages between existing sites. They aim to define specific landscape-scale areas where conservation action is likely to have the most benefit for biodiversity, based on existing biodiversity interest and physical opportunities for enhancement. An individual BOA consists of a spatial concentration of already recognised and protected sites for wildlife conservation along with further but as yet un-designated 'Priority habitat' types, all of which have common and contiguous geological, soil, hydrological and topographic characteristics to those of the designated sites.

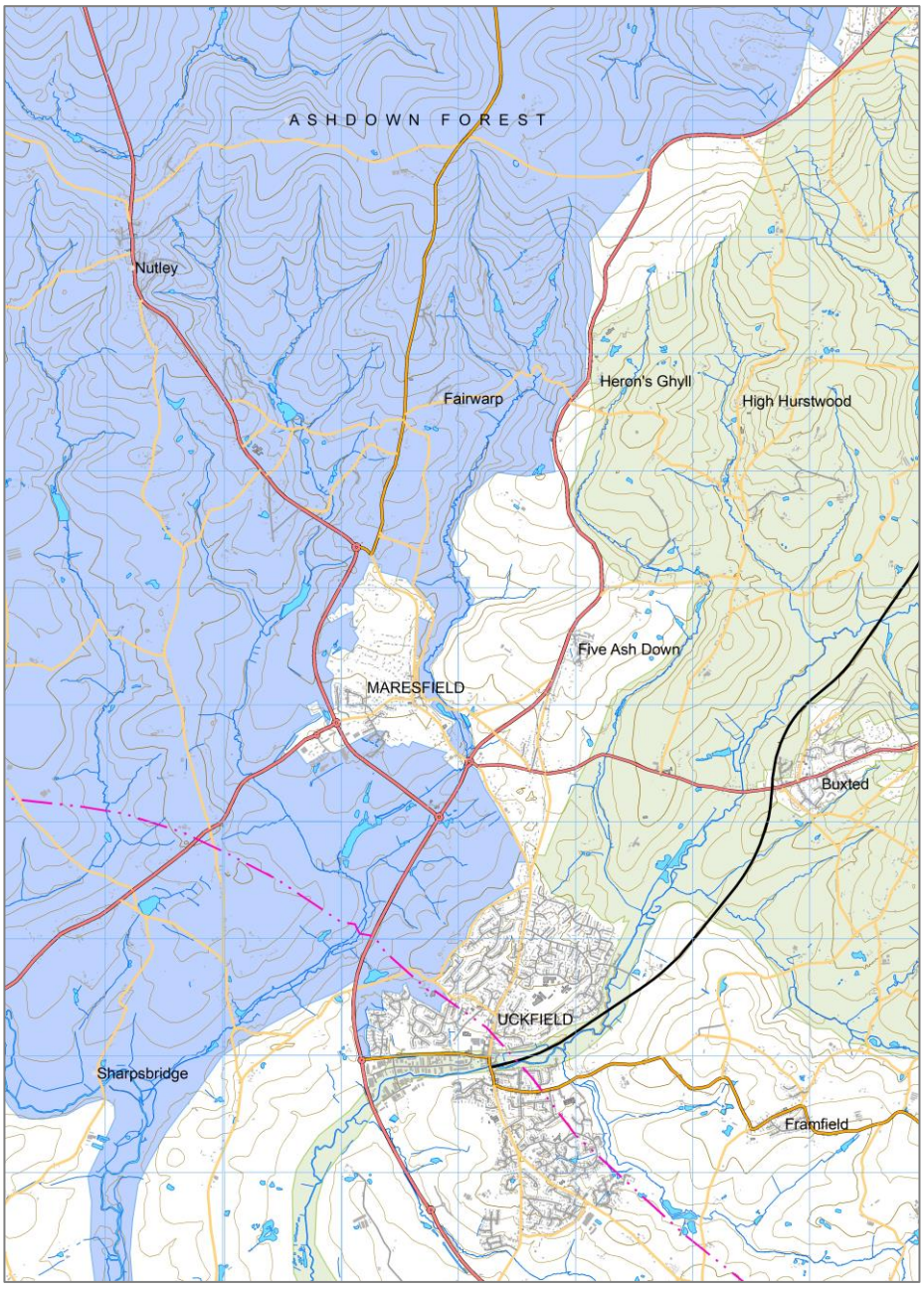


Figure 10: Biodiversity Opportunity Areas within the local study area: the Western Ouse streams and Ashdown Forest *(shaded purple)* ***and the River Uck and its Headwaters*** *(shaded green)*

Specific opportunities and 'targets' that have already been identified for one or both of these areas, and which are relevant to the present study area include:

- Heathland management, restoration and creation;
- Wetland habitat management, restoration and creation;
- Woodland management and restoration;
- River and floodplain restoration, rehabilitation and reconnection;
- Floodplain meadow and woodland creation;
- Ecological networks, including expansion of hedgerow networks;
- Water quality improvement;
- Access improvements; and
- Education and community engagement

Each of these opportunities ties-in with one or more of the four main themes of the **Nature Recovery Network** and are discussed more fully in the 'Opportunities' section of this report.

Habitat Networks

The Lawton Report '**Making Space for Nature**' (Lawton *et al*, 2010) set out the essence of what needs to be done to enhance the resilience and coherence of England's ecological networks. It proposed that this could be summarised in four key words: *more*, *bigger*, *better* and *joined*.

In response to this, and to contribute towards the development of a Nature Recovery Network as required by the 25-year Environment Plan, Natural England has produced a series of '**habitat network maps**' which are intended to be used, *alongside other information*, to help identify areas for future habitat creation and restoration at a landscape scale. The maps are expressly NOT to be considered as definitive advice, but are intended only as guide, to be used in conjunction with other datasets and with local knowledge to take full account of local opportunities and constraints. **Although the maps have no direct links with geodiversity information, they are capable of being used – *in conjunction with geological maps and other geodiversity data* – to help inform potential opportunities for nature recovery**.

With those caveats and background in mind, Figure 11, on the following page, shows three of the four 'Network Enhancement and Expansion Zones' produced by Natural England, together with two of their 'existing habitat zones' which relate most directly to the areas where improvement action is either required or already underway. These are shown superimposed upon the two Biodiversity Opportunity Areas, so that they can be considered in parallel with the 'targets' identified for those areas (as listed above). More detailed explanations for each of the zones, based on Natural England's User Guidance (version 2, May 2020), are set out alongside Figure 11.

- **Network Enhancement Zone 1** (*shaded brown on Fig. 11*) comprises land within close proximity to the existing habitat components that are likely to be suitable for habitat re-creation for the particular habitat concerned. Factors affecting suitability include: proximity to primary habitat, land use (urban/rural), soil type, slope and proximity to the coast. Action to expand and join up existing habitat patches and to improve the connections between them can be targeted here;
- The **Fragmentation Action Zone** (*shown in bright orange*) comprises land within Enhancement Zone 1 that connects existing habitat patches that are small or highly fragmented, and where fragmentation could be reduced by new habitat creation.
- The **Habitat Creation / Restoration Zone** (*shown in bright yellow*), which indicates areas where work is already underway to either create or restore the primary habitat;

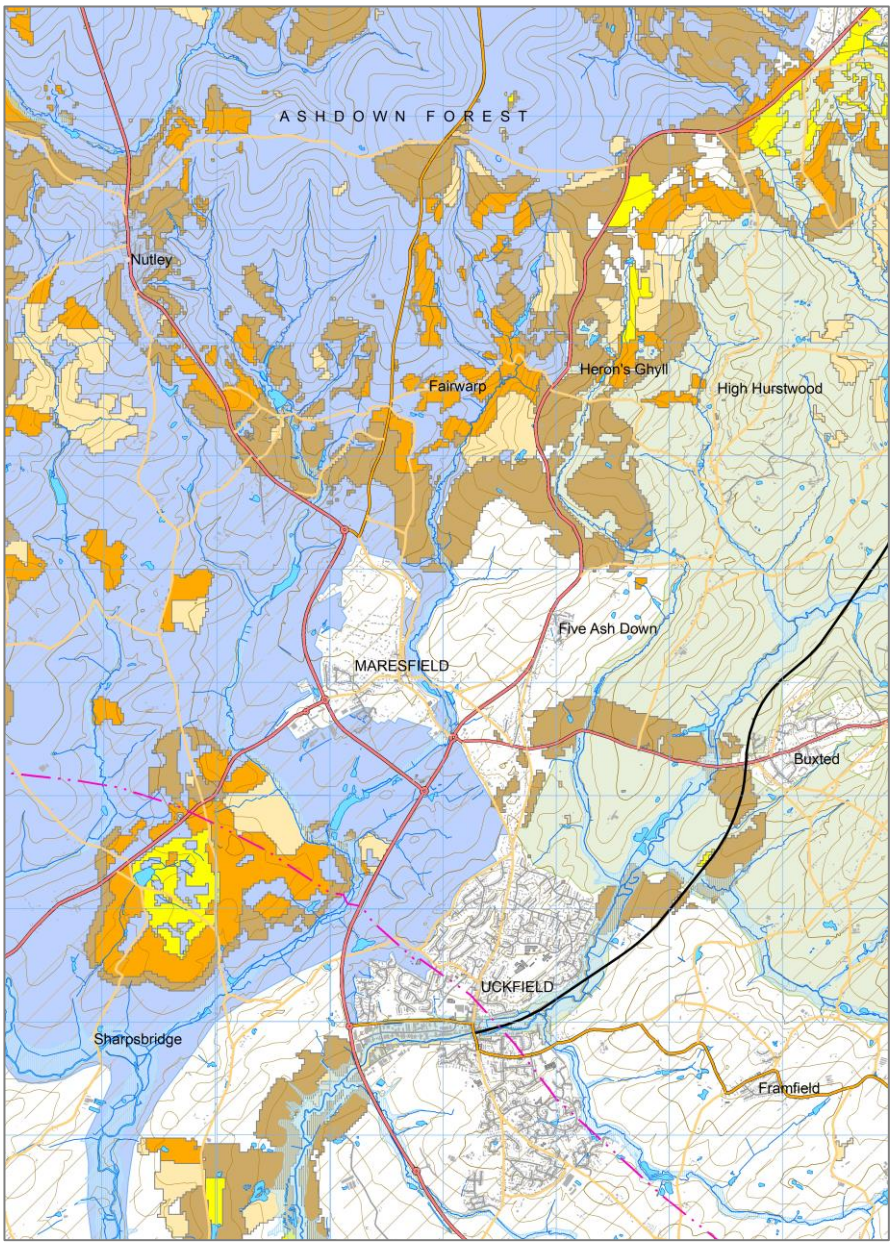


Figure 11: Combined Habitat Network Map superimposed on the Biodiversity Opportunity Areas *(from Figure 10)* ***within the local study area.***
(see text for explanation of colours)

- The **Restorable Habitat Zone** (*shown in pale orange*) comprising areas of existing semi-natural habitat where the primary habitat is present in a degraded or fragmented form, and which are likely to be suitable for restoration; and
- **Network Enhancement Zone 2** (*shown in brown diagonal stripes*) comprises land within close proximity to the existing habitat components that are less likely to be suitable for habitat re-creation but where other types of habitat may be created or where land management may be enhanced including the delivery of suitable Green Infrastructure.

The information portrayed in Figure 11 may prove to be useful in targeting particular types of nature recovery, but it does not paint a complete picture: as noted earlier, the maps need to be combined with geodiversity information in order to provide a more holistic understanding of all nature recovery opportunities. Moreover, areas which fall outside the coloured network zones are, in many cases, those which are already characterised by the presence of existing priority habitats and/or designated sites which need little or no intervention, other than continued protection and management.

Opportunities for Nature Recovery linked to Geodiversity

Geodiversity is an integral part of nature. Since the aim of 'Nature Recovery' is to recover 'nature', it follows that geodiversity should be able both to contribute to and benefit from nature recovery initiatives. More specifically, as indicated within the previous section, geodiversity is capable of contributing to each of the four main aims of the Nature Recovery Network, including the enhancement of designated sites, improving landscape resilience, reinforcing the geological diversity of our landscapes, and enabling us to better connect with nature.

Biodiversity Opportunity Areas (BOAs), together with Natural England's Habitat Networks data, as described above, provide a strong, evidence-based starting point for the identification of effective nature recovery initiatives. Additional factors can also make potentially useful contributions, such as those that are highlighted in the innovative '**Weald to Waves**' project, which is aiming to create a nationally significant wildlife corridor of largely contiguous natural habitat, stretching from Ashdown Forest in the High Weald, along the floodplains of the Arun, Adur and Ouse rivers, to the sea.

Figure 12: Schematic illustration of the 'Weald to Waves' concept (SOURCE: www.wealdtowaves.co.uk)

Each of these ideas already incorporates certain aspects of geodiversity – particularly through the focus on river floodplains as natural wildlife corridors and the influence of soil types and topography on the potential for habitat network enhancement. It is no coincidence that rivers, together with their floodplains and the wider freshwater ecosystems which they support, are key aspects of both the BOAs and the Weald to Waves initiatives. Rivers are widely acknowledged to be the 'unsung heroes of biodiversity' and are effectively the 'vascular system' of the natural world, providing and supporting habitats for around 40% of all living species, on a global scale. In the UK, they are recognised as being of huge importance for biodiversity and ecosystem services (Addy *et al*, 2016). For all of these reasons, it makes perfect sense for nature recovery initiatives to be focused on river systems and their connections to adjoining areas.

The present case study has demonstrated that river floodplains and other geological and geomorphological factors frequently underpin and reinforce the natural characteristics and conservation value of designated sites, priority habitats and aspects of cultural heritage within the selected study area. It has also shown that they can be important in their own right, for example with certain geological outcrops and features such as river floodplains providing connections between individual designated sites. Understanding these connections can help us to harness and improve the landscape's natural resilience to climate change – for example by maintaining natural ecosystems and wildlife corridors rather than disrupting and fragmenting them, and by 'rewilding' natural

floodplains and headwater areas to control flooding. The following sections explore in greater detail what specific opportunities may exist, within the study area, for geodiversity to both contribute to and benefit from nature recovery, as an example that can be extended to wider areas. In each case, the opportunities are linked to one or more of the four main themes of the **Nature Recovery Network** (**NRN**) as set out on page 1 of this report.

Floodplain Restoration

The floodplain of the river Uck, below Uckfield, looking upstream towards the distant headwaters on Ashdown Forest © Cuesta 2007

With the exception of a roughly 1km section through Uckfield, river floodplains within the study area are generally in reasonable condition, in terms of their functionality (i.e. their ability to store and transmit floodwater), though there is considerable scope for improvement in terms of the natural habitats which they provide. Such improvements could range from the re-introduction of meanders in artificially-straightened sections of channel to more substantial 'rewilding' projects of the sort seen at the Knepp Castle Estate on the nearby River Adur. Knepp has demonstrated that this kind of ecological restoration can be highly effective, producing dramatic and profitable results for failing or abandoned farmland. It has shown that rewilding projects can support existing nature reserves and other designated sites by providing an expansion of habitats and wildlife, enabling these to re-establish connections on a landscape scale.

One particular location where this approach might be considered is the section of the River Uck floodplain which passes through the Buxted Park SSSI. The floodplain here was subject to deliberate modification, as part of a high profile Defra/EA project in partnership with the Ouse and Adur Rivers Trust. This involved removing a redundant weir and 'seeding' gravel in the channel, thus encouraging natural processes of erosion and deposition to operate on the river bed and banks in a controlled way. Inevitably, this gave rise to bank erosion and collapse in places, markedly increasing morphological diversity in this formerly uniform reach of channel – a major benefit to geodiversity as well as ecology. The new natural bank profiles, in-channel features and gravel deposits provided valuable habitat for coarse fish species, aquatic invertebrates and plants. There would be scope for additional work of this kind both within and downstream of the site, contributing to **Themes 1 and 4 of the NRN** *(enhancing sites and enabling people to enjoy and connect with nature)*.

Thriving horsetails within the Hempstead Meadows LNR. M. Stenning 2024

The benefits of floodplain improvement can also be achieved simply by protecting existing natural environments and leaving nature to take its course. This has been demonstrated at the Hempstead Meadows Local Nature Reserve alongside the River Uck, immediately upstream of Uckfield. This area was designated in 2004, and part of the site is now a thriving wilderness of floodplain marsh. Such actions contribute further to **Themes 1 and 4 of the NRN**. Further information on this site is given, along with other local designations, in Appendix A.

A much greater challenge, in terms of improving the natural environment, is presented by the short section of the River Uck floodplain within Uckfield. Here, the functional floodplain has been subject to what has proved to be inappropriate development, in the form of the Bell Brook industrial estate. This was constructed in piecemeal fashion during the 1970s and 80s and has completely replaced the floodplain's natural environment with one of industrial and commercial buildings. In doing so it has fragmented the natural wildlife corridor which previously existed. By reducing the floodplain's storage and conveyance capacity for floodwater, it also increased the level of local flood hazard.

Flooding of the Uckfield Industrial Estate on 12th October 2000.
Courtesy of D. Charity, Solent News

Following the historic October 2000 floods, which completely inundated the industrial estate and other parts of the town centre, a voluntary group of local professionals were invited by Wealden District Council to produce a report on potential solutions to the problem. That report[18] noted that "*the main reason for the flooding problem in Uckfield is that development has taken place within the floodplain and that, in the absence of any viable way of eliminating the natural hazard, the process now needs to be reversed*". The report noted that any progress that could be made towards this would have long-term benefits, not only in terms of reduced flood risk but also in terms of environmental enhancement. It would enable local biodiversity to be increased and would provide other environmental gains, through the reinstatement of semi-natural floodplain habitats and the creation of a wildlife corridor, linking to the existing Local Nature Reserve at Hempstead Meadows, directly upstream. The report also noted that floodplain reinstatement would provide public amenity benefits through the creation of green open space with footpaths and cycle routes. All of those suggestions would now be seen as 'Nature Recovery' initiatives, contributing especially to **Themes 2 and 4 of the NRN** *(improving resilience to climate change, reducing flood risk and enabling local people to enjoy and connect with nature)*. They would also represent a major benefit to geodiversity by re-establishing a more natural-looking continuation of the floodplain through the town. None of the suggestions have yet been implemented – primarily because the industrial estate is one of the most successful in Sussex – but with projections of increasing flood frequencies, the rising cost of insurance and a growing public awareness of environmental benefits, the possibilities remain.

Habitat Restoration and Expansion

Both within and beyond river floodplains, there is considerable scope for the restoration and even expansion of various priority habitats in many parts of the study area. Deciduous woodlands, in particular, are a major feature of the High Weald, providing important habitats for a wide range of species as well as being an essential component of landscape character. Opportunities exist in several areas for fragmented woodland corridors to be re-connected. An important aspect of this, from a geodiversity point of view, is that the soils which remain beneath areas of felled or damaged woodland provide a starting-point for woodland regeneration. This is especially significant in the case of Ancient Woodlands, where distinctive ground flora including Ancient Woodland indicator species such as bluebell, wood anemone, wild daffodil and many others, are likely to survive.

[18] *Flood Defences in the Uck Catchment: Some Observations by the Uckfield Flood Action Group* (UFAG). Report to Wealden District Council, November 2002. (Copy available in the offices of Uckfield Town Council).

If these areas can be safeguarded (for example by updating the AW Inventory to take account of these areas and by mapping the wildlife corridors and 'stepping stones' between them in Local Plans), there is every chance that gaps within former Ancient Woodland corridors can be filled by natural regeneration, thus providing a major contribution to nature recovery with minimal effort.

Ancient Woodland ground flora (bluebells) within Lake Wood, Uckfield. M. Stenning 2024

Existing corridor of (mostly Ancient) woodland fragmented by the A22 Uckfield Bypass, looking south-west from Budletts. South Downs National Park in the far distance. © Kit Ridley 2022

A further opportunity relates to the restoration of lowland heathland habitats. As previously noted, these occur extensively across the higher parts of Ashdown Forest but also on the sandy soils of Piltdown Common. Very small remnants of heathland vegetation are also found elsewhere, for example within the Lake Wood LWS, the West Park LNR/LWS, Rocks Park LGS and Budletts Common. Here again, conservation work by local volunteers has helped to clear invasive rhododendron and bracken from some of these areas, allowing heathland plant communities to regenerate on the thin, sandy soils. A great deal more of this work could be done, to help diversify the existing woodland and grassland habitats.

Heather *(Calluna vulgaris)* growing on Ardingly Sandstone soils at Lake Wood. M. Stenning 2023

Small area of restorable heathland on sandy soils above Ardingly Sandstone near Budletts Wood. B. Reed 2023

Within the same general area, between the Lake Wood LWS and Malling Budletts, including the land at Downlands Farm, Professor Trevor Beebee of the University of Sussex noted that the combination of all five amphibians and four of the six reptile species found in the UK together on this site was remarkable and quite possibly unique in the region.

Lake Wood LWS, with its low pH peat-fed lake and surrounding Ardingly Sandstone outcrops within Ancient Woodland. Ashdown Forest in the distance. © Kit Ridley 2022

Other features of interest here, which emphasise the links between geodiversity and biodiversity, include the presence of a rare, low pH peat-fed lake within the large ghyll valley at Lake Wood and the importance of the Ardingly Sandstone aquifer, which provides base-flow to support rare bryophyte assemblages within the adjoining ghyll woodlands and to the EU-designated Shortbridge Stream, immediately to the west of the site.

Sunken Lane, heavily overgrown with rhododendron, within the Ardingly Sandstone outcrop near High Hurstwood. © Cuesta 2024

On a more localised scale, opportunities may exist to utilise sunken lanes as a means of enhancing biodiversity, and geodiversity and improving connections between fragmented habitats. Within the local study area, these are found primarily where minor roads and footpaths cut through outcrops of Ardingly Sandstone, but are frequently overgrown, often with invasive rhododendron. As with the Lake Wood example, clearance of the rhododendron would provide opportunities for colonisation by native ericaceous plants such as common heather, thereby providing benefits for bees and other pollinators and helping to create or reinforce linear corridors for species migration between sites.

All of these local examples of opportunities for the restoration and/or expansion of natural habitats would contribute primarily to **Theme 1 of the Nature Recovery Network** (enhancing designated sites and other wildlife-rich places and, in particular, providing corridors and stepping stones to help wildlife populations grow and move). Some of them would also contribute to **Themes 2 and 4 of the NRN** *(improving resilience to climate change, reducing flood risk and enabling local people to enjoy and connect with nature)* and most would also contribute to **Theme 3** (reinforcing the natural, geological and cultural diversity of the landscape), offering reciprocal benefits to geodiversity by re-exposing sandstone outcrops previously hidden by invasive vegetation.

Habitat Creation


Areas of bare ground above Ardingly Sandstone outcrops in Lake Wood., following Rhododendron clearance © Cuesta 2023

More ambitious opportunities for creating new areas of Priority habitat – or indeed any habitat that could be beneficial to the concept of nature recovery – may also be considered. One example of this could be related to the regeneration of heathland habitats, as described above, but focused on creating complementary areas of bare soil and rock outcrops – particularly in association with the Ardingly Sandstone (see Figure 13, below) or the Ashdown Sandstone. Where this has taken place in Lake Wood, to expose natural sandstone outcrops, there has been a recorded increase in the abundance and diversity of specialised insects, including the green tiger beetle *Cicindela campestris* which requires a bare ground habitat with dry sandy soil. Without such intervention, in areas which cannot easily be grazed by animals or controlled by natural erosion, there would eventually be a full sequence of natural regeneration to deciduous woodland, (and to Ancient Woodland where this can regenerate from retained Ancient Woodland soils). Where the latter is possible it would be highly beneficial to biodiversity but, in other cases, greater benefits may arise from the diversity of habitats created by clearance and from the enhanced geodiversity value that can be achieved.

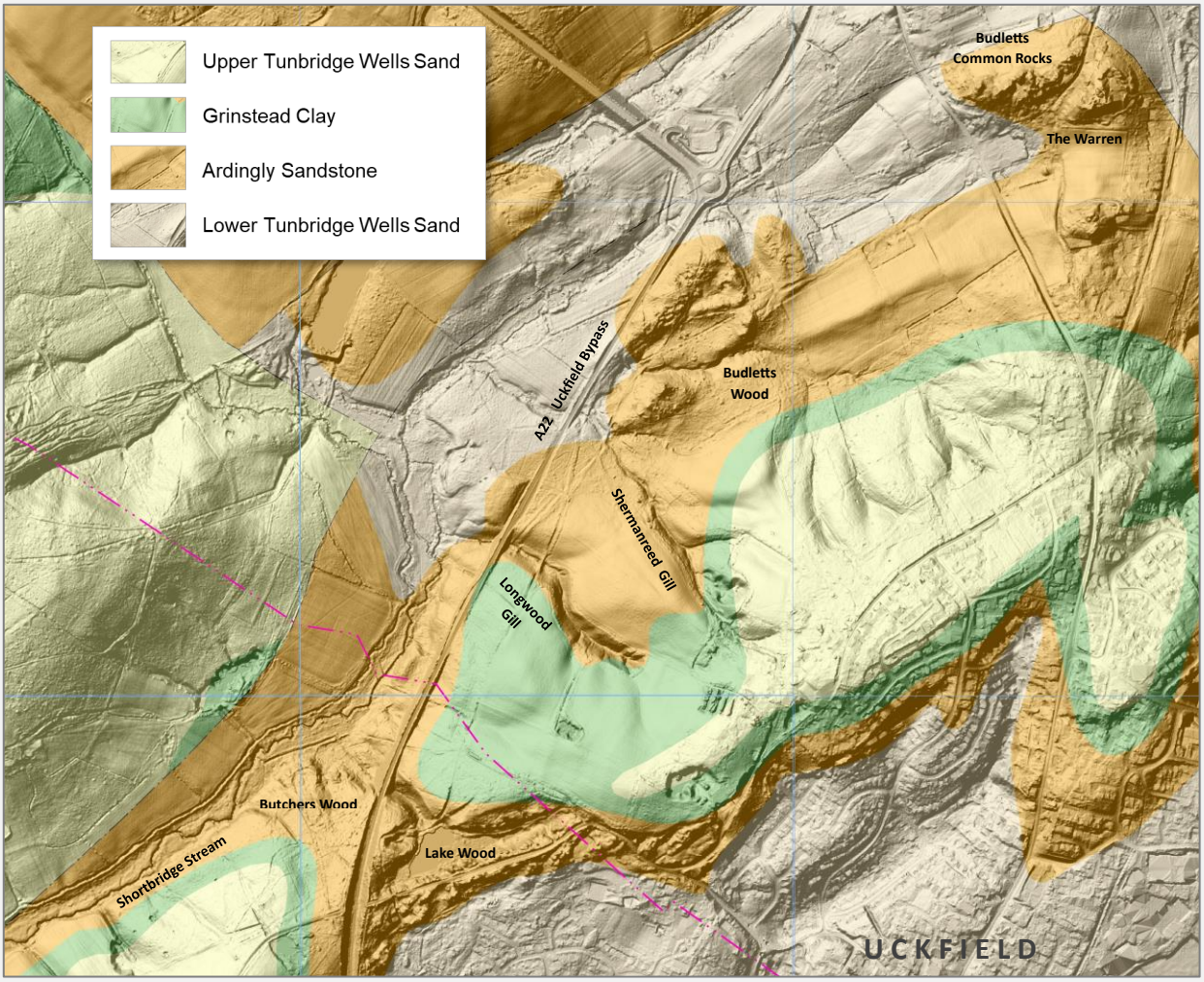


Figure 13: Hill-shaded LiDAR image of the area alongside the A22 Uckfield bypass, superimposed on bedrock geology. The Ardingly Sandstone can be seen to be clearly associated with distinctive rocky outcrops and deeply-incised ghylls.

Derived from 1:50,000 scale BGS Data under Natural England Licence No. 2011/052. British Geological Survey © UKRI 2024
Background DTM elevation data licensed by Natural England from APHDS/APGB © Bluesky International and Getmapping Plc 2024

A similar approach has been used very successfully in recent years as part of the 'Purple Horizons' nature recovery project in the West Midlands, where encroaching scrub vegetation has been cleared to re-expose rock outcrops created originally by quarrying but also to create bare ground habitats that are suitable for pollinators such as burrowing bees and wasps. This type of approach brings with it the need for continuous ongoing management in order to maintain such diversity, but funding for such work can now potentially be obtained through the mandatory requirements for Biodiversity Net Gain, linked to new built development projects nearby. The concept could feed directly in to the suggested Nature Recovery Corridor for this area (see page 50, below) and would contribute to **all four Themes of the NRN**, particularly in view of the willing involvement of local community conservation volunteers.

Catchment Flood Management

One of the main characteristics of flooding in Uckfield is the speed with which the hydrograph rises following heavy rainfall in the steep upper catchment. This 'flashy' regime is a natural consequence of the geology and topography of the catchment but has been exacerbated in the past by artificial land drainage which speeds up the flow of surface run-off into the river system. The above-mentioned report to Wealden District Council in November 2002, by a voluntary group of local professionals, noted that these effects could be mitigated by building (or modifying existing) small earth embankment structures within each of the smaller tributaries, in order to span or restrict the narrow valley floors and thereby significantly retard the flow of water during flood events. Such features formerly existed in many of the headwater valleys in this area (and across the High Weald) as relicts of the former Wealden iron industry and are shown on OS maps as 'Pond Bays'. Some of these bunds are still intact but most have been breached and could be modified with minimal effort by constructing 'leaky dams' where the sluice gates would formerly have been. These would be sufficient to retard the flow of water during flood events, flattening-out the hydrograph and spreading the flow of water out over a longer period, with much reduced peak flow levels. Since the river valleys are fairly steep and narrow, the amount of storage behind anything other than a very high bund would be limited. The concept therefore lends itself to series of small simple bunds at successive locations along each watercourse, as was often the case for the 'hammer ponds' which supported the 16th and 17th Century iron furnaces and forges in this area. In terms of geodiversity benefits, such actions would complement floodplain restoration projects further downstream by encouraging increased, catchment-wide recognition and understanding of the linkages between climate, geo-morphology and flood risk.

Breached section of the old pond bay structure within the Rocks Wood SSSI © Cuesta 2024

One of the main difficulties of this approach would be the need to gain the co-operation of numerous landowners and farmers. However, in 2002, at least some rural landowners within the Uck catchment were known to be in favour of this option. Now, more than two

Localised wetland habitat created by impeded drainage adjacent to Batts Bridge Stream B. Reed, 2024

decades on, and with much greater public awareness of flood risk, climate change and the need for nature recovery, there could now be a much greater level of acceptance – as demonstrated, for example, by many of the landowners involved in the 'Weald to Waves' project. Assuming that to be the case, the concept could now be revisited, and possibly expanded to include related land-management activities within other parts of the catchment, such as holding back surface runoff from individual fields and woodland areas, during times of flood and allowing it to drain more slowly afterwards. This would allow the development of small wetland areas with enhanced biodiversity, including the creation or restoration of wet woodland habitats (as seen in the example near Hartfield, shown on page 21, above, at the expense of some reduction in agricultural productivity. Overall, these concepts for catchment flood management would contribute primarily to **Theme 2 of the NRN** (improving the landscape's resilience to climate change and providing natural solutions to manage flood risk).

Enhanced Designations

The recognition of important geodiversity features could potentially enhance the protection afforded by existing ecological, landscape or heritage designations, with reciprocal benefits for the protection of geodiversity interests.

As demonstrated earlier in this report, and in Appendix A, almost all such designations within the local study area have at least some connection with geodiversity, though this is not always brought out in their citations or reflected in their management regimes. Geodiversity is very clearly integral to the High Weald National Landscape (AONB) designation, and to the three Local Geological Sites in the area. It is also fundamental to the existence and characteristics of many others, including:

- The **Ashdown Forest**, **Rocks Wood** and **Buxted Park** Sites of Special Scientific Interest;
- The **Hempstead Meadows** and **West Park** Local Nature Reserves;
- Eight of the eleven Local Wildlife Sites in the area, including **Budlett's Common Rocks**, **Shortbridge Stream Meadow**, **Piltdown Common**, **Uckfield Cemetery**, **Butcher's Wood**, **Lake Wood**, **West Park** and the **Ridgewood Clay Pit**;
- One or more of the Scheduled Monuments in the area, notably **Hendall Furnace, Oldlands Furnace** and **Iron Plat Furnace**, as well as other similar sites (e.g. **Langley Furnace**) which at present are undesignated heritage assets.

In some cases, existing designations could be enhanced by extending them into adjoining areas, so as to expand their ability to act as 'stepping stones' between these and other wildlife-rich places, or to re-connect previously-fragmented wildlife corridors. Mention has already been made of the Downlands Farm site where there are clear opportunities for both of these things – directly contributing to **Theme 1 of the Nature Recovery Network**.

Similar opportunities exist in relation to the Budletts Common Rocks Local Wildlife Site (see location on Figure 13, on page 43, above), which could easily be expanded to incorporate the rock outcrops and associated bryophyte vegetation within neighbouring land at 'The Warren', where the owner has already submitted a request to the Sussex Biodiversity Records Centre for this to be considered. As well as providing further examples of the Ardingly Sandstone's characteristic weathering features and periglacial gulls, it also includes a former sandstone quarry which provides demonstrable links with local heritage as a source of building stone and was originally part of the historic Buxted Park estate.

Periglacial Gull within the Ardingly Sandstone outcrop at The Warren. B. Reed, 2023

In each of these cases, it would clearly be beneficial to recognise the geodiversity components of nature conservation, and its relationship to local ecology, in any promotional literature / websites / visitor information and whenever management work is being undertaken. This, in turn would contribute to **Theme 4 of the NRN** (enabling local people to enjoy and connect with nature).

Access and Recreation

An important aspect of the Nature Recovery Network – specifically under **Theme 4** (enabling people to enjoy and connect with nature) is the improved provision of public access to and opportunities for recreation within at least some of the areas of interest. This will not always be compatible with nature conservation, particularly in areas of sensitive habitats or easily damaged soft sandstone outcrops, but there will often be ways of controlling the degree and type of access provided. Boardwalks can be provided to allow access through areas of marshy habitat but may not be suitable in areas of Ancient Woodland, because of the risk of damage to tree roots and important ground flora. In a number of areas, 'sunken lanes' already provide access to localised geological outcrops, especially where these are now occupied by roads or public footpaths. In several parts of the High Weald, the Ardingly Sandstone crags are used extensively for outdoor recreation – particularly climbing, but the soft sandstone can easily be damaged, and access may need to be controlled. Within the Local study area, the outcrops are generally less high than in areas such as High Rocks and Bowles, near Tunbridge Wells, and are therefore less likely to be damaged, but are still susceptible to the impact of scrambling and graffiti, for example. Managed access could usefully be linked to education about the importance of floodplains and sandstone outcrops as natural wildlife corridors. The outcrops within Lake Wood, Rocks Park, West Park and Butcher's Wood, in particular, provide the basis of a fascinating demonstration of the links between geodiversity, biodiversity and the historic environment. All are located directly adjacent to the population of Uckfield and the promotion of these sites by means of guided walks and/or local guidebooks would provide multiple benefits in relation to **Theme 4**, as well as being of benefit to geodiversity itself.

The soft Cretaceous sandstones of the Weald are susceptible to high levels of visitor pressure © Cuesta 2024

Areas that are designated as SANGs (Suitable Alternative Natural Greenspaces) in connection with proposed new development, in order to deflect increased visitor pressure that might otherwise have an adverse impact on nearby SPAs or SACs, such as Ashdown Forest[19], will inevitably give rise to increased visitor pressure on those areas. Whist this may not give rise to adverse impacts in most situations, and may be beneficial for geodiversity if used in connection with managed access to geological features, it can be problematic where SANGs are located within or in close proximity to sensitive, irreplaceable habitats, such as Ancient Woodlands. In addition to their core purpose, however, SANGs can potentially offer a range of other benefits that can contribute directly to nature recovery objectives. One particular opportunity is for SANGs to be utilised, where appropriate, for the delivery of Biodiversity Net Gain (BNG) requirements[20], thus providing a potential funding mechanism for nature recovery initiatives in areas where these are needed. From April 2024, BNG is a Statutory requirement for all new developments, both large and small, and can be achieved by using land (within or outside the development

[19] The requirement for SANGs applies within a 7km radius of existing SACs or SPAs. This effectively includes the whole of the Local Study Area, and slightly beyond.

[20] Natural England's SANG Guidelines (2021) created specifically for the Thames Basin Heath Special Protection Area, confirm that BNG can be delivered on SANG but, as yet, there is no formal national Government guidance on the topic.

site) for ecological enhancements such as habitat creation or restoration (depending on local circumstances). In this way, the SANGs concept can contribute to **Themes 1 and 3 of the Nature Recovery Network** as well as providing space for recreation. Most significantly, it can provide a mechanism for funding actions that are needed to make nature recovery work, once requirements have been identified through Local Nature Recovery Strategies and preferred locations have been recognised in spatial planning policies.

Increased Awareness and Engagement

In each of the examples outlined above, geodiversity has been shown to assist in providing a more integrated and holistic approach to the concept of nature recovery. It helps to inform the narrative which links the nature of the present environment to its geological past and to the potential for future improvement. This, in particular, provides a means of engaging with the general public so that they can contribute to nature recovery initiatives within their local areas. This has already been a feature of the area around Lake Wood in Uckfield, for example, where local conservation volunteers have made substantial contributions to the eradication of non-native Rhododendron (thereby re-exposing geological outcrops) and even to the localised removal of fallen trees which were causing accelerated siltation within the lake.

Sussex Express, Friday, January 2, 1998

Heave! Pulling storm victim from watery grave

SCOUTS, the Woodland Trust, an angling syndicate, conservation volunteers and working horses all joined forces last week to clear timber from a lake.

The operation at Lake Wood, Uckfield, was to remove a 300-year-old beech tree felled in the great storm of 1987.

The tree had lain in the water for 10 years but was causing problems for anglers, responsible for the upkeep of the lake, who had their tackle caught up around the timber.

It was also feared that the size and shape of the lake would be affected by silt building up around the wood.

After a decade it was decided to move the old tree with the help of local groups including the 4th Uckfield Scouts and animals from the Working Horses Trust in Eridge.

Other groups joined the effort as the volunteers struggled to pull the tree from its watery grave.

Operation co-ordinator Martyn Stenning said: 'It did not go as smoothly as we had hoped as we were unable to move the tree in one go and had to cut it up in the water.

'We will have to come back and finish the job next year.'

The horses were chosen for environmental as well as educational reasons and were a vital part of the three-and-a-half hour operation.

'Overall it was a good day,' said Dr Stenning. 'There were around 40 people there and it was good to see traditional techniques in use.'

The work of local conservation volunteers in Lake Wood, as reported by the Sussex Express, Friday, 2nd January, 1998

Increasing awareness of geodiversity, not only by the public but also among other professionals, including ecologists, planners and developers, can stimulate the interactions and mutual understanding that are needed to make things happen – to take full advantage of the opportunities for nature recovery and for the enhancement of geodiversity value that have been identified in this report. Particular examples which highlight this potential include floodplain restoration and conservation in areas such as Buxted Park SSSI and the Hempstead Meadows LNR in Uckfield; explanations of the geological and historical background to other publicly accessible sites, such as Ashdown Forest SSSI/SAC, Rocks Wood SSSI, West Park LNR, Lake Wood LWS/LGS and the Ridgewood Clay Pit LWS; demonstrations of the benefits to be gained from re-exposing overgrown geological outcrops in these areas; and recognition of the closely-integrated linkages between biodiversity, geodiversity and landscape evolution within less accessible but equally fascinating sites such as the ghyll woodlands of Downlands Farm, Budletts Common Rocks LWS and various relics of the Wealden iron industry, throughout the area.

Increased awareness of, and engagement with, all aspects of the natural environment – including geodiversity connections – is an essential aspect of the nature recovery concept, linking directly in to **Theme 4 of the NRN**. This report seeks to be part of that process, raising awareness of the role which geodiversity factors can play in joining-up the dots. More generally, awareness can be increased by means of posters, interpretation boards and promotional activities such as guided walks, relating to local conservation initiatives and nature recovery projects.

Summary

This section has identified a number of ways in which geodiversity factors, in conjunction with biodiversity, could potentially contribute to Nature Recovery Networks within the local study area. Before consideration is given to what such networks might look like, it is worthwhile summarising these potential contributions under each of the four main themes of the NRN (see table on next page).

NRN Theme	Potential Contributions	Geodiversity Benefits
1) **Enhance** sites designated for nature conservation and other wildlife-rich places - newly created and restored wildlife-rich habitats, corridors and stepping-stones will help wildlife populations to grow and move.	Floodplain restoration and 'rewilding', particularly along the course of the River Uck upstream of the Hempstead Meadows LNR and downstream of the Uckfield bypass, building on the work already carried out within the Buxted Park SSSI. Habitat Restoration and Expansion, including • Natural regeneration of previously-fragmented Ancient Woodlands in areas which retain Ancient Woodland soils and updating the AW Inventory. • Restoration of lowland heathland priority habitats, through the ongoing work of local conservation volunteers in eradicating invasive species. • Potential designations of new SSSIs / LNR / LWS / LGS to protect areas which are not currently designated, where this is justified by evidence. Habitat Creation, including the creation of bare ground habitats through scrub clearance on low outcrops of Ardingly or Ashdown Formation Sandstone. Enhancing and extending existing designations, aided in part by recognising the value of geodiversity factors in underpinning existing wildlife designations. Biodiversity Net Gain initiatives, including those associated with the creation of SANGs, especially where targeted in areas of greatest potential benefit,	Geomorphological improvement and reconnection of the river to its floodplain, encouraging the operation of natural geomorphological processes. Re-exposing sandstone outcrops through the removal of invasive scrub. Protection of geodiversity features through National or at least Local designations.
2) **Improve** the landscape's resilience to climate change, providing natural solutions to reduce carbon and manage flood risk, and sustaining vital ecosystems such as improved soil, clean water and clean air.	Floodplain restoration – particularly along the course of the River Uck through Uckfield itself. Habitat Creation, as detailed under Theme 1 Catchment Flood Management, through the installation of leaky dams and other areas of deliberately impeded drainage within headwater areas, including utilisation of numerous abandoned 'pond bay' structures which are a relic of the historic Wealden iron industry. Improving water quality within surface watercourses, through improved management of soils, livestock and water treatment works.	Substantial improvement in fluvial geomorphology within both floodplains and headwater areas. Increased recognition and understanding of the linkages between climate, geomorphology and flood risk.
3) **reinforce** the natural, geological and cultural diversity of our landscapes, and protect our historic natural environment.	Habitat Restoration and Expansion, as detailed under Theme 1 Habitat Creation, as detailed under Theme 1 Biodiversity Net Gain initiatives, as detailed under Theme 1 Increased Awareness, as detailed under Theme 4, below, but specifically including awareness of the cultural links between geodiversity factors, landscape evolution and heritage (e.g. Mesolithic rock shelters, Medieval field patterns, locally-quarried building stone and clay used in bricks and tiles)	As above
4) enable us to **enjoy and connect with nature** where we live, work and play - benefiting our health and well-being.	Floodplain restoration and 'rewilding', as detailed under Themes 1 and 2. Habitat Creation, as detailed under Theme 1. Enhancing and extending existing designations, as detailed under Theme 1. Access and recreational opportunities, where these are compatible with conservation objectives, including access related to the creation of SANGs. Increased Awareness, through the use of posters, interpretation boards and promotional activities such as guided walks, particularly regarding the role of geodiversity factors in the conservation of wildlife-rich places and the historic environment. Initiatives should be aimed at the general public and landowners, but also at other professionals including ecologists, planners and developers, in order to stimulate the interactions between disciplines that are needed to make things happen.	Increased awareness of the ways in which geodiversity relates to and supports both ecological and heritage features within the landscape. Guided walks could be used to provide more specific opportunities for geological and geomorphological education.

Growing the Network

For nature recovery to succeed, it will generally not be sufficient simply to identify opportunities; specific actions will be needed to promote the right outcomes (for recovery) and, in some cases, to guide other forms of development to more appropriate locations, elsewhere. This, fundamentally, is the function of the existing planning system and can be achieved through the use of Biodiversity Net Gain (BNG) requirements. By embracing the need for new development (in appropriate locations) and by harnessing BNG funding to help realise the opportunities for nature recovery, where it is needed, Local Planning Authorities can play a major role in the halting the decline in biodiversity.

The 'Weald to Waves' project used Biodiversity Opportunity Areas as a framework for linking together land controlled by an initial group of concerned landowners with existing priority habitats, nature reserves and other important areas for nature that lie between those areas. The same concept can be applied within the present study area, using the additional BOA of the River Uck and its headwaters, and the specific opportunities outlined above, to connect existing designations and natural features to each other and to the Weald to Waves corridor.

As explained earlier, the natural corridor of the River Uck has already been compromised, within Uckfield itself, by extensive built development on the floodplain, effectively severing the connections between areas upstream and downstream of the town. Considerable attention has therefore already been given by local people, councils and interest groups (e.g. Stenning, 2023) to the notion of providing alternative wildlife corridors around the northern and western sides of the town, linking together a number of existing designated sites and natural features, including geodiversity features such as river floodplains and rock outcrops. The suggestion was that this might be achieved as part of the emerging LNRS for East Sussex, although work on the LNRS began after those suggestions were made. There is now an opportunity to examine this concept further, in the light of the information compiled within this report.

Figure 14, below, shows the suggested location and extent of such a strategic '**Nature Recovery Corridor**'. This is based on the logical concept of linking together the BOAs for the Ouse and Uck catchments and incorporating most of the Network Enhancement Zone 1, Fragmentation Action Zones and Habitat Restoration Zones within that area (from Natural England's Habitat Network mapping as shown in Figure 11, above). The concept focuses naturally on the western and northern sides of Uckfield, where the opportunities are clearly most in evidence. It therefore lends support to the suggestions that have already been voiced by local people and ties-in with the geodiversity-based opportunities linked to the Ardingly Sandstone features shown in Figure 13, above. It would also usefully extend the 'Weald to Waves' corridor by overlapping with that in the Ouse valley (south-west of Uckfield) and linking it to the High Weald National Landscape, in the north.

The more detailed maps in Appendix B show the same suggested 'Nature Recovery Corridor' in relation to existing designations, priority habitat areas, river floodplains and Ardingly Sandstone outcrops (taken from Figures 3 to 9, above). The presence of these features adds substantially to the evidence base in support of the suggestion: It shows that the Shortbridge Stream and its floodplain would provide a focus of existing connectivity, and that the wider zone would incorporate an 'arc' of existing wildlife and geodiversity designations, Ancient Woodlands, other priority habitats and natural features (floodplains and rock outcrops) all of which are already acting as natural 'stepping stones' for wildlife, in between the two BOAs. As a spatial planning tool – for example if used as a 'target area' for off-site BNG funding and other schemes – this concept would enable wildlife corridors to be established, enhanced or extended within these areas, connecting the lower and upper parts of the Uck Valley. In effect, it would create a 'wildlife bypass' for the town, compensating to some degree for the industrial development along the floodplain that has taken place in previous years. From a geodiversity perspective, it would also help to provide a focus for increased awareness of and engagement with the various geological and geomorphological features which help to link many of the individual components.

Whilst not, necessarily, being a constraint to future development in those areas, it would help to encourage such development to be located elsewhere, in more appropriate locations. In this way it would also support other

local planning objectives by helping to maintain the rural separation between Uckfield, Maresfield and Buxted and to preserve evidence of the distinctive Medieval landscapes which still exist in those rural areas. Before any of this could become a reality, however, the co-operation of landowners would need to be sought. In the Weald to Waves project, landowners provided the original incentive and the wider connections followed. In this case, it would be the other way round, but the outcome could be equally positive.

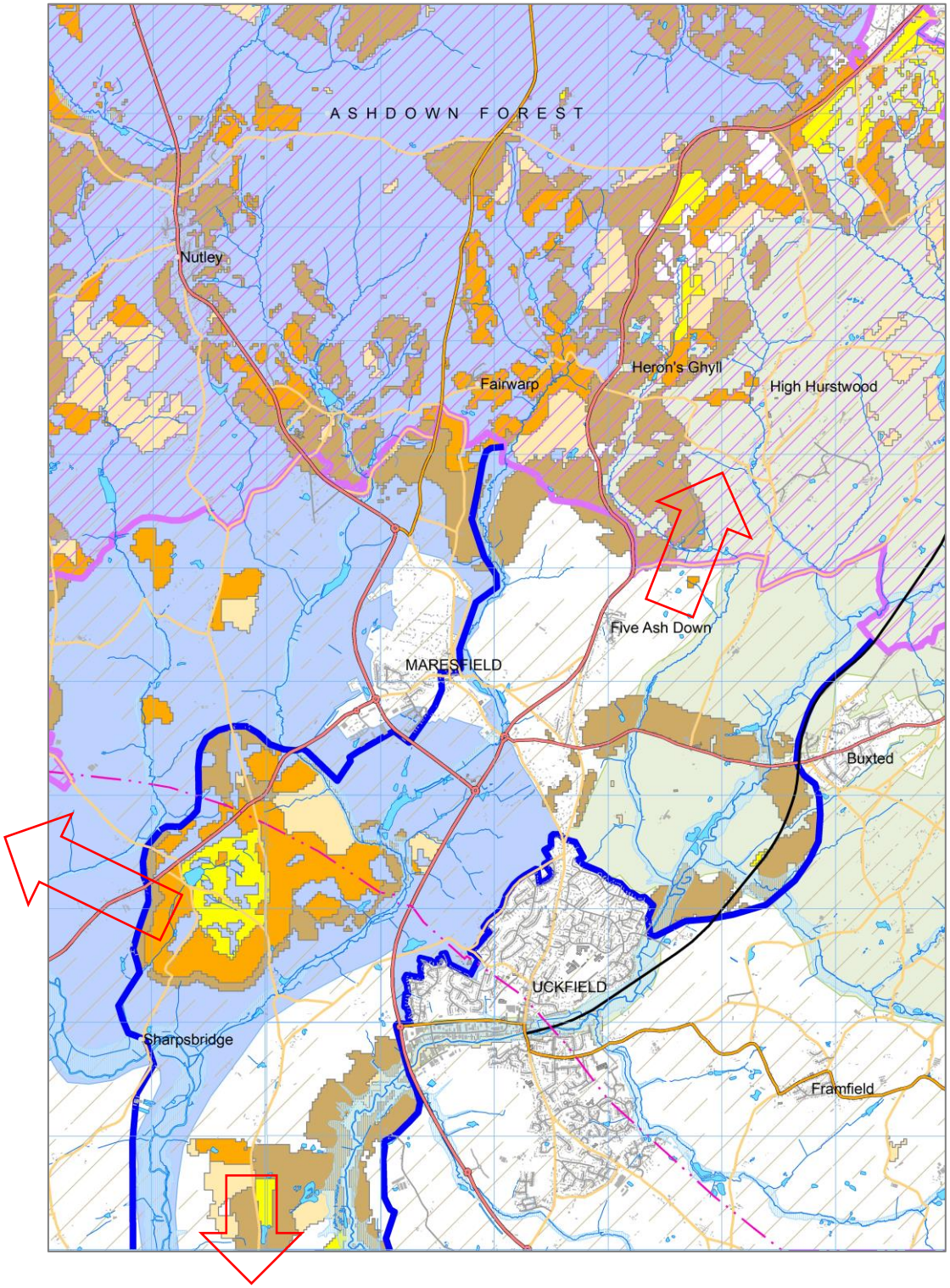


Figure 14: Suggested location and spatial extent of a possible Nature Recovery Corridor *(outlined in blue),* ***between Uckfield, Maresfield and Buxted, linking the Biodiversity Opportunity Areas for the Ouse and Uck catchments by incorporating Natural England's Network Enhancement Zones*** *(see page 37 for explanation)* ***and, as indicated by the red arrows, linking the Weald to Waves corridor in the Ouse valley to the High Weald National Landscape, north of Uckfield.*** *More detailed mapping of these areas, showing the locations of individual designations, priority habitats, floodplains and rock outcrops, is provided in Appendix B.*

Conclusions

This case study has demonstrated how geodiversity is frequently linked to biodiversity, though the influence of rocks, sediments, landforms and active geomorphological processes on soil types, topography, hydrological and hydrogeological conditions, hydromorphology in river channels and many different natural habitats. Throughout the High Weald, these associations have greatly influenced the extent to which Ancient Woodlands, narrow floodplains, small-scale Medieval field patterns and areas of open heathland have survived the threat of intensive agriculture. The study has also shown how the same geodiversity factors can contribute, just as well, to nature recovery initiatives in areas which have experienced biodiversity decline and fragmentation. Most importantly, it has shown that **geodiversity factors not only underpin existing biodiversity; they also provide the groundwork for enhancing and rebuilding it**.

The **recognition of geodiversity as an integral aspect of nature recovery** can thus be highly beneficial to the preparation of Local Nature Recovery Strategies (LNRS) which, in turn, can reciprocate by promoting greater interest in, and understanding of, geodiversity itself.

Across the High Weald as a whole, opportunities for geodiversity to contribute to (and for geodiversity value to benefit from) nature recovery initiatives have been identified in relation to each of the geological formations and associated landscape units. Those opportunities include:

- Recognising the importance of geological outcrops and landforms in the creation or enhancement of a rich mosaic of habitats – particularly in areas which have contrasting geology and soil types;
- Recognising the geological and geomorphological characteristics of headwater areas as a means of targeting appropriate policy and action for nature recovery, including the restoration of Lowland Heathland, and the creation of upstream wetlands and wet woodland areas as a catchment-wide approach to flood management.
- The recognition of sunken lanes as a means of providing linear geological exposures, wildlife corridors, particularly for pollinators, and areas of high potential for Biodiversity Net Gain.
- The creation of interactive, creative exhibitions which inform and explore the biodiversity and fossils of the High Weald's geological past.
- The identification and restoration of historic ponds and hollows as new or re-established wetland habitats.
- Utilising the distinctive outcrops and crags of the Ardingly Sandstone as features of both geodiversity and ecological interest to a wide range of people.
- The removal of invasive bracken and rhododendron from these and other sandstone outcrops to enhance geodiversity interest whilst also providing conditions suitable for localised heathland communities and specialised invertebrates to establish and thrive.
- Recognising that river floodplains – even those within minor tributary streams in the upland areas – have a high potential in terms of providing opportunities for the creation and enhancement of Nature Recovery Networks. Through more effective management, functional river floodplains have the potential to reduce the risk of flooding and to create or enhance priority habitats which help to reconnect existing wildlife corridors.

The local study area between Uckfield and the Ashdown Forest has enabled these and other opportunities to be explored in much greater detail. Specific opportunities have been identified, within that area, for:

- Floodplain restoration and rewilding to reconnect rivers with their floodplains and to promote the functioning of natural, fluvial processes, whilst also reducing flood risk elsewhere and increasing biodiversity;
- Facilitating the natural regeneration of previously-fragmented Ancient Woodlands in areas which retain Ancient Woodland soils;
- Re-exposing existing natural outcrops, restoration of lowland heathland priority habitats and the creation of bare ground habitats, through the ongoing work of local conservation volunteers in eradicating invasive species and scrub from low outcrops of Ardingly or Ashdown Formation Sandstone;
- Enhancing existing designations, and potentially the creation of new designations, where justified by evidence, recognising the value of geodiversity factors in underpinning existing wildlife sites;
- Biodiversity Net Gain initiatives, including those associated with the creation of SANGs, within the 7km 'shadow' of the Ashdown Forest SAC and SPA;
- Catchment-scale flood management initiatives, through the installation of leaky dams and other areas of deliberately impeded drainage in areas of suitable topography, within headwater areas;
- Managed access to and recreational opportunities associated with features of integrated geodiversity, biodiversity and historical interest, where these are compatible with conservation objectives, including access provision related to the creation of SANGs; and
- Increased awareness, through the use of posters, interpretation boards and activities such as guided walks, particularly regarding the role of geodiversity factors in the conservation of wildlife-rich places and in historical landscape evolution.

Overall, the case study has demonstrated that various geological and geomorphological factors frequently underpin and reinforce the natural characteristics and conservation value of designated sites, priority habitats and aspects of cultural heritage. It has also shown that they can be important in their own right, for example in providing connections between individual sites along undesignated river floodplains and geological outcrops. Understanding these connections can help us to harness and improve the landscape's natural resilience to climate change – for example by maintaining natural ecosystems and wildlife corridors rather than disrupting and fragmenting them, and by 'rewilding' natural floodplains and headwater areas to control flooding.

It is no coincidence that rivers, together with their floodplains and the wider freshwater ecosystems which they support, including headwater areas in the uplands, are key aspects of a number of existing nature recovery initiatives within Sussex. Rivers are effectively the 'vascular system' of the natural world and are recognised as being of huge importance for biodiversity and ecosystem services. Rivers, of course, are also geodiversity features. They are commonly the most prominent examples, inland, of active geomorphological processes, responsible for the creation of steep-sided ghyll valleys on higher ground and for floodplains and associated features further downstream, as well as providing natural connections throughout the landscape. For all of these reasons, it makes perfect sense for nature recovery initiatives to be focussed on river systems and their linkages to adjoining areas.

This case study has illustrated how geodiversity can be integrated with and make positive contributions to all four of the main themes of nature recovery. It can **enhance** the value of existing designated sites and the level of interest in them. Understanding the ways in which geodiversity factors underpin biodiversity can help us to harness and **improve** the landscape's natural resilience to climate change, by maintaining and expanding natural ecosystems and wildlife corridors. An understanding of geodiversity can also help to **reinforce** awareness of the natural, geological and cultural diversity of the area, demonstrating important links between geology, landscape

and the historical evolution of the area. Bringing all of these aspects together and presenting them to the wider public will help local people **enjoy** and **connect with** these important aspects of their natural, local environment.

In each of these cases there are also benefits for geodiversity itself, by virtue of geoconservation work (e.g. to re-expose geological outcrops whilst creating or extending important habitats), as well as through increased awareness and appreciation of its role in nature recovery projects.

For nature recovery to succeed, it will generally not be sufficient simply to identify opportunities; specific actions will be needed to promote the right outcomes (for nature) and to guide other forms of development to more appropriate locations. This, fundamentally, is the function of the existing planning system and could be achieved through the use of Biodiversity Net Gain (BNG) requirements. By embracing the need for new development (in appropriate locations) and by harnessing BNG funding to help realise the opportunities for nature recovery, where it is needed, Local Planning Authorities can play a major role in halting the decline in biodiversity.

The case study has indicated how this might work within the Uckfield area, based on joining-up existing designations, habitats and other natural features to enable wildlife corridors to be established, enhanced or extended, connecting the lower and upper parts of the Uck Valley. In effect, such a corridor would create a '**wildlife bypass**' for the town, compensating to some degree for the industrial development along the floodplain that has taken place in previous years. It would also help to provide a focus for increased awareness of and engagement with the geodiversity features which help to link many of the individual components.

This evidence-based suggestion illustrates what could be achieved by adopting a **holistic approach to nature recovery – one that benefits from (and provides reciprocal benefits to) geodiversity**.

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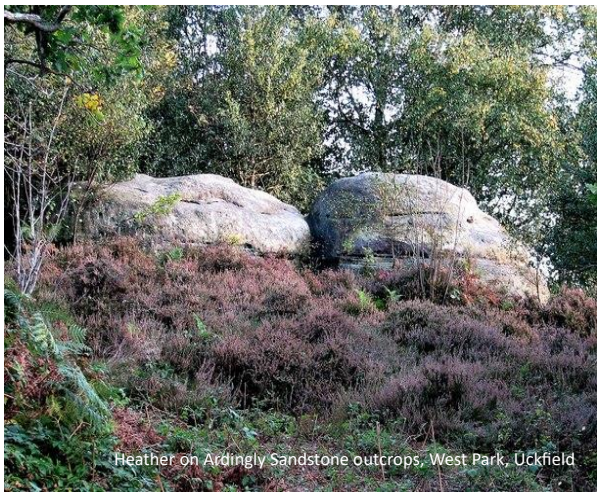
APPENDIX A: Local Designations within the Local Study Area

The following descriptions relate to designated nature conservation sites within the local study area, between Uckfield and Ashdown Forest. They include statutory Local Nature Reserves together with non-statutory Local Geological Sites and Local Wildlife Sites. Their locations are shown on Figure 6 of the main report.

Local Nature Reserves

- **West Park, Uckfield**. This is a small but varied nature reserve situated on the western edge of Uckfield and is bordered by roads and housing. It comprises a mosaic of habitats including semi-improved grassland, localised acidic grassland, developing broadleaved woodland, exposed outcrops of Ardingly Sandstone, and a marshy area. Grassland bordering the sandstone outcrops is acidic and species-rich, developed on a sandy soil, with small patches of heath. Centrally, there is an interesting (probably spring-fed) marshy area that supports a diverse flora and ground-nesting birds. Taken together, this is a rich assemblage in such a small site and is particularly important due to its proximity to an urban area.


Heather on Ardingly Sandstone outcrops, West Park, Uckfield


Flint artefacts from the West Park LNR, Uckfield. M. Stenning 2022

The sandstone outcrops within the reserve are separately designated as a Local Geological Site (Rocks Park LGS - see below). These support a range of bryophytes including the rare and localised Meylan's Pouchwort. The footpaths and their locality have exposed sand and are important for invertebrates, including solitary mining bees, Common Spiny Digger Wasp and Spider Hunting Wasp species. West Park is also of archaeological value, as the site (referred to as 'The Rocks' in articles by Hemingway, 1979, 1980) includes one or more Mesolithic rock shelters and more than 10,000 Mesolithic flint artefacts have been recovered from layers of sand within the meadows.

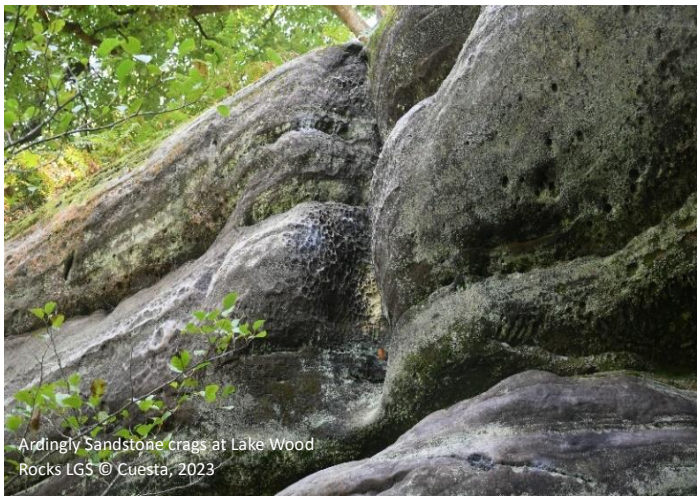

Hempstead Meadows LNR, Uckfield. M. Stenning 2024

- **Hempstead Meadows, Uckfield**. This site forms part of the River Uck floodplain and is an important wetland habitat in the heart of Uckfield. Being part of the floodplain, the site is subject to periodic flooding during the winter months. Habitats include regularly inundated tussocky damp grassland, ditches, scrub, established trees including willow, alder, and black poplars, and mixed grassland. The site supports a good flush of greater tussock sedge, considered uncommon in the South East. Fauna of interest include grass snakes and slow worms, whilst the stream along the northern boundary of the reserve supports maturing European eels prior to them returning to the Sargasso Sea to breed when they are mature, which can take 20 years or more. Bird species are variable and include snipe,

sparrowhawk, song thrush, and goldfinch. Insect life is rich and includes a wide range of butterflies, hoverflies, dragonflies, mayflies, and beetles.

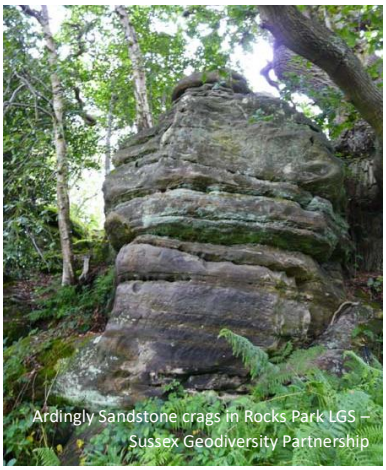
Local Geological Sites

- **Lake Wood Rocks LGS, Uckfield.** This site, located within the Lake Wood Local Wildlife Site (see below) comprises a discontinuous outcrop of Ardingly Sandstone on the northern and southern sides of the lake and extending round the head of the valley to the east. The outcrops extend to about 500m in total length and are typically 4 to 8m in height. Those around the northern side of the lake are generally the more imposing and accessible. In all areas, but particularly on the southern side of the lake, and within gulleys and overhangs on the northern side, the outcrops are commonly associated with a range of bryophytes and ferns, characteristic of sandstone ghylls in this area. This applies particularly in areas which are continuously fed by groundwater seeping through the rock, primarily along bedding planes. Further east, the outcrops tend to be slightly more subdued and are covered by a wide range of lichen species and moss, set back from the path and partially obscured by trees.

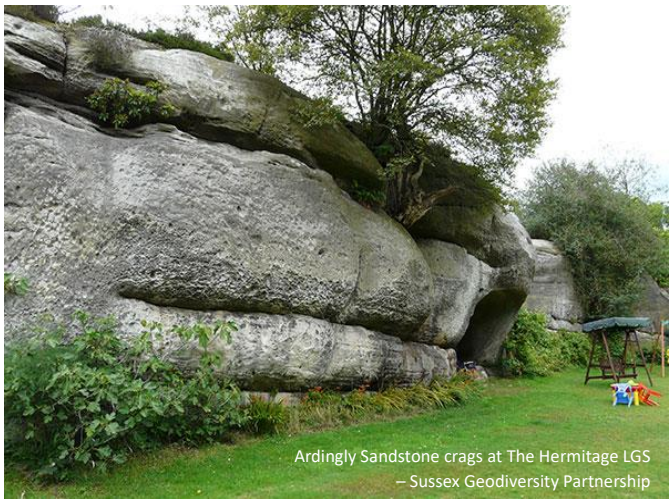

Ardingly Sandstone crags at Lake Wood Rocks LGS © Cuesta, 2023

The rocks themselves generally comprise fine to coarse-grained sandstones deposited in a fluvial channel environment. In places there are isolated pebbles up to 2cm diameter and some iron staining occurs. Geomorphological features include a weathering crust, undercutting by selective water erosion (by seeping groundwater) along bedding planes, open joint planes (in some cases expanded to form 'gulls', as a consequence of former periglacial cambering processes), honeycomb weathering and polygonal cracks. Periglacial slope processes may also have assisted in the exposure of the sandstone faces. Caves around the edge of the lake, apparently of natural origin, were greatly enlarged and modified to form tunnels and arches in the late 18th and early 19th Centuries. Long before that, in Mesolithic times, it is thought likely that some of the original caves may have been used as primitive rock shelters. Mesolithic artefacts have been found in front of the similar outcrops in neighbouring Rocks Park (see below). In recent decades, the removal of invasive, non-native Rhododendron by local conservation volunteers has helped to re-expose areas of sandstone above the cliff faces. These areas are often characterised by ground-dwelling invertebrates within the warm, dry, sandy soils.

- **Rocks Park LGS, Uckfield**, This site comprises a further discontinuous outcrop of Ardingly Sandstone about 300m long, forming cliffs and blocks up to 5m high, within the West Park LNR. The sedimentology and weathering features are essentially the same as those seen in the more prominent exposures within the Lake Wood LGS. Unlike the Lake Wood site, however, the outcrops seen within Rocks Park do not seem to have been modified by 19th Century landscaping. They do, however, include one or more Mesolithic rock shelters and, as noted earlier in the description of the LNR, more than 10,000 Mesolithic flint artefacts have been discovered within the meadows in front of the rock outcrops. The area has benefitted from conservation management to reduce invasive rhododendron and bracken, allowing heather to become re-established on the thin sandy soils above some of the outcrops.


Ardingly Sandstone crags in Rocks Park LGS – Sussex Geodiversity Partnership

- **The Hermitage LGS, High Hurstwood**. This is a further linear outcrop of Ardingly Sandstone about 250m long, forming cliffs and blocks 5 to 8m in height, located in private garden. The outcrop provides clean exposures with well-developed weathering features that have not been damaged by climbing. The sandstone is of fluvial origin, displaying both large and small-scale channelling and cross-bedding. Weathering features include honeycomb weathering, polygonal cracking, undercutting and open joints. There is a sandstone cave next to the house, enlarged from a natural cave, and reputed to have been occupied by a hermit in late medieval times. Archaeological research has also identified a Mesolithic site at the eastern end of the outcrop, dating certainly from around five thousand years BC, and possibly even from the seventh millennium BC, making it one of the earliest Mesolithic sites in England. The excavation yielded an assemblage of just over four thousand pieces of struck flint together with charcoal deposits and a hearth, constructed of sandstone pieces. A subdued continuation of the rock exposures is seen directly to the west of the site, to the south of Rocks Road.



Ardingly Sandstone crags at The Hermitage LGS – Sussex Geodiversity Partnership

Local Wildlife Sites

- **Brown Knoll LWS**. This site occupies an area of good quality, semi-improved grassland, and unimproved acidic grassland habitats at the edge of Ashdown Forest, on a steep, west-facing slope of a headwater valley draining northward towards the River Medway. This is in contrast to the majority of the study area which drains southwards into the Uck and Ouse catchments. The whole of the site is underlain by interbedded sandstones and siltstones of the Ashdown Formation.

- **Crowborough Common LWS**. This site is home to the Crowborough Beacon Golf Club. Away from the manicured greens and tees, the site includes areas of good quality, semi-improved grassland (primarily along the fairways) together with areas of lowland heath (including both dry and wet heathland) and deciduous woodland – the latter having developed largely since the 1930s. As with the more extensive areas of lowland heath on nearby Ashdown Forest, these habitats have developed over the interbedded sandstones and siltstones of the Ashdown Formation.

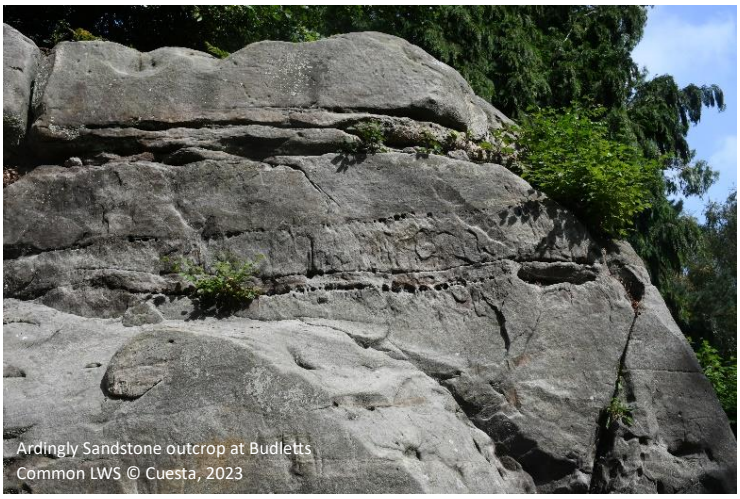
- **Furnace Wood LWS**. A large area of Ancient (Replanted) Woodland which formerly would have provided the main source of charcoal for the nearby Hendall Furnace - a Scheduled Monument comprising the site of a 16th Century blast furnace, wheel-pit, dam, water system and slag heaps. The woodland is developed mainly on the Wadhurst Clay Formation but extends onto the Ashdown Formation outcrop in the south west. The Shortbridge Stream, which runs along the western boundary is of note and the woodland has quite significant Bryophyte interest.

- **Courtland Wood, Nutley**. This is an area of Ancient, Semi-Natural Woodland, occupying a broad valley on both sides of a minor tributary to Batts Bridge Stream. The woodland is dominated by Oak over Hazel and the canopy is reasonably dense, resulting in a less rich ground flora. However, there are numerous bryophytes along the small stream that bisects the site. The site overlies a number of separate geological units, from the Ashdown Formation and the Wadhurst Clay in the north-eastern part of the site, separated by faulting from the younger Ardingly Sandstone and Grinstead Clay in the south-west and the overlying Upper Tunbridge Wells Sand in the south-east.

- **Stonehouse Wood LWS**. This site occupies part of the headwater valley of a tributary of the River Uck. It comprises a strip of mostly Ancient, Semi-Natural Woodland, on either side of the stream. This consists

mainly of Hornbeam coppice, developed largely on Wadhurst Clay Formation but also extends onto the overlying Lower Tunbridge Wells Sandstone on the higher parts of the eastern valley side.

- **Budlett's Common Rocks**. This site consists of impressive Ardingly Sandstone rock outcrops located within three large gardens. The site supports a rich assemblage of rare and uncommon liverworts and mosses, including a number of characteristic 'sandrock' species. The previously unrecorded species Thatch-moss, a nationally rare species, was recorded on areas of bare rock. Although principally a wildlife site, the geological exposures here, and in the adjoining gardens at 'the Warren', immediately east of the site, are substantial, revealing evidence of periglacial cambering (gulls) as well as smaller-scale weathering features.



Ardingly Sandstone outcrop at Budletts Common LWS © Cuesta, 2023

- **Maresfield Churchyard**. The churchyard is important for fungi, with all of the permanently short areas of grass (front and sides) being rich in waxcap fungi species. The grassland itself is neutral with species-rich areas of short lawn and long and short turf amongst gravestones surrounding the Church. The site is located on Ardingly Sandstone but there are no outcrops and no direct associations with the biodiversity, other than through soil type.
- **Shortbridge Stream Meadow**. This site is a rare example of species- and herb-rich marshy grassland, which is dependent upon the floodplain environment and high water levels. It has a varied structure, with marshy grassland, tall herb and swamp-type vegetation grading into each other and reflecting differences in soil water levels.
- **Piltdown Common**. This is a large, well-managed site within a golf course. The playing areas comprise short mown greens, tees and fairways but the areas of rough typically have high quality acid-grassland and heathland vegetation, reflecting the underlying Upper Tunbridge Wells Sand (interbedded sandstones and siltstones). There are also areas of gorse scrub and mixed deciduous woodland, together with some wet flushes with abundant Purple Moor-grass, rushes and sedges. There is also a large pond which is good for water beetles and Common Toad, though this is also a popular angling spot and has high visitor pressure. As a consequence of this diversity, although parts of the site are classified as Lowland Heath, much of it falls into the category of 'No main Habitat but additional habitats present'. Piltdown was at the centre of an archaeological hoax in 1912 when a skull was discovered that was claimed to be the 'missing link' between humans and apes. The link is celebrated in the name of the local pub – The Piltdown Man.
- **Uckfield Cemetery**. The main southern section is generally comprised of neutral species-rich grassland. The northern section of the site is more acidic in character and supports some excellent species-rich low acidic grassland sward. The differences are potentially linked to the underlying geology and soils, with the northern section being located firmly within the outcrop of Upper Tunbridge Wells Sand, whilst the southern area lies at the feather edge of that unit, extending southwards onto the underlying Grinstead Clay.

- **Butcher's Wood, Uckfield**. This is an ancient woodland which once was contiguous with Lake Wood (see below) but is now separated from it by the A22 Uckfield by-pass. Much of it consists of Hazel coppice with Oak standards and some dense Sweet Chestnut coppice. The ground flora is generally carpeted by Bluebells and of particular note is a large population of Wild Daffodil. Along the northern boundary of the woodland, adjacent to the Shortbridge Stream, there is a line of Ardingly Sandstone outcrops with deeply recessed underhangs (reflecting erosion by percolating groundwater). Historically, very rare mosses and liverworts have been recorded here. Within the site there is a large open, sandy area with exposed areas of sandstone. This was once a heathy clearing, but, in recent decades it has been frequently used for motorbike scrambling and 4-wheel driving, and now has expanses of bare sand substrate with sparse vegetation, although rare and interesting bryophytes survive on some of the sheltered sandstone outcrops directly below the site.


Ardingly Sandstone outcrop at Butcher's Wood LWS © Cuesta 2024


Ardingly Sandstone clearing in Butcher's Wood LWS © Cuesta 2024

- **Lake Wood, Uckfield**. This is a complex site that was once part of a large estate ('The Rocks') owned by the Streatfeild family but is now owned and managed by the Woodland Trust. The site is classified as ancient semi-natural woodland, although much of it was extensively modified in the late 18th and early 19th Centuries by the owners of the estate. This included enlargement of the original lake (by constructing a clay dam at the western end, to raise the water level) and the planting of exotic trees and shrubs. The lake itself is understood to be fed by springs, but also receives surface runoff, some of which enters via an area of Sphagnum bog at the eastern end of the lake, helping to account for the low pH of the water. The woodland is varied in composition and supports a diverse fauna, including many species of woodland birds, rare bats and Hazel Dormice. European Eels have been reported within the lake itself. Imposing outcrops of Ardingly Sandstone surround the lake and are separately designated as a Local Geological Site (see earlier description). Under the guidance of local ecologist, Dr. Martyn Stenning, the removal of invasive Rhododendron and bracken by local conservation volunteers has helped to re-expose areas of sandstone above the cliff faces, to create a far more natural environment – an excellent example of community-led nature recovery. These sandstone outcrops support acidic flora including heather in open areas as well as bryophytes, ferns and a diverse range of rare lichen species. Small caves and hollows within the sandstone are also used by bats, which are known to roost within the numerous open joints and fissures in the rock. The lake and its rich mosaic of surrounding habitats supports a diverse invertebrate fauna including an abundance and several varieties of dragonfly. – perhaps because of the low pH of the water.


Lake Wood LWS © Cuesta 2023


Lichens growing on Ardingly Sandstone outcrop at Lake Wood LWS © Cuesta 2024

- **West Park, Uckfield**. This local wildlife site is coincident with the West Park Local Nature Reserve and, in part, with the Rocks Park Local Geological Site (see earlier descriptions of both).
- **Hempstead Wood, Framfield**. This is a diverse ancient woodland on a gentle northwest-facing slope. It comprises predominantly Oak over mixed coppice species including Hazel, Hornbeam, Sweet Chestnut and Ash. The ground flora includes extensive carpets of Bluebell and a good range of other ancient woodland indicator species. Streams, flushes and ponds are present across the wood and the site is likely to be important as terrestrial and breeding habitat for amphibians. Several small streams are present around and within the wood along with wet flushes and ponds. There are also features of archaeological interest present such as old pits, boundary banks, ditches and internal wood banks. There are no obvious connections with geodiversity.
- **Harlands Farm Pond & Stream, Uckfield**. Harlands Farm pond, which is now surrounded by modern residential development, supports the largest known breeding population of Common Toad in Sussex. The population is subject to local conservation action and in excess of 1000 toads are helped across the adjoining roads each spring. It is estimated that a similar number of toads migrate to the pond unaided via the adjoining stream. The pond is directly surrounded by mature trees and scrub whilst the stream has bordering semi-natural wet woodland comprising of Alder, Hazel, Elder and Sycamore with a ground flora of Bluebell, Lesser Celandine, Moschatel, Hemlock Water-Dropwort and Marsh Marigold. There are no obvious connections with geodiversity.
- **Ridgewood Clay Pit**. This site was formerly a group of clay pits associated with a nearby brick-making operation. The pits were active between 1922 and 1970 and extracted various seams of clay from the Wadhurst Clay Formation. Yellow clay was dug for flowerpots whilst grey clay was dug separately for pipes and shale clay for brickmaking. Following closure of the brickworks, natural regeneration has allowed wildlife to flourish. In 1998 the site, together with an adjoining piece of land became a Millennium Green and now provides a mosaic of different habitats from seasonal and permanent ponds and wetlands to areas of grassland, managed woodland and pathways.

Other Woodland Sites

- **Views Wood (The Williams Wood)**, a large, Ancient Semi-Natural Woodland, owned by the Woodlands Trust, and located between the town of Uckfield and the Buxted Park Estate, to which it originally belonged. It is one of the remaining fragments of the vast medieval forest of 'Andredesweald' that once stretched from West Sussex to Kent. The underlying geology of the wood consists of Lower Tunbridge Wells Sand with slightly acidic loamy and clayey soils with impeded drainage, which results in seasonal waterlogging.
- **Park Wood** is a Forestry Commission site which has been woodland since at least 1610 according to historic maps and is a relic of a former deer park which existed at the same time as that of Ashdown Forest. Part of the ancient boundary can still be discerned within the woodland. It is not simply uniform plantation but has a variety of trees and woodland areas, together with streams and ponds. It does not appear to have any obvious links with geodiversity factors but (as with the Woodland Trust sites) could be an important element in the development of nature recovery strategies because it is already being managed for nature conservation.


Park Wood © Cuesta 2024

APPENDIX B: Detailed Maps of a Suggested Nature Recovery Corridor for the Uckfield area

Key to the maps presented on the following pages.

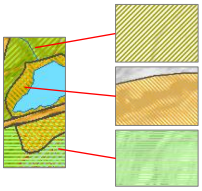
The following details are shown only within the suggested corridor. In each case, the full extents of the features are shown on other maps (Figures 3 to 11) within the report.

DESIGNATIONS


High Weald National Landscape


Site of Special Scientific Interest


Scheduled Monument


Local Wildlife Site

Local Geological Site

Local Nature Reserve

LANDSCAPE FEATURES


High Weald National Character Area


River Floodplains


Rivers & Ponds


Ardingly Sandstone outcrops
(note: these are also present in adjoining areas which are mapped as various habitats and designations)

WOODLANDS & OTHER PRIORITY HABITATS


Deciduous Woodland


Other Woodland (non-priority)


Ancient Semi-Natural Woodland


Plantation on Ancient Woodland Site


Wood Pasture in Parkland


Traditional Orchard


Lowland Heathland


Lowland Dry Acid Grassland

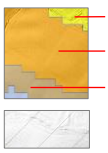

Good Quality Semi-Improved Grassland


Lowland Meadow


No Main Habitat but other habitats present


Coastal & Floodplain Grazing Marsh

OPPORTUNITY AREAS (see main text for explanations)


Habitat Creation / Restoration Zone

Fragmentation Action Zone

Network Enhancement Zone 1

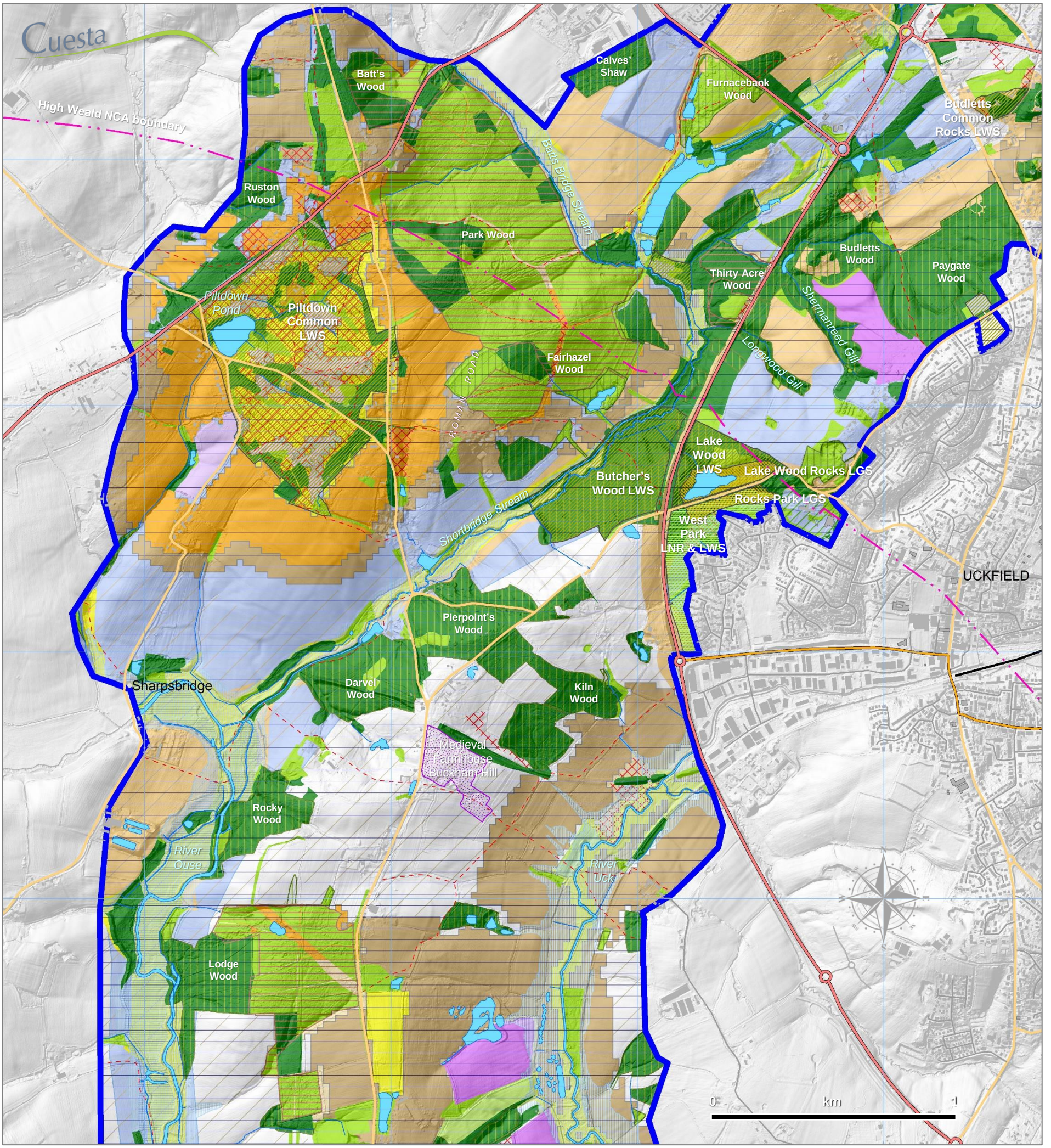
Network Enhancement Zone 2


Biodiversity Opportunity Area: Western Ouse Streams & Ashdown Forest


Biodiversity Opportunity Area: River Uck & its Headwaters


Other areas within the suggested Nature Recovery Corridor

Designations, Features, Habitats and Opportunities within the suggested Nature Recovery Corridor
(southern section)



Designations, Features, Habitats and Opportunities within the suggested Nature Recovery Corridor
(northern section)