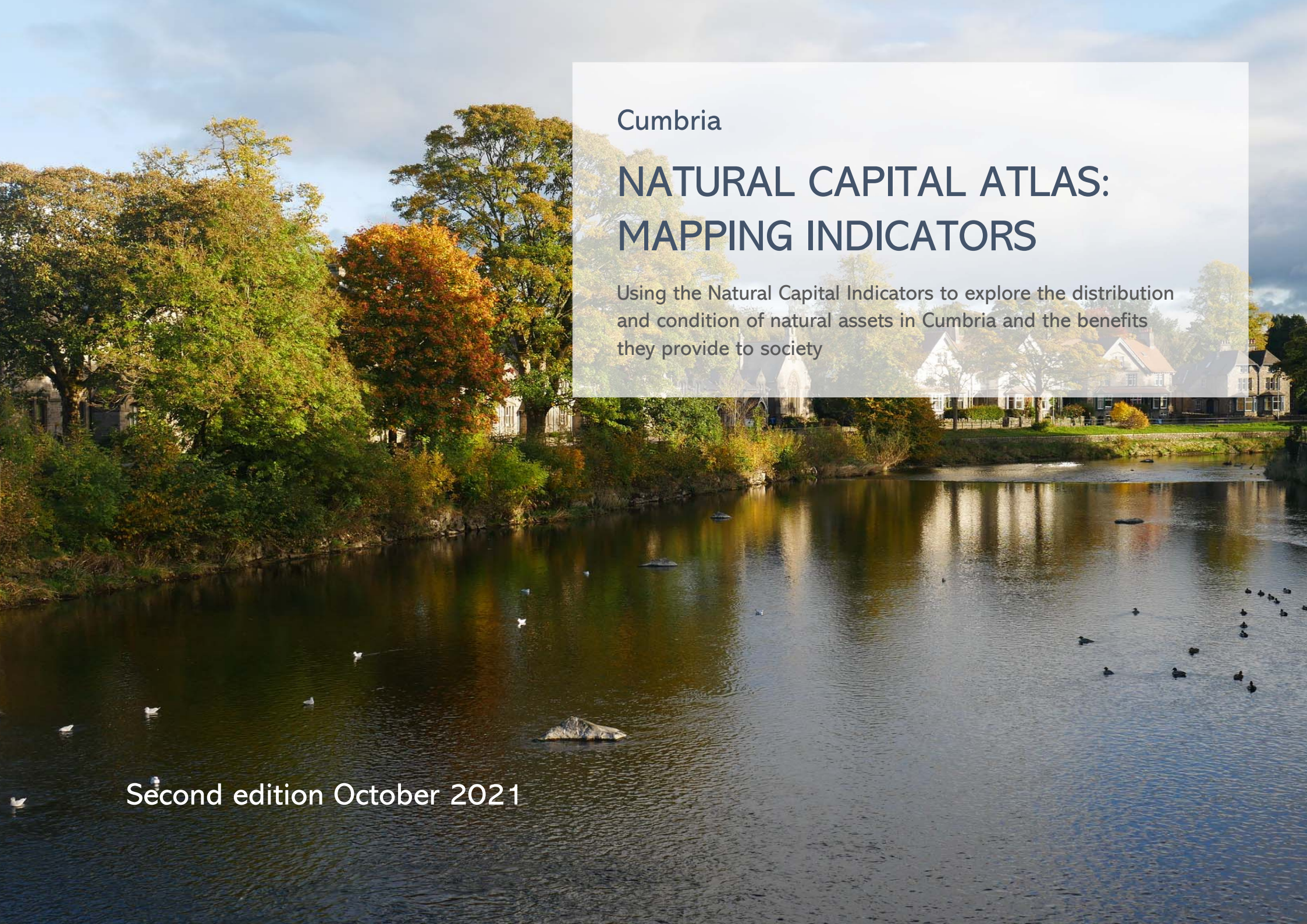

Cumbria

NATURAL CAPITAL ATLAS: MAPPING INDICATORS

Using the Natural Capital Indicators to explore the distribution and condition of natural assets in Cumbria and the benefits they provide to society

Second edition October 2021

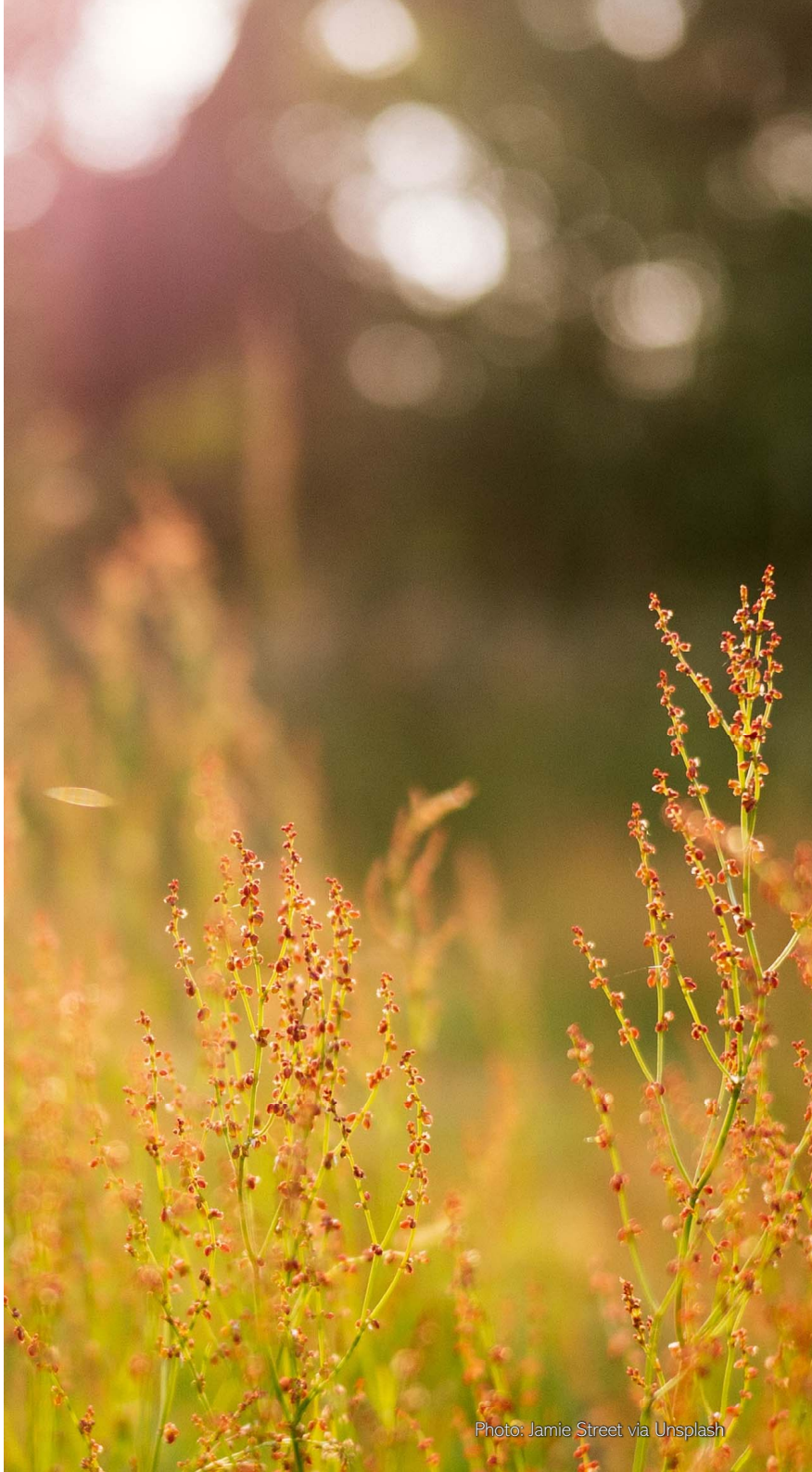

Photo: Jamie Street via Unsplash

NATURAL ENGLAND

This document is an output from the Natural England County & City Natural Capital Atlas project (NE191022-1418-045), delivered by Westcountry Rivers Ltd.

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Project Overview

England's varied natural environment, its ecosystems, geodiversity and landscapes, provides people with a wide range of benefits, upon which human wellbeing depends. These benefits include thriving wildlife, cultural and spiritual enrichment, food, clean water and air and reduced risks from environmental hazards, such as flooding and drought. All of our natural assets are needed for the provision of the full suite of benefits, from ancient woodlands, to city parks.

This atlas takes an in-depth look at the distribution and condition of these valuable natural assets in your place. Using Natural England's Natural Capital Indicators it illustrates, through maps and tables, the state of the natural capital in this area and highlights how it provides benefits to people. It is important to remember that the natural assets in your place are part of a complex natural and cultural system. This atlas is a great starting point upon which to build up a comprehensive natural capital evidence base to support decision making.

What is Natural Capital?

Natural capital means "the elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions" (Natural Capital Committee, 2017).

It is helpful to consider natural capital in the form of a logic chain that shows the links between ecosystem assets, services, benefits and value to people (Figure 1). Figure 1 shows that how much, how good and where natural assets are, affect the ecosystem services, benefits and value people get from them. It shows how management interventions, as well as pressures and drivers of change, influence this chain. Other capital inputs are also often needed for people to obtain the benefits from ecosystem services (a simple example is the processing of trees to produce wood products).

As an example, an area of woodland (ecosystem asset) may reduce air pollution created by traffic on a nearby road. This woodland is therefore improving air quality (ecosystem service) in the local area which results in cleaner air and improved health in the adjacent residential street (benefit). This cleaner air has a value because we know it impacts the health and wellbeing of communities. Sometimes we can use economic methods to put a value on benefits in monetary terms.

Figure 2 shows how natural capital assets support the provision of ecosystem services, benefits and value. The roots of the tree show how aspects of asset quality are critical to the provision of ecosystem services. The roots also show that geodiversity underpins the ecosystem assets and therefore the ecosystem services and benefits they can provide. It is important to remember that this diagram, and natural capital frameworks more generally, are a simplification of how nature works in practice.

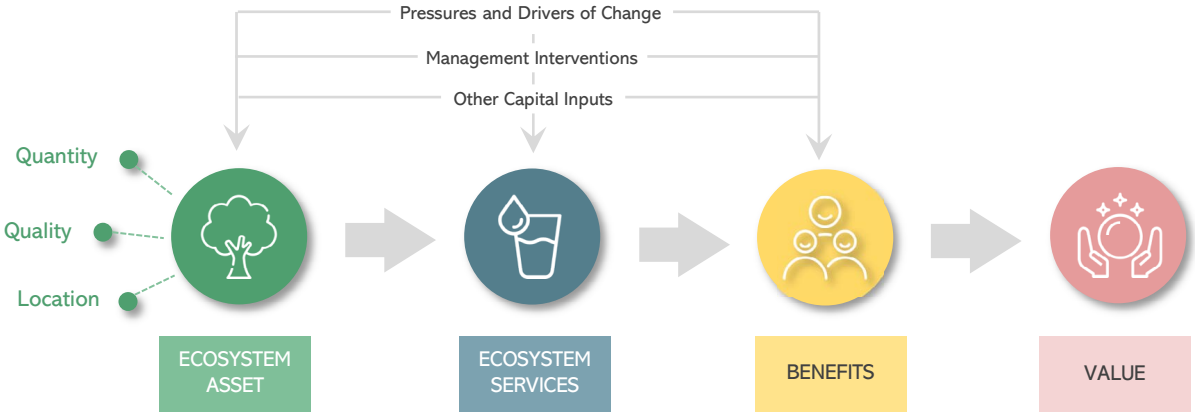


Figure 1: Generalised natural capital logic chain.

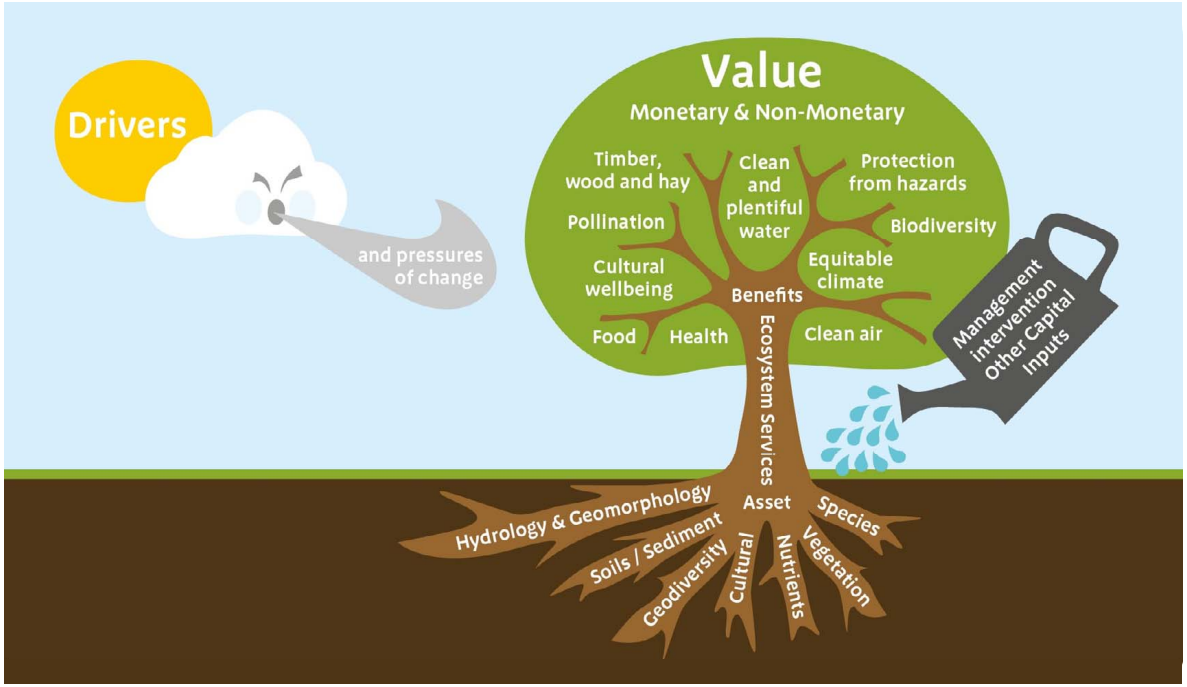


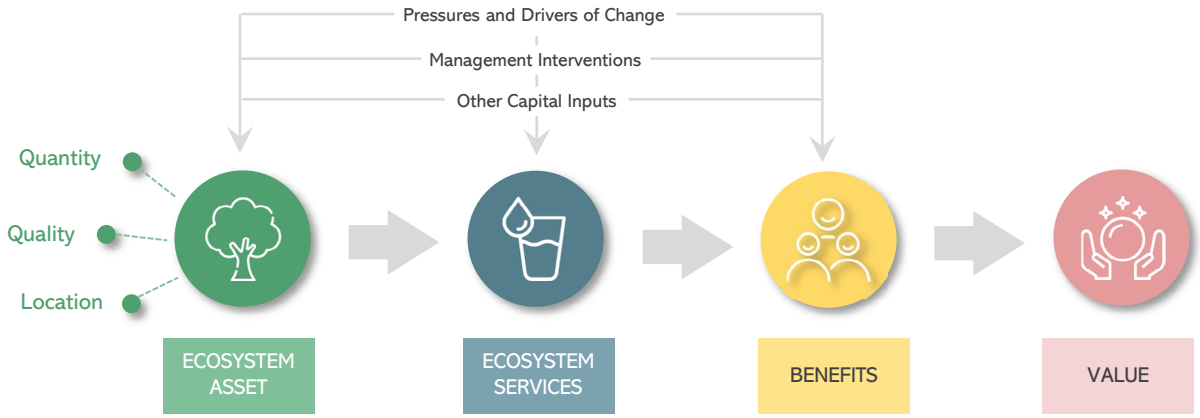
Figure 2: Natural Capital attributes: Sunderland et al. (2019). Image created by Countryscape 2019.

Measuring our Natural Capital

In 2018, Natural England published 'Natural Capital Indicators: for defining and measuring change in natural capital'. This report identified key properties of the natural environment vital for the long-term sustainability of benefits, which can act as indicators of change.

Natural England developed an innovative, systematic approach to identify attributes of the natural environment underpinning the provision of ecosystem services. This approach took account of the expert opinion of nearly 90 specialists in Natural England and the Environment Agency. From this list of attributes, indicators for measuring change were selected and prioritised into short list and long list indicators. Principles were established for defining robust indicators, stating that they should be; transparent, relevant, meaningful, knowable, actionable and scalable. Datasets that could potentially be used to map these indicators were also identified.

Logic chains were used to identify the attributes relevant to the provision of ecosystem services within each broad habitat. Only the key ecosystem services were analysed for each habitat and not all attributes were identified as indicators. For an example of a logic chain see the woodland and air quality logic chain below.



Example – Logic chain showing the characteristics that link woodland assets to the ecosystem service; air quality improvement. Short-list indicators are underlined.

Quantity:

- Coniferous woodland
- Broadleaved, mixed and yew woodland
- Individual trees/veteran trees

Location:

- Distribution, connectivity and fragmentation of woodland and interaction with other habitats
- Distribution of woodland in relation to settlements

Quality:

- Soil/sediment processes:
  - Soil depth
  - Soil bacteria
  - Soil mycorrhizal associations
  - Soil water retention
  - Soil Type
  - Soil erosion
  - Degree of compaction
  - Infiltration
- Nutrient (and chemical) status:
  - Soil N, P, C, pH
  - Atmospheric deposition (exceedance of critical loads - S, N, ozone)
- Vegetation:
  - Age structure
  - Canopy (density and spp. composition)
  - Leaf surface area and duration across year
  - Understorey (density and spp. composition)
  - Shadiness
  - Structural diversity
  - Cover/bare soil
  - Surface roughness/microtopography
  - Tree health
- Species Composition:
  - Naturalness of biological assemblage (no. of trophic levels and spp. composition within levels)
- Geology and topography:
  - Geology
  - Altitude, slope, aspect, landform
  - Catchment characteristics
- Climatic:
  - Air temperature
  - Sunlight/cloud cover
  - Precipitation (inc. distribution, seasonality, intensity)
  - Snow cover and length of snow lie
  - Frequency of freeze thaw
  - Wind (especially for wind throw)
  - Drought
  - Length of growing season (vegetation)

Ecosystem Service Flow:

- Air pollutants removed by vegetation

Benefits:

- Clean air, also underpinning health benefits

Value:

- It is difficult to measure the value of cleaner air; monetary savings (e.g. from reduced healthcare needs) should be considered, as well as social, cultural and environmental value

Ecosystem Services

There are many different ways of classifying ecosystem services. The Natural Capital Indicators and this atlas are based on The Common International Classification of Ecosystem Services (CICES Version 4.3). In this atlas the names of those ecosystem services are expressed more simply and are represented throughout by icons. The table below provides a summary of these services and what they mean.

A table at the start of each section shows which maps to look at for each ecosystem service, and the ecosystem services are described in more detail at the start of each sub-section.

Icon	Ecosystem Service *Natural Capital Atlas – plain English*	*Natural Capital Indicators Report – based on CICES*	Benefits provided
M	Timber, hay and other materials	Materials from plants, animals and algae	Materials e.g. hay, grass for fodder, timber, paper and other products from wood.
W	Fish and other marine products from wild sources	Wild animals, plants, algae and outputs	Products from the sea e.g. fish, shellfish & seaweed for food, fertiliser, angling bait, medicines.
P	Plant-based energy	Plant-based energy	Energy from wood.
C	Cultivated crops	Cultivated crops	Food from crops e.g. cereals, vegetables, fruit.
S	Water supply	Water supply	Plentiful water e.g. water for drinking, domestic use, irrigation, livestock, industrial use including cooling, wildlife.
R	Livestock	Reared animals and outputs	Products from animals e.g. meat, dairy products, honey.
W	Water quality	Water quality	Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.
A	Air quality	Air quality	Clean air, also underpinning health benefits and sustainable ecosystems.
N	Noise regulation	Noise regulation	Health benefits e.g. reduced stress, hypertension, hearing impairment; benefits to sustainable ecosystems through reduction in disturbance; reduced impacts on educational & work performance.
M	Erosion control	Mass stabilisation	Erosion control e.g. soil/land retention, lack of transport disruption, protection of housing, businesses & infrastructure, reduced health & safety risk, reduced flood risk.
F	Flood protection	Flood protection	Reduced flood risk, affecting e.g. reduced health & safety risk, reduced impact on mental health and well-being, protection of housing, businesses & infrastructure, lack of transport disruption.
P	Pollination	Pollination and seed dispersal	Pollination underpinning cultivated crops dependent on insect pollination e.g. field beans, apples, plums, pears, cucumbers, strawberries, oil seed rape.
H	Biodiversity - thriving plants and wildlife	Maintenance of nursery populations and habitats	Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.
C	Climate regulation	Climate regulation	Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.
C	Cultural services	Cultural services	Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.
G	Geodiversity services	Geodiversity services	Geodiversity, in and of itself, products, such as minerals, materials, fossil fuels and renewable energy, fossils, and underpinning other services (for example by providing landscape features and habitats for example, sea cliffs, reef).

Methodology

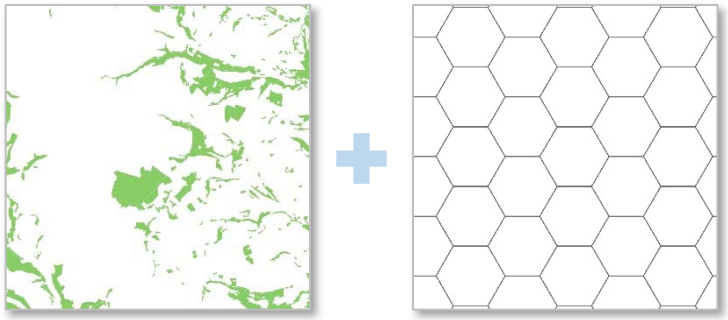
The indicators and datasets identified in Natural England's Natural Capital Indicators Project provide the foundation for this atlas. The National Natural Capital Atlas (Natural England Commissioned Report Number 285, Wigley et al. 2020) tested the feasibility of using the indicators for producing a mapped natural capital baseline assessment. This atlas is a cut of the National Atlas, using the same nationally available indicators and datasets, however, displaying the data at a finer resolution of 5km².

This atlas provides an easy and pragmatic starting point upon which to build your natural capital evidence base. Local data might be available to map some of the Natural Capital Indicators which have not been mapped in this atlas.

The linked "How to Start Using your Atlas" document, data package and user guidance will help you to understand how to begin to use this atlas to engage others, to support the creation of strategic plans and to target interventions or measures.

To create this atlas the following steps were taken:

1. **Review indicators and datasets**
   - ⇨ A systematic process for evaluating the datasets and indicators was undertaken
   - ⇨ The feasibility of mapping each indicator was investigated
   - ⇨ New datasets were added and inappropriate datasets discounted
   - ⇨ Dataset queries and enquiries were made
2. **Access and collate datasets**
   - ⇨ National datasets were obtained from a variety of sources
   - ⇨ Datasets were processed for use in GIS software
3. **Define spatial analysis unit**
   - ⇨ The pros and cons of different unit shapes and sizes were reviewed
   - ⇨ Hexagonal units of 5km² were chosen and a 'grid' was created
     N.b. this is not related to the resolution of the data itself, just the optimum size of the units for display
4. **Calculate indicator values**
   - ⇨ Datasets were processed and indicator values were calculated and assigned to each spatial unit (e.g. area of habitat per hexagon)
5. **Create indicator maps and summary tables**
   - ⇨ The values were symbolised for the whole of the country, and indicator maps were created for each county or similar local area



Raw spatial data

5km² hexagon grid

Calculate indicator value per hexagon

Symbolise based on range of values across the country

Understanding & Interpreting the Maps

The maps in this atlas are a 'cut' of a national level mapping process. Therefore, the presentation of the maps has to be interpreted with this in mind.

Map Symbol Classification

The maps show values summarised by 5km^2 hexagons, which are then symbolised using a colour scale based on the values across the whole country. The legend at the top of each page gives a generalised key of the map colours. In order to see variation amongst the bulk of the data values, the highest 10% of values per hexagon are separated from the rest and symbolised as 'outliers' (coloured purple on the map). This is purely for visualisation purposes. The remaining per hexagon values are divided into 10 equal interval classes and are symbolised using a colour gradient (shades of blue). Values of zero are shown as either grey or white – see below and each individual page key to clarify.

Largely pale- or dark-coloured maps

Symbolising at a national scale means that for the county in this atlas there may be some maps which are predominately pale or dark shades. This means that for that specific indicator, the values are very low, or very high, when considering the data for the whole country.

Alongside this atlas, Natural England will be making the data available for use in GIS. It will therefore be possible to change the colours to make clearer the differences within a local area.

White & grey hexagons

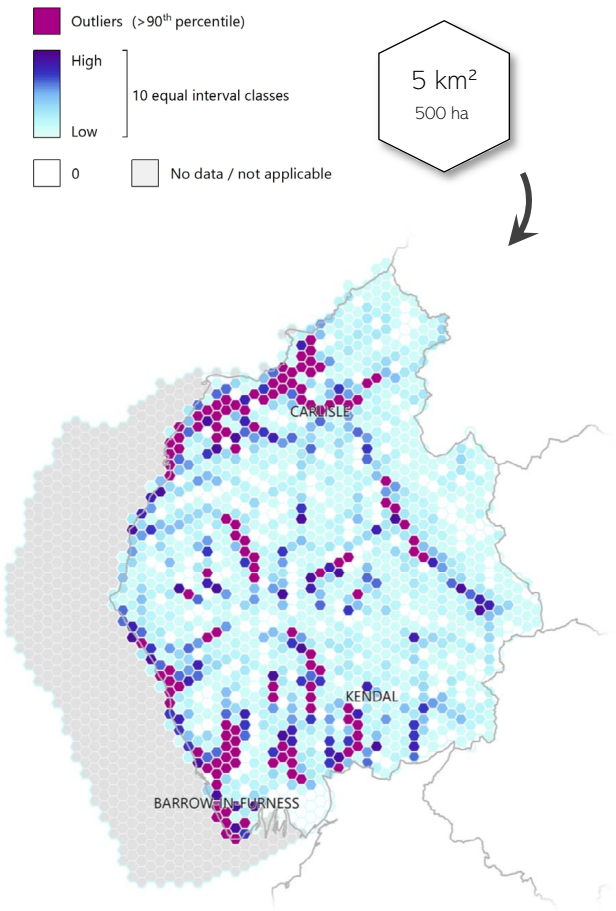
In the maps, white represents a value of 0 for the indicator for that hexagon. This could mean several things:

- The indicator does have a value of zero in that hexagon, for example, there are no areas of a particular habitat in that hexagon. See below for the difference between white hexagons and grey hexagons.
- The data shows that the indicator has a value of 0 in that hexagon, but the data is subject to one or more limitations. A limitation which may result in white hexagons is that the data is not detailed enough or is inaccurate. The datasets used in this project are all mapped at a national level and have been chosen to balance national consistency with providing accurate data. Although many of the datasets are very detailed, it may be that, for example, the national dataset used to map this indicator may not be detailed enough to pick up small areas of habitat. the hexagon may be showing that there is 0m^2 or ha of this habitat when reality this is not the case. National datasets have been used for consistency across the county, but local knowledge can be used in combination with these maps to build up a more detailed picture.

While white hexagons have a value of 0, grey hexagons have a 'null' value for the given indicator. This means either:

- There is a gap in the dataset, and therefore there is no value available for that hexagon.
- It is not possible for the hexagon to have a value for the indicator. This is based on some broad, national-level assumptions:
  - A terrestrial habitat cannot be present in a hexagon which is entirely marine, and vice versa. Thus, the hexagons, marine or terrestrial respectively, have a 'null' value.
  - For indicators which map upland habitats, such as upland streams or upland woodland, the hexagons below the upland area are given a value of null.

The difference between white and grey, 0 and null, is another situation where local knowledge will aid interpretation. There may be indicators which are predominately white in a particular county's atlas, but this is not a concern as the area is generally not appropriate for that particular habitat. For example, a low-lying area may be rich in lowland habitats, and it will not be an issue that it is not home to any upland habitats.



Quantity of Floodplains in Cumbria

Majority (90%) of values range from **0 – 1.33 km²** per hexagon
The 'outliers' (top 10%) range from **1.33 – 5 km²** per hexagon

Report Structure

This report illustrates the state of natural capital in Cumbria. It maps a series of indicators of the quantity, quality and location of natural assets and the ecosystem services they support. The report structure follows this process. The quantity chapter is divided into broad habitat categories; freshwater; farmland; grassland; mountains, moors and heaths; urban; woodland; coastal; and marine. The remaining chapters cover the quality, location and, where possible, the ecosystem services from all habitats combined.

Indicator Summary - Asset Quantity

The 'quantity indicators' are listed according to their broad habitat type, with references to the page where the mapped outputs appear in this report.

A quantity indicator may occur in more than one broad habitat. This is the case with the water related services (water quality, flood protection and water supply) which are considered at a whole catchment scale, in the Freshwater section. The marine and coastal parts of the report should be considered together.

Freshwater (p.14)

- 1 Active flood plain
- 2 Coastal & floodplain grazing marsh
- 3 Lakes & standing waters
- 4 Lowland Fens
- 5 Lowland raised bog
- 6 Rivers
- 7 Modified waters (reservoirs)
- 8 Reedbeds
- 9 Ponds
- 10 Blanket bog
- 11 Woodland
- 12 Other semi-natural habitats

Farmland (p.20)

- 13 Arable and rotational leys
- 13 Horticulture
- 14 Improved grassland
- 15 Orchards and top fruit
- \- Permanent pasture

Grasslands (p.23)

- 16 Meadows
- 17 Other semi-natural grasslands

Mountains, Moors and Heaths (p.26)

- 18 Blanket bog
- \- Bracken
- 19 Dwarf shrub heath
- 20 Inland rock, scree and pavement (AML)
- 21 Lakes (AML)
- 21 Reservoirs (AML)
- 22 Mountain heath and willow scrub
- 23 Rivers (AML)
- 24 Semi-natural grassland (AML)
- 25 Upland flushes fens and swamps
- 26 Wood pasture (AML)
- 27 Woodland (AML)

AML = Above Moorland Line

Woodland (p.32)

- 28 Broadleaved, mixed and yew woodland
- 29 Coniferous woodland
- 30 Individual trees/veteran trees
- 31 Woodland priority habitats

Indicator Key

- Included in this atlas
- Not included in this atlas
- 12 Map ID

Urban (p.36)

- 32 Blue space
- 33 Green space - not semi-natural
- 34 Open mosaic habitats
- \- Urban/street trees
- 35 Semi-natural habitats
- 36 Woodland, scrub and hedge

Coastal (p.40)

- 37 Beach
- 38 Coastal lagoons
- 39 Mudflats
- 40 Salt marsh
- 41 Sand dunes
- 42 Sea cliff
- 43 Shingle

Marine (p.45)

- 44 Intertidal rock
- 45 Maerl beds
- 46 Reefs
- 47 Sea grass beds
- 48 Shallow subtidal sediment
- 49 Shelf subtidal sediment
- 50 Subtidal rock

Indicator Summary - Asset Quality

The 'quality indicators' are divided into broad categories, listed below with references to the page where the mapped outputs appear in this report.

Hydrology and Geomorphology (p.52)

- ○ - Extent of artificial drainage
- ● 51 Natural aquifer function - recharge and discharge
- ○ - Naturalness of flooding regime
- ● 52 Naturalness of flow regime
- ○ - Naturalness of lake hydrological regime
- ○ - Naturalness of water level regime
- ● 53 Lack of physical modifications of water bodies
- ● 54 River continuity – lack of obstructions

Nutrient and Chemical Status (p.56)

- ○ - Atmospheric deposition - exceedance of critical loads
- ● 55 Chemical status of water bodies
- ● 56 Nutrient status of water bodies
- ○ - pH
- ● 57 Nutrient status of soil
- ○ - Dissolved oxygen

Soil/Sediment Processes (p.59)

- ○ - Sediment supply/availability (inc. type, grain size)
- ● 58 Peat depth
- ● 59 Soil/sediment carbon/organic matter content
- ● 60 Soil/sediment biota

Species Composition (p.62)

- ○ - Invasive non-native species
- ○ - Net productivity by species
- ● 61 Naturalness of biological assemblage - no. of trophic levels and community composition in each level
- ○ - Plant species diversity

Vegetation (p. 65)

- ○ - Extent and condition of linear vegetation features and pockets of semi natural vegetation
- ○ - Plant growth rate
- ● 62 Presence and frequency of pollinator (larval and adult) food plants
- ○ - Proportion of peat mass actively forming peat
- ○ - Surface/vegetation roughness
- ● 63 Extent of permanent vegetation cover
- ○ - Vegetation next to water bodies
- ○ - Vegetation structure/structural diversity

Indicator Key

- ● Included in this atlas
- ○ Not included in this atlas
- 12 Map ID

Cultural (p.68)

- ○ - Visibility of wildlife
- ○ - Presence of flagship species
- ○ - Presence of rare (red list) species
- ○ - Species diversity
- ● 64 Naturalness of watercourses
- ● 65 Favourable condition of SSSIs/geosites/MPAs
- ○ - Size of environmental space
- ○ - Boundary features: type, length and condition
- ● 66 Designated historic environment assets
- ● 67 Tranquility
- ○ - Perimeter access points
- ● 68 Public Rights of Way
- ○ - Presence of paths accessible to all
- ○ - No. of organised events
- ○ - Presence of clubs, schools, training centres
- ○ - Active geomorphological processes

Indicator Gaps and Limitations

The Natural England Natural Capital Indicators report identified ideal indicators for measuring change in natural capital, as well as data to measure these indicators and gaps where data is not available. From the list on this page, it is evident that a number of indicators could not be included in this atlas because data was not available to measure them. Each indicator was investigated in turn and the datasets identified for mapping each indicator were tested. Many of the indicators were not mappable because the datasets were not appropriate, not readily accessible, or not available with national coverage. Some datasets existed for sub-national extents, but it was decided to use nationally-available data only, for consistency and clarity (rather than merging datasets of differing resolution or accuracy). If local data is available in some places, this data may be able to be used to map some of the missing indicators and fill in the gaps. While every effort was made to use datasets that honoured the principles outlined in the Natural England report (e.g. transparent, knowable, scalable), some indicators ultimately used less favourable datasets when no alternative was available.

Indicator Summary - Others

Location and ecosystem service indicators are listed with references to the page where the mapped outputs appear in this report.

Asset Location (p.72)

- ○ - Distribution of habitats in relation to water quality – source-pathway-receptor
- ○ - Distribution of habitats and trees in relation to air quality, noise and temperature regulation
- ○ - Distribution of habitats and boundary features in relation to soil erosion and landslip risk
- ○ - Size and distribution of habitats in relation to flood protection of settlements and infrastructure
- ● 69 Patch size, shape and edge
- ○ - Proximity of boundary features and semi-natural habitats to insect pollinator crops
- ○ - Transition and connectivity of aquatic, terrestrial and marine habitats
- ○ - Area for dynamic movement and development of coastal habitats
- ○ - Proximity and accessibility of habitats to people

Ecosystem Service Flows (p.76)

- ● 70 Number and type of reared animals (table)
- ● 71 Production of crops (table)
- ○ - Production of fodder
- ○ - Production of timber, paper and other wood products
- ○ - Wood-based fuel harvested
- ● 72 Amount of water available for abstraction
- ○ - Amount of fish and other marine products
- ○ - Abundance of pollinators
- ● 73 Carbon sequestered and greenhouse gases fixed
- ○ - Local urban cooling
- ○ - Maintenance of wildlife, habitats and species
- ○ - Regulation of flooding
- ○ - Stabilisation of soil/sediment
- ○ - Noise abatement
- ○ - Air quality
- ● 74 Water quality (chemical & biological, including viral & bacterial)

Cultural

- ○ - Number of visits
- ○ - Duration of visits
- ○ - Range of activities undertaken
- ○ - Number of school visits
- ○ - Number of research projects

Indicator Key	
	● Included in this atlas
	○ Not included in this atlas
	12 Map ID

Photo: Niklas Hamann via Unsplash

Photo: hehaden via Flickr (CC BY-NC 2.0)

ASSET QUANTITY

This section breaks down England's natural environment into broad habitat types used by the UK National Ecosystem Assessment. These broad habitat types sit within landscapes and are underpinned and influenced by geodiversity. This classification system breaks down ecosystems into component parts, but in reality all aspects of a place should to be considered together to fully understand the state of natural capital.

The broad habitat types included in this atlas are:

- Freshwater
- Farmland
- Grassland
- Mountains, moors and heaths
- Woodland
- Urban
- Coastal
- Marine

ASSET QUANTITY: FRESHWATER

Freshwater habitats encompass all waterbodies and wetlands, such as rivers, lakes, ponds, fens, marshes and bogs. The importance of artificial freshwater habitats, such as canals and reservoirs, for some ecosystem services is also acknowledged. Despite occupying only 0.7% of land in England (CEH LCM2015), freshwater habitats are vital for many plant and animal species.

Freshwater habitats can regulate flooding, erosion, sedimentation, local climates and water quality, while facilitating the dilution and disposal of pollutants. Additionally, rivers provide cultural value for recreation, tourism, and education (UK NEA, 2011). This assessment primarily focuses on freshwater habitats themselves (i.e. water bodies and wetlands). However, indicators of importance for water quality, water supply and flood protection are considered in this chapter for whole freshwater catchments. This means that some indicators appear in more than one broad habitat type.


Photo: Roger Bunting (CC BY-NC-ND 2.0)

Ecosystem Services

The following are key ecosystem services that can be assessed using the freshwater quantity indicators which are mapped in this atlas (shown on the following page).

Water Supply

Plentiful water e.g. water for drinking, domestic use, irrigation, livestock, industrial use including cooling, wildlife.

Flood Protection

Reduced flood risk, affecting e.g. reduced health & safety risk, protection of housing, businesses & infrastructure, lack of transport disruption.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Asset Quantity Indicators - Freshwater

This page illustrates how the indicators for freshwater habitat quantity, or extent, are connected to ecosystem services, benefits and value, as shown in the logic chain below.

The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which were possible to map.

	Indicator ↓	Water supply *	Water quality *	Flood protection *	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
Extent	Active flood plain			●			
	Coastal and floodplain grazing marsh			●	●		●
	Lakes and standing waters	●			●		●
	Lowland fens				●	●	●
	Lowland raised bog				●	●	●
	Modified waters (reservoirs)	●					●
	Reedbeds				●	●	●
	Ponds				●		●
	Rivers	●			●		●
	Blanket bog **	●	●	●			
	Woodland **	●	●	●			
	Other semi-natural habitats **	●	●	●			

Catchment services

Please note:

Land across the wider catchment can play a vital role in providing catchment services: water supply, regulating water quality and flood protection.

Blanket bog and woodland are particularly important, however all other semi-natural habitats also play a role in contributing to these services.

The other ecosystem services provided by woodland and blanket bog are listed in the relevant broad habitat sections.

* Ecosystem service that relates to the entire hydrological catchment

** Indicator that relates to the entire hydrological catchment

ASSET QUANTITY

Indicators showing freshwater habitat quantity in Cumbria

Map Key

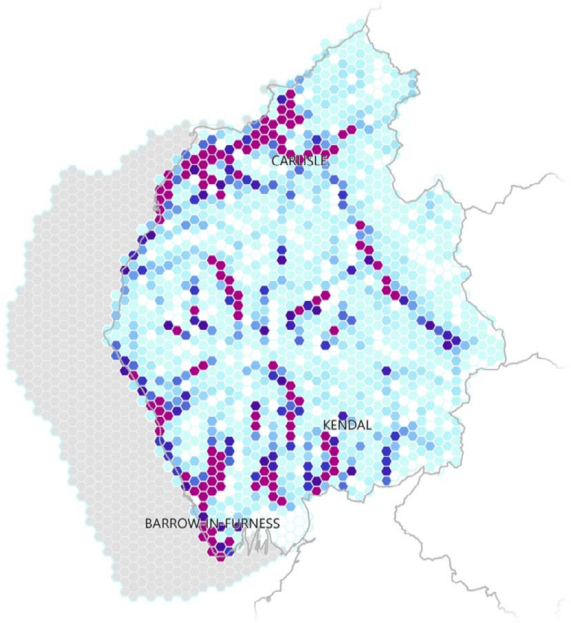
Indicator value:
(symbolised based on the range of values across England)

- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

F Active Flood Plain (ID: 1)

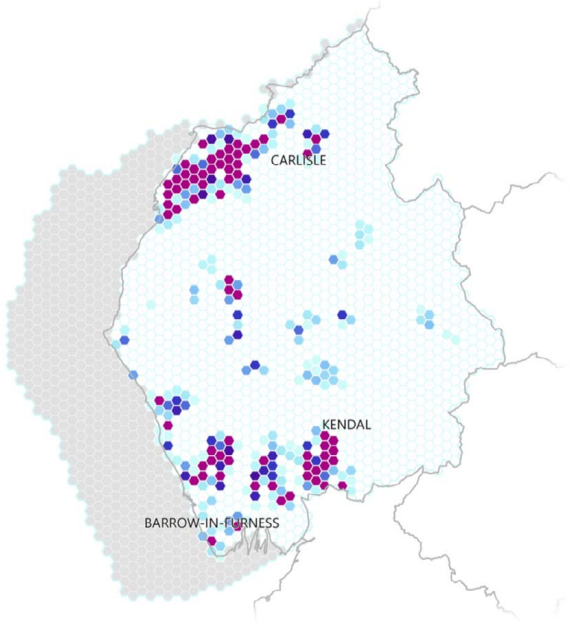
The Environment Agency (EA)'s Risk of Flooding from Rivers and Sea dataset can be used to highlight the distribution of river flood plains. This map shows areas at high or medium risk.
Note that coastal flood areas are also included.



Hexagon values: 0 – 1.33 km²; Outliers: 1.33 – 5 km²

F H C Coastal and Floodplain Grazing Marsh (ID: 2)

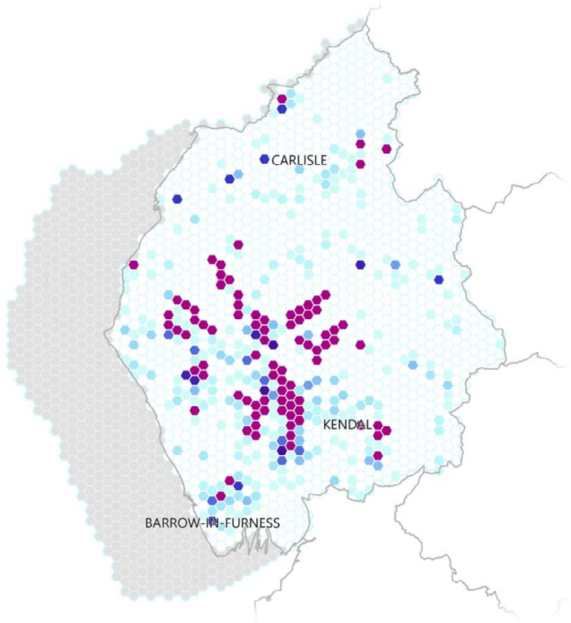
Area of coastal floodplain and grazing marsh mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 1.05 km²; Outliers: 1.05 – 4.75 km²

S H C Lakes and Standing Waters (ID: 3)

Area of lakes and reservoirs mapped using the Centre for Ecology and Hydrology (CEH)'s UK Lakes Portal dataset.



Hexagon values: 0 – 0.11 km²; Outliers: 0.11 – 4.51 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY

Indicators showing freshwater habitat quantity in Cumbria

Map Key

Indicator value:

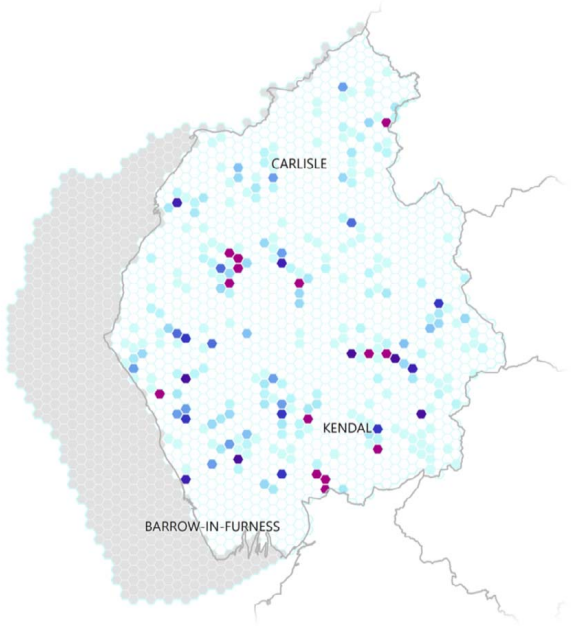
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Lowland Fens (ID: 4)

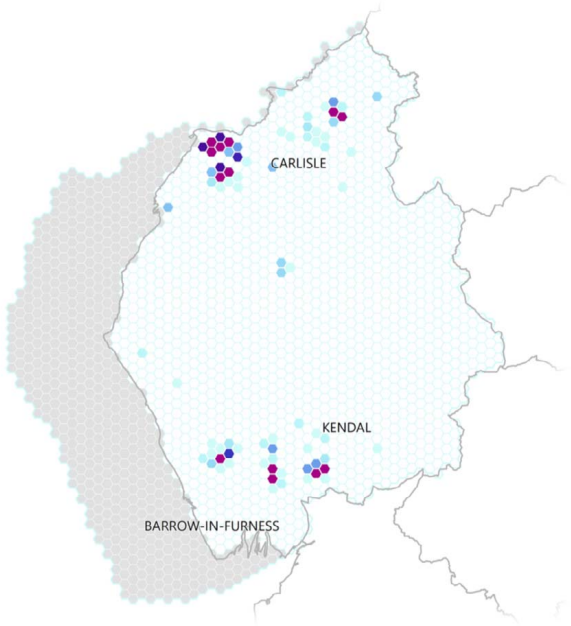
Area of lowland fens mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 1.44 km²; Outliers: 1.44 – 3.44 km²

Lowland Raised Bog (ID: 5)

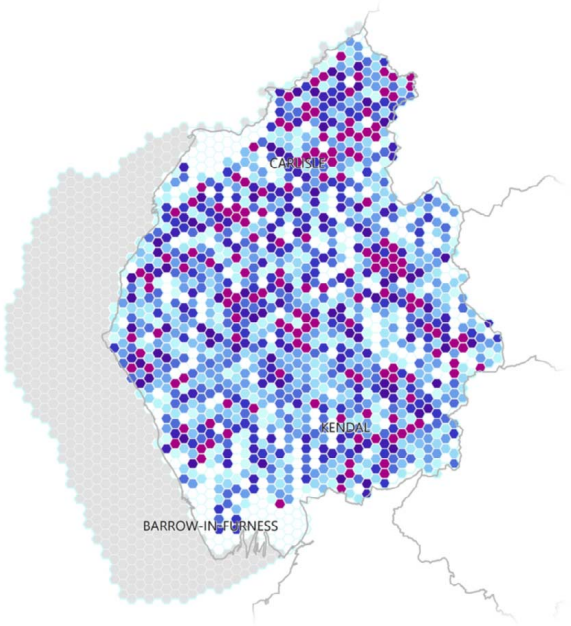
Area of lowland raised bog mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 1.11 km²; Outliers: 1.11 – 4.23 km²

Rivers (ID: 6)

Length of rivers mapped using EA's Water Framework Directive (WFD) river waterbodies dataset (cycle 1, to include coastal streams).



Hexagon values: 0 – 4.81 km; Outliers: 4.81 – 14.44 km

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY

Indicators showing freshwater habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

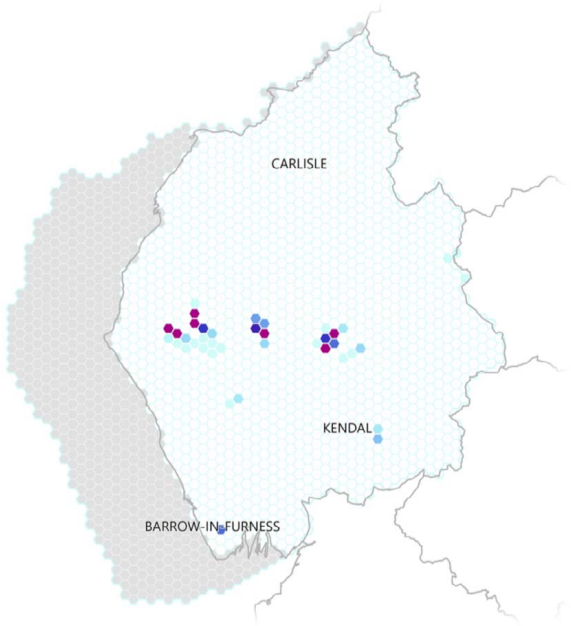
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Modified Waters (Reservoirs) (ID: 7)

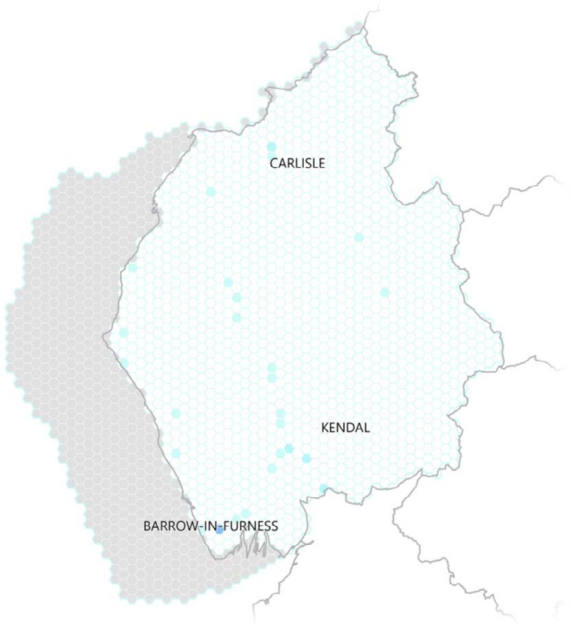
Area of reservoirs mapped by intersecting CEH's inventory of UK reservoirs (points) with surface water polygons (OS VectorMap District).



Hexagon values: 0 – 0.88 km²; Outliers: 0.88 – 3.68 km²

Reedbeds (ID: 8)

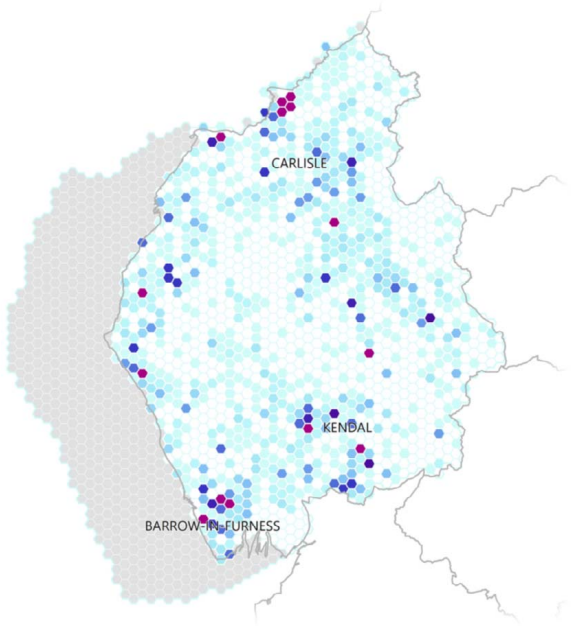
Area of reedbed habitat mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 0.1 km²; Outliers: 0.1 – 1.52 km²

Ponds (ID: 9)

Area of ponds mapped by selecting surface waterbodies (from OS VectorMap District) that do not intersect rivers, are smaller than 2ha in size and are non-linear.



Hexagon values: 0 – 0.02 km²; Outliers: 0.02 – 0.33 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY

Indicators showing freshwater habitat quantity in Cumbria

River Catchments

The indicators shown on this page refer to the whole hydrological catchment, not just freshwater habitats themselves. Land across the wider catchment can play a vital role in providing water supply and regulating water quality and flows. The other ecosystem services provided by these habitats are listed in the relevant broad habitat sections.

Map Key

Indicator value:

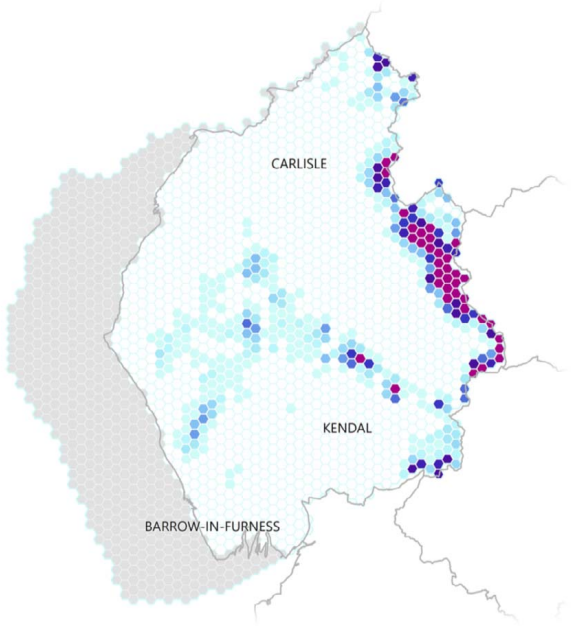
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Blanket Bog (ID: 10)

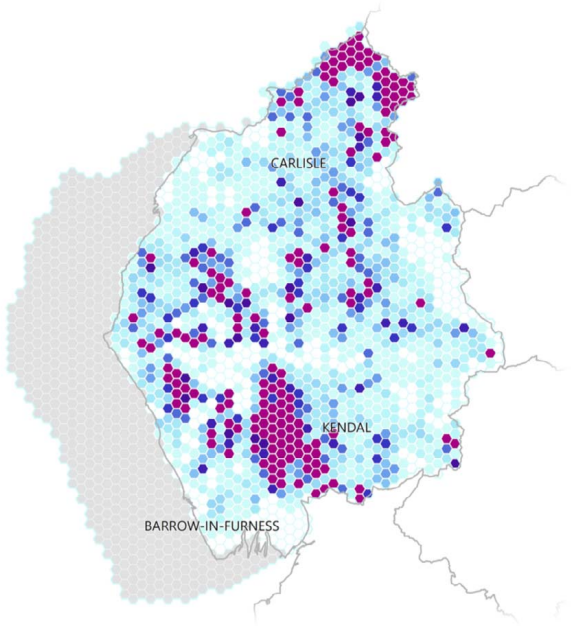
Area of blanket bog mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 4.01 km²; Outliers: 4.01 – 5 km²

Woodland (ID: 11)

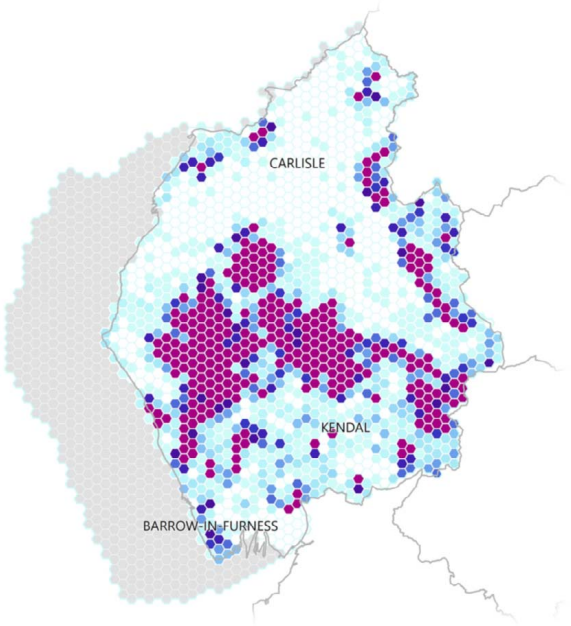
Area of woodland mapped using Forestry Commission (FC)'s National Forest Inventory.



Hexagon values: 0 – 1.21 km²; Outliers: 1.21 – 4.98 km²

Other Semi-Natural Habitats (ID: 12)

Area of other semi-natural habitat mapped using Natural England's Priority Habitat Inventory (including upland and lowland grasslands, heathland and saltmarsh).



Hexagon values: 0 – 1.86 km²; Outliers: 1.86 – 5 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY: FARMLAND

About 70% of land in the UK is used for agriculture (Defra, 2017), producing a variety of goods for consumers across the UK and around the world. This section considers enclosed farmland, for example grazing pastures, arable fields and orchards. It varies greatly in character across the country due to a variety of factors.

In addition to primary agricultural products, farmland provides many other services to society. If managed effectively, farmland can help to prevent soil erosion by stabilising soils, support flood risk alleviation through surface water storage and runoff attenuation, and sequester carbon, assisting in global climate regulation (UK NEA, 2011). Furthermore, rare farmland birds rely on sympathetically managed farmland for food and nesting sites, and farmlands hold significant cultural and heritage value. They are often considered a key component of England's traditional countryside landscape, as well as a place for recreation via rural Public Rights of Way.

Ecosystem Services

The following are key ecosystem services that can be assessed using the farmland quantity indicators which are mapped in this atlas (shown on the following page).
Note that the role of farmland habitats in providing water supply, water quality and flood protection services is included in the freshwater catchments section.

Cultivated Crops

Food from crops e.g. cereals, vegetables, fruit.

Livestock

Products from animals e.g. meat, dairy products, honey.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Asset Quantity Indicators - Farmland

This page illustrates how the indicators for farmland habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

	Indicator	Cultivated crops	Livestock	Cultural services
Extent	Arable and rotational leys	●		●
	Horticulture	●		
	Improved grassland		●	●
	Orchards and top fruit	●		●

ASSET QUANTITY

Indicators showing farmland habitat quantity in Cumbria

Map Key

Indicator value:

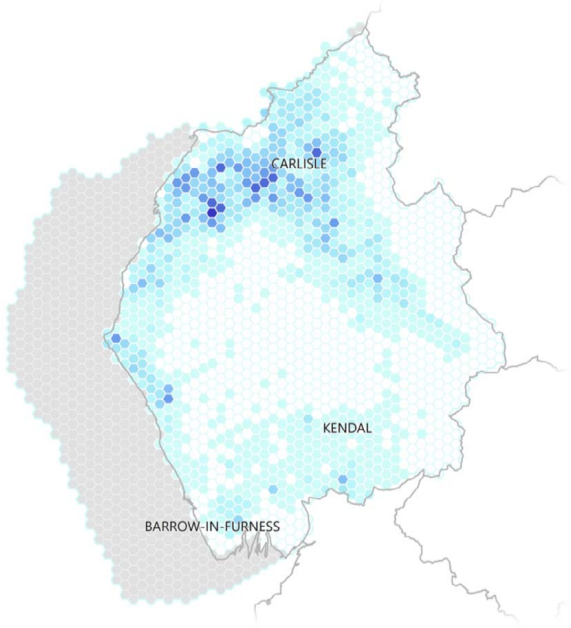
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Arable and Horticulture (ID: 13)

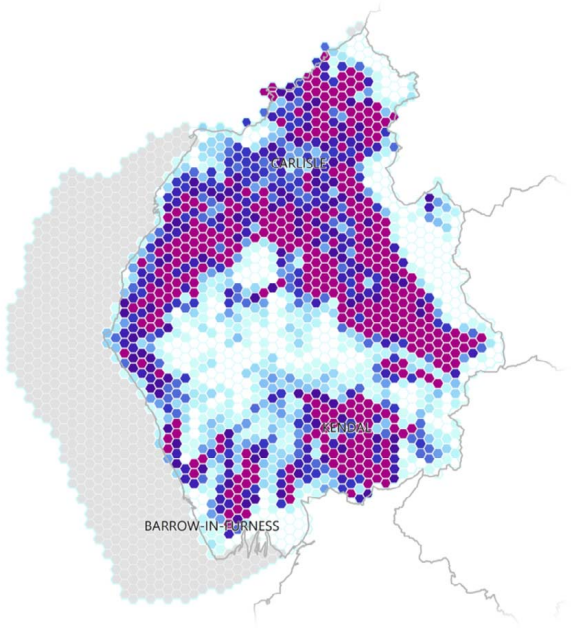
The indicators 'Arable and Rotational Leys' and 'Horticulture' have been combined to be shown together on this map. The area of farmland used for arable and horticulture has been mapped using CEH's Land Cover Map 2015 (LCM2015).



Hexagon values: 0 – 4.14 km²; Outliers: 4.14 – 5 km²

Improved Grassland (ID: 14)

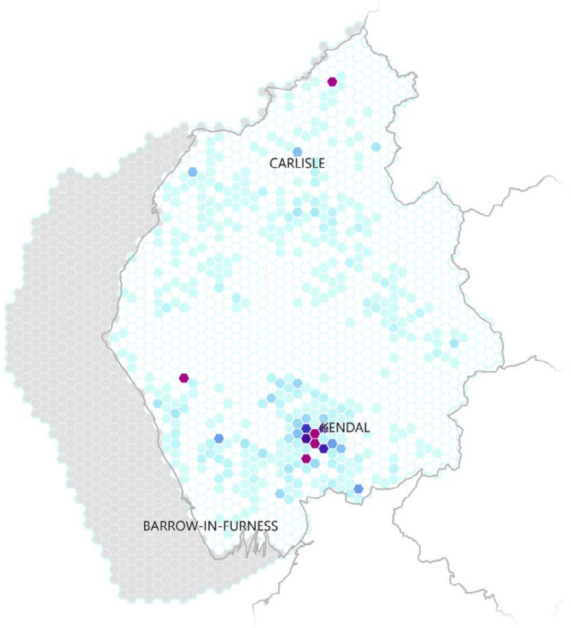
Area of improved grassland mapped using CEH's LCM2015.



Hexagon values: 0 – 3.51 km²; Outliers: 3.51 – 5 km²

Orchards and Top Fruit (ID: 15)

Area of orchards and top fruit mapped using Natural England's Priority Habitat Inventory ('traditional orchards').



Hexagon values: 0 – 0.04 km²; Outliers: 0.04 – 0.82 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY: GRASSLAND

Grassland habitats comprise almost 40% of England's land cover (CEH LCM2015), taking a variety of forms ranging from rough moorland grazing to urban parks and gardens. This chapter focuses on semi-natural grasslands, which are scarcer than other grassland types, accounting for only 5% of England's land cover. Encompassing acid, neutral and calcareous grasslands along with purple moor grass and rush pastures, semi-natural grasslands represent an important habitat for many plants and animals.

Semi-natural grassland provides a range of ecosystem services, such as supporting thriving plants and wildlife, sequestering carbon and mitigating climate change and livestock production. They also provide open space for recreation and exercise, yielding physical and mental health benefits for visitors and residents, as well as potential economic gain.

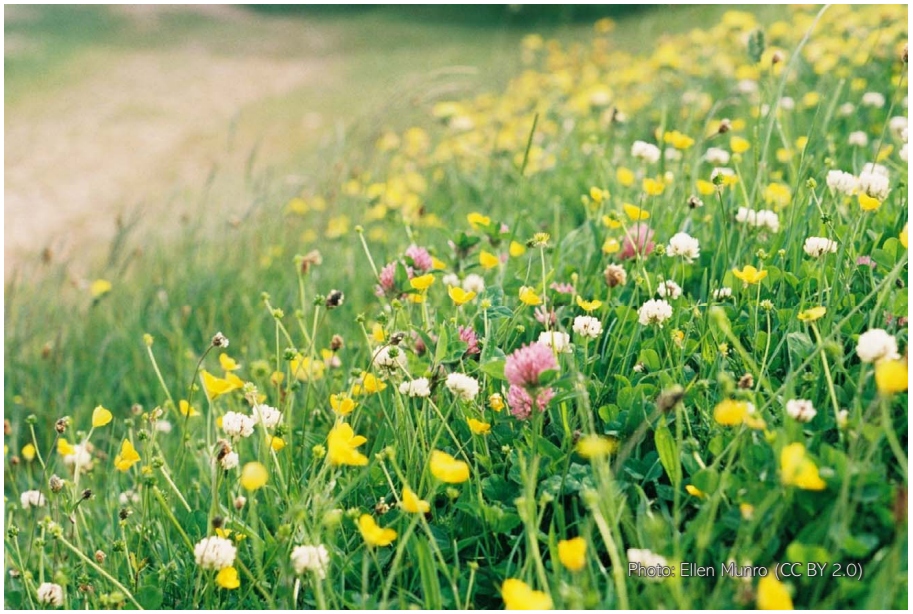


Photo: Ellen Munro (CC BY 2.0)

Ecosystem Services

The following are key ecosystem services that can be assessed using grassland quantity indicators which are mapped in this atlas (shown on the following page).
Note that the role of grassland, in providing water supply, water quality and flood protection services, is included in the freshwater catchments section.

Timber, hay and other materials

Materials e.g. hay, grass for fodder, timber, paper and other products from wood.

Pollination

Pollination underpinning cultivated crops dependent on insect pollination e.g. field beans, apples, plums, pears, cucumbers, strawberries, oil seed rape.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Livestock

Products from animals e.g. meat, dairy products, honey.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Asset Quantity Indicators - Grassland

This page illustrates how the indicators for semi-natural grassland habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

Extent	Indicator	Timber, hay and other materials	Livestock	Pollination	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
	Meadows	•	•	•	•	•	•
	Other semi-natural grasslands		•	•	•	•	•

Catchment Services

Please note:

These semi-natural habitats also contribute to providing catchment services: water supply, water quality and flood protection.

Please refer to the Freshwater section.

ASSET QUANTITY

Indicators showing grassland habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

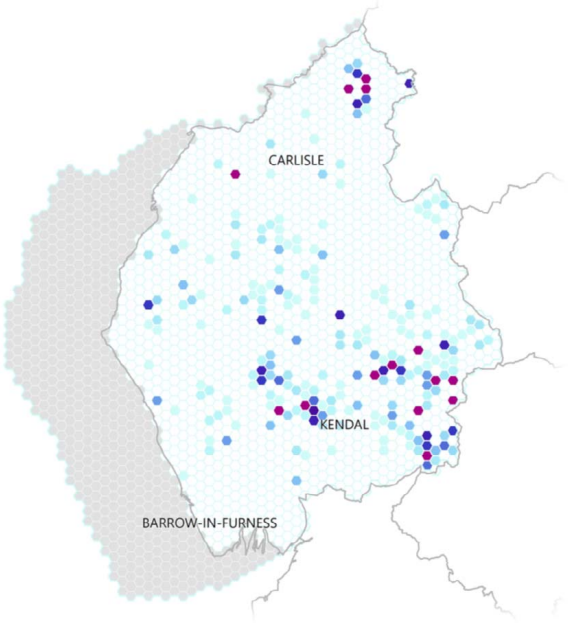
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Meadows (ID: 16)

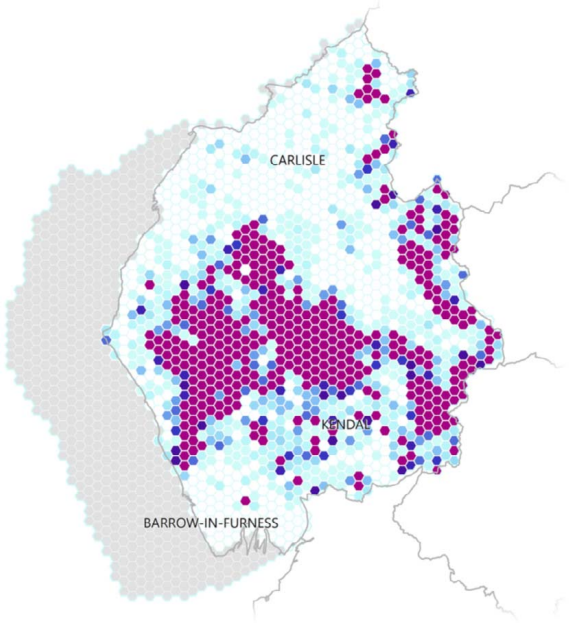
Area of upland meadow and lowland meadow mapped using Natural England's Priority Habitat Inventory ('upland meadows' and 'lowland meadows'). This includes traditional hay meadows and other species rich grassland.



Hexagon values: 0 – 0.16 km²; Outliers: 0.16 – 3.96 km²

Other Semi-Natural Grassland (ID: 17)

Area of other semi-natural grassland, mapped using Natural England's Priority Habitat Inventory ('upland calcareous', 'lowland calcareous', 'lowland dry acid', 'good quality semi-improved', 'grass moorland' and 'purple moor grass and rush pasture').



Hexagon values: 0 – 0.59 km²; Outliers: 0.59 – 4.98 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY: MOUNTAINS, MOORS & HEATHS

Mountains, moors and heaths cover 18% of the UK's land area (CEH LCM2015), ranging from highly fragmented lowland heaths to upland moors and heathland, representing some of the largest contiguous semi-natural habitats in the UK. Mountains, moors and heaths are the source of around 70% of the UK's drinking water, hold an estimated 40% of UK soil carbon (UK NEA, 2011) and host numerous rare plants and animals.

Mountains, moors and heaths provide a wide range of ecosystem services, including food provision (from livestock, crops and game), fibre provision (sheep wool) and the regulation of water quality and river flows, as well as a host of cultural, historical and recreational services.

Photo: Sean Paul Kinnear via Unsplash

Ecosystem Services

The following are key ecosystem services that can be assessed using the mountains, moors and heaths quantity indicators which are mapped in this atlas (shown on the following page).

Water Supply

Plentiful water e.g. water for drinking, domestic use, irrigation, livestock, industrial use including cooling, wildlife.

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Flood Protection

Reduced flood risk, affecting e.g. reduced health & safety risk, protection of housing, businesses & infrastructure, lack of transport disruption.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Livestock

Products from animals e.g. meat, dairy products, honey.

Erosion control

Erosion control e.g. soil/land retention, lack of transport disruption, protection of housing, businesses & infrastructure, reduced health & safety risk, reduced flood risk.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Asset Quantity Indicators - Mountains, Moors and Heaths

This page illustrates how the indicators for mountains, moors and heaths habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below.

The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which were possible to map.

Extent	Water supply *	Livestock	Water quality *	Erosion control	Flood protection *	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
Blanket bog	●		●	●	●	●	●	●
Dwarf shrub heath		●		●	●	●	●	●
Inland rock, scree and pavement AML						●		●
Lakes and reservoirs AML	●					●		●
Mountain heath and willow scrub						●	●	●
Rivers AML	●					●		●
Semi-natural grassland AML		●		●		●	●	●
Upland flushes, fens and swamps						●	●	●
Wood pasture AML								●
Woodland AML			●	●	●	●	●	●

Catchment Services

Please note:

In upland headwater areas some habitats are particularly important for providing catchment services: water supply, regulating water quality and flood protection. These are highlighted in the table. Other semi-natural habitats also contribute to providing catchment services.

Please refer to the Freshwater section.

* Ecosystem service that was also considered under the 'freshwater hydrological catchment' chapter AML = Above moorland line

ASSET QUANTITY

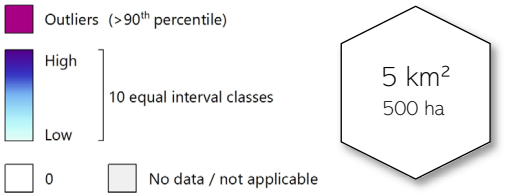
Indicators showing mountains, moors and heaths habitat quantity in Cumbria

Duplication

Some of the moorland indicators duplicate habitats that are included in the freshwater indicators, e.g. blanket bog, lakes and rivers. If used for accounting purposes, the moorland components of the freshwater indicators would need to be excluded.

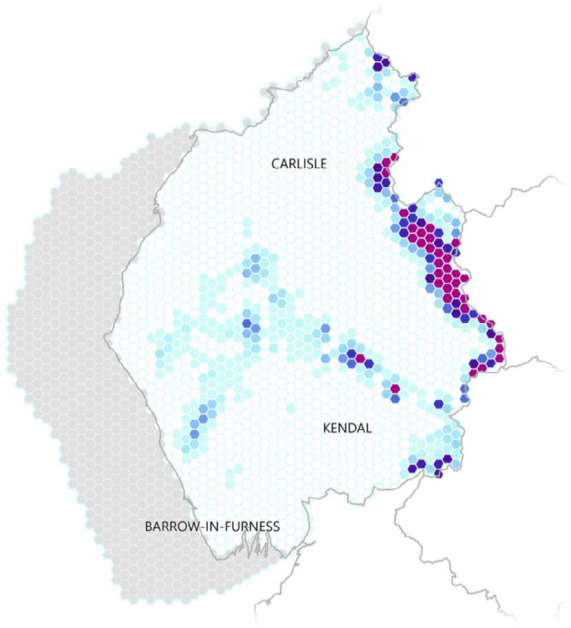
Map Key

Indicator value:



Blanket Bog (ID: 18)

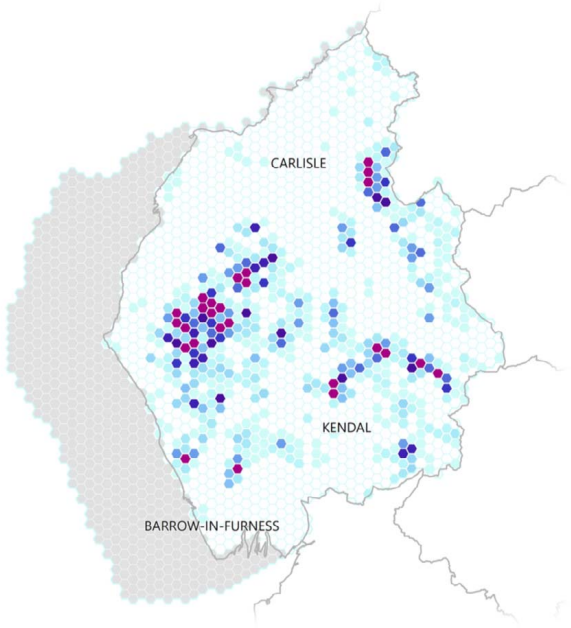
Area of blanket bog mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 4.01 km²; Outliers: 4.01 – 5 km²

Dwarf Shrub Heath (ID: 19)

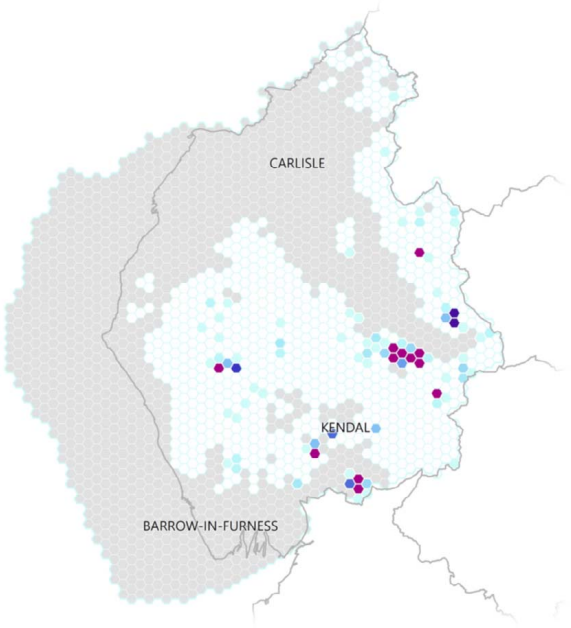
Area of dwarf shrub heath mapped using Natural England's Priority Habitat Inventory ('fragmented heath', 'lowland heathland' and 'upland heathland').



Hexagon values: 0 – 2.23 km²; Outliers: 2.23 – 4.98 km²

Inland Rock, Scree and Pavement (Above Moorland Line) (ID: 20)

Area of inland rock and limestone pavement above the moorland line, mapped using CEH's LCM2015 ('inland rock'), Natural England's Priority Habitats Inventory ('limestone pavement') and Rural Payments Agency (RPA)'s Moorland Line dataset.



N.b. on this map, grey = below moorland line, white = 0 km²

Hexagon values: 0 – 0.45 km²; Outliers: 0.45 – 3.43 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

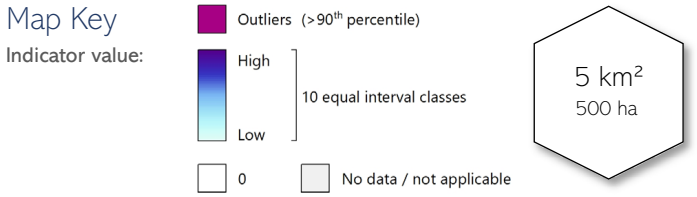
- Cultural services

Geodiversity:

- Geodiversity services

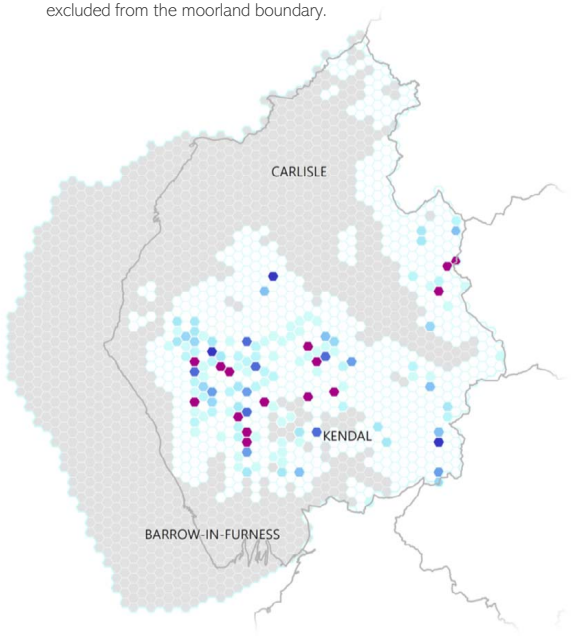
ASSET QUANTITY

Indicators showing mountains, moors and heaths habitat quantity in Cumbria



Lakes and Reservoirs (Above Moorland Line) (ID: 21)

The indicators 'Lakes (AML)' and 'Reservoirs (AML)' have been combined to be shown together on this map. The area of lakes and reservoirs above the moorland line has been mapped using CEH's UK Lakes dataset, CEH's Inventory of UK reservoirs dataset and RPA's Moorland Line dataset. Note: many large water bodies are excluded from the moorland boundary.

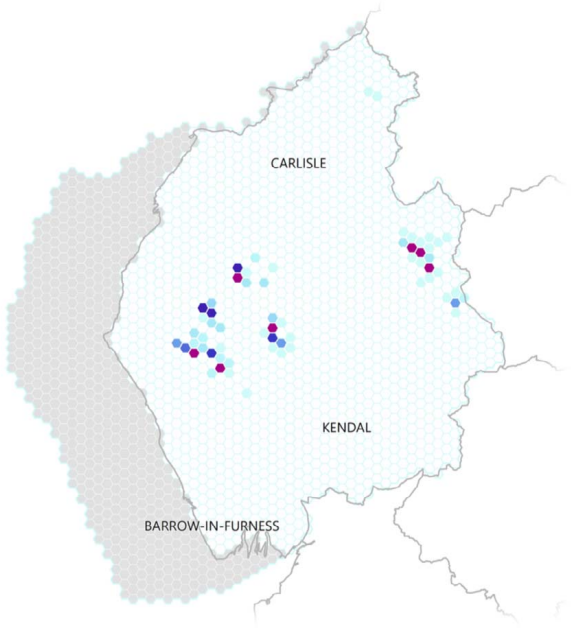


N.b. on this map, grey = below moorland line, white = 0 km²

Hexagon values: 0 – 0.03 km²; Outliers: 0.03 – 0.25 km²

Mountain Heath and Willow Scrub (ID: 22)

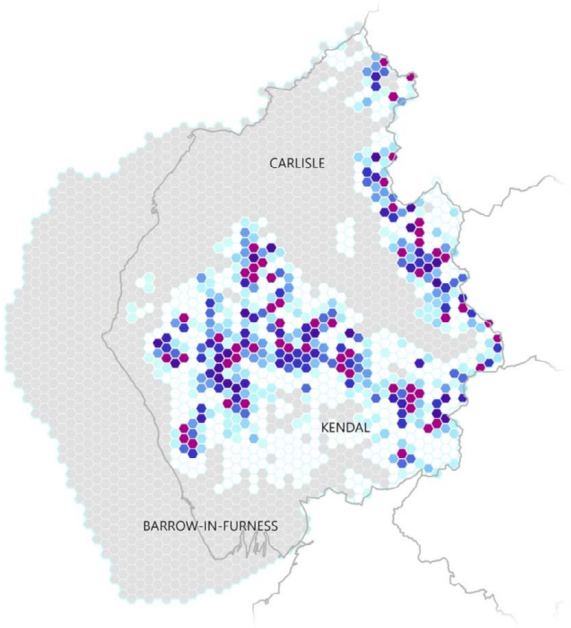
Area of mountain heath and willow scrub mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 0.68 km²; Outliers: 0.68 – 1.27 km²

Rivers (Above Moorland Line) (ID: 23)

Length of rivers mapped using EA's WFD river waterbodies dataset and RPA's Moorland Line dataset.



N.b. on this map, grey = below moorland line, white = 0 km²

Hexagon values: 0 – 2.9 km; Outliers: 2.9 – 6.26 km

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

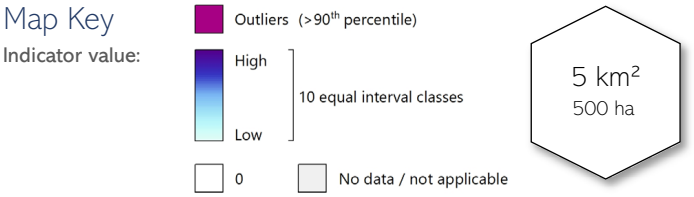
- C Cultural services

Geodiversity:

- G Geodiversity services

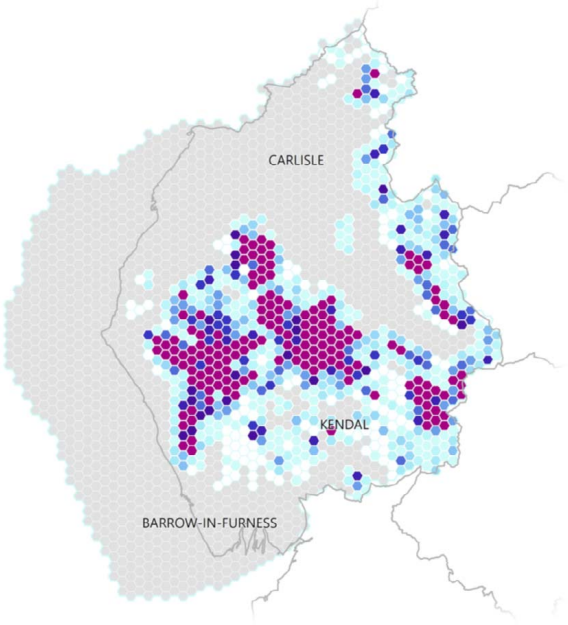
ASSET QUANTITY

Indicators showing mountains, moors and heaths habitat quantity in Cumbria



Semi-Natural Grassland (Above Moorland Line) (ID: 24)

Area of semi-natural grassland above the moorland line, mapped using Natural England's Priority Habitat Inventory (including calcareous grassland, good quality semi-improved grassland, grass moorland, meadows etc.) and RPA's moorland line dataset.

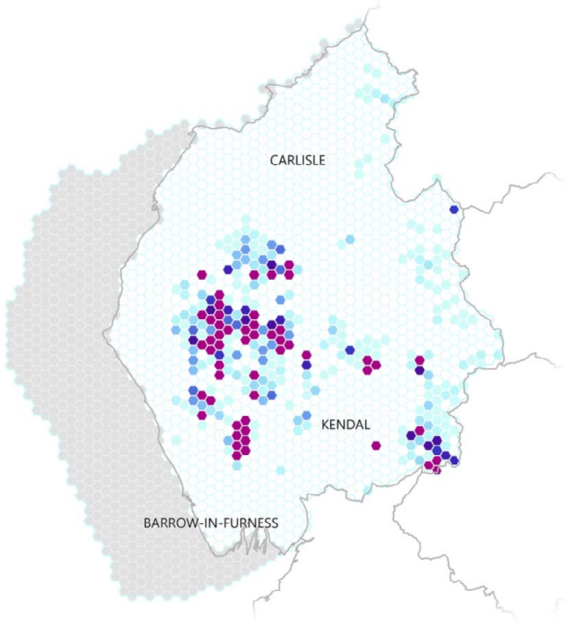


N.b. on this map, grey = below moorland line, white = 0 km²

Hexagon values: 0 – 1.94 km²; Outliers: 1.94 – 4.97 km²

Upland Flushes, Fens & Swamps (ID: 25)

Area of upland flushes, fens and swamps, mapped using Natural England's Priority Habitat Inventory.



Hexagon values: 0 – 0.25 km²; Outliers: 0.25 – 3.38 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY

Indicators showing mountains, moors and heaths habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

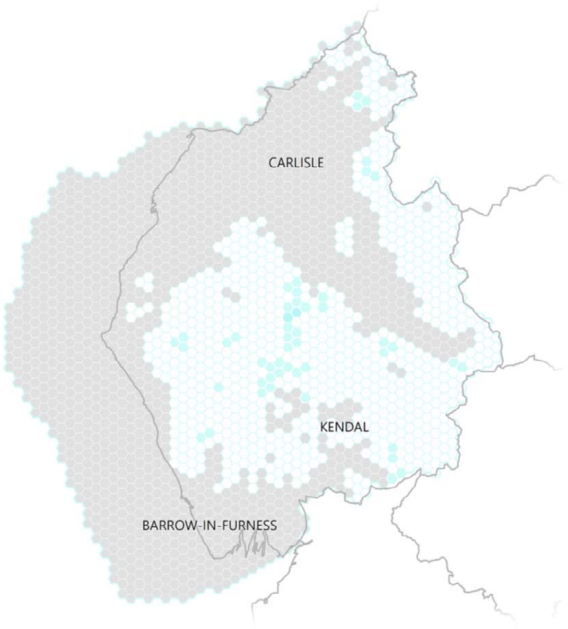
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

C Wood Pasture (Above Moorland Line) (ID: 26)

Area of wood pasture above the moorland line, mapped using Natural England's provisional Wood-Pasture and Parkland BAP Priority Habitat Inventory and RPA's Moorland line dataset.

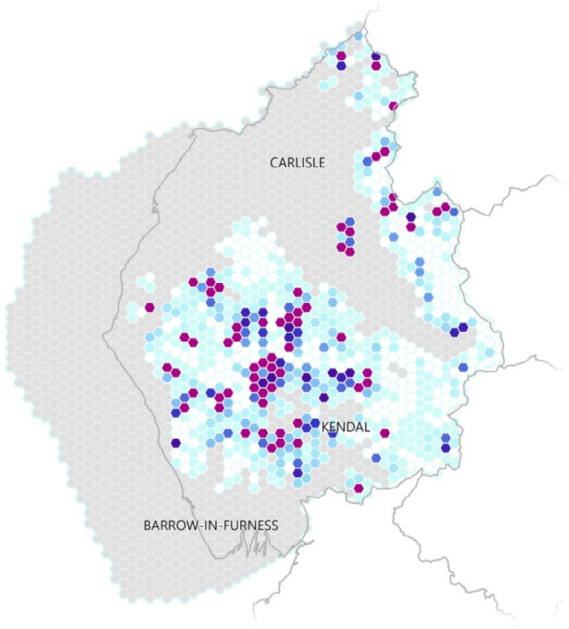


N.b. on this map, grey = below moorland line, white = 0 km²

Hexagon values: 0 – 0.16 km²; Outliers: 0.16 – 0.91 km²

W M F H C C Woodland (Above Moorland Line) (ID: 27)

Area of woodland above the moorland line, mapped using FC's National Forest Inventory and RPA's moorland line dataset.



N.b. on this map, grey = below moorland line, white = 0 km²

Hexagon values: 0 – 0.15 km²; Outliers: 0.15 – 1.44 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY: WOODLAND

Woodland occupies 1.3 million hectares (12.5%) of England's land cover, of which 74% is broadleaved and 26% is coniferous (Forestry Research, 2018). Much of this woodland has been subject to extensive management and modification, but nonetheless still represents very important habitat for a multitude of rare and threatened organisms. Ancient woodlands are especially important, supporting unique, complex and rich ecosystems.

As well as providing habitats for wildlife, woodlands both store and sequester large amounts of carbon, helping to negate the effects of global climate change. Urban woodland can improve air quality by filtering particulate pollutants and can also mitigate noise pollution when appropriately positioned. Woodlands play an important role in water management, helping to improve water quality and alleviate downstream flood risk. Woodland also has immense cultural and recreational value.

Photo: Roman Hobler (CC BY-SA 2.0)

Ecosystem Services

The following are key ecosystem services that can be assessed using the woodland quantity indicators which are mapped in this atlas (shown on the following page).
Note that the role of woodland, in providing water supply, water quality and flood protection services, is included in the freshwater catchments section.

Timber, hay and other materials

Materials e.g. hay, grass for fodder, timber, paper and other products from wood.

Air Quality

Clean air, also underpinning health benefits and sustainable ecosystems.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Plant-Based Energy

Energy from wood.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Asset Quantity Indicators - Woodland

This page illustrates how the indicators for woodland habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

	Timber, hay and other materials	Plant-based energy	Air quality	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
Extent: Broadleaved, mixed and yew woodland	●	●	●	●	●	●
Extent: Coniferous woodland	●	●	●		●	●
Extent: Individual trees/veteran trees				●		●
Extent: Woodland priority habitats				●		●

Catchment Services

Please note:

Woodland habitats also contribute to providing catchment services: water supply, water quality and flood protection.

Please refer to the Freshwater section.

ASSET QUANTITY

Indicators showing woodland habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

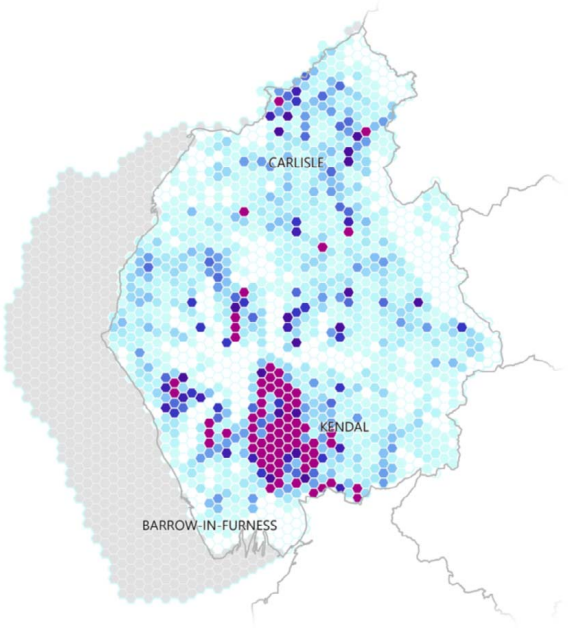
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Broadleaved, Mixed and Yew Woodland (ID: 28)

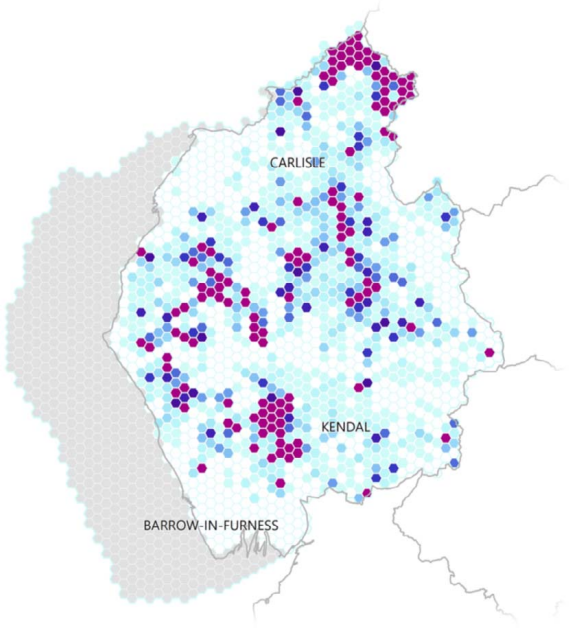
Area of broadleaved, mixed and yew woodland mapped using FC's National Forest Inventory.



Hexagon values: 0 – 0.81 km²; Outliers: 0.81 – 4.07 km²

Coniferous Woodland (ID: 29)

Area of coniferous woodland mapped using FC's National Forest Inventory.



Hexagon values: 0 – 0.46 km²; Outliers: 0.46 – 4.1 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY

Indicators showing woodland habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

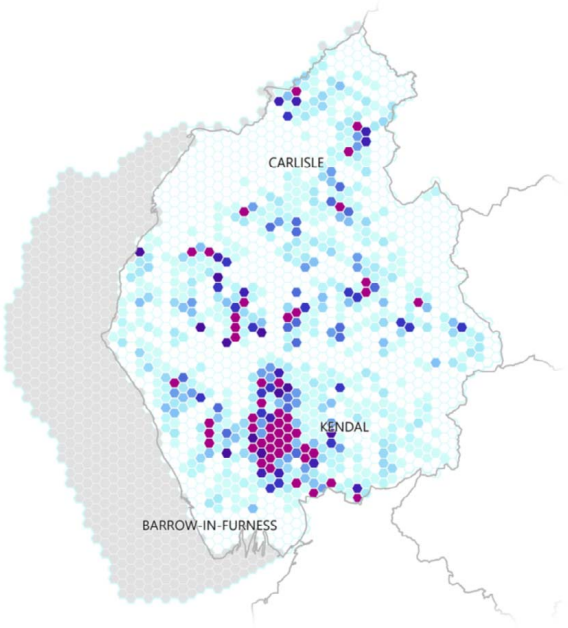
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

H C Ancient Woodland (Individual/veteran trees) (ID: 30)

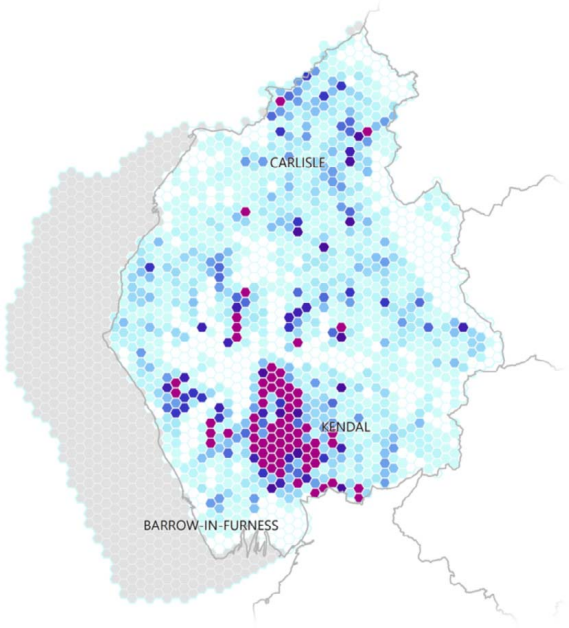
The natural capital indicator is individual/veteran trees, but it was unfeasible to map this at a national scale, so instead mapped here is ancient woodland using Natural England's Ancient Woodland dataset.



Hexagon values: 0 – 0.76 km²; Outliers: 0.76 – 4.8 km²

H C Priority Woodland Habitats (ID: 31)

Area of woodland priority habitat mapped using Natural England's Priority Habitat Inventory ('deciduous woodland').



Hexagon values: 0 – 0.71 km²; Outliers: 0.71 – 3.86 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY: URBAN

Urban areas in the UK cover just under 7% of land area, yet are home to 8 out of 10 people, often living at extremely high population densities. Pockets of green space assume disproportionate ecological and cultural significance within urban areas. However, urban populations are also dependent on other broad habitats in rural areas for provision of most of their ecosystem services (UK NEA, 2011).

Despite occupying a relatively small area within our towns and cities, the urban natural environment provides a wide range of ecosystem services. Gardens represent a highly heterogeneous urban sub-habitat, supporting a diverse array of plants and animals, and can be particularly important for pollination services. Amenity greenspaces (parks, outdoor sports facilities) are vital for community cohesion, and the mental and physical health of urban residents (UK NEA, 2011). Such cultural and recreational services are particularly important in urban areas, where human population density is higher than in all other habitats.

Ecosystem Services

The following are key ecosystem services that can be assessed using the urban quantity indicators which are mapped in this atlas (shown on the following page).
Note that the role of urban areas, in providing water supply, water quality and flood protection services, is included in the freshwater catchments section.

Air Quality

Clean air, also underpinning health benefits and sustainable ecosystems.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Noise Regulation

Health benefits e.g. reduced stress, hypertension, hearing impairment; benefits to sustainable ecosystems through reduction in disturbance; reduced impacts on educational & work performance.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Asset Quantity Indicators - Urban

This page illustrates how the indicators for urban habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

	Indicator	Air quality	Noise regulation	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
Extent	Blue space			●	●	●
	Green space – not semi-natural		●	●	●	●
	Open mosaic habitats			●		
	Woodland, scrub and hedge	●	●	●	●	●
	Semi-natural habitats	●	●	●	●	●

Catchment Services

Please note:

Urban semi-natural and woodland habitats also contribute to providing catchment services: water supply, water quality and flood protection.

Please refer to the Freshwater section.

ASSET QUANTITY

Indicators showing urban habitat quantity in Cumbria

Map Key

Indicator value:

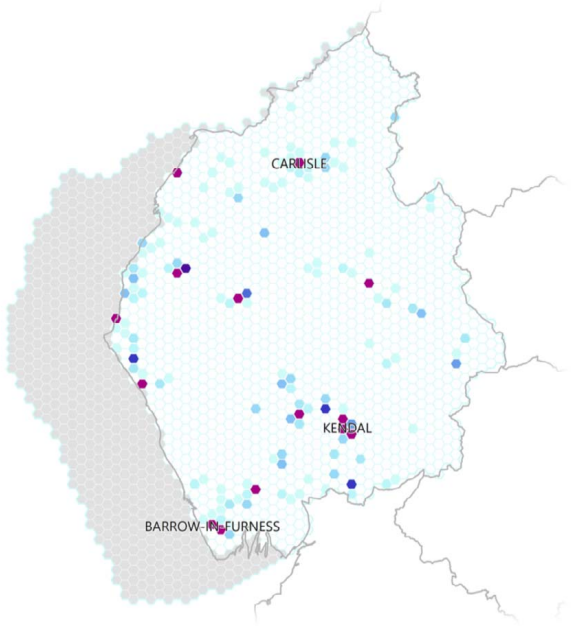
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Blue Space (ID: 32)

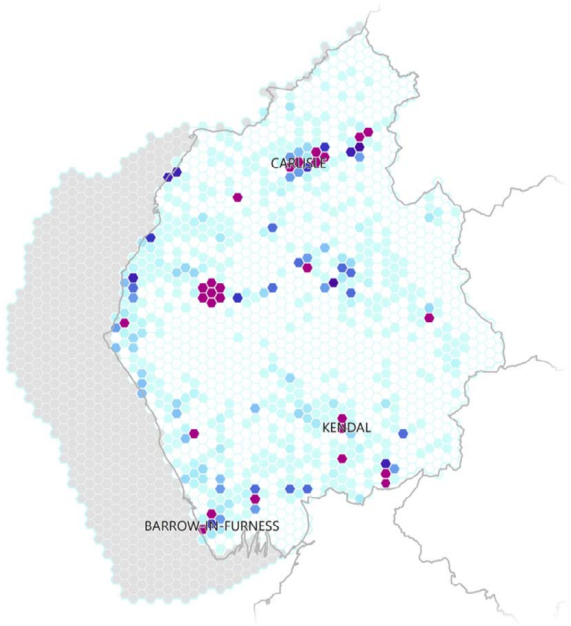
Area of urban blue space mapped by intersecting OS VectorMap District Surface Water with the Office for National Statistic (ONS)'s Built-Up areas dataset.



Hexagon values: 0 – 0.05 km²; Outliers: 0.05 – 1.54 km²

Green Space (ID: 33)

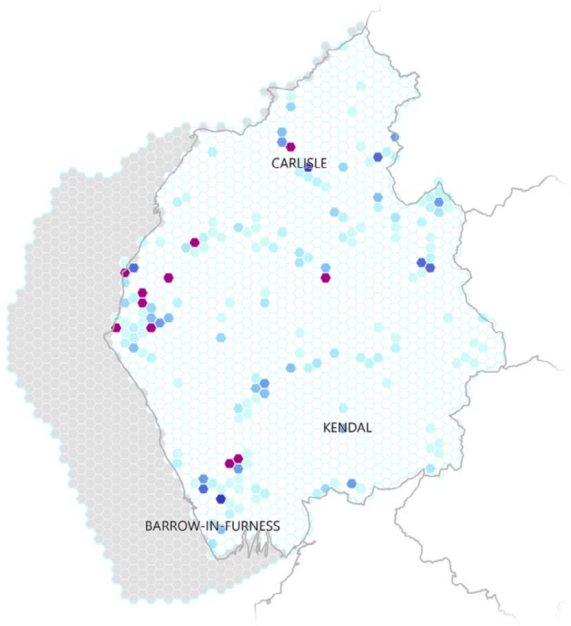
Area of urban green space (not semi-natural), mapped using the OS Open Greenspace Layer.



Hexagon values: 0 – 0.53 km²; Outliers: 0.53 – 4.9 km²

Open Mosaic Habitats (ID: 34)

Area of open mosaic habitats on previously developed land, mapped using Natural England's draft Open Mosaic Habitat dataset.



Hexagon values: 0 – 0.23 km²; Outliers: 0.23 – 3.81 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY

Indicators showing urban habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

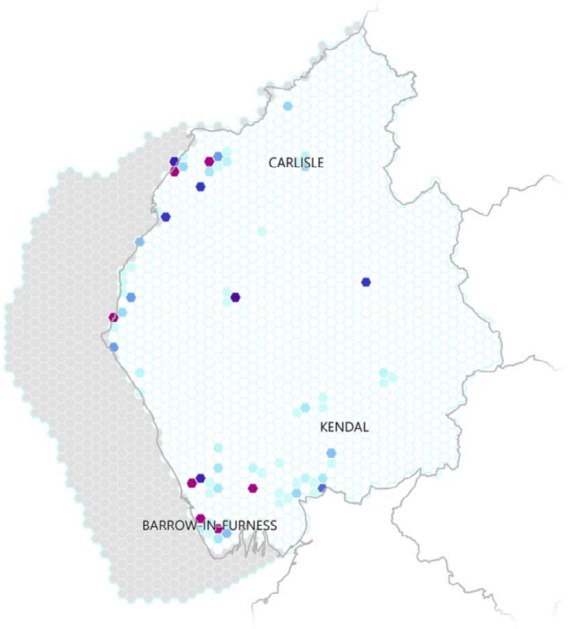
0

No data / not applicable

5 km²
500 ha

Semi-Natural Habitats (ID: 35)

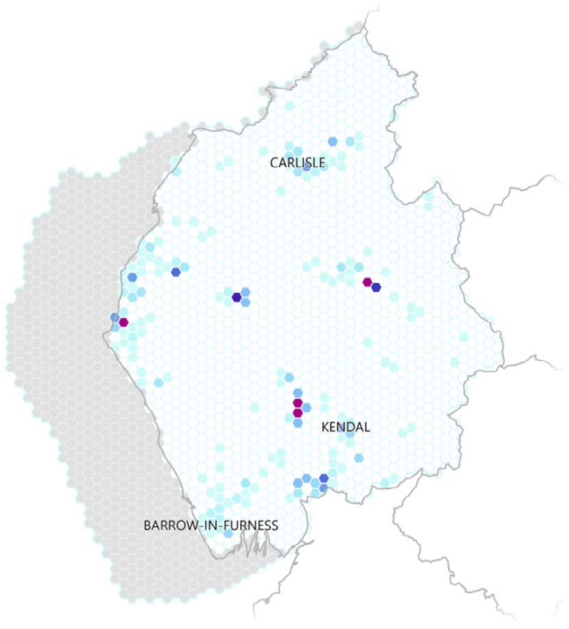
Area of urban semi-natural habitats mapped by intersecting Natural England's Priority Habitat Inventory habitats (excluding woodland, good quality semi-improved grassland and traditional orchards) with ONS Built-Up Areas.



Hexagon values: 0 – 0.03 km²; Outliers: 0.03 – 3.13 km²

Woodland, Scrub and Hedge (ID: 36)

While urban scrub and hedge are difficult to map at a national scale, the area of urban woodland is mapped here by intersecting FC's National Forest Inventory with ONS Built-Up Areas.



Hexagon values: 0 – 0.13 km²; Outliers: 0.13 – 1.92 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY: COASTAL

England's coastline accounts for less than 1% of land cover, but hosts a wealth of habitats, including saltmarsh, shingle, sand dunes, mudflats and sea cliffs. These habitats are important for a variety of life, such as rare coastal plants, wading birds and marine mammals. Additionally, coastal habitats can act as important nursery sites for commercially valuable fish species.

Coastal habitats provide a range of benefits to society. While provisioning services in the coastal margins are relatively minor (e.g. meat and wool from livestock grazing on saltmarsh, cooling water for nuclear power stations), cultural and regulatory services can be immensely valuable. For example, coastal habitats act as sea defences, dissipating energy to protect coastal settlements from storm events. Cultural services are numerous and are primarily linked to tourism and recreation, alongside social, artistic, and physical/mental health benefits (UK NEA, 2011).

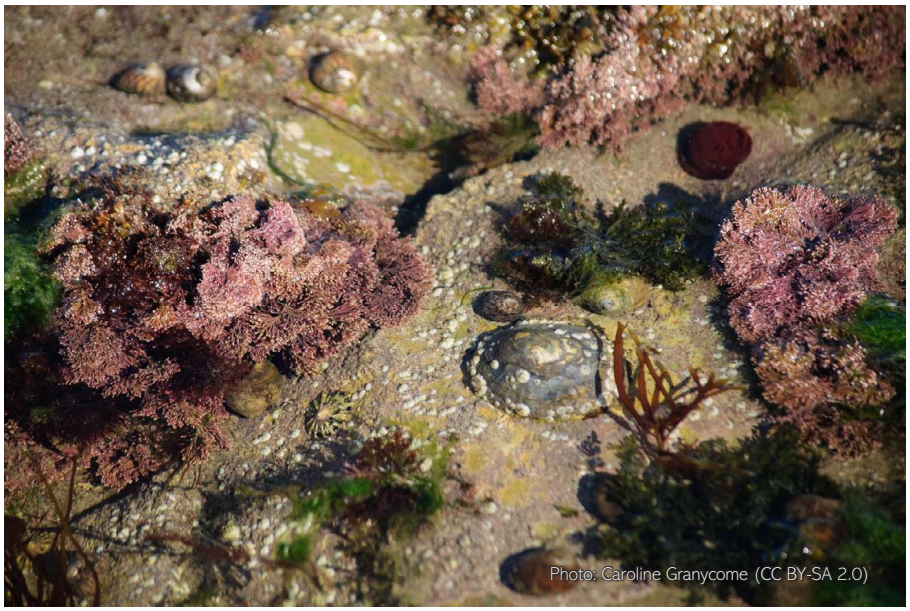


Photo: Caroline Granycome (CC BY-SA 2.0)

Ecosystem Services

The following are key ecosystem services that can be assessed using the coastal quantity indicators which are mapped in this atlas (shown on the following page). For a more comprehensive suite of ecosystem services from coastal and marine areas, these two parts of the report should be considered together.

Erosion control

Erosion control e.g. soil/land retention, lack of transport disruption, protection of housing, businesses & infrastructure, reduced health & safety risk, reduced flood risk.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Flood Protection

Reduced flood risk, affecting e.g. reduced health & safety risk, protection of housing, businesses & infrastructure, lack of transport disruption.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Asset Quantity Indicators - Coastal

This page illustrates how the indicators for coastal habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

Extent	Indicator	Erosion control	Flood protection	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
	Beach	●	●	●	●	●
	Coastal lagoons			●		●
	Mudflats	●	●	●	●	●
	Salt marsh	●	●	●	●	●
	Sand dunes	●	●	●	●	●
	Sea cliff			●		●
	Shingle	●	●	●		●

ASSET QUANTITY

Indicators showing coastal habitat quantity in Cumbria

Map Key

Indicator value:

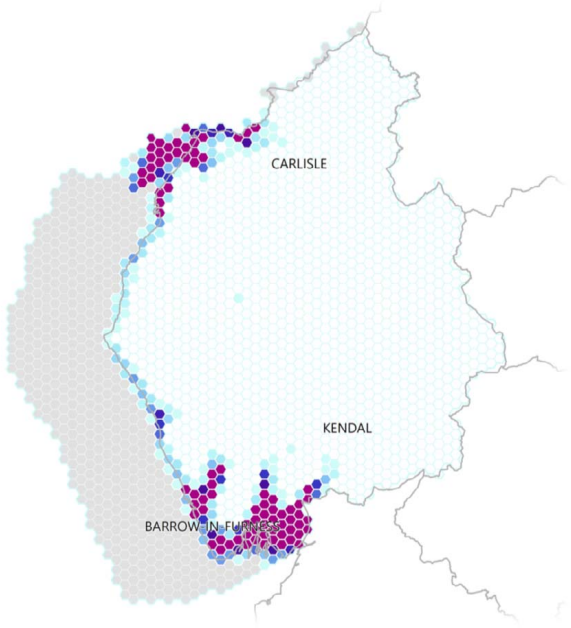
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

Beach (ID: 37)

M F H C C

Area of beach mapped using OS VectorMap District ('foreshore'). Note that this dataset includes areas of intertidal sediment as well as beaches.



Hexagon values: 0 – 2.28 km²; Outliers: 2.28 – 5 km²

Coastal Lagoons (ID: 38)

H C

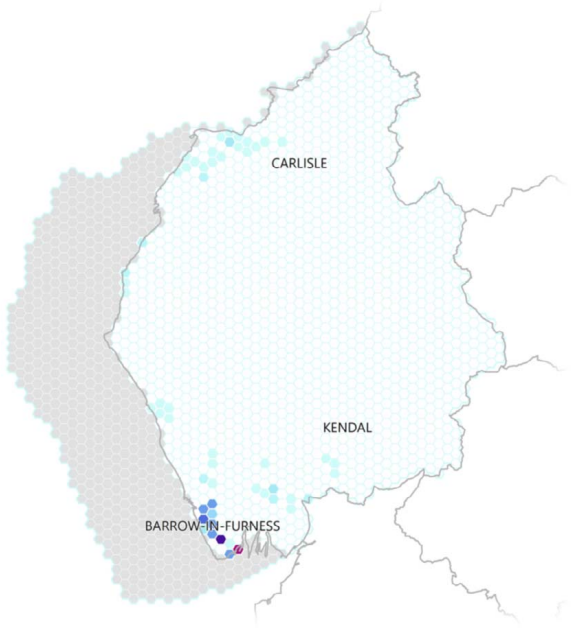
Area of coastal lagoons mapped using Natural England's Priority Habitat Inventory ('saline lagoons').

Hexagon values: 0 – 0.2 km²; Outliers: 0.2 – 1.01 km²

Mudflats (ID: 39)

M F H C C

Area of intertidal mudflats mapped using the EMODnet (Natural England) Intertidal Mudflats dataset.



Hexagon values: 0 – 0.64 km²; Outliers: 0.64 – 4.99 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY

Indicators showing coastal habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

No data / not applicable

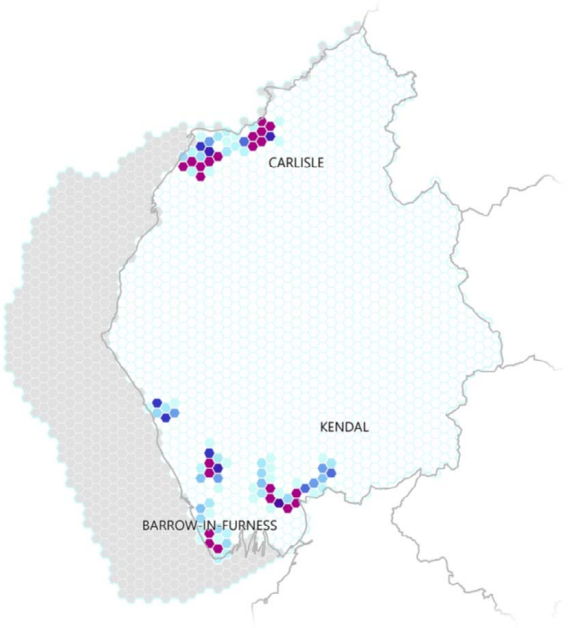
5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Salt Marsh (ID: 40)

M F H C C

Area of saltmarsh mapped using EA's Saltmarsh Extent dataset.

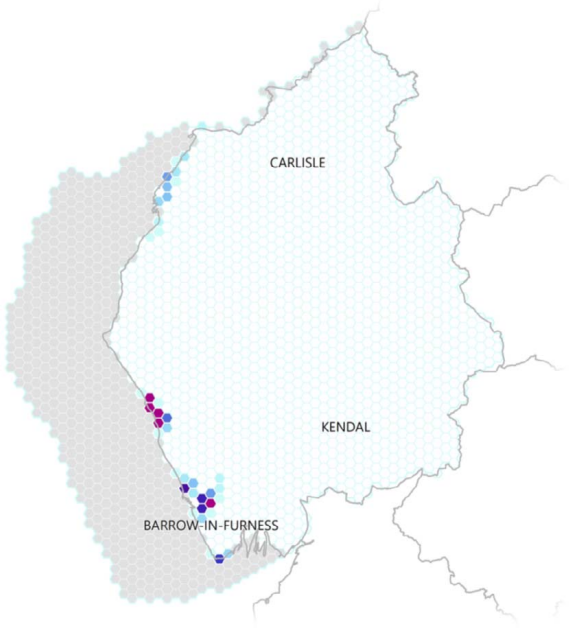


Hexagon values: 0 – 0.87 km²; Outliers: 0.87 – 4.54 km²

Sand Dunes (ID: 41)

M F H C C

Area of sand dunes mapped using Natural England's Priority Habitat Inventory ('coastal dunes').



Hexagon values: 0 – 0.88 km²; Outliers: 0.88 – 3.22 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY

Indicators showing coastal habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

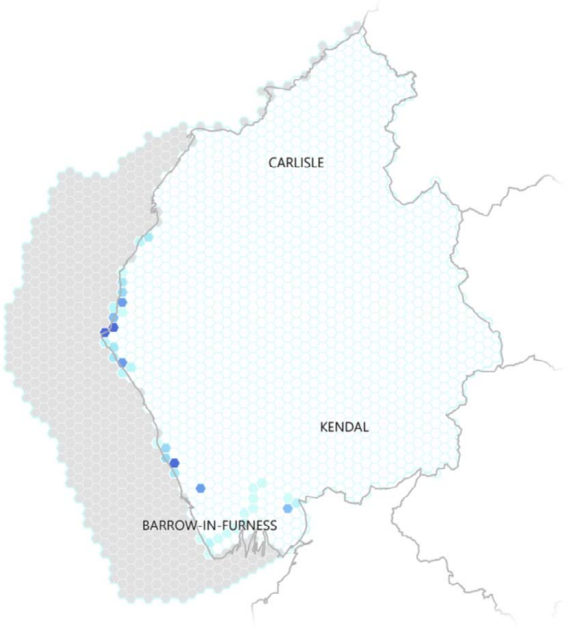
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Sea Cliff (ID: 42)

Area of sea cliff habitat mapped using Natural England's Priority Habitat Inventory ('maritime cliff and slopes').



Hexagon values: 0 – 0.42 km²; Outliers: 0.42 – 1.33 km²

Shingle (ID: 43)

Area of shingle mapped using Natural England's Priority Habitat Inventory ('coastal vegetated shingle').

Hexagon values: 0 – 0.42 km²; Outliers: 0.42 – 4.23 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY: MARINE

Marine habitats of the UK cover more than three and a half times the land area and are composed of a wide variety of sub-habitats. These sub-habitats support a diverse array of life, including seabirds, marine mammals and sharks.

Marine habitats provide numerous ecosystem services, many of which are of significant value to society. The fishing industry remains an important socio-economic activity in coastal regions, harvesting fish and shellfish for consumption in the UK and abroad. The marine environment acts as a carbon sink, regulating the global climate, while various sub-tidal habitats stabilise sediment and reduce wave energy, creating natural sea defences. In addition, marine habitats provide tourism, leisure and recreation opportunities, and promote physical and mental health (UK NEA, 2011). This assessment focuses on inshore waters, up to 12 nautical miles from the coastline. This section includes intertidal and subtidal habitats, other than those covered in the coastal section. Marine indicators include both the seabed and the water column above.

Photo: Sam Tasker (CC BY-SA 2.0)

Ecosystem Services

The following are key ecosystem services that can be assessed using the marine quantity indicators which are mapped in this atlas (shown on the following page). For a more comprehensive suite of ecosystem services from coastal and marine areas, these two parts of the report should be considered together.

Fish and other marine products from wild sources

Products from the sea e.g. fish, shellfish & seaweed for food, fertiliser, angling bait, medicines.

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Asset Quantity Indicators - Marine

This page illustrates how the indicators for marine habitat quantity are connected to ecosystem services, benefits and value, as shown in the logic chain below.

The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which were possible to map.

Note: these indicators include the seabed and the water column.

Extent: Indicator ↓	Fish and other marine products from wild sources	Water quality	Biodiversity - thriving plants and wildlife	Climate regulation	Cultural services
Intertidal rock	●		●		
Maerl beds	●		●		
Reefs	●	●	●	●	●
Seagrass beds	●	●	●	●	●
Shallow subtidal sediment	●		●	●	
Shelf subtidal sediment	●		●	●	
Subtidal rock	●		●		

ASSET QUANTITY

Indicators showing marine habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

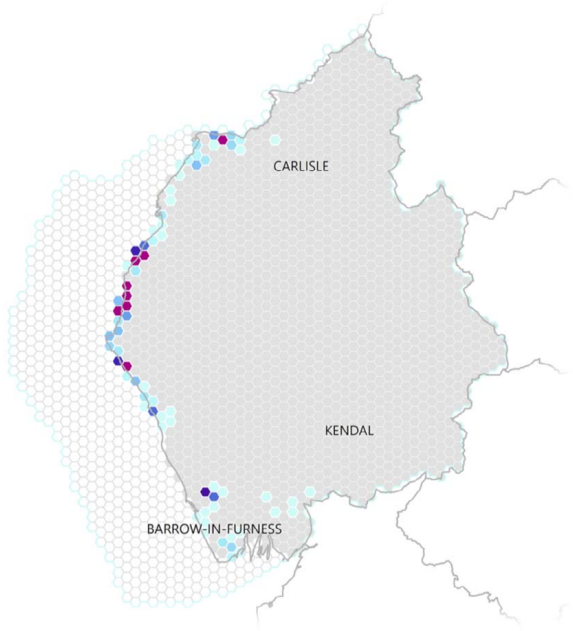
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Intertidal Rock (ID: 44)

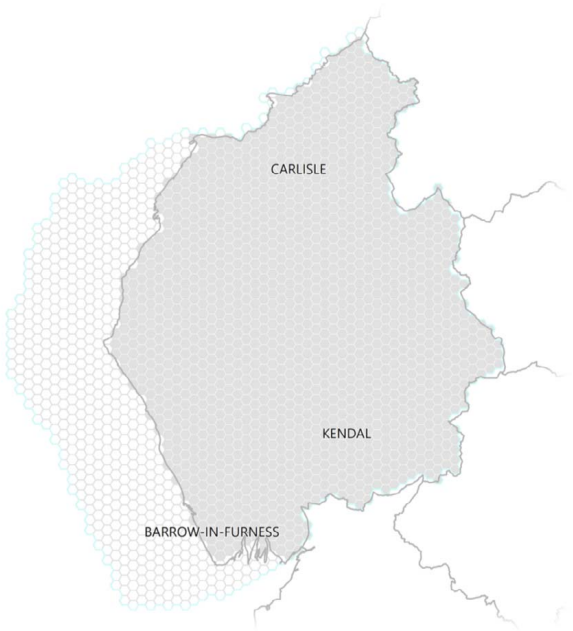
Area of intertidal rock mapped using Natural England's Open Marine Evidence Base (EUNIS code A1).



Hexagon values: 0 – 0.28 km²; Outliers: 0.28 – 3.5 km²

Maerl Beds (ID: 45)

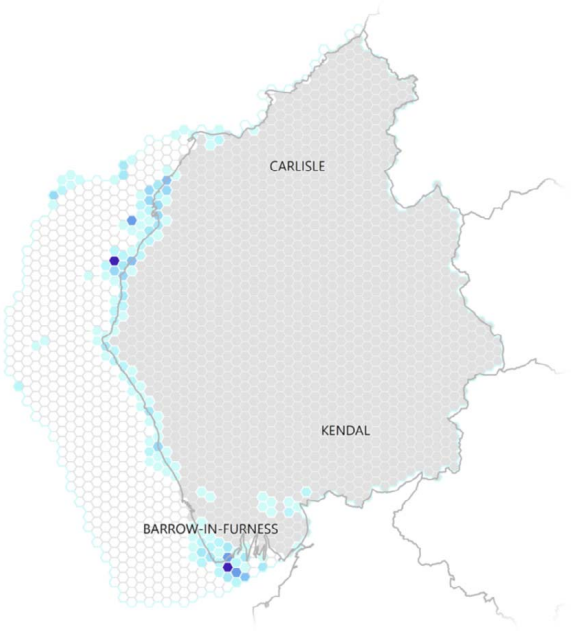
Area of maerl beds mapped using Natural England's Open Marine Evidence Base (EUNIS code A5.51).



Hexagon values: 0 – 2.34 km²; Outliers: 2.34 – 4.95 km²

Reefs (ID: 46)

Area of reefs mapped using JNCC's Potential Annex 1 Reefs.



Hexagon values: 0 – 5 km² (see note on data distribution)

N.b. There are no 'outliers' symbolised on this map because a large number of the data values are distributed at the high end of the scale. Instead, 10 equal interval classes are used.

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY

Indicators showing marine habitat quantity in Cumbria

Map Key

Indicator value:

- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Seagrass Beds (ID: 47)

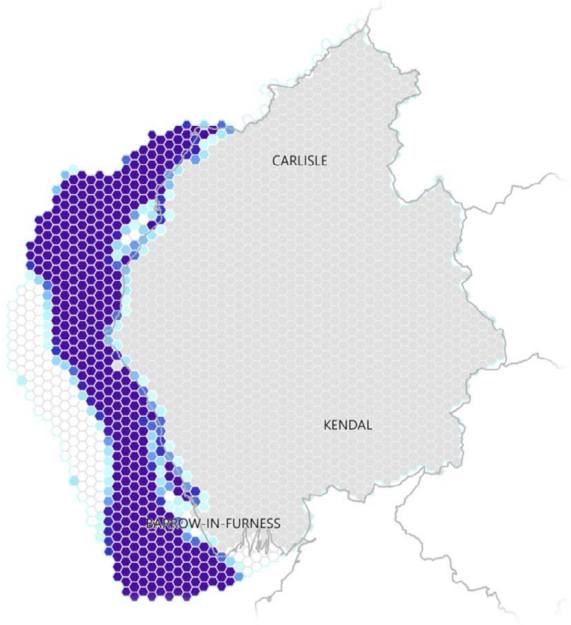
Area of seagrass beds mapped using Natural England's Open Marine Evidence Base (EUNIS code A2.61).

There are pockets of seagrass beds all around the English coast. A number of citizen science projects are attempting to map seagrass distribution, which should help to improve the accuracy of these habitat maps.

Hexagon values: 0 – 0.62 km²; Outliers: 0.62 – 1.68 km²

Shallow Subtidal Sediment (ID: 48)

Area of shallow subtidal sediment mapped using JNCC's UKSea Map 2018 (biozone = shallow circalittoral or infralittoral and substrate = sediment, sand or mud).



Hexagon values: 0 – 5 km² (see note on data distribution)

N.b. There are no 'outliers' symbolised on this map because a large number of the data values are at the high end of the scale. Instead, 10 equal interval classes are used.

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- Timber, hay and other materials
- Fish and other marine products from wild sources
- Plant-based energy
- Cultivated crops
- Water supply
- Livestock

Regulating:

- Water quality
- Air quality
- Noise regulation
- Erosion control
- Flood protection
- Pollination
- Biodiversity - thriving plants and wildlife
- Climate regulation

Cultural:

- Cultural services

Geodiversity:

- Geodiversity services

ASSET QUANTITY

Indicators showing marine habitat quantity in Cumbria

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

No data / not applicable

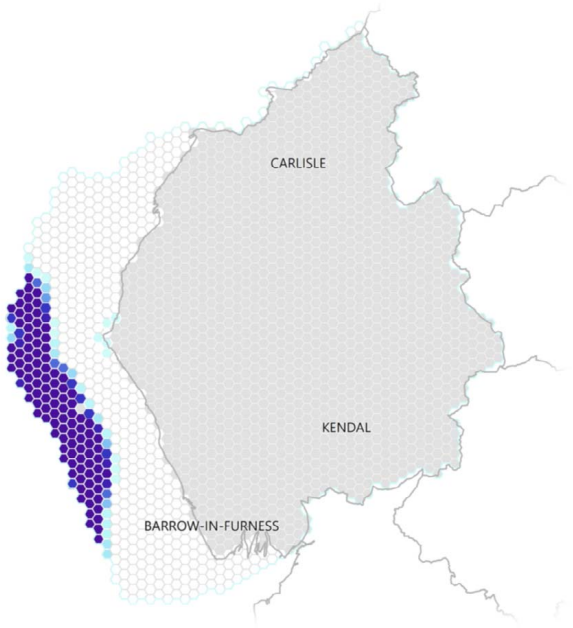
5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Shelf Subtidal Sediment (ID: 49)

W H C

Area of shelf subtidal sediment mapped using JNCC's UKSea Map 2018 (biozone = deep circalittoral and substrate = sediment, sand or mud).



Hexagon values: 0 – 5 km² (see note on data distribution)

N.b. There are no 'outliers' symbolised on this map because a large number of the data values are at the high end of the scale. Instead, 10 equal interval classes are used.

Subtidal Rock (ID: 50)

W H

Area of subtidal rock mapped using JNCC's UKSea Map 2018 (substrate = rock).

Hexagon values: 0 – 3.14 km²; Outliers: 3.14 – 5 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUANTITY

Summary statistics for habitat quantity in Cumbria

ID	Type	Indicator of habitat extent	Area (km^2)	Percentage of total land area
1	Fr	Active flood plain	580.9	8.0
2	Fr	Coastal & floodplain grazing marsh	206.8	2.9
3	Fr	Lakes & standing waters	81.8	1.1
4	Fr	Lowland fens	10.0	0.1
5	Fr	Lowland raised bog	41.1	0.6
7	Fr	Modified waters (reservoirs)	15.9	0.2
8	Fr	Reedbeds	0.2	0.0
9	Fr	Ponds	3.0	0.0
10	Fr	Blanket bog	467.2	6.4
11	Fr	Woodland	687.4	9.5
12	Fr	Other semi-natural habitats	1304.0	18.0
13	Fa	Arable & horticulture	422.3	5.8
14	Fa	Improved grassland	2958.4	40.8
15	Fa	Orchards & top fruit	1.5	0.0
16	Gr	Meadows	10.5	0.1
17	Gr	Other semi-natural grasslands	853.5	11.8
18	MMH	Blanket bog	467.2	6.4
19	MMH	Dwarf shrub heath	304.7	4.2
20	MMH	Inland rock, scree and pavement AML	19.2	0.3
21	MMH	Lakes and reservoirs AML	1.4	0.0

ID	Type	Indicator of habitat extent	Area (km^2)	Percentage of total land area
22	MMH	Mountain heath & willow scrub	14.1	0.2
24	MMH	Semi-natural grassland AML	805.4	11.1
25	MMH	Upland flushes fens & swamps	51.2	0.7
26	MMH	Wood pasture AML	6.1	0.1
27	MMH	Woodland AML	34.1	0.5
28	Wo	Broadleaved, mixed & yew woodland	282.2	3.9
29	Wo	Coniferous woodland	212.1	2.9
30	Wo	Ancient woodland	162.8	2.2
31	Wo	Woodland Priority Habitats	237.8	3.3
32	Ur	Blue space	0.9	0.0
33	Ur	Green space: not semi-natural	59.8	0.8
34	Ur	Open mosaic habitats	11.3	0.2
35	Ur	Semi-natural habitats	1.0	0.0
36	Ur	Woodland, scrub and hedge	4.0	0.1
37	Co	Beach	390.3	5.4
38	Co	Coastal lagoons	1.7	0.0
39	Co	Mudflats	5.3	0.1
40	Co	Salt marsh	54.9	0.8
41	Co	Sand dunes	15.4	0.2
42	Co	Sea cliff	3.5	0.0
43	Co	Shingle	0.3	0.0

ID	Type	Indicator of habitat extent	Area (km^2)	Percentage of total marine area
44	Ma	Intertidal rock	10.0	0.3
45	Ma	Maerl beds	0.0	0.0
46	Ma	Reefs	95.2	3.3
47	Ma	Sea grass beds	1.3	0.0
48	Ma	Shallow subtidal sediment	2104.6	72.3
49	Ma	Shelf subtidal sediment	618.1	21.2
50	Ma	Subtidal rock	1.8	0.1

ID	Type	Indicator of habitat extent	Length (km)
6	Fr	Rivers	3458.1
23	MMH	Rivers (above moorland line)	628.1

Habitat type codes:

Fr – Freshwater
Fa – Farmland
Gr – Grassland
MMH – Mountains, Moors and Heaths
Wo – Woodland
Ur – Urban
Co – Coastal
Ma – Marine

AML = Above moorland line

ASSET QUALITY

In addition to habitat asset quantity, it is important to consider the quality of habitats. This chapter explores how the condition of habitats influences the ecosystem services they provide. Indicators describing asset quality are mapped for all habitat types combined, using the following themes:

- Hydrology and geomorphology
- Nutrient and chemical status
- Soil/sediment processes
- Species composition
- Vegetation
- Cultural

In this section, some of the indicators are mapped using the spatial properties of the original dataset, rather than summarising by hexagon. This is to ensure that darker shades represent a higher quality of the indicator, rather than simply a larger amount, and thus avoid conflating quality with quantity.

ASSET QUALITY: HYDROLOGY & GEOMORPHOLOGY

The hydrology and geomorphology of habitats influence their ability to provide ecosystem services and subsequently impacts the benefits received by society. Hydrology is concerned with the properties of the Earth's water, especially its movement in relation to land. Geomorphology is the study of landforms, their processes, form and sediments at the surface of the Earth.

To understand natural capital quality, hydrological and geomorphogical processes are important, because they relate to the processes, distribution and effects of water, the water cycle and sediment processes.

Hydrology and geomorphology have wide-ranging effects on the delivery of ecosystem services. Water supply is affected by the naturalness of aquifer function and river flow regime. River channel obstruction may block the migration of diadromous fishes and channel modification may lead to the loss of fish nursery habitat. Flood risk in different locations is influenced by the underlying geology and the way in which the local natural hydrological processes operate. It can be increased by human management actions for example, modifying river channels and covering natural surfaces with impermeable materials.

Ecosystem Services

The following are key ecosystem services that can be assessed using the hydrology and geomorphology indicators which are mapped in this atlas (shown on the following page).

Water Supply

Plentiful water e.g. water for drinking, domestic use, irrigation, livestock, industrial use including cooling, wildlife.

Flood Protection

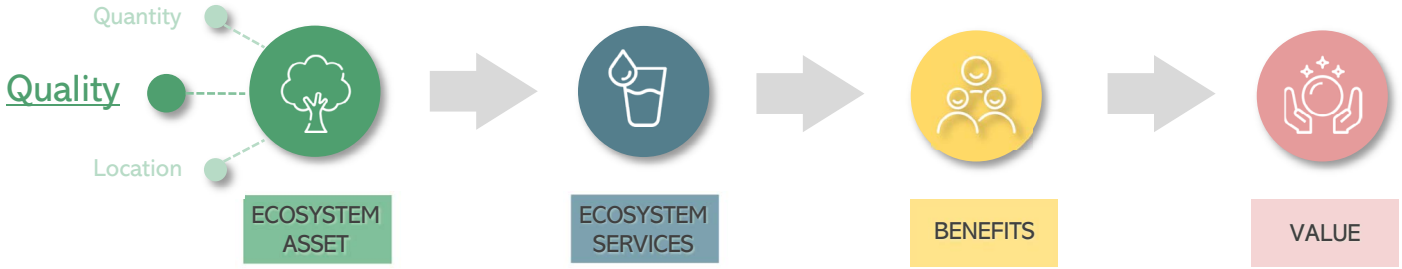
Reduced flood risk, affecting e.g. reduced health & safety risk, protection of housing, businesses & infrastructure, lack of transport disruption.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Asset Quality Indicators - Hydrology & Geomorphology

This page illustrates how the indicators for habitat quality (hydrology and geomorphology) are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.



	Habitat Types ↓	Water supply *	Flood protection *	Biodiversity - thriving plants and wildlife
Natural aquifer function - recharge and discharge	Fr / MMH	●		
Naturalness of flow regime	Fr / MMH	●	●	●
Lack of physical modifications of water bodies	Fr / MMH			●
River continuity – lack of obstructions	Fr			●

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

* Ecosystem service that was considered for freshwater catchments

ASSET QUALITY

Indicators of habitat quality: hydrology and geomorphology

Map Key

Indicator value:

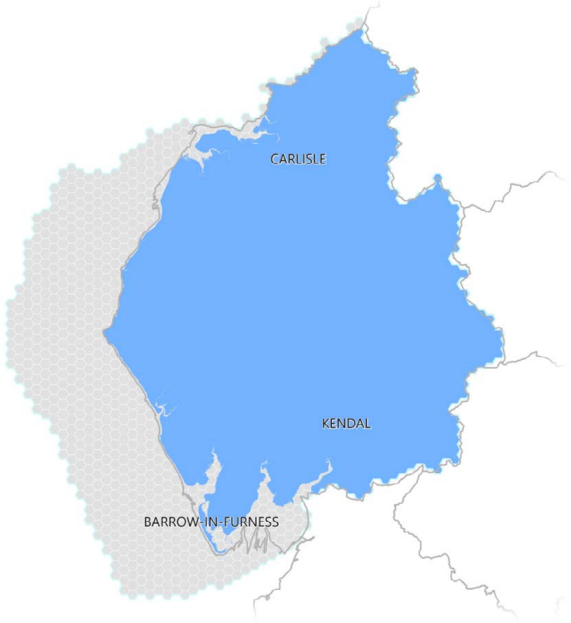
- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

(S) Natural Aquifer Function (ID: 51)

Area of groundwater catchment with 'good' quantitative status for WFD 2016 shown in blue and mapped using EA's WFD data and groundwater catchment boundaries (C2).

Ground water quantity status is described as 'good' when the long-term available water resource is not exceeded by the long-term rate of abstraction. This includes consideration of flow required to achieve good ecological status.



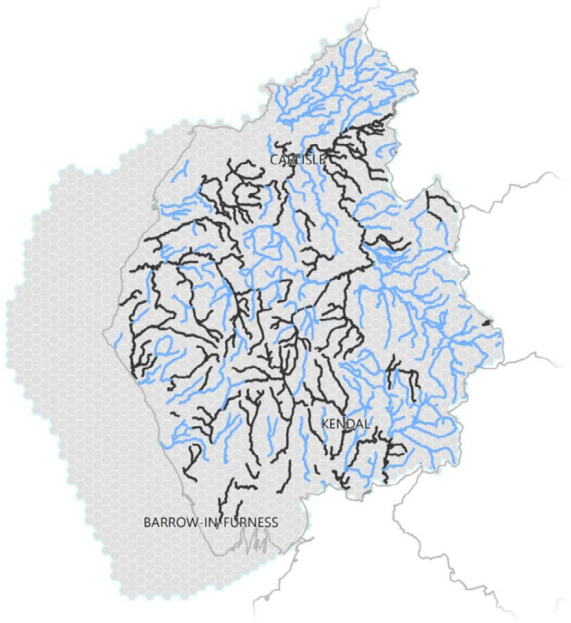
Groundwater status:

- Good
- Poor

(S) (F) (H) Naturalness of Flow Regime (ID: 52)

The WFD hydrological regime classification describes the naturalness of river flows. This map shows the length of river with 'high' WFD hydrological status in 2016, shown in blue and mapped using EA's WFD data and river water bodies (C2).

'High' status signifies the quantity and dynamics of flow, and the resultant connection to groundwaters, reflect totally, or nearly totally, undisturbed conditions.



WFD Hydrological Status:

- High
- Supports good, does not support good, or not assessed

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- (M) Timber, hay and other materials
- (W) Fish and other marine products from wild sources
- (P) Plant-based energy
- (C) Cultivated crops
- (S) Water supply
- (R) Livestock

Regulating:

- (W) Water quality
- (A) Air quality
- (N) Noise regulation
- (M) Erosion control
- (F) Flood protection
- (P) Pollination
- (H) Biodiversity - thriving plants and wildlife
- (C) Climate regulation

Cultural:

- (C) Cultural services

Geodiversity:

- (G) Geodiversity services

ASSET QUALITY

Indicators of habitat quality: hydrology and geomorphology

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

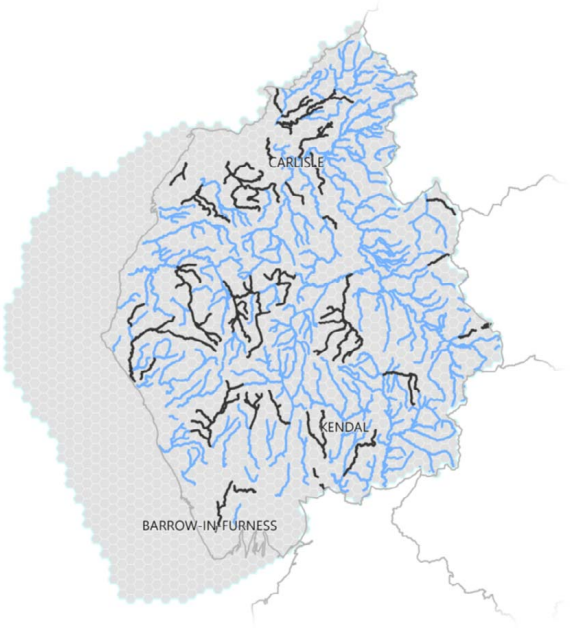
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

H Lack of Physical Modifications of Water Bodies (ID: 53)

Lack of physical modification of rivers, shown in blue and mapped using EA's Reasons for Not Achieving Good Status data 2013-2016 (Significant Water Management Issue (SWMI) = 'physical modification').

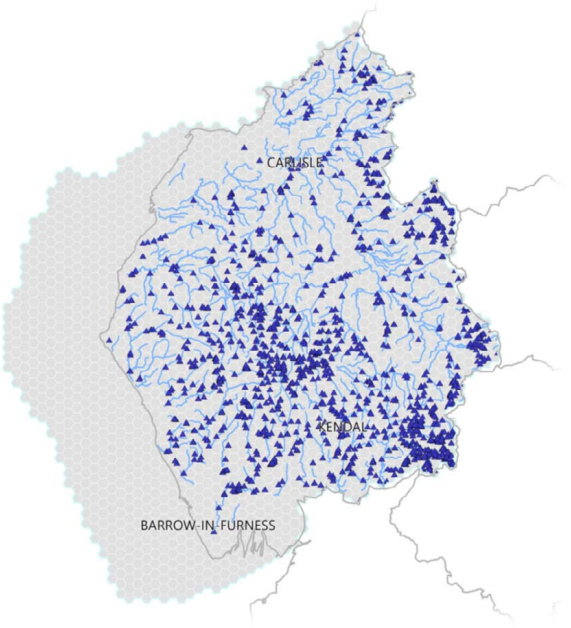


WFD Significant Water Management Issue:

- **Does not** have a 'physical modification' (SWMI)
- **Does** have a 'physical modification' (SWMI)

H River Continuity – Lack of Obstructions (ID: 54)

River obstructions have been mapped using EA's Potential Sites of Hydropower Opportunity dataset. Sections without (or with fewer) river obstructions have higher river continuity.



- Potential sites of hydropower opportunity (obstruction)
- WFD river

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUALITY: NUTRIENT & CHEMICAL STATUS

The nutrient and chemical status of habitats influence their ability to provide ecosystem services and subsequently impacts benefits received by society. Nutrient and chemical factors encompass the availability of innumerable elements and compounds in water and soil/sediment.

Excess nitrate and phosphate leads to eutrophication, with a potentially deleterious impact on biodiversity. Nitrogen and phosphate levels also affect the processing of potable water at treatment plants. For agriculture, the availability of nitrogen, phosphorus and potassium are vital to primary production, thus affecting the provision of food and raw materials. Nutrient and chemical status also influences waste decomposition, climate regulation and the purification of water and air.

Ecosystem Services

The following are key ecosystem services that can be assessed using the nutrient and chemical status indicators which are mapped in this atlas (shown on the following page).

Cultivated Crops

Food from crops e.g. cereals, vegetables, fruit.

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Livestock

Products from animals e.g. meat, dairy products, honey.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Asset Quality Indicators - Nutrient and Chemical Status

This page illustrates how the indicators for habitat quality (nutrient and chemical status) are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

Indicator ↓	Habitat Types ↓	Cultivated crops	Livestock	Water quality *	Biodiversity - thriving plants and wildlife	Climate regulation
Chemical status of water bodies	Fr			●	●	
Nutrient status of water bodies	Fr			●	●	
Nutrient status of soil	Fr / Fa / Gr / Wo / Co	●	●	●	●	●

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

* Ecosystem service that was considered for freshwater catchments

ASSET QUALITY

Indicators of habitat quality: nutrient and chemical status

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

No data / not applicable

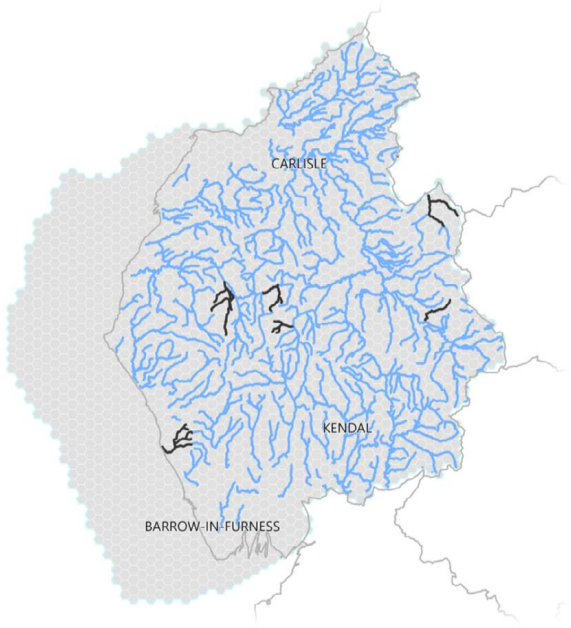
5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Chemical Status of Water Bodies (ID: 55)

W H

River chemical status for WFD 2016, mapped using EA's WFD data and river water bodies (C2).



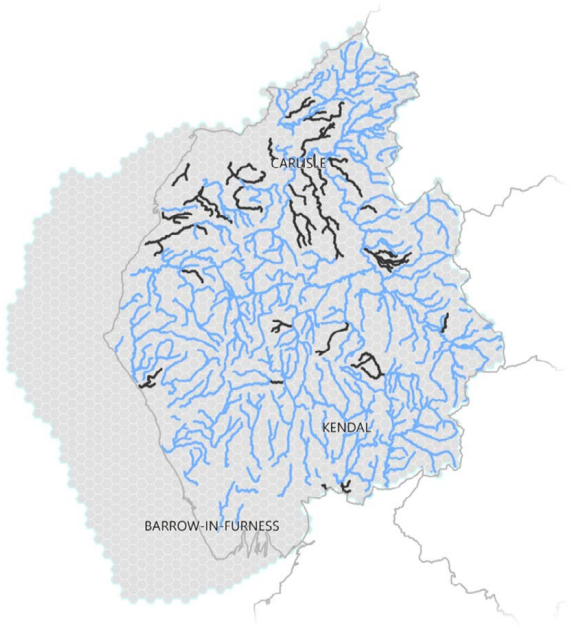
WFD Chemical Status:

- Good
- Fail

Nutrient Status of Water Bodies (ID: 56)

W H

Length of river with 'good' or 'high' status for phosphate levels for WFD 2016, mapped using EA's WFD data and river water bodies (C2).



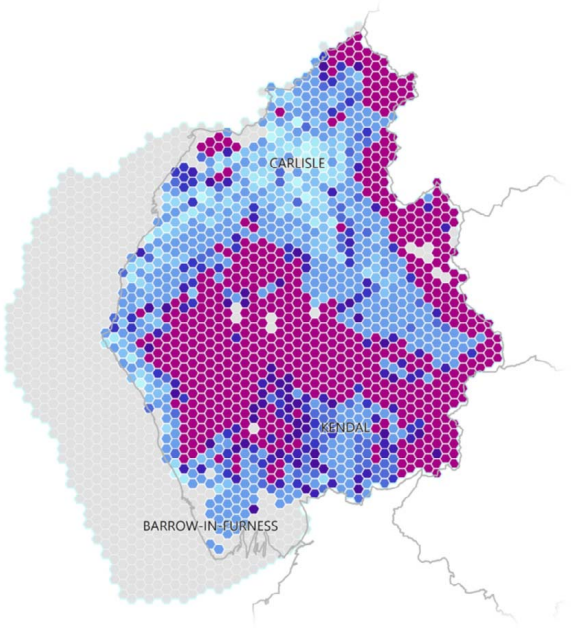
WFD Phosphate Levels Status:

- High or Good
- Moderate, Poor or Bad

Nutrient Status of Soil (ID: 57)

C R W H C

Mean estimates of total nitrogen concentration in topsoil (0-15cm depth) - % dry weight of soil, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project: Soil nitrogen (Henrys et al., 2012).



N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007.

Hexagon values: 0.17 – 0.68%; Outliers: 0.68 – 1.7%

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUALITY: SOIL/SEDIMENT PROCESSES

The soil/sediment processes that occur in habitats influence their ability to provide ecosystem services and subsequently impacts the benefits received by society. Soil/sediment processes influence factors such as peat depth, organic matter content and soil structure.

Density of carbon/organic matter in topsoil is of vital importance to the production of both cultivated crops and natural vegetation, due to its role as the primary energy source in soils. As soil carbon is the biosphere's largest carbon reservoir, soils also play a vital role in climate regulation. Peatlands store approximately twice the carbon that is stored in all the world's forests (UN Environment, 2019), making them irreplaceable in climate regulation. Additionally, peatland supports numerous cultural services, from the preservation of ancient human artefacts to the unique and cherished 'wilderness' landscapes it underpins. Soil biota are easily overlooked, yet are crucial in nutrient cycling, soil aeration and the maintenance of healthy soil structure.

Ecosystem Services

The following are key ecosystem services that can be assessed using the soil/sediment processes indicators which are mapped in this atlas (shown on the following page).

Erosion control

Erosion control e.g. soil/land retention, lack of transport disruption, protection of housing, businesses & infrastructure, reduced health & safety risk, reduced flood risk.

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Asset Quality Indicators - Soil/Sediment Processes

This page illustrates how the indicators for habitat quality (soil/sediment processes) are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

	Habitat Types ↓	Water quality *	Erosion control	Biodiversity - thriving plants and wildlife	Climate regulation
Peat depth	Fr / MMH	●			●
Soil carbon/organic matter	Fr / Fa / Gr / MMH / Wo	●	●	●	●
Soil biota	Fa / Gr / Wo			●	●

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

* Ecosystem service that was considered for freshwater catchments

ASSET QUALITY

Indicators of habitat quality: soil/sediment processes

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

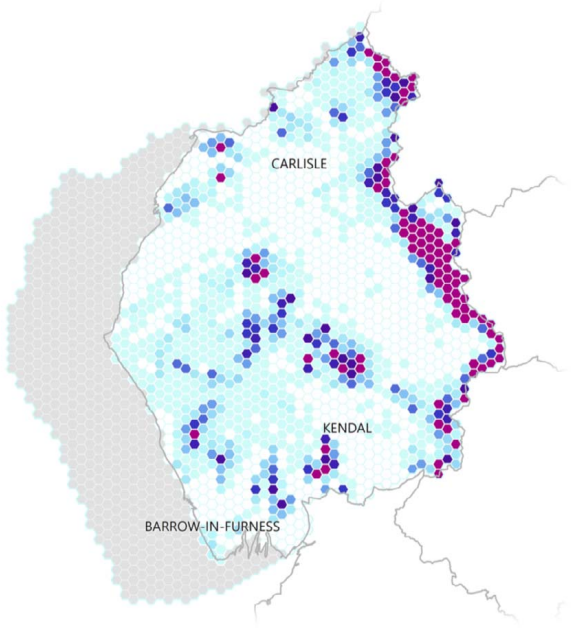
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

Peat Depth (ID: 58)

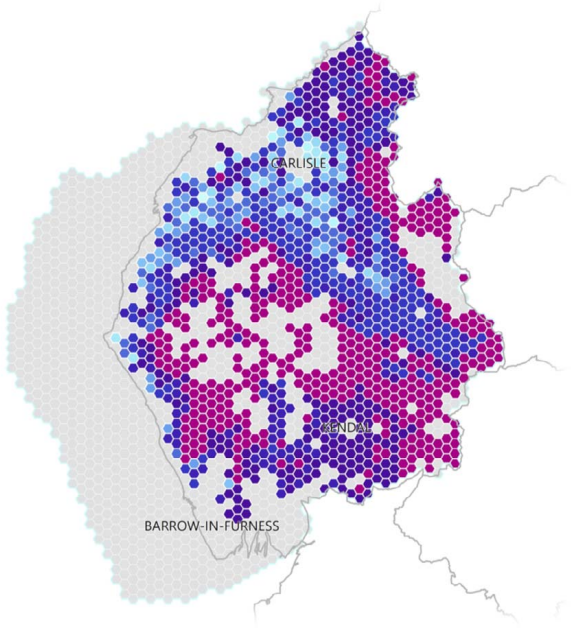
Area of deep peat mapped using Natural England's peaty soils location dataset.



Hexagon values: 0 – 3.9 km²; Outliers: 3.9 – 5 km²

Soil Carbon/Organic Matter (ID: 59)

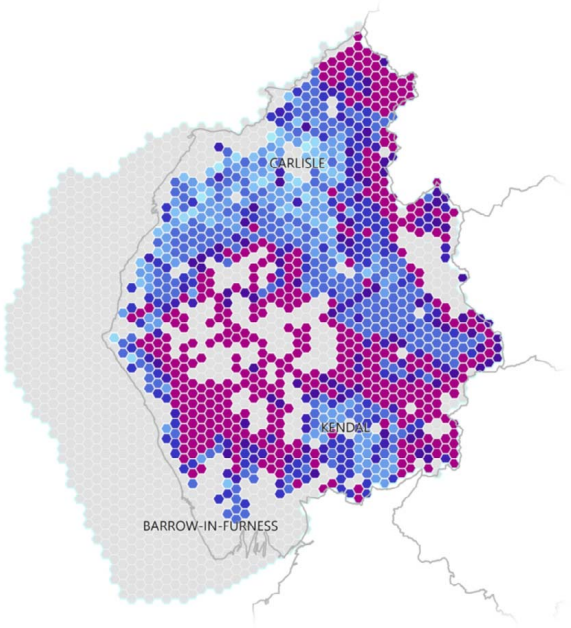
Mean estimates of carbon density in topsoil (0-15cm depth) – tonnes per hectare, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project: Soil carbon (Henrys et al., 2012). N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007.



Hexagon values: 45.64 – 74.73 t; Outliers: 74.73 – 101.27 t

Soil Biota (ID: 60)

Mean estimates of total abundance of invertebrates in topsoil (0-8 cm depth), mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project: Soil invertebrates (Henrys et al., 2012). N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007.



The modelled dataset shows that higher densities of soil invertebrates tend to be found in semi-natural, less intensively managed habitats such as woodland, acid grassland and dwarf shrub heath (Henrys et al., 2012)

Hexagon values: 11 - 80; Outliers: 80 – 183

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUALITY: SPECIES COMPOSITION

The species composition of habitats influence their ability to provide ecosystem services and subsequently impacts the benefits received by society. The composition of plant and animal species present within a habitat reflects the degree of naturalness of that habitat.

Habitats with a more natural species assemblage often have greater aesthetic and cultural value, with associated benefits for tourism, education and recreation. Species composition also impacts on provisioning services, for example, increased species richness has been shown to increase biomass production in natural and plantation forests, bolstering timber provision (Piotto, 2008). Invasive species may impair the delivery of ecosystem services due to out competing species in the natural biological assemblage.

Ecosystem Services

The following are key ecosystem services that can be assessed using the species composition indicators which are mapped in this atlas (shown on the following page).

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Asset Quality Indicators - Species Composition

This page illustrates how the indicators for habitat quality (species composition) are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

Indicator ↓	Habitat Types ↓	Water quality *	Biodiversity - thriving plants and wildlife
Naturalness of biological assemblage - no. of trophic levels and community composition in each level	Fr / Fa / Gr / MMH / Wo / Co	•	•

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

* Ecosystem service that was considered for freshwater catchments

ASSET QUALITY

Indicators of habitat quality: species composition

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

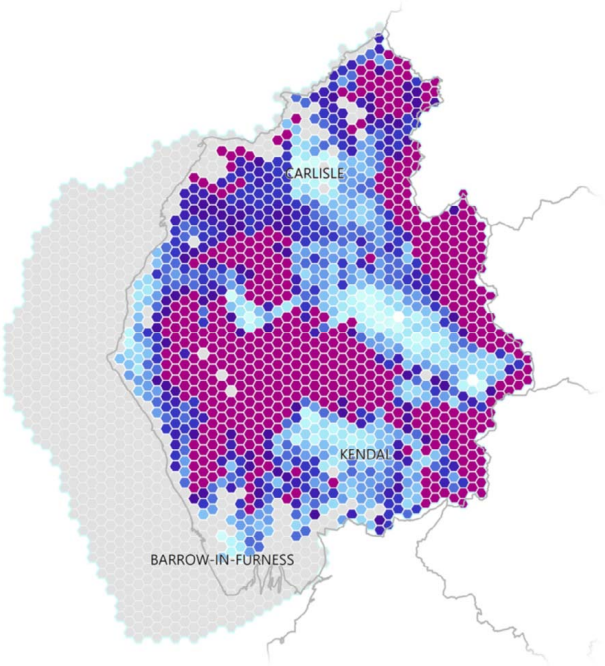
10 equal interval classes

0

No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.



WH Naturalness of Biological Assemblage (ID: 61)

Naturalness of biological assemblage is a difficult indicator to map as there are a number of factors to consider. The presence of certain plant species can be indicative of good quality, natural habitats. This map shows the mean estimates of expected plant habitat indicators (% of plant habitat indicators present), mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project: Plant indicators for habitats in good condition (Maskell et al., 2016). N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007.

Indicator plants were identified in the Common Standards Monitoring Guidance for SSSIs, so represent habitats of high conservation value.

Hexagon values: 0 – 2.81%; Outliers: 2.81 – 12.09%

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUALITY: VEGETATION

The vegetation characteristics of habitats influence their ability to provide ecosystem services and subsequently impacts the benefits received by society. Vegetation cover, structure and the presence of nectar plants are important factors influencing the provision of ecosystem service provision. Furthermore, linear vegetation features, such as hedgerows and wooded strips, are important features of the English rural mosaic for habitat connectivity and aesthetic appreciation.

Vegetation stabilises soils and reduces flood risk by regulating the hydrological cycle. Additionally, vegetation can buffer noise pollution from roadways and scrubs gaseous pollutants like nitrogen oxides and particulates from the air. Vegetation promotes pollination of cultivated crops through the provision of nectar to pollinators.


Photo: Martin Sepion via Unsplash

Ecosystem Services

The following are key ecosystem services that can be assessed using the vegetation indicators which are mapped in this atlas (shown on the following page).

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Erosion control

Erosion control e.g. soil/land retention, lack of transport disruption, protection of housing, businesses & infrastructure, reduced health & safety risk, reduced flood risk.

Pollination

Pollination underpinning cultivated crops dependent on insect pollination e.g. field beans, apples, plums, pears, cucumbers, strawberries, oil seed rape.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Flood Protection

Reduced flood risk, affecting e.g. reduced health & safety risk, protection of housing, businesses & infrastructure, lack of transport disruption.

Asset Quality Indicators - Vegetation

This page illustrates how the indicators for habitat quality (vegetation) are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

Indicator ↓	Habitat Types ↓	Water quality *	Erosion control	Flood protection *	Pollination	Climate regulation
Presence and frequency of pollinator (larval and adult) food plants	Fa / Gr				●	
Extent of permanent vegetation cover	Fr / Fa / Gr / MMH / Wo / Ur / Co	●	●	●		●

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

* Ecosystem service that was considered for freshwater catchments

ASSET QUALITY

Indicators of habitat quality: Vegetation

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

No data / not applicable

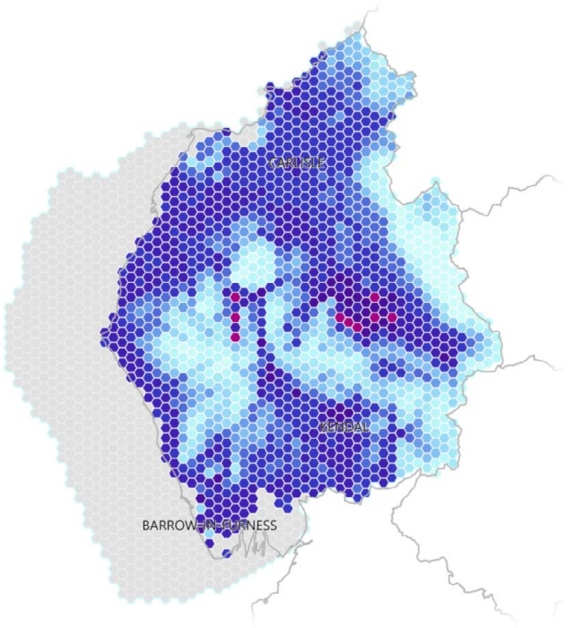
5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

P Presence & Frequency of Pollinator Food Plants (ID: 62)

Mean estimates of number of nectar plant species for bees per 2x2m plot, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project: Nectar plant diversity for bees (Maskell et al., 2016).

N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007.

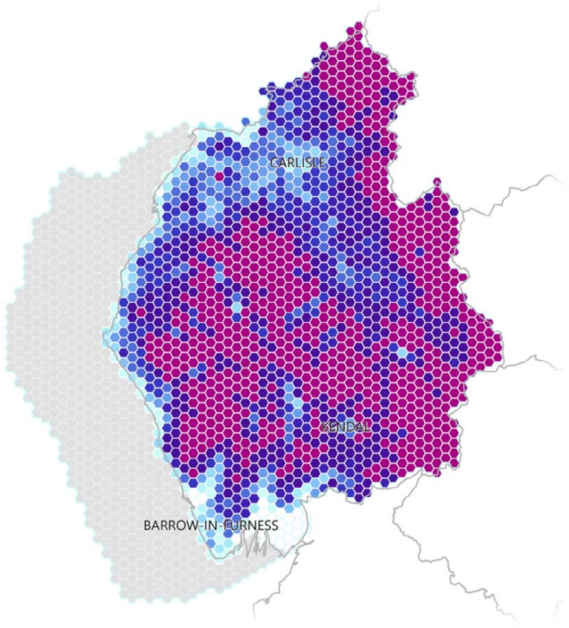


Hexagon values: 0.55 – 6.12; Outliers: 6.12 – 10.69

W M F C Extent of permanent vegetation cover (ID: 63)

The ratio of vegetated to non-vegetated surfaces is illustrated here using CEH's Land Cover Map 2015. The values indicate the percentage area of each spatial unit that is vegetated (n.b. non-vegetated = urban, water, rock, sediment and arable using LCM2015 - in the absence of bare soil data, arable land is treated as bare).

Please note that this map does not show small scale patches of bare soil which can be vital for wildlife, especially invertebrates, including pollinator and pest controlling species.



Hexagon values: 0 – 97.73%; Outliers: 97.73 – 100%

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET QUALITY: CULTURAL

There are a number of characteristics that influence the cultural value that the natural environment provides to society. If accessible, well managed habitats can significantly enhance the mental and physical health of visitors and residents. Landscapes, and the habitats and biodiversity they support have an intrinsic value, beyond the services they deliver to human beings. They can hold an emotional or spiritual value to individuals or communities. Cultural benefits are often difficult to measure as they are less tangible than other benefits provided by nature.

Biodiversity is an important factor influencing the delivery of cultural services. A natural habitat with high species richness has the potential to offer valuable aesthetic, recreational or educational services. The presence of rare or flagship species (such as wetland bitterns and the grey seals of England's coasts) is also important and may generate revenue for the local economy through tourism. Landscapes often contain designated heritage assets and boundary features that have remained in place for centuries and accrue tremendous historical value. Public Rights of Way facilitate the delivery of cultural services in habitats that would otherwise be inaccessible to most.

Ecosystem Services

The indicators on the following page have been selected to measure how the quality of habitat influences the cultural ecosystem services they provide.

Cultural Services

Health and wellbeing benefits, including sense of place, spirituality, inspiration, physical and mental wellbeing.

Geodiversity services

Geodiversity, in and of itself, products, such as minerals, materials, fossil fuels and renewable energy, fossils, and underpinning other services (for example by providing landscape features and habitats for example, sea cliffs, reef).

Photo: Annie Spratt via Unsplash

Asset Quality Indicators - Cultural

This page illustrates how the indicators for quality (cultural) are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in the atlas.

	Indicator ↓	Habitat Types ↓	Cultural services	Geodiversity services
Nature	Naturalness of watercourses	Fr / MMH	●	
	Favourable condition of SSSIs	All + Geodiversity	●	●
Culture and History	Designated historic environment assets	All	●	
Quietness	Tranquility	Fr / Fa / Gr / MMH / Co	●	
Accessibility	Public Rights of Way	Fr / Fa / Gr / MMH / Wo / Ur / Co	●	

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

ASSET QUALITY

Indicators of habitat quality: Cultural

Map Key

Indicator value:

Outliers (>90th percentile)

High

Low

10 equal interval classes

0

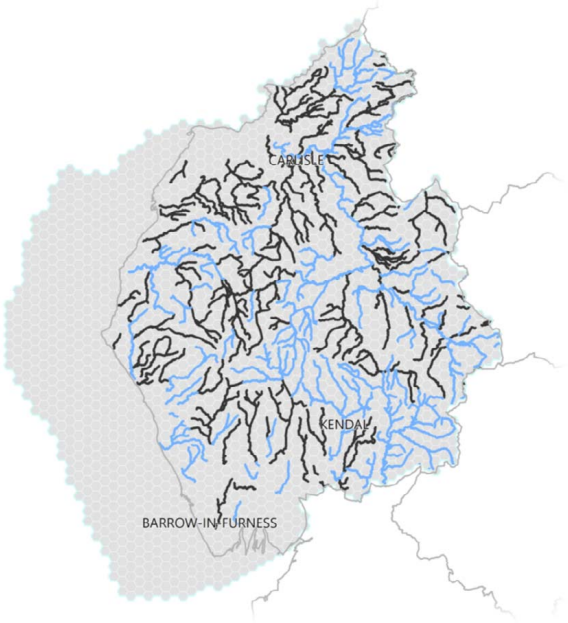
No data / not applicable

5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

C Naturalness of Watercourses (ID: 64)

WFD river 'ecological status' describes how the quality of a river compares to its natural 'reference' condition. It is based on biological quality elements, supported by physico-chemical and hydromorphological quality elements. The map shows length of river with 'good' or 'high' WFD Ecological Status in 2016.



WFD Ecological Status:

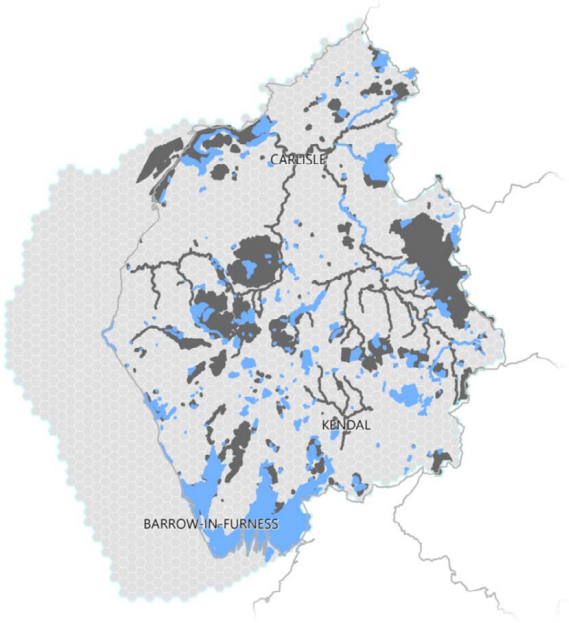
'High' or 'Good'

'Moderate', 'Poor' or 'Bad'

C G Favourable Condition of SSSIs (ID: 65)

Area of SSSIs with 'favourable' condition status mapped using Natural England's SSSI Units dataset. All SSSIs have been mapped below, including those designated for geological features.

Note: To make small areas of SSSI visible, all areas have been mapped with a thick border. This means areas may appear larger on this map than they are in reality.



SSSI Condition:

Favourable

Unfavourable, part destroyed, destroyed or not assessed

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

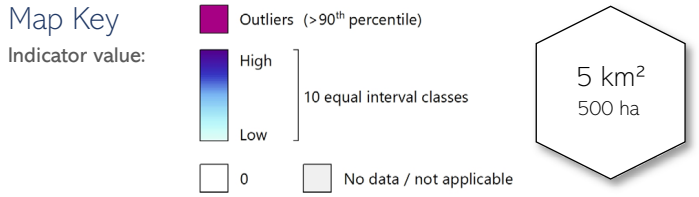
- C Cultural services

Geodiversity:

- G Geodiversity services

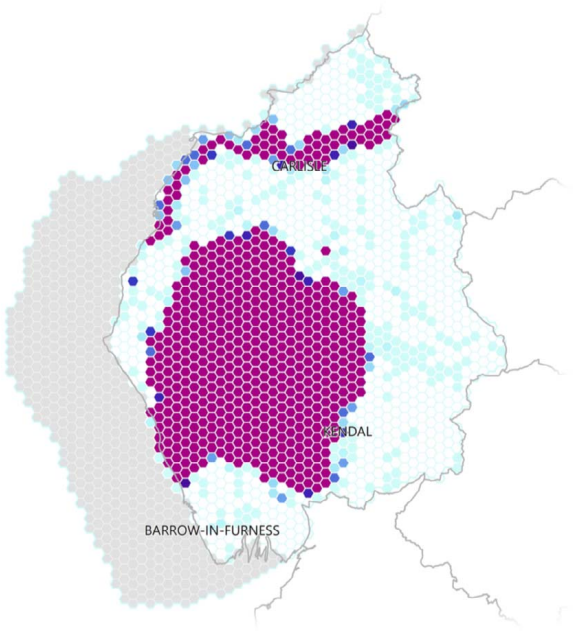
ASSET QUALITY

Indicators of habitat quality: Cultural



C Designated Historic Environment Assets (ID: 66)

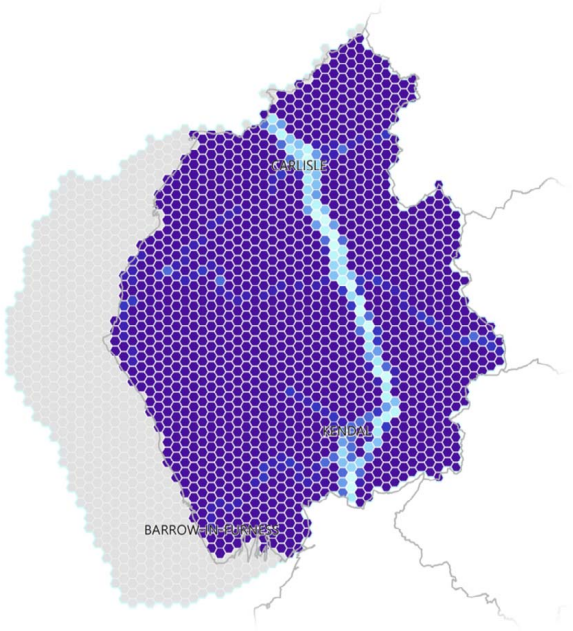
Area of designated historic environment assets (World Heritage Sites, scheduled monuments, parks and gardens, battlefields) mapped using Historic England's designated sites datasets.



Hexagon values: 0 – 1.38 km²; Outliers: 1.38 – 5 km²

C Tranquillity (ID: 67)

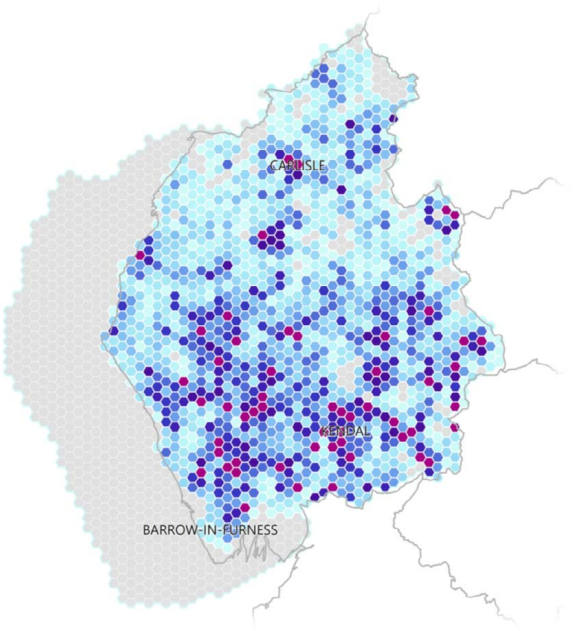
This map indicates areas where roads or rail impact on tranquillity using Defra's 2012 modelled noise map (combined road and rail, 24hr annual average). There will be other factors which contribute to tranquillity which should be considered locally.



Hexagon values: 0 – 5 km² (see note on data distribution)
N.b. There are no 'outliers' symbolised on this map because a large number of the data values are distributed at the high end of the scale. Instead, 10 equal interval classes are used.

C Public Rights of Way (ID: 68)

Length of Public Right of Way mapped by combining open Local Authority datasets. N.b. for small areas it is difficult to differentiate between no data and absence of PROW, therefore all gaps are being treated as no data (grey).



Hexagon values: 0 – 13.61 km; Outliers: 13.61 – 46.31 km

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ASSET LOCATION

In addition to quantity and quality of natural assets, it is important to consider how the size and location of these assets affects ecosystem service provision.

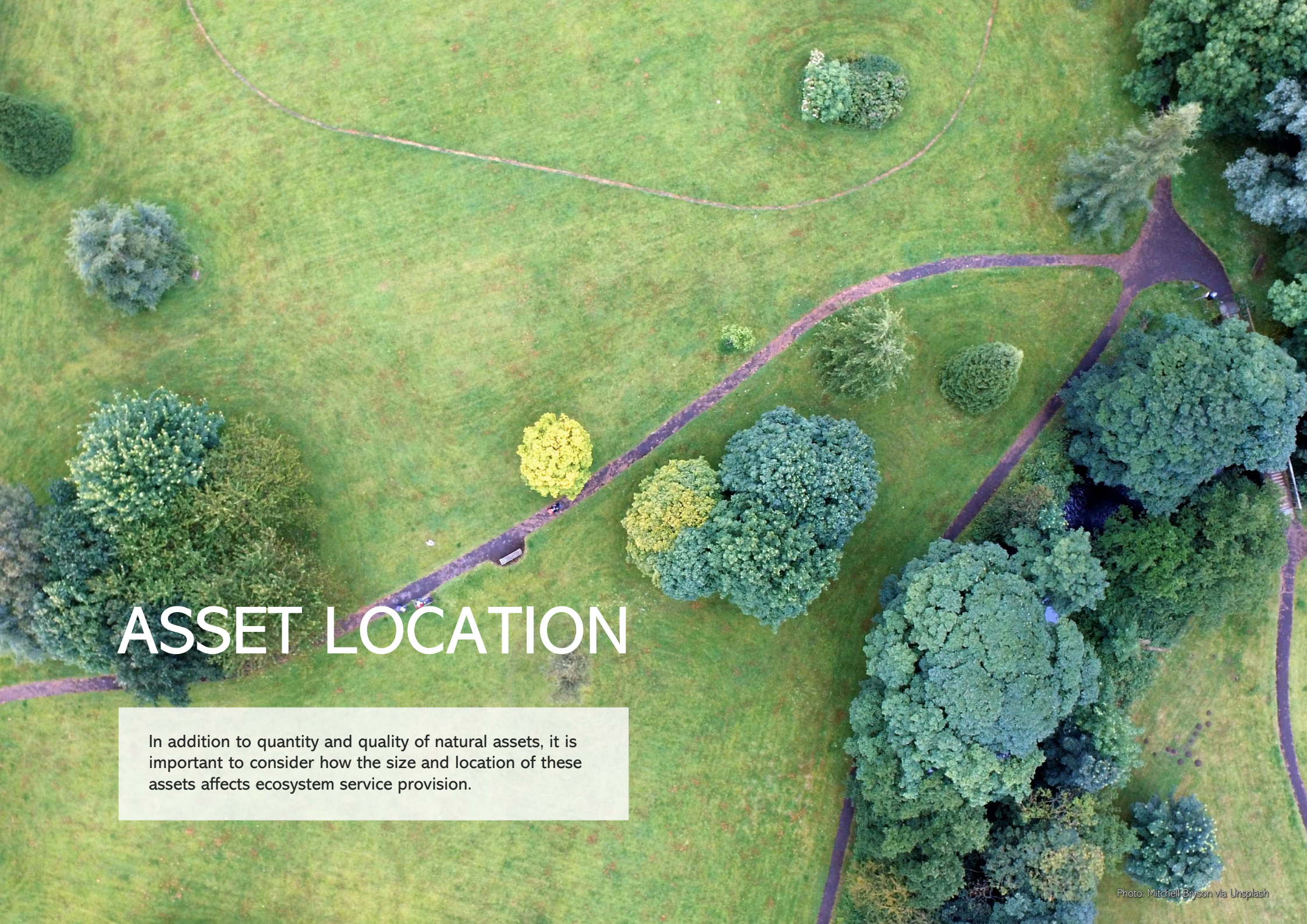


Photo: Mitchell Bryson via Unsplash

ASSET LOCATION

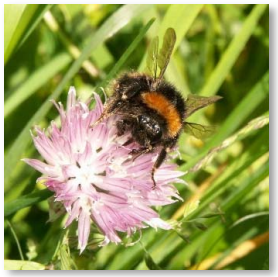
Previous chapters have described how the quantity and the quality of habitats influence the level of ecosystem services that those habitats provide, and subsequently the benefits received by society. This chapter describes how the location of habitats can also have a significant impact on ecosystem service provision. It is important to understand how the location of habitats in relation to other features in the landscape or beneficiaries, influences the level of service provision and also the number of people that benefit.

Habitats can reduce pollution of rivers and lakes by intercepting and filtering surface water runoff, but only if they are positioned along the transfer pathway between the pollution source and the receiving water bodies. Located in the right place, they can also reduce downstream flood risk by storing or slowing the flow of water and improve air quality by filtering the air.


Photo: Peter Fleming via Unsplash

Ecosystem Services

The following are key ecosystem services that can be assessed using the asset location indicators which are mapped in this atlas (shown on the following page).



Pollination

Pollination underpinning cultivated crops dependent on insect pollination e.g. field beans, apples, plums, pears, cucumbers, strawberries, oil seed rape.

Biodiversity - thriving plants and wildlife

Biodiversity, in and of itself, and underpinning all other services such as recreation (including wildlife watching), tourism, research and education, food from wild populations & aquaculture, flood protection (salt marsh, dunes), climate regulation.

Asset Location Indicators

This page illustrates how the indicators for asset location are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped in this atlas.

Indicator	Habitat Types	Pollination	Biodiversity - thriving plants and wildlife
Patch size, shape and edge	Fr / Fa / Gr / MMH / Wo / Ur	●	●

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

ASSET LOCATION

Indicators describing the location of habitats

Map Key

Indicator value:

- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

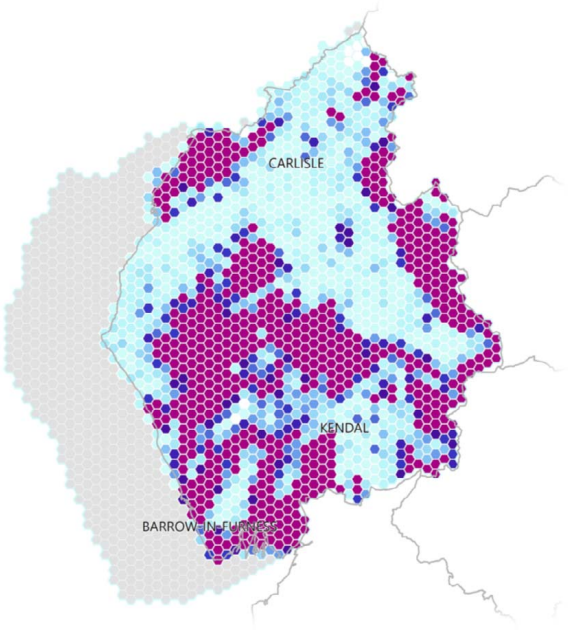
5 km²
500 ha

Note: All maps are © Natural England, 2020. Data sources and attributions for each map are listed on pages 82 and 83.

(P) (H) Patch size, shape and edge (ID: 69)

This is a difficult indicator to map for all habitat types combined and at a national scale. Factors such as habitat type, area, patch size and proximity should be considered. A combination of maps are included here to show average patch size and total habitat area for each spatial unit, using Natural England's Priority Habitats Inventory.

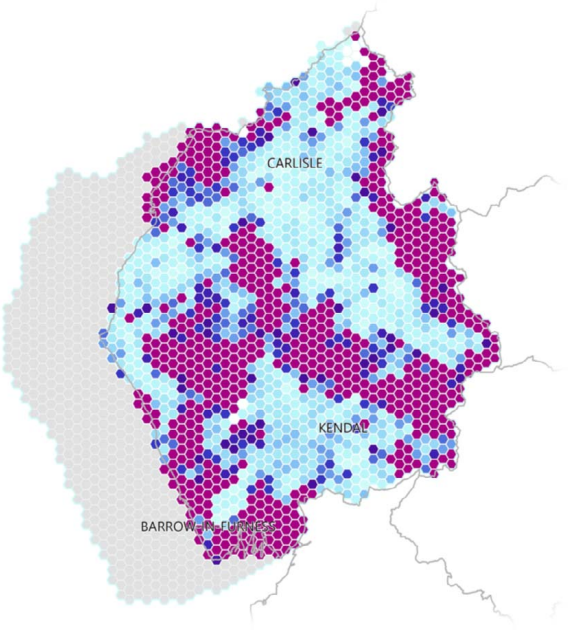
Total Priority Habitat Area



Hexagon values: 0 – 2.16 km²; Outliers: 2.16 – 5 km²

Average Patch Size

Note: this indicator can have hexagon values that are larger than the size of each hexagon because it uses the total size of patches that intersect each hexagon.



Hexagon values: 0 – 0.05 km²; Outliers: 0.05 – 89.67 km²

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- (M) Timber, hay and other materials
- (W) Fish and other marine products from wild sources
- (P) Plant-based energy
- (C) Cultivated crops
- (S) Water supply
- (R) Livestock

Regulating:

- (W) Water quality
- (A) Air quality
- (N) Noise regulation
- (M) Erosion control
- (F) Flood protection
- (P) Pollination
- (H) Biodiversity - thriving plants and wildlife
- (C) Climate regulation

Cultural:

- (C) Cultural services

Geodiversity:

- (G) Geodiversity services

ECOSYSTEM SERVICE FLOW

Through the previous sections in this atlas, the quantity, quality and location of natural capital assets have been investigated and mapped. This section starts to look at the next step of the natural capital logic chain: the flow of ecosystem services from a natural asset through to the people who benefit.

Photo: Denny Muller via Unsplash

ECOSYSTEM SERVICE FLOW

Thus far, this atlas has focused on the state of natural capital assets. The final part of the assessment looks at the flow of ecosystem services from habitats to humans and attempts to measure and map this process, for specific services.

The flow of ecosystem services is often difficult to measure as there are usually numerous factors that influence the service in question. For example, for water quality it is difficult to separate out improvements produced by riparian woodland from other factors, especially pollution inputs. Natural England's Natural Capital Indicators Project (2018) identified a number of indicators and datasets for ecosystem service flow, though many of these were not feasible to map at a national scale. The following pages show maps and tables that attempt to describe a selection of these ecosystem services, including water available for abstraction and carbon storage.

Ecosystem Services

The following are key ecosystem services that can be assessed using indicators which are mapped in this atlas (shown on the following page).

Water Quality

Clean water, also underpinning e.g. water supply, sustainable ecosystems, cultural services, health benefits.

Water Supply

Plentiful water e.g. water for drinking, domestic use, irrigation, livestock, industrial use including cooling, wildlife.

Climate Regulation

Equitable climate e.g. reduced risk of drought, flood & extreme weather events, lower summer temperatures, reduced health & safety risks, protection of infrastructure/lack of transport disruption.

Cultivated Crops

Food from crops e.g. cereals, vegetables, fruit.

Livestock

Products from animals e.g. meat, dairy products, honey.

Ecosystem Service Flow Indicators

This page illustrates how the indicators for ecosystem service flow are connected to ecosystem services, benefits and value, as shown in the logic chain below. The Natural England Natural Capital Indicators report only produced logic chains for key ecosystem services from each broad habitat type, therefore the matrix below shows the short-list indicators for the key ecosystem services which are mapped and tabulated in this atlas.

Indicator ↓	Habitat Types ↓	Cultivated crops	Water supply *	Livestock	Water quality	Climate regulation
Number and type of reared animals (table)	Fa / Gr / MMH			●		
Production of crops (table)	Fa	●				
Amount of water available for abstraction	Fr / MMH		●			
Carbon sequestered and greenhouse gases fixed	All					●
Water quality (chemical & biological, including viral & bacterial)	Fr / Co / MMH				●	

Habitat types: Fr – Freshwater, Fa – Farmland, Gr – Grassland, MMH – Mountains, Moors and Heaths, Wo – Woodland, Ur – Urban, Co – Coastal, Ma - Marine

* Ecosystem service that was considered for freshwater catchments

ECOSYSTEM SERVICE FLOW

Indicators describing the flow of ecosystem services from habitats

C Production of Crops (ID: 70)

Summary of crop data from DEFRA June Survey of Agriculture and Horticulture 2016 by local authority.

Local Authority	Total Farmed Area (ha)	Cereals (ha)	Other arable crops (ha)	Total crops (ha)	Percentage of farmed area used for crops
ALLERDALE	99,391	8,156	1,103	9,259	9
BARROW-IN-FURNESS	4,028	154	34	187	5
CARLISLE	74,060	7,618	1,073	8,690	12
COPELAND	55,443	1,948	362	2,310	4
EDEN	161,284	8,963	1,603	10,566	7
SOUTH LAKELAND	113,798	1,432	693	2,124	2

R Number and Type of Reared Animals (ID: 71)

Summary by local authority of number of reared animals (total livestock and individual types of reared animal), from DEFRA June Survey of Agriculture and Horticulture 2016.

Local Authority	Cattle	Sheep	Pigs	Poultry	Total livestock
ALLERDALE	115,895	345,604	11,121	664,559	1,137,179
BARROW-IN-FURNESS	4,571	14,392	701	4,313	23,977
CARLISLE	94,935	211,895	20,775	376,102	703,707
COPELAND	35,828	206,494	2,791	265,966	511,079
EDEN	124,735	729,391	13,190	1,448,802	2,316,118
SOUTH LAKELAND	72,550	527,319	3,031	189,515	792,415

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services

ECOSYSTEM SERVICE FLOW

Indicators describing the flow of ecosystem services from habitats

Map Key

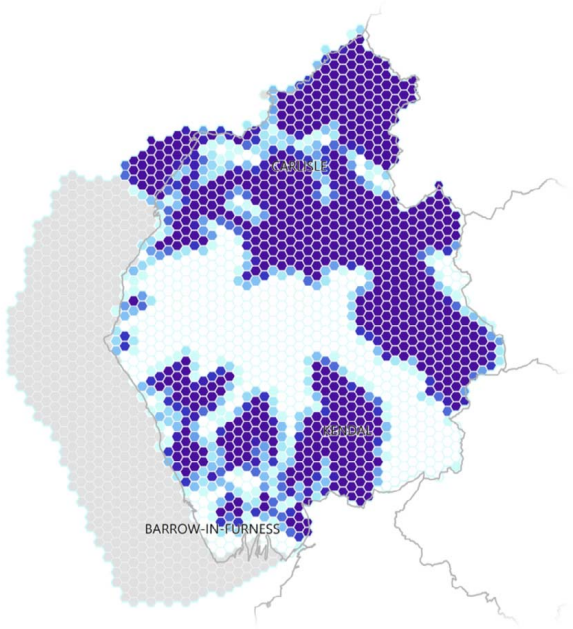
Indicator value:

- Outliers (>90th percentile)
- High
- Low
- 10 equal interval classes
- 0
- No data / not applicable

5 km²
500 ha

S Amount of Water Available for Abstraction (ID: 72)

Area of land where surface water is available for abstraction at least 70% of the time, mapped using EA's Water Resource Availability and Abstraction Reliability Cycle 2 dataset.



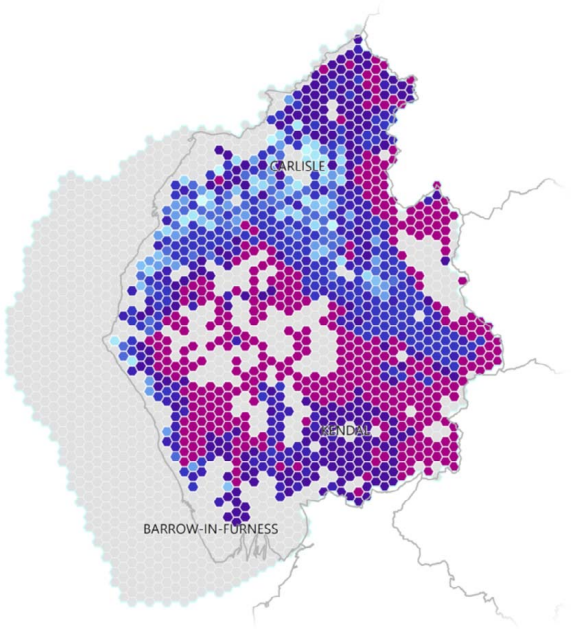
Hexagon values: 0 – 5 km² (see note on data distribution)

N.b. There are no 'outliers' symbolised on this map because a large number of the data values are distributed at the high end of the scale. Instead, 10 equal interval classes are used

C Carbon Sequestered & Greenhouse Gases Fixed (ID: 73)

Mean estimates of carbon density in topsoil (0-15cm depth) – tonnes per hectare, mapped using data produced from Natural England and CEH's 'Mapping Natural Capital' project (2016).

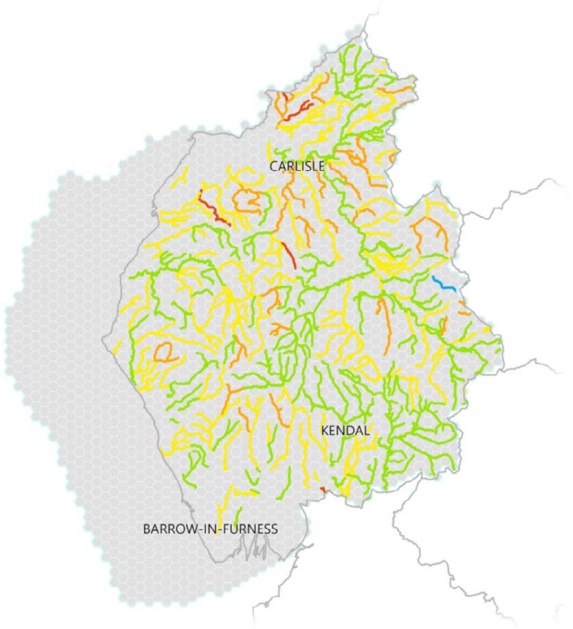
N.b. This dataset is statistically extrapolated to a national level from CEH Countryside Survey data 2007.



Hexagon values: 45.64 – 74.73 t; Outliers: 74.73 – 101.27 t

W Water quality (chemical & biological, including viral & bacterial) (ID: 74)

Overall status of rivers, canals and surface water under the Water Framework Directive mapped using Environment Agency WFD Cycle 2 2016 data.



WFD Overall Status:

- High
- Good
- Moderate
- Poor
- Bad

Ecosystem Services Key

The coloured circles denote the key ecosystem services that are associated with each indicator

Provisioning:

- M Timber, hay and other materials
- W Fish and other marine products from wild sources
- P Plant-based energy
- C Cultivated crops
- S Water supply
- R Livestock

Regulating:

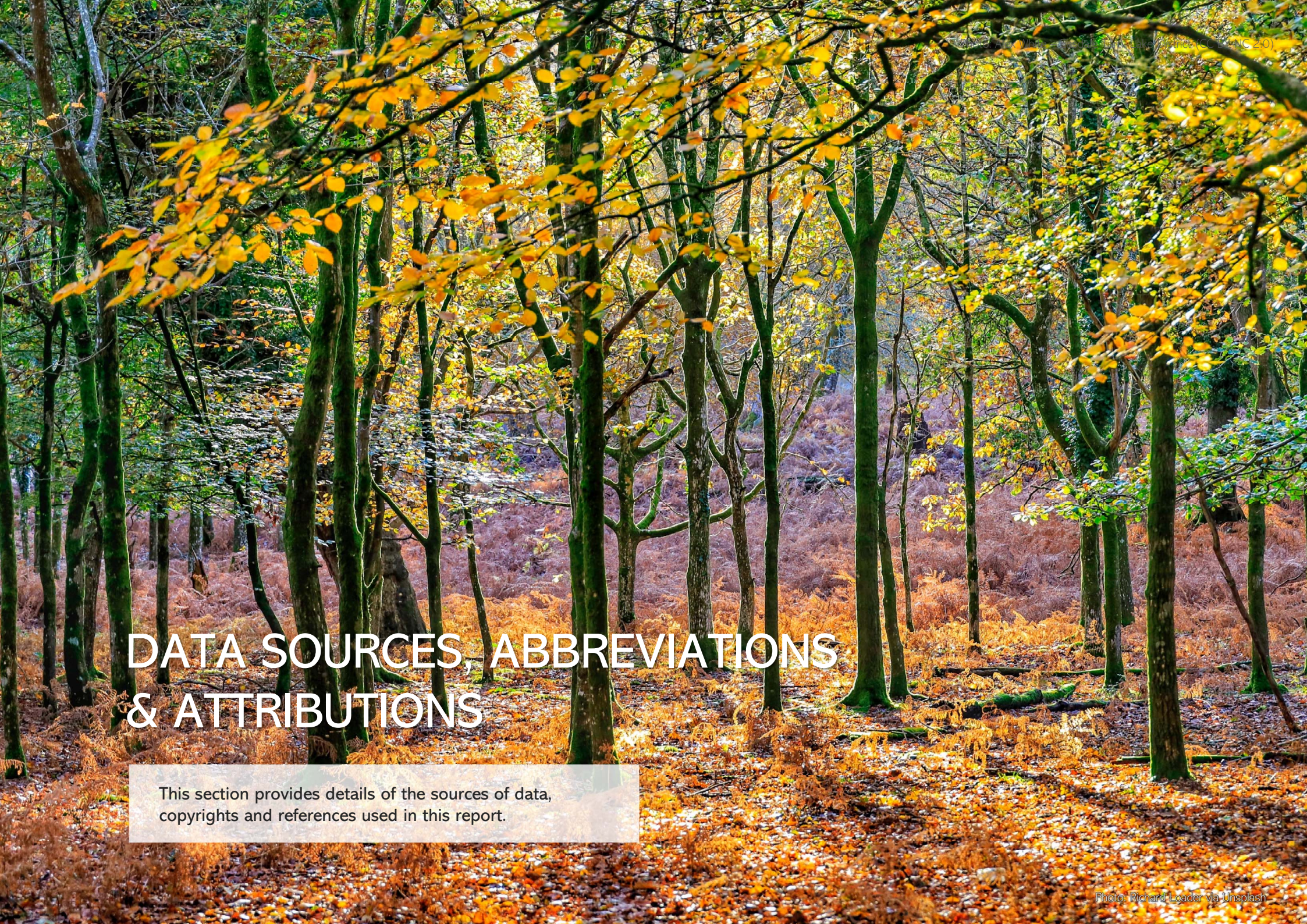
- W Water quality
- A Air quality
- N Noise regulation
- M Erosion control
- F Flood protection
- P Pollination
- H Biodiversity - thriving plants and wildlife
- C Climate regulation

Cultural:

- C Cultural services

Geodiversity:

- G Geodiversity services



DATA SOURCES, ABBREVIATIONS & ATTRIBUTIONS

This section provides details of the sources of data, copyrights and references used in this report.

Photo: Richard Loader via Unsplash

Dataset Sources

Numbers in pink show which maps/indicators the dataset was used to create.
Please note: the indicator list and data references include the coastal and marine indicators, which only appear in the relevant atlases.

Centre for Ecology & Hydrology (CEH)

- **Land Cover Map 2015** (13, 14, 20, 63)

  LCM2015 © NERC (CEH) 2011. Contains Ordnance Survey data © Crown Copyright 2007.
  Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (25m raster, GB). NERC Environmental Information Data Centre. https://doi.org/10.5285/bb15e200-9349-403c-bda9-b430093807c7

- **UK Lakes Portal** (3, 21)

  UK Lakes Database © Centre for Ecology and Hydrology Contains Ordnance Survey data © Crown copyright and database right [2020]
  Hughes M., Bennion H., Kernan M., Hornby D.D., Hilton J., Phillips G. & Thomas R. (2004) The development of a GIS-based inventory of standing waters in Great Britain together with a risk-based prioritisation protocol. Water, Air, and Soil Pollution: Focus, 4 (2-3), 73-84. 10.1023/B:WAFO.0000028346.27904.83

- **Inventory of reservoirs amounting to 90% of total UK storage** (7, 21)

  Durant, M.J.; Counsell, C.J. (2018). Inventory of reservoirs amounting to 90% of total UK storage. NERC Environmental Information Data Centre. https://doi.org/10.5285/f5a7d56c-cea0-4f00-b159-c3788a3b2b38

Department for Environment, Food & Rural Affairs (Defra)

- **Strategic Noise Mapping** (67)

  © Defra

- **Structure of the agricultural industry in England and the UK at June 2016** (70, 71)

  https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june

EMODnet / Natural England / Defra

- **Intertidal mudflats layer for England** (39)

  Contains Defra information © Defra - Project MB0102

Environment Agency

The following datasets were used in this atlas:
© Environment Agency and/or database right

- **Saltmarsh Extents** (40)
- **WFD Water Body Water Status** (52, 55, 56, 64, 74)
- **Reasons for Not Achieving Good Database** (53)
- **WFD River Waterbodies Cycle 1** (6, 23)
- **WFD River Waterbodies Cycle 2** (52, 53, 54, 55, 56, 64, 74)
- **WFD Groundwater Bodies Cycle 2** (51)
- **Surface Water Resource Availability and Abstraction Reliability Cycle 2** (72)
- **Risk of Flooding from Rivers and Sea** (1)
- **Potential Sites of Hydropower Opportunity** (54)
- **Detailed River Network** (9)

Forestry Commission

- **National Forest Inventory** (11, 27, 28, 29, 36)

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Historic England

The following datasets were used in this atlas: © Historic England [2020]. Contains Ordnance Survey data © Crown copyright and database right [2020]

- **Scheduled Monuments** (66)
- **World Heritage Sites** (66)
- **Registered Battlefields** (66)
- **Registered Parks and Gardens** (66)

Joint Nature Conservation Committee (JNCC)

- **UKSeaMap 2018** (48, 49, 50)
  © Joint Nature Conservation Committee
- **Potential Annex 1 Reefs** (46)
  © Joint Nature Conservation Committee

Map/Indicator List

Asset Quantity

1 Active flood plain
2 Coastal & floodplain grazing marsh
3 Lakes & standing waters
4 Lowland fens
5 Lowland raised bog
6 Rivers
7 Modified waters (reservoirs)
8 Reedbeds
9 Ponds
10 Blanket bog
11 Woodland
12 Other semi-natural habitats
13 Arable & horticulture
14 Improved grassland
15 Orchards & top fruit
16 Meadows
17 Other semi-natural grasslands
18 Blanket bog
19 Dwarf shrub heath
20 Inland rock, scree and pavement (above moorland line)
21 Lakes and reservoirs (above moorland line)
22 Mountain heath and willow scrub
23 Rivers (above moorland line)
24 Semi-natural grassland (above moorland line)
25 Upland flushes fens and swamps
26 Wood pasture (above moorland line)
27 Woodland (above moorland line)
28 Broadleaved, mixed & yew woodland
29 Coniferous woodland
30 Ancient woodland
31 Priority woodland habitats
32 Blue space
33 Green space: not semi-natural
34 Open mosaic habitats
35 Semi-natural habitats
36 Woodland, scrub and hedge
37 Beach
38 Coastal lagoons
39 Mudflats
40 Salt marsh
41 Sand dunes
42 Sea cliff
43 Shingle
44 Intertidal rock
45 Maerl beds
46 Reefs
47 Sea grass beds
48 Shallow subtidal sediment
49 Shelf subtidal sediment
50 Subtidal rock

Asset Quality

51 Natural aquifer function
52 Naturalness of flow regime
53 Lack of physical modifications of water bodies
54 River continuity – lack of obstructions
55 Chemical status of water bodies
56 Nutrient status of water bodies
57 Nutrient status of soil/sediment
58 Peat depth
59 Soil carbon/organic matter content
60 Soil biota
61 Naturalness of biological assemblage
62 Presence & frequency of pollinator (larval & adult) food plants
63 Extent of permanent vegetation cover
64 Naturalness of watercourses
65 Favourable condition of SSSIs
66 Designated historic environment assets
67 Tranquility
68 Public Rights of Way

Asset Location

69 Patch size, shape and edge

Ecosystem Service Flow

70 Production of crops
71 Number and type of reared animals
72 Amount of water available for abstraction
73 Carbon sequestered and greenhouse gases fixed
74 Water Quality (chemical & biological, including viral & bacterial)

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Natural England

The following datasets were used in this atlas: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right [2020]

- **Priority Habitat Inventory** (2, 4, 5, 8, 10, 12, 15, 16, 17, 18, 19, 20, 22, 24, 25, 31, 35, 38, 41, 42, 43, 69)
- **SSSI Units** (65)
- **Open Mosaic Habitat (Draft)** (34)
- **Wood Pasture and Parkland** (26)
- **Open Marine Evidence GDB** (44, 45, 47)
- **Ancient Woodlands** (30)

Natural England & Centre for Ecology & Hydrology (CEH)

- **Natural Capital Maps** (57, 59, 60, 61, 62, 73)

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Natural England, British Geological Survey (BGS) and Cranfield University

- **Peaty Soils Location** (58)

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Office for National Statistics (ONS)

- **Built-up Areas (December 2011) Boundaries V2** (32, 35, 36)

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Ordnance Survey

The following datasets were used in this atlas: Contains Ordnance Survey data © Crown copyright and database right [2020]

- **VectorMap District** (7, 9, 21, 32, 37)
- **Open Green Space Layer** (33)
- **Boundary-Line™**

Rural Payments Agency (via MAGIC)

- **Moorland Line (England)** (20, 21, 23, 24, 26, 27)

  Contains Rural Payments Agency data © Crown copyright and database right [2020]

  N.b. Dataset used as a guide for identifying habitats above the moorland line.

Public Rights of Way Data – Multiple Sources

The rights of way data is derived from multiple sources, directed from the rowmaps website: www.rowmaps.com

All datasets used have open licenses (terms equivalent to OS Opendata License or Open Government License). The following Local Authorities produced data that was used to map rights of way in England (70)

- Barnsley Metropolitan Borough Council
- Bath & North East Somerset Council
- Bedford Borough Council
- London Borough of Bexley
- Birmingham City Council
- Blackburn with Darwen Borough Council
- Blackpool Council
- Bolton Council
- BCP Council
- Bracknell Forest Council
- City of Bradford Metropolitan District Council
- Brighton & Hove City Council
- Bristol City Council
- London Borough of Bromley
- Buckinghamshire County Council
- Bury Council
- Calderdale Council
- Cambridgeshire County Council
- Central Bedfordshire Council
- Cheshire East Council
- Cheshire West and Chester Council
- Cornwall Council
- Cumbria County Council
- Derbyshire County Council
- Devon County Council
- Doncaster Council
- Dorset Council
- Dudley Metropolitan Borough Council
- Durham County Council
- East Riding of Yorkshire Council
- East Sussex County Council
- Essex County Council
- Gateshead Council
- Gloucestershire County Council
- Hampshire County Council
- Herefordshire Council
- Hertfordshire County Council
- Hull City Council
- Isle of Anglesey County Council
- Isle of Wight Council
- Kent County Council
- Kirklees Council
- Knowsley Metropolitan Borough Council
- Lake District National Park
- Lancashire County Council
- Leicester City Council
- Leicestershire County Council
- Lincolnshire County Council
- Manchester City Council
- Medway Council
- Norfolk County Council
- North Lincolnshire Council
- North Somerset Council
- North Yorkshire County Council
- Northamptonshire County Council
- Northumberland County Council
- Nottingham City Council
- Nottinghamshire County Council
- Oldham Council
- Oxfordshire County Council
- Peterborough City Council
- Plymouth City Council
- Bournemouth, Christchurch and Poole Council
- Portsmouth City Council
- Reading Borough Council
- Redcar and Cleveland Borough Council
- Rochdale Borough Council
- Rotherham Metropolitan Borough Council
- Rutland County Council
- Salford City Council
- Sefton Council
- Sheffield City Council
- Shropshire Council
- Slough Borough Council
- Somerset County Council
- South Gloucestershire Council
- Southampton City Council
- St Helens Council
- Staffordshire County Council
- Stockport Metropolitan Borough Council
- Stockton Council
- Suffolk County Council
- Surrey County Council
- Tameside Metropolitan Borough Council
- Thurrock Council
- Torbay Council
- Trafford Council
- Wakefield Council
- Walsall Council
- Warrington Borough Council
- Warwickshire County Council
- West Berkshire Council
- West Sussex County Council
- Wigan Council
- Wiltshire Council
- Royal Borough of Windsor and Maidenhead Council
- Wirral Council
- Wokingham Borough Council
- Worcestershire County Council
- City of York Council

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42 Sea cliff
43 Shingle
44 Intertidal rock
45 Maerl beds
46 Reefs
47 Sea grass beds
48 Shallow subtidal sediment
49 Shelf subtidal sediment
50 Subtidal rock

Asset Quality

51 Natural aquifer function
52 Naturalness of flow regime
53 Lack of physical modifications of water bodies
54 River continuity – lack of obstructions
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57 Nutrient status of soil/sediment
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67 Tranquility
68 Public Rights of Way

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Ecosystem Service Flow

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71 Number and type of reared animals
72 Amount of water available for abstraction
73 Carbon sequestered and greenhouse gases fixed
74 Water quality (chemical & biological, including viral & bacterial)

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Lusardi, J., Rice, P. Waters, R.D. & Craven J. (2018). **Natural Capital Indicators: for defining and measuring change in natural capital**. Natural England Research Report, Number 076

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- Henrys, P.A.; Keith, A.M.; Robinson, D.A.; Emmett, B.A. (2012). NERC Environmental Information Data Centre
  - **Model estimates of topsoil invertebrates [Countryside Survey].** (http://doi.org/10.5285/f19de821-a436-4b28-95f6-b7287ef0bf15)
  - **Model estimates of topsoil carbon [Countryside Survey].** (http://doi.org/10.5285/9e4451f8-23d3-40dc-9302-73e30ad3dd76)
  - **Model estimates of topsoil nutrients [Countryside Survey].** (http://doi.org/10.5285/7055965b-7fe5-442b-902d-63193cbe001c)
- Maskell, L.; Henrys, P.; Norton, L.; Smart, S. (2016). NERC Environmental Information Data Centre
  - **Bee nectar plant diversity of Great Britain** (http://doi.org/10.5285/623a38dd-66e8-42e2-b49f-65a15d63beb5)
  - **Model estimates of expected diversity of positive plant habitat condition indicators** (http://doi.org/10.5285/cc5ae9b1-43a0-475e-9157-a9b7fccb24e7)

Piotto, Daniel. (2008). **A meta-analysis comparing tree growth in monocultures and mixed plantations**. Forest Ecology and Management. 255. 781-786. http://doi.org/10.1016/j.foreco.2007.09.065

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Sunderland, T., Waters, R.D., Marsh, D. K. V., Hudson, C., & Lusardi, J. (2019). **Accounting for National Nature Reserves: A natural capital account of the National Nature Reserves managed by Natural England**. Natural England Research Report, Number 078

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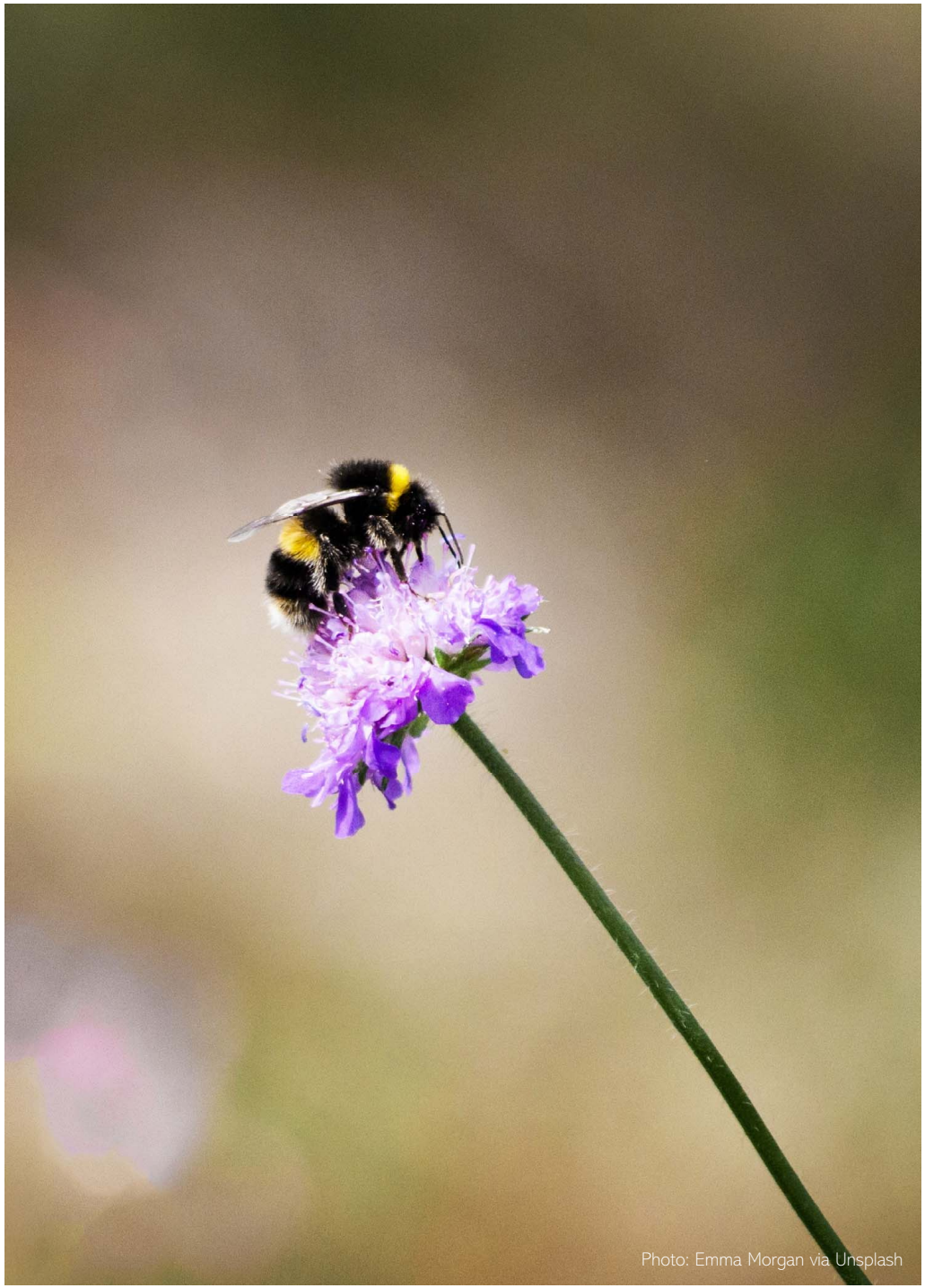

Photo: Emma Morgan via Unsplash

Photo Attributions

Most photo attributions are given as text on the photo itself, but the following sources were used for the ecosystem services photos, included on each of the chapter introduction pages.

1. Timber, hay and other materials:
[Flickr] Steven Lilley – Timber pile (CC BY-SA 2.0)

2. Fish and other marine products from wild sources:
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3. Plant-based energy:
[Flickr] David Wright – Miscanthus (CC BY 2.0)

4. Cultivated crops:
[Flickr] Andrew Gustar – Wheat (CC BY-ND 2.0)

5. Water supply:
[Pexel] Sarah Jane – Person using Watering Can

6. Livestock:
[Flickr] BenGrantham – Mooooo (CC BY 2.0)

7. Water quality:
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Abbreviations

Defra	Department for Environment, Food & Rural Affairs
CICES	Common International Classification of Ecosystem Services
EA	Environment Agency
CEH	Centre for Ecology & Hydrology
WFD	Water Framework Directive
OS	Ordnance Survey
FC	Forestry Commission
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
UK NEA	UK National Ecosystem Assessment
LCM2015	Land Cover map 2015
NFU	National Farmers Union
STEAM	Scarborough Tourism Economic Activity Model
AML	Above Moorland Line
RPA	Rural Payments Agency
ONS	Office for National Statistics
JNCC	Joint Nature Conservation Committee
EUNIS	European University Information Systems
SWMI	Significant Water Management Issue
INNS	Invasive Non-Native Species
SSSI	Site of Special Scientific Interest
PROW	Public Right of Way