National Character Area profile:

6: Solway Basin

Supporting documents

NATURAL ENGLAND

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Introduction

As part of Natural England's responsibilities as set out in the Natural Environment White Paper[1], Biodiversity 2020[2] and the European Landscape Convention[3], we are revising profiles for England's 159 National Character Areas (NCAs). These are areas that share similar landscape characteristics, and which follow natural lines in the landscape rather than administrative boundaries, making them a good decision-making framework for the natural environment.

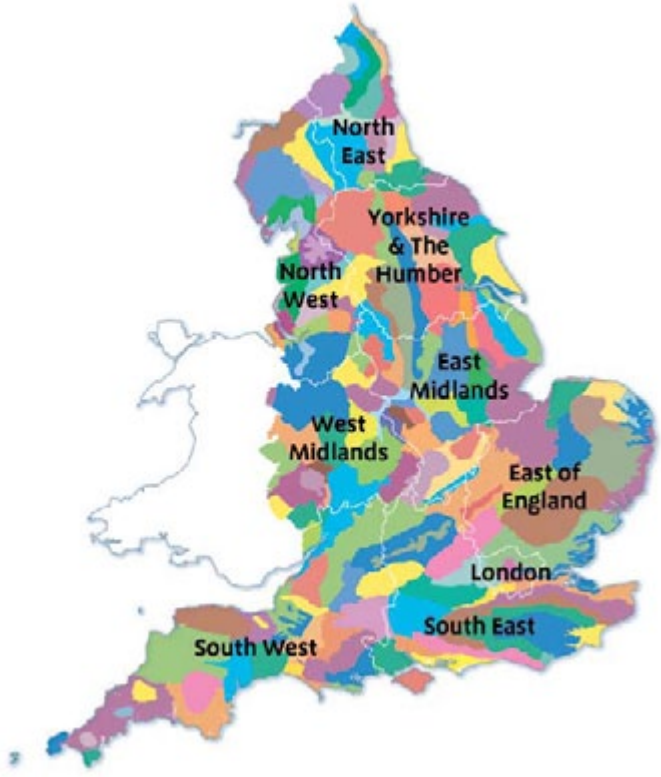
NCA profiles are guidance documents which can help communities to inform their decision-making about the places that they live in and care for. The information they contain will support the planning of conservation initiatives at a landscape scale, inform the delivery of Nature Improvement Areas and encourage broader partnership working through Local Nature Partnerships. The profiles will also help to inform choices about how land is managed and can change.

Each profile includes a description of the natural and cultural features that shape our landscapes, how the landscape has changed over time, the current key drivers for ongoing change, and a broad analysis of each area's characteristics and ecosystem services. Statements of Environmental Opportunity (SEOs) are suggested, which draw on this integrated information. The SEOs offer guidance on the critical issues, which could help to achieve sustainable growth and a more secure environmental future.

NCA profiles are working documents which draw on current evidence and knowledge. We will aim to refresh and update them periodically as new information becomes available to us.

We would like to hear how useful the NCA profiles are to you. You can contact the NCA team by emailing ncaprofiles@naturalengland.org.uk

National Character Areas map

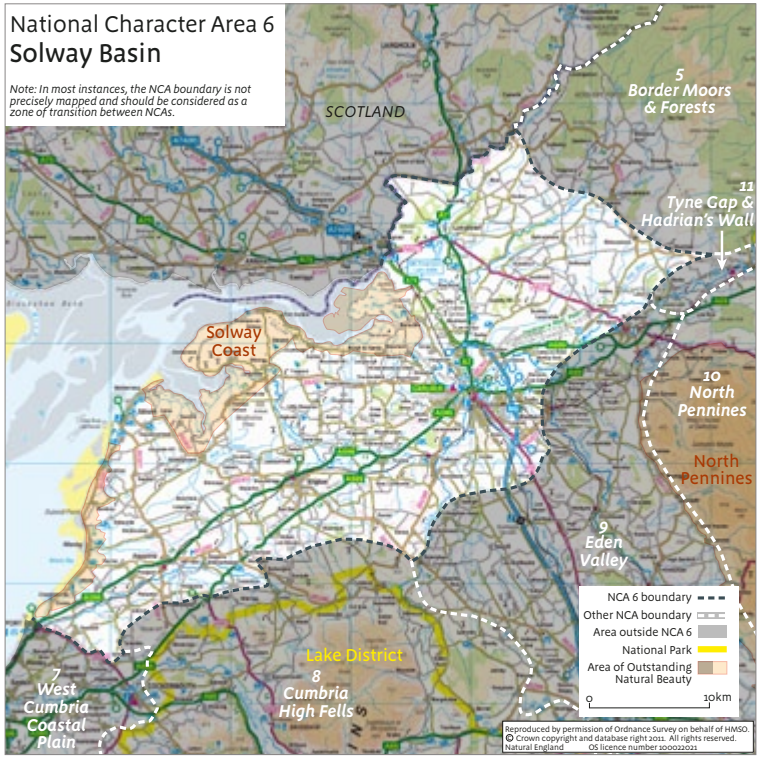


[1] The Natural Choice: Securing the Value of Nature, Defra (2011; URL: www.official-documents.gov.uk/document/cm80/8082/8082.pdf)
[2] Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services, Defra (2011; URL: www.defra.gov.uk/publications/files/pb13583-biodiversity-strategy-2020-111111.pdf)
[3] European Landscape Convention, Council of Europe (2000; URL: http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm)

Summary

The Solway Basin is a low-lying National Character Area (NCA) of gently undulating low hills that grade into the coastal plain and estuarine landscape of the Solway Firth. To the east and south and across the lowlands of the Dumfries coast to the north, the lowland landscape is framed by the uplands of the Lake District, the North Pennines and southern Scotland. The area has a long history as border country, originally divided by the Roman frontier of Hadrian's Wall, which has World Heritage Site designation, and through succeeding centuries it has been a part of the disputed lands of the English–Scottish border. The area is dominated by pastoral agriculture in rectilinear fields bounded by hedges but with increasing arable farming on the low hills. The coastal zone is characterised by a more open, wind-swept, dynamic and tidal landscape of salt marshes, beaches, sand dunes and intertidal flats along the margins of the Solway Firth and the Irish Sea.

As well as being part of the Solway Coast Area of Outstanding Natural Beauty (AONB), almost the entire NCA coastline and many of the lowland wetlands are nationally and internationally important for their habitats and the species they support, as well as for their geomorphology and record of past environmental conditions. Along the coast, the Solway Firth is designated as a Special Area of Conservation (SAC) for its salt marshes, sand dunes and intertidal habitats, and as a Special Protection Area and Ramsar site for its populations of breeding birds and wintering waders and wildfowl, including barnacle geese and whooper swans, whose daily movements between roosts and feeding areas are also an iconic feature of the landscape. Inland from the coast, many of the series of lowland raised bogs make up the South Solway Mosses SAC which includes the most intact and extensive series of sites in England, with their unique communities of peat-forming mosses, dwarf shrubs, cotton grasses and large heath butterflies. This is added to in the eastern part of the NCA by Bolton Fell Moss SAC and Walton Moss SAC and the River Eden SAC, which extends far beyond this NCA, with its populations of salmon, otter and lamprey and its beds of water crowfoot.



Settlements are scattered across the NCA area, with a number along the coast, but the largest is Carlisle. Developed at a strategic crossing of the River Eden, it has been a settlement site since at least Roman times and has been an important defensive site through the centuries of border disputes with Scotland as well as a focus for both north–south and east–west travel and trade. This cathedral city has grown up around a fortified medieval core built of red sandstone but has expanded over peaceful times and is well known for its Georgian architecture.

Dominated by pastoral agriculture, the rural landscape is also important for recreation supported by the AONB coastline, the Hadrian's Wall Path (a National Trail), the new England Coastal Path and the attractions of the open tranquil landscapes which are asset-rich in both historic and natural heritage. In recent years the landscape and the views across the surrounding uplands and the northern Irish Sea have been modified by wind turbines, including both large- and small-scale developments.

In the future, climate change and its associated impacts on sea levels and weather patterns are likely to have an even greater effect on this low-lying area at the head of the Irish Sea; adaption to these challenges will be a driver for future management.

Protecting and restoring peat bogs supports unique wildlife, protects archaeology and stores carbon.

Statements of Environmental Opportunity

SEO 1: Conserve and enhance the designated coastal landscapes and the diverse range of habitats of the Solway coast, managing the internationally important coastal and estuary systems, including the intertidal flats, salt marshes and sand dunes, for the species they support, their geomorphology, recreation and tranquillity value and the flood risk protection they provide, in order to aid adaptation to the effects of climate change and enhance their importance in the local economy.

SEO 2: Manage and restore the freshwater wetland landscape of the Solway Basin, including internationally important raised bogs and rivers with their associated fens, lakes, riparian woodlands and channels, for the important habitats they provide, their contribution to landscape character, the environmental record and historical assets they hold, and to manage flood risk and maintain water quality.

SEO 3: Work with landowners and land managers to protect, enhance and strengthen the network of farmland features; create and expand farmland habitats to enhance biodiversity and improve soil and water quality; strengthen the resilience of habitats to climate change; enhance landscape character; and support a diverse rural economy.

SEO 4: Conserve and promote the historic landscape and settlement character, including the many heritage assets linked to the area's history as a disputed boundary zone, such as the World Heritage Site of Hadrian's Wall, promote education and understanding through interpretation, enhance recreation opportunities and ensure that the design of new development enhances the character of the area.

Allonby on the outer Solway Coast. Vernacular settlement style varies across the NCA in response to local resources.

Description

Physical and functional links to other National Character Areas

The Solway Basin National Character Area (NCA) is a broad, lowland landscape of low rounded hills grading to a coastal plain that is fringed to the north and west by the relatively remote coastline of the Solway Firth and Irish Sea. It is framed by the Cumbria High Fells NCA to the south, the hills of the Scottish borders to the north and the Border Moors and Forests NCA to the north-east. The pastoral landscape of the broad Eden Valley NCA stretches away to the south-east. The outward views from the NCA are to the encircling uplands of the Lake District, North Pennines and southern Scotland, broken only by the open mouth of the Solway Firth as it expands into the head of the Irish Sea.

The Solway estuary receives water from catchments that drain a large part of North Cumbria and the Scottish borders including, in England, the upland NCAs of the Cumbria High Fells, the Orton Fells, the North Pennines, the Tyne Gap and Hadrian's Wall, and the Border Moors and Forests. Many of these river systems join to form the River Eden which flows down from the Eden Valley NCA, forming an important physical and cultural corridor. Along the coast the relationship with the West Cumbria Coastal Plain NCA is important as the source of sedimentary material that moves northwards along the coast to feed the barrier coastline of the outer Solway.

The eastern part of the area acts a major transport hub with the main routes linking Scotland and England west of the Pennines, such as the M6, A7and the West Coast Main Line railway, and east–west links such as the A69, A595 and the Carlisle to Newcastle railway line converging on Carlisle.

The upland fringes of the NCA are still a broad and open landscape but forestry plantations and more extensive farming systems mark the transition to the adjoining uplands.

Between the first millennium ad and the 16th century, the Solway Basin was a contested and fluid boundary between English and Scottish cultures; accordingly, cultural links with Scotland to the north and Newcastle to the east are as significant as links with other parts of Cumbria. The Roman frontier of Hadrian's Wall with its World Heritage Site status, links the Solway Basin with the Tyne Gap and Hadrian's Wall NCA.

Key characteristics

- A flat, open landscape lying between the more dramatic upland areas of the Cumbria High Fells NCA and the Southern Uplands of Scotland, with smooth low hills inland and a flat coastal plain.
- Geology of underlying Triassic sedimentary sandstones, siltstones, mudstones and, more locally, Carboniferous limestones and coal measures, shaped by glacial processes including streamlining and deposition, and modified by post-glacial coastal, estuarine and peat-forming processes.
- A coastline of sand and pebble beaches backed by low cliffs or sand dunes, internationally important for its vegetated shingle and dune communities and designated as an Area of Outstanding Natural Beauty (AONB).

The entire Svalbard-breeding population of barnacle geese winters on the Solway.

- Extensive areas of coastal salt marsh, with a seaward edge characterised by dendritic creeks and low soft river cliffs and fronted by intertidal mudflats supporting internationally important wildfowl and wader populations.
- Crossed by the lower and gradually flowing reaches of six main rivers, many with catchments that reach far inland.
- Lower than average tree and woodland cover, with native, often ancient, woodland cover largely confined to river valleys on the area's upland margins.
- Improved grassland managed for dairy and beef cattle and sheep, with some arable farming on lighter soils.
- Internationally important suite of lowland raised peat bogs, known as 'mosses', of high conservation value for their biodiversity and as a record of past environmental change.
- Rectilinear fields defined by hedges throughout, with accompanying drainage ditches on reclaimed land and kests (earthbank boundaries) in many areas.
- Along the exposed outer coast, stone-faced kests replace hedges as field boundaries.
- Rich archaeological heritage, particularly in relation to the Roman landscape of Hadrian's Wall and its accompanying infrastructure, and medieval monastic remains.
- Victorian coastal resorts, small market towns and villages. Carlisle is the focus of many primary transport routes and a major crossing point of the River Eden.
- Vernacular building style dominated by red St Bees Sandstone, but with local variations including rare surviving examples of clay-walled buildings.
- Presence of a suite of Second World War airfields, now adapted for recreation or light industry, with wind farms increasing as a feature of the landscape.
- An extensive and tranquil coastline popular with visitors seeking solitude, with links to the new England Coast Path and the Hadrian's Wall Path.

Solway Basin today

The Solway Basin NCA is a shallow basin composed of a broad, lowland plain landscape framed by the uplands of the Cumbria High Fells NCA to the south, the hills of the Scottish borders to the north and the Border Moors and Forests NCA to the east and opening out into the northern parts of the Irish Sea. The dominant character is of a mainly pastoral landscape, with significant areas of arable cropping on gentle hills of glacially streamlined, sedimentary geology and glacial deposits, and extensive areas of reclaimed flood plain and former wetland.

The open expanse of the inner Solway Firth is dominated by large expanses of intertidal mudflats etched by shifting dendritic channels. The intertidal expanse is bordered by wide salt marshes, grazed by cattle and sheep. To the south of the estuary mouth, the Irish Sea coastal fringe, the estuary becomes more exposed and the sediments coarser. Here, intertidal sand flats, with occasional boulder-skears formed from eroded drumlins, are bordered by a narrower strip of shingle and sand beach and sand dune. Along this coast are a few villages and the Victorian coastal resort of Silloth. The dunes themselves are nationally important for their dune communities and are popular with visitors; there are a number of caravan parks spread along the coastal strip.

The coastal zone is designated for its landscape quality as the Solway Coast AONB and is internationally important both for the coastal habitats and for the species they support including large numbers of waders and wildfowl, and natterjack toads. The geomorphology of the Solway is also nationally important, as is the sedimentary record of past sea level change.

River corridors flanked by ancient and riparian woodlands are a feature of the eastern part of the NCA.

Inland from the coastal margin is the broad flat expanse of the Solway Plain. Throughout the coastal plain the landscape is dominated by pastoral agriculture in rectilinear fields framed by hedges, but with some arable particularly on the more elevated land. The pastoral agriculture includes many dairy and beef enterprises with associated land managed for silage. The farmsteads, hamlets and small linear villages are mainly to be found on higher ground and are often linked by road networks that have Roman origins. The larger settlements are generally linked to former religious settlements,

the former railway network, key river crossings or trade points. The smaller settlements are often surrounded by systems of narrow linear fields while field patterns on the lower-lying reclaimed land are larger and more regular.

Crossing the NCA to enter the Solway are a number of rivers. In the west the Ellen and in the east the systems of the Sark, Esk and Eden are relatively natural in their courses and river structure. Slow-flowing and stable near the coast, they are more dynamic when moving into the upland fringes where they flow through deepened channels in the landscape – the result of erosion by glacial melt water. Between these lie the rivers Waver and Wampool. The lower stretches of these rivers have been greatly modified with embanked over-deepened channels and a network of connected drainage channels that have allowed the reclamation of a formerly more extensive wetland landscape for agriculture.

Broadleaved woodland is largely restricted to shallow valleys around the upland fringes with some larger blocks of conifer and mixed woodland. Many of the woodlands are under-managed. The town of Brampton is set in an undulating agricultural landscape which is characterised by semi-natural woodland and mature specimen trees. Sandy knolls, of glacial origin, which support impressive stands of mature beech and Scots pine, are notable features of the area. The land to the north and north-east of Carlisle in the lower reaches of the rivers Esk and Lyne is flatter, with larger blocks of mainly coniferous woodland. The River Eden is particularly important for wildlife and as a landscape feature.

Across the low-lying plain are a series of lowland raised bogs, some of the largest and most intact sites in England. These bogs with their raised peat domes blanketed in specialised plants are of international importance for their wildlife and past ecological record, and contrast with the improved pastures that surround them. As well as the raised bogs, the freshwater wetlands of the area include rivers, kettle hole lakes and low-lying fens often present as pockets of semi-natural habitat in a surrounding matrix of intensively managed pasture.

At the head of the Solway, guarding a crossing point on the lower reaches of the Eden and acting as a focus for the transport routes from all directions, sits the cathedral city of Carlisle. Today, surrounded by a suburban spread, the medieval walled city at its core is built of red St Bees Sandstone. Though sandstone dominates as a building material across the area, there is a mix of building styles. On the outer coast, beach cobbles are a regular building material feature, while many farmsteads have walls built of clay, known as clay dabbin, with a limewash render. Post-17th-century buildings show an increase in the use of bricks. Most buildings are slate roofed.

To the east of Carlisle and to the south of Wigton, the area starts to gradate into an upland fringe character. Although the gently rolling open topography persists, the river channels become deeper, often forming steep-sided valleys clothed in native woodland, and rush pastures and conifer plantations become more frequent.

There are many historic assets and influences in this landscape, most notable being the features associated with the Frontiers of the Roman Empire World Heritage Site including Hadrian's Wall itself as well as a series of milefortlets, larger forts and features such as salt pans. More recently the landscape has been heavily influenced by medieval monastic activity and by its position as the Debatable Land – an administrative no man's land that once separated England from Scotland and was dominated by the Border Reivers (raiders). This

has left a legacy of abbey ruins, tower houses, defensible farmsteads (bastles) and a nucleated rural settlement pattern as well as the field patterns and areas of ridge and furrow that are a key feature of the rural landscape. There are some rare surviving examples of clay-walled houses and barns, some of which date from the 14th–16th centuries. The most recent features of the historical landscape are again associated with conflict – a suite of Second World War airfields now largely adapted to light industrial uses.

In the 19th century, Solway was popular with contemporary artists who were attracted to the area by the seascapes and the quality of light. Samuel Bough (1822–78), Robert Salmon (1775–1844) and Joseph Heard (1799–1859) were all influenced by the area's marine connections. While literary portrayals of the areas are limited, Sir Walter Scott set his historical novel Redgauntlet (1824) in the general area of the Solway Firth and Charles Dickens also visited and wrote about the Solway coast in 1857. More recently, the area around Wigton has provided the settings for several novels by Melvyn Bragg who was born and brought up in the town, while the author Margaret Forster was born and brought up in Carlisle.

Today, recreation remains an important part of the rural economy with the (partly overlapping) AONB, World Heritage Site and various nature conservation designations, and their associated nature reserves, as well as National Trails, encapsulating a landscape rich in environmental assets that are popular with those seeking quiet recreation. To these can be added coastal links golf courses, other areas of historical heritage and open access areas enjoyed by local residents and visitors alike.

Guarding the Eden crossing, Carlisle Castle was built in red sandstone, the dominant building material across the area.

The landscape through time

The Solway Basin NCA is generally underlain by Lower Triassic deposits of St Bees Sandstone and Mercia Mudstone, with a Jurassic/Triassic Lias plateau of mudstone, siltstone, limestone and sandstone west of Carlisle. In the north-west of the NCA there is a narrow belt of Permian sandstone and conglomerate bordering the Carboniferous limestones and sandstones beyond Longtown.

The basic landform of the Solway owes its origins to smoothing and streamlining of the land by ice flowing from surrounding upland areas during the Quaternary period. This left a broad open landscape that was subsequently modified by fluvial and coastal processes, including the development of a number of peat-forming wetlands. Evidence of the effect of different ice flows over the landscape can still be seen in both the shape and orientation of the streamlined hills and drumlins. The area is also characterised by features formed by glacial erosion and deposition, including melt water channels, moraines and eskers, and the formation of kames, ice-contact deltas (for example, at Holme St Cuthbert) and kettle hole lakes from ice decay at the end of the last ice age. Since the last ice age, climatic amelioration allowed the lower part of the Solway Basin to develop into a network of coastal wetlands formed by the accretion of estuarine material behind the barrier spit running north from Maryport to Grune Point. These coastal wetlands gradually evolved into peat-forming freshwater wetlands, including fens and raised bogs that characterised the landscape of the lower parts of the Solway Basin until they were drained in the Middle Ages. The sediments along the margins of the Solway estuary contain records of past sea level changes and the raised bogs

Hadrian's Wall ends at the Solway but a suite of defenses extend to Maryport, including Milefortlet 21, marking the edge of the Roman empire.

contain an important record of past environmental change.

While there is some evidence of Neolithic to iron-age settlement, including early woodland clearance, the Romans appear to be the first people to have heavily influenced the character of the area although, as the edge of the Roman Empire, this was largely limited to fortifications. From Bowness-on-Solway eastwards, Hadrian's Wall was built. To the west, a series of milefortlets, separated by watch towers every third of a mile, were established along the coast as far as the garrison forts at Beckfoot and Maryport. These defences were serviced through a road network that forms part of the basis of the modern road network. Despite the coming and going of the Roman frontier in rural areas, it is likely that there would have been little change in agricultural and settlement practices from the late Iron Age into the early medieval period. The present settlement patterns, reflected in settlement names, were influenced by the Irish-Scandinavians who arrived in the 9th and early 10th centuries.

Protecting archaeological features is an onging challenge. Here Hadrian's wall has been turfed to protect it from the elements and livestock.

From the late 11th century, following the Norman conquest, the entrenchment of the Norman feudal system created a distinctively medieval barony-type landscape, with significant religious centres and associated settlements established at Holme Cultram Abbey and Lanercost Priory. The Cistercian monks at Holme Cultram had a particularly strong impact on the landscape, being responsible for draining some of the inland marshes, establishing sea dykes, clearing woodland, encouraging the establishment of farms and introducing sheep grazing in an area that had hitherto been largely wilderness.

The era of peace and expansion came to an abrupt end in 1296 when the Scots invaded and the northern part of the Solway Basin became known as the Debatable Land, suffering intermittent warfare and border raids locally known as 'reiving'.

The decline in prosperity following the Dissolution of the Monasteries from the late 1530s, combined with the ongoing border conflicts and raids, meant that there was little change in the rural landscape until the late 17th century. From this period, and given added impetus by the Napoleonic Wars of the early 19th century, the agricultural economy recovered with an intensification

of the cattle trade through the droving of Scottish cattle across the Solway 'waths' (crossing points over the estuary), combined with a new phase of land reclamation and increased arable cultivation (particularly wheat) and, from the late 18th century, the introduction of rotations using turnips. Modernisation continued with the development of the railway system, which survived until the 1960s, that helped the growth of a dairying industry in the coastal plain by allowing milk to be transported to markets, but simultaneously brought to an end the centuries-old pattern of cattle droving. The railway also led to the development of Silloth both as a Victorian seaside resort and as a port.

Through the first half of the 20th century, military need once again reshaped the landscape of the Solway Basin with the construction of the huge munitions factory and armaments depot at Longtown and a suite of airfields with associated hangar buildings and aircraft parking pads at Silloth, Kirkbride, Anthorn, Great Orton and Carlisle. These sites, along with recent wind farm developments, survive as industrial sites in an otherwise rural landscape.

The modern agricultural landscape includes sheep and cattle that wander freely on the unenclosed salt marshes, regulated by 'marsh committees' and managed under a stinted system (restricting the number of animals) that dates back to the 16th century. Inland, the enclosed land lies mainly in holdings of 20–40 ha and is dominated by land that has been improved for agriculture by drainage, fertilising and reseeding. Arable cultivation is found on the better-drained land, particularly over the low hills. Recent years have seen further significant changes with the shift from hay to silage production and the introduction of maize as a fodder crop. As well as the agricultural economy, the area is popular with visitors seeking the open-air recreation afforded by the area's wildlife, coastal AONB landscape, golf courses and Hadrian's Wall.

Through the Middle Ages many farmhouses were built as fortified structures to guard against attack, as here at Drumburgh.

The late 20th and early 21st centuries have seen improvement of the road network with the arrival of the M6 and the subsequent, and continuing, upgrading of its linking trunk road network, most recently in the areas north and east of Carlisle. Across the rural parts of the landscape, wind farms have become a common feature with installations both inside the NCA and in the surrounding upland fringes, on both sides of the Solway, and out to sea.

Ecosystem services

The Solway Basin NCA provides a wide range of benefits to society. Each is derived from the attributes and processes (both natural and cultural features) within the area. These benefits are known collectively as 'ecosystem services'. The predominant services are summarised below. Further information on ecosystem services provided in the Solway Basin NCA is contained in the 'Analysis' section of this document.

Provisioning services (food, fibre and water supply)

- **Food provision:** Pastoral systems for dairy, beef and sheep are supported by the relatively high rainfall, mild climate and long growing season. The majority of the NCA is made up of Grade 3 agricultural soils, with lower grades (4 and 5) associated with areas of wet peaty soils in valley bottoms or on peat bogs. The salt marshes of the Solway estuary are generally grazed with cattle during the summer months and sheep from the uplands during the winter. Summer grazing on the marshes by livestock releases inland grasslands to be managed for silage production. In the coastal zone, traditional fisheries play a variable role in the rural economy.

- **Water availability:** Water from sub-surface aquifers is growing in importance for both agriculture and some businesses. Water is abstracted from catchments upstream of the NCA for a variety of purposes, including industrial use, public water supply, farming, private water supply, hydropower and bottling. On the Solway Plain a number of farms and other water users, such as golf courses, abstract water from underground aquifers in drift deposits which generally have a high recharge potential.

The shellfish beds of the outer Solway are important both for the industry and wildlife alike.

Regulating services (water purification, air quality maintenance and climate regulation)

- **Climate regulation:** The landscape stores a large amount of carbon, predominantly within lowland raised bogs and associated and surrounding fenland peat but also in the woodlands of the east and south. The large areas of salt marsh also act as carbon stores through retaining organic matter and carboniferous material. It is thought that this is one of the most important lowland carbon stores in England with the potential to lock in more carbon with changes in land management.

- **Regulating coastal flooding and erosion:** The dune system on the Solway coast and the salt marshes of the inner Solway act as natural sea defences in absorbing the sea's energy and protecting inland areas. This dynamic system helps to trap sediments, increasing the level and extent of sand dunes and salt marshes which provide enhanced protection as they increase in height or expand seawards.

Cultural services (inspiration, education and wellbeing)

- **Sense of place/inspiration:** The dynamic coastal zone of the Solway Firth with its network of ever-changing tidal habitats, flocks of wintering birds moved by the tide, and expansive views to Criffel and the other hills of southern Scotland and the northern reaches of the Irish Sea is both unique and inspiring.

- **Sense of history:** Amid the predominantly rural landscape is a network of sites which lend a strong sense of history to the landscape, including Hadrian's Wall, the cathedral city of Carlisle, the monastic sites of Holme Cultram and Lanercost, the Victorian town of Silloth and a suite of Second World War airfields.

- **Tranquillity:** Tranquillity is a significant feature of this NCA with 71 per cent of its land undisturbed. The margins of the Solway Firth are particularly noted for their tranquillity.

- **Recreation:** The NCA offers a network of rights of way totalling 747 km at a density of 0.76 km per sq km. Open access land covers 4,063 ha or 4.1 per cent of the NCA, including a number of marshes along the Solway coast, a large proportion of the sand dune coast and the lowland raised bogs. Hadrian's Wall Path and cycle way and the Cumbria Coastal Way are long-distance routes which cross the area. This has also been one of the first areas in the county to receive formal coastal access provision.

Salt marshes and sand dunes are the primary sea defense along much of the Solway Coast, as here at Anthorn.

- **Biodiversity:** Priority habitats within the NCA include coastal and flood plain grazing marsh, salt marsh, lowland raised bog and coastal sand dunes as well as a number of other habitats. The NCA contains five Special Areas of Conservation, one Special Protection Area, one Ramsar site and five National Nature Reserves, and 8,000 ha are nationally designated as Sites of Special Scientific Interest (SSSI). There are also large extents of priority habitat outside the designated sites. The area supports nationally and regionally important populations of many species. Many such as natterjack toads, breeding and wintering waders, wintering wildfowl and coastal plants are associated with the designated site series. However, others such as farmland birds are associated with the wider landscape.

- **Geodiversity:** The glacially derived landform and post-glacial geology of the area are important, with coastal features and terrestrial peats providing significant information about past climatic environmental fluctuations. There are five SSSI notified for their geological interest in this NCA and 13 local sites of geological importance.

The Solway is a place of quiet and tranquility.

Statements of Environmental Opportunity

SEO 1: Conserve and enhance the designated coastal landscapes and the diverse range of habitats of the Solway coast, managing the internationally important coastal and estuary systems, including the intertidal flats, salt marshes and sand dunes, for the species they support, their geomorphology, recreation and tranquillity value and the flood risk protection they provide, in order to aid adaptation to the effects of climate change and enhance their importance in the local economy.

For example by:

- Securing sympathetic management of the diverse array of high-quality semi-natural habitats and the physical processes that support them within the coastal zone, both inside and outside designated sites, including salt marshes, sand dunes, intertidal habitats, vegetated shingle and coastal cliffs.
- Restoring and enhancing the National Character Area's (NCA's) suite of coastal Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Special Protection Areas and Ramsar sites and their component habitats and geological features and processes, such as salt marsh geomorphology and coastal geological exposures, through both targeted measures and wider promotion of the sensitivity and value of these sites. Ensuring that habitat quality is sufficiently high to support habitat specialist species, such as breeding and wintering waders and wildfowl, breeding seabirds and the natterjack toad.
- Ensuring that sustainable management extends beyond the designated site network so that the wider coastal zone is sympathetically managed, with a particular focus on maintaining natural processes and areas of priority and transitional habitats, such as brackish wetlands, with the result that these habitats are present, valued and, where necessary, restored and re-created to provide ecological links, allow for climate change impacts and support the provision of ecosystem services benefits.
- Conserving archaeological evidence of earlier settlement and land use and, where appropriate, securing off-site conservation of artefacts at risk from coastal change, such as the Roman sites on the Beckfoot to Maryport coastline.
- Delivering key actions in the Solway Coast Area of Outstanding Natural Beauty (AONB) aimed at restoring and enhancing estuarine and coastal character.
- Raising awareness of the cultural heritage specific to the coastal margins, such as 'waths' (crossing points over the estuary) and 'haaf netting' (a traditional technique for catching salmon) fisheries.
- Establishing a coastal access route that allows for improved access to, and understanding of, the coast while respecting the sensitive habitats and species of the coastal margin.
- Seeking opportunities to re-establish the transitional habitats of the coastal margin such as saline and brackish lagoons.
- Protecting the tranquil and remote character of the Solway coast.
- Managing the impacts of access and recreation in the coastal zone to protect from disturbance sensitive features such as breeding and roosting birds, honeycomb worm reefs and shingle vegetation, and using the profile of the new England Coast Path to raise awareness of the sensitivity of the coastal zone and the role it plays in coastal flood protection.
- Securing sustainable management of coastal shell fisheries to support coastal economies and biodiversity.

SEO 2: Manage and restore the freshwater wetland landscape of the Solway Basin, including internationally important raised bogs and rivers with their associated fens, lakes, riparian woodlands and channels, for the important habitats they provide, their contribution to landscape character, the environmental record and historical assets they hold, and to manage flood risk and maintain water quality.

For example by:

- Securing sympathetic management of the diverse array of high-quality wetlands both inside and outside designated sites, including rivers, valley mires, lowland raised bogs, coastal and flood plain grazing marsh, reedbeds and fens.
- Restoring and enhancing the suite of wetland SSSI and SAC and their component habitats present in the NCA, through both targeted measures and the wider promotion of the value of these sites.
- Protecting and restoring riparian corridors, particularly where ancient woodlands survive, for biodiversity, water quality and flood control.
- Delivering key actions in the Solway Coast AONB management plan aimed at restoring and enhancing wetlands.
- Ensuring that invasive species such as signal crayfish, pitcher plants and Himalayan balsam are managed and do not damage the unique heritage of the NCA.
- Ensuring that wetland habitat quality is sufficiently high to support habitat specialist species such as white-faced darter dragonfly, marsh fritillary and large heath butterflies, lamprey and eels, including species that have been lost in the past, such as the corncrake.
- Ensuring that sustainable management extends beyond the designated site network so that the wider wetland landscape, particularly the physical processes, priority habitats, locally important sites and sites that support transitional habitats, are sympathetically managed; providing ecological links between core sites; supporting species associated with the wider wetland landscape such as breeding waders; reinforcing NCA character; and supporting the provision of ecosystem services benefits.
- Supporting programmes that deliver social, cultural and economic benefits from sustainable management of wetland resources and that promote informed interaction with the wetland landscape, such as educational and volunteer programmes that raise awareness of the unique wetlands in the NCA and promote knowledge of traditional management such as wetland grazing.
- Protecting and restoring lowland raised bogs for their biological, scientific and historical values, including as an archive of past environmental conditions and as a climate regulator.
- Ensuring that ditches and other watercourses have buffers of vegetation, especially trees where appropriate, and riparian habitats along their margins to support riparian species and facilitate species movement, trap sediment and run-off in areas of high erosion risk, and ensure that stock access does not result in sediment entering the watercourses.
- Developing new wetlands that trap sediments manage agricultural flood risk and help support wetland species.

SEO 3: Work with landowners and land managers to protect, enhance and strengthen the network of farmland features; create and expand farmland habitats to enhance biodiversity and improve soil and water quality; strengthen the resilience of habitats to climate change; enhance landscape character; and support a diverse rural economy.

For example by:

- Adapting farming systems to be more flexible in the face of a changing climate, such as establishing pastoral regimes which suit wetter lowlands.
- Seeking adaptations to farming systems such as vegetation buffers, including trees, and more focused nutrient inputs that reduce off-site impacts through diffuse pollution.
- Seeking opportunities to support farm business diversification to establish a robust rural economy through developing links to the visitor economy associated with designated landscapes, sites and the network of long-distance trails.
- Establishing agricultural systems with more diverse swards to benefit both biodiversity and productivity, for example planting grasses which bind soils to reduce soil erosion, encouraging species such as clover which fix nitrogen, and establishing appropriate cutting and grazing regimes to allow flowering and seed to set to support pollinators.
- Maintaining pastoral systems in areas of high erosion risk, such as on steep slopes on the mineral soils, and areas of waterlogged soils throughout, with particular reference to priorities identified by the Catchment Sensitive Farming Programme, which aims to improve water quality and reduce nutrient loading through simple adaptive farm business measures.
- Maintaining arable production on areas of suitable soils, avoiding steep slopes and areas prone to waterlogging, and incorporating measures such as break crops that support the maintenance of soil productivity.
- Encouraging management interventions on arable farmland to benefit farmland bird species such as grey partridge, lapwing, yellow wagtail, tree sparrow, corn bunting, barn owl and yellowhammer.
- Protecting, expanding and connecting surviving areas of ancient woodland, particularly along river corridors and on steep slopes, to support biodiversity, increase resilience to climate change and act as stepping stones for woodland species moving across the landscape.
- Managing and establishing economic woodlands away from the coastal plain by developing links with local biomass power stations and promoting wood fuel as a local energy source.
- Re-establishing coppice management, aiming to support climate regulation by promoting low carbon energy sources. Enhancing the biodiversity of woodland ecosystems by re-establishing managed woodland systems as well as low intervention systems, locally reducing soil erosion; and addressing water quality issues by stabilising watercourse boundaries and steep slopes, and buffering watercourses to trap sediment and run-off.
- Encouraging access and quiet recreational activities that support and benefit from the high-quality rural environment and that make use of the open access areas and network of quiet roads, tracks, bridleways and footpaths, such as walking, cycling, riding, wildlife watching, visiting heritage assets and exploring geological features.

Continued over...

SEO 3 continued

- Working with local landowners and managers to provide facilities such as accommodation and refreshments for users of long-distance routes, and include discreet and imaginative interpretation of the key features and assets of the area.
- Working with local tourism organisations and accommodation providers to establish local routes from villages to key features, for improved recreation and enjoyment, providing clear and engaging information to residents and visitors, thus enabling them to learn about and enjoy the distinctive landscape.
- Ensuring that hedges provide habitat, food such as nectar and berries, and enhanced connectivity for wildlife by securing good management such as cutting regimes that allow flowering and fruiting.

Scattered across the Solway Basin are a suite of restored hay meadows, reminders of formerly common agricultural systems and an important resource for wildlife.

SEO 4: Conserve and promote the historic landscape and settlement character, including the many heritage assets linked to the area's history as a disputed boundary zone, such as the World Heritage Site of Hadrian's Wall, promote education and understanding through interpretation, enhance recreation opportunities and ensure that the design of new development enhances the character of the area.

For example by:

- Protecting and restoring the key features of the historic landscape including Hadrian's Wall and its surrounds, the religious sites of Holme Cultram and Lanercost and the built heritage of Carlisle.
- Promoting awareness of the historic landscape including archaeological sites, buildings and associated landscapes, improving access to sites and linking cultural heritage sites to natural heritage sites and the rights of way network including long-distance paths and cycle ways.
- Conserving archaeological features and palaeo-environmental archives through land management practices – for example, through reversion of arable land to grassland where ploughing threatens the integrity of below-ground archaeology.
- Conserving traditional buildings and developing the skills to restore them using traditional techniques and appropriate materials including cobbles, clay dabbin and local sandstone.
- Protecting and restoring boundary features such as hedges, mature trees, ditches, sandstone gate stoops and riparian corridors; carrying out works such as earthbank kest restoration, and gapping up and protecting hedges, including management in the Cumberland hedgelaying style.
- Maintaining the landscape structure of fields bounded by stone-faced kest banks on the open coast, hedges with ditches on the reclaimed coastal plain and mainly hedges, often on earthbanks, elsewhere.
- Seeking opportunities to maintain local vernacular styles in new developments and seeking to ensure that the layout of new developments reflects local settlement structure.
- Improving the interpretation of historic sites through both on-site information and new technologies such as web-based resources and mobile technologies.
- Improving access to the coast for walking and, where possible, for cycling and horse riding, providing appropriate access for people of all abilities through the sustainable use of old railway lines, tracks and paths, and encouraging reduced car use. Securing opportunities for the public to enjoy the natural environment through the implementation of the England Coast Path while ensuring appropriate protection of it.
- Ensuring that the promotion of access opportunities educates people about the vulnerability of the historic features in the NCA and encourages visits which avoid any adverse impacts on agricultural management, landscape, habitats and wildlife.

Supporting document 1: Key facts and data

Total area: 98,350 ha

1. Landscape and nature conservation designations

This NCA contains one designated landscape – the Solway Coast Area of Outstanding Natural Beauty (AONB), which is situated entirely within the NCA and covers 11,904 ha (12 per cent of the NCA).

Management plans for the protected landscape can be found at:
www.solwaycoastaonb.org.uk/

Source: Natural England (2011)

1.1 Designated nature conservation sites

The NCA includes the following statutory nature conservation de1signations:

Tier	Designation	Name	Area (ha)	% of NCA
International	Ramsar	Upper Solway Flats and Marshes	4,236	4
European	Special Protection Area (SPA)	Upper Solway Flats and Marshes SPA	4,236	4
	Special Area of Conservation (SAC)	Solway Firth SAC; South Solway Mosses SAC; Bolton Fell Moss SAC; River Eden SAC; Walton Moss SAC.	7,211	7
National	National Nature Reserve (NNR)	South Solway Mosses NNR; Drumburgh Moss NNR; Finglandrigg Woods NNR; Walton Moss NNR; Thornhill Moss and Meadow NNR	1,196	1
National	Site of Special Scientific Interest (SSSI)	A total of 25sites wholly or partly within the NCA	7,861	8

Source: Natural England (2011)

Please note: (i) Designated areas may overlap (ii) all figures are cut to Mean High Water Line, designations that span coastal areas/views below this line will not be included.

There are 77 local sites in the Solway Basin NCA covering 1,090 ha, which is 1 per cent of the NCA.

Source: Natural England (2011)

- Details of individual Sites of Special Scientific Interest can be searched at: http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm
- Details of Local Nature Reserves (LNR) can be searched: http://www.lnr.naturalengland.org.uk/Special/lnr/lnr_search.asp
- Maps showing locations of Statutory sites can be found at: http://magic.defra.gov.uk/website/magic/ – select 'Rural Designations Statutory'.

1.1.1 Condition of designated sites

SSSI condition category	Area (ha)	% of SSSI land in category condition
Unfavourable declining	188	2
Favourable	4,422	56
Unfavourable no change	650	8
Unfavourable recovering	2,579	33
Part Destroyed	9	<1

Source: Natural England (March 2011)

Details of SSSI condition can be searched at:
http://www.sssi.naturalengland.org.uk/Special/sssi/reportIndex.cfm

2. Landform, geology and soils

2.1 Elevation

Elevation in the NCA varies from sea level around the Solway coast to a high point of 210 m. The highest parts of the NCA are generally along the fringe with the Cumbria High Fells to the south and Border Moors and Forest to the north-west.

Source: Natural England (2010)

2.2 Landform and process

The NCA consists of a shallow glacial exposed basin with superficial deposits of glacial till overlain in large areas by more recent deposits of estuarine materials and peats. Post-glacial isostatic lift on the salt marshes that border the Solway has resulted in a defined terraced structure.

Source: Natural England (2010)

2.3 Bedrock geology

The bedrock geology is derived from sedimentary strata dominated by sandstones, mudstones and lesser extents of siltstone. The lowest parts of the NCA, including much of the area between Carlisle and Allonby, is underlain by shales which generally grade into sandstones on rising ground, then other more diverse geologies around the fringes of the NCA.

Source: Natural England (2010)

2.4 Superficial deposits

Away from the coastal plain superficial deposits are dominated by glacially derived deposits, with features such as kettle-holes and peats. On the coastal plain the drift geology becomes more estuarine-derived in origin but with significant areas of peat.

Source: Natural England (2010)

2.5 Designated geological sites

Designation	Number of sites
Geological Site of Special Scientific Interest (SSSI)	2
Mixed interest SSSI	3

There are 13 Local Geological Sites within the NCA

Source: Natural England (2011)

- Details of individual Sites of Special Scientific Interest can be searched at: http://www.sssi.naturalengland.org.uk/Special/sssi/search.cfm

2.6 Soils and Agricultural Land Classification

The predominant soils in the NCA are slowly permeable and seasonally wet slightly acid but base-rich loamy and clayey soils, which are found across the low-lying heart of the NCA. Around the coastal margins and river valleys different soils have developed, while on glacially exposed ridges freely draining soils predominate. The majority of the NCA is made up of Grade 3 agricultural soils, with lower grades (4 and 5) associated with areas of wet peaty soils in valley bottoms or on peat bogs. Better quality Grade 2 land is restricted to areas of free draining soils on elevated ground such as around Wigton and east of Carlisle.

Source: Natural England (2010)

The main grades of agricultural land in the NCA are broken down as follows (as a proportion of total land area):

Agricultural Land Classification	Area (ha)	% of NCA
Grade 1	0	0
Grade 2	3,584	4
Grade 3	75,380	77
Grade 4	8,369	9
Grade 5	4,351	4
Non-agricultural	2,305	2
Urban	3,142	3

Source: Natural England (2010)

Maps showing locations of Statutory sites can be found at: http://magic.defra.gov.uk/website/magic/ – select 'Landscape' (shows ALC and 27 types of soils).

3. Key water bodies and catchments

3.1 Major rivers/canals

The following major rivers/canals (by length) have been identified in this NCA.

Name	Length (km)
River Wampool	26
River Ellen	24
River Lyne	23
River Eden	22
River Waver	18
River Caldew	17
River Esk	11
River Petteril	11
River Irthing	10
King Water	8
River Sark	6
Liddel Water	2

Source: Natural England (2010)

Please note: other significant rivers (by volume) may also occur. These are not listed where the length within the NCA is short.

Most of the principal watercourses in the NCA rise in adjacent upland NCAs and flow west or north through the area to discharge into the Inner Solway Firth. The Sark and the Esk form much of the northern boundary of the NCA, and England. Of the main rivers the King Water, Liddel Water, Caldew, Irthing, and Petteril are all part of the Eden System, a catchment that drains much of the eastern half of Cumbria. Of the other rivers the River Ellen flows west through this NCA and discharges into the Outer Solway Firth at Maryport in the West Cumbria Coastal Plain NCA, while the rivers Waver and Wampool, whose whole length is in this NCA, rise from the edge of the NCA near the boundary with the High Fells NCA and flow north to discharge into Morecambe Bay on the Inner Solway.

3.2 Water quality

The total area of Nitrate Vulnerable Zone is 13,764 ha, or 14 per cent of the NCA.

Source: Natural England (2010)

3.3 Water Framework Directive

Maps are available from the Environment Agency showing current and projected future status of water bodies http://maps.environment-agency.gov.uk/wiyby/wiybyController?ep=maptopics&lang=_e

4. Trees and woodlands

4.1 Total woodland cover

The NCA contains 4,763 ha of woodland (5 per cent of the total area), of which 1,022 ha is ancient woodland.

Source: Natural England (2010), Forestry Commission (2011)

4.2 Distribution and size of woodland and trees in the landscape

Most of the native woodland in the NCA is associated with river corridors particularly along the Eden, Sark and Esk river systems and is most extensive in the upland fringes of the NCA. There are also significant areas of conifer plantation around the margins of the NCA, particularly in the area north and west of Carlisle, associated with the large estates. Woodland cover in the low lying parts of the NCA is quite restricted and mainly consists of woodland that has colonised peat bodies after abandonment of peat extraction.

Source: Natural England (2010)

4.3 Woodland types

A statistical breakdown of the area and type of woodland found across the NCA is detailed below.

Area and proportion of different woodland types in the NCA (over 2 ha)

Woodland type	Area (ha)	% of NCA
Broadleaved	3,073	3
Coniferous	1,062	1
Mixed	247	<1
Other	381	<1

Source: Forestry Commission (2011)

Area and proportion of Ancient Woodland and Planted Ancient Woodland within the NCA.

Woodland type	Area (ha)	% of NCA
Ancient semi-natural woodland	474	<1
Ancient re-planted woodland (PAWS)	549	1

Source: Natural England (2004)

5. Boundary features and patterns

5.1 Boundary features

The NCA is estimated to contain 7,615 km of boundary features, mainly hedgerows, with some fences. There are other boundary features in certain areas such as earth banks along the exposed Solway Coast, and ditches in some of the lowest lying areas. In 2003 about 15 per cent of this resource was under agri-environment scheme management, and by 2013 this had increased to approximately 27 per cent.

Source: Solway Basin Countryside Character Area description; Countryside Quality Counts (2003)

5.2 Field patterns

Field patterns vary around the NCA though the usual form is of large rectilinear pastoral and arable fields. Around many settlements strips of narrow fields, separated by hedgebanks, survive reflecting historical allocation of land strips to individual properties. Large areas of salt marsh and to a lesser extent raised bog survive in an unenclosed form although the margins of the latter have been modified by turbary (digging turf or peat) practices giving an irregular stepped edge.

Source: Solway Basin Countryside Character Area description; Countryside Quality Counts (2003)

6. Agriculture

The following data has been taken from the Agricultural Census linked to this NCA.

6.1 Farm type

Farm type is quite diverse across the NCA, giving the landscape a mixed character, which is also still reflected at the holding level on many farms. Livestock production farms for meat (36 per cent of holdings) or dairy (26 per cent) are the dominant farm types.

Source: Agricultural Census, Defra (2010)

6.2 Farm size

There is a wide range of farm size, although 50 per cent of farms are over 50 ha in size, accounting for 88 per cent of the area of holdings. The number of farms over 100 ha has increased between 2000 and 2009.

Source: Agricultural Census, Defra (2010)

6.3 Farm ownership

The majority of farmland is owned (77 per cent), with little change in the area of owned land between 2000 and 2009.

2009: Total farm area = 85,353 ha; owned land = 65,600 ha
2000: Total farm area = 77,864 ha; owned land = 65,705 ha

Source: Agricultural Census, Defra (2010)

6.4 Land use

Linked to the predominance of livestock holdings, grass and uncropped land account for about 80 per cent of the agricultural land area, with a proportion of the remaining area given over to other livestock related crops. Otherwise the land is mainly arable, with small areas of other crop types.

Source: Agricultural Census, Defra (2010)

6.5 Livestock numbers

Livestock are dominated by cattle and sheep, with similar numbers of each. Overall cattle numbers decreased over the period between 2000 and 2009 (from 155,100 in 2000 to 147,900 in 2009) and sheep numbers declined from 255,500 in 2000 to 147,000 in 2009. Pig numbers have remained stable.

Source: Agricultural Census, Defra (2010)

6.6 Farm labour

Of the 2,608 agricultural workers in the NCA 74 per cent were principal farmers with smaller numbers of employed staff many of whom are associated with the larger estates.

Source: Agricultural Census, Defra (2010)

Please note: (i) Some of the Census data is estimated by Defra so will not be accurate for every holding (ii) Data refers to Commercial Holdings only (iii) Data includes land outside of the NCA belonging to holdings whose centre point is within the NCA listed.

7. Key habitats and species

7.1 Habitat distribution/coverage

The principal habitats of note in the NCA are costal and fresh water wetlands; however, lesser extents of a range of other habitats occur including species-rich grasslands, and ancient woodlands. The mixed farmland landscape is also important for the farmland bird communities it supports, characterised by species such as grey partridge, lapwing and tree sparrow.

Coastal habitats:

Throughout the inner Solway the coastal margin is dominated by grazed salt marsh communities, with the full transition of communities from pioneer marsh areas where only glasswort can survive through to areas of grassland that are only rarely influenced by saline conditions. This completeness of transition is rarely seen. As well as its habitat value these marshes are hugely important for the bird communities they support including breeding waders and seabirds in summer and waders and wildfowl in winter including the entire world population of Svalbard-breeding barnacle geese.

On the outer Solway coast the shingle and sand dune habitats become more prevalent with again complete transitions from highly mobile pioneer communities through mobile and fixed sand dune communities to dune grassland and maritime heath with notable species including sand leek, Isle of Man cabbage and natterjack toad.

Freshwater wetlands:

The Solway Basin contains some of the most extensive areas of lowland raised mire in the country. These wetlands are rainwater fed leading to the development of unique communities that can survive in waterlogged and nutrient poor conditions. The best sites have rich assemblages of peat-forming bog mosses, alongside carnivorous sundews, and cotton grasses and cranberry. These sites also support rare species such as white-faced darter dragonfly and large heath butterfly.

Around the margins of the raised mires, and in areas of groundwater seepage, a wide range of other wetland communities have developed. Although many

have been modified significant areas of species-rich habitat survive including species such as marsh stitchwort, grass-of-Parnassus, and petty whin along with great burnet meadows, tussock-sedge swamps and willow carr. In some areas where wet grasslands support devil's-bit scabrous the marsh fritillary butterfly can be found.

In the east of the NCA the river systems are also highly important with high diversity of aquatic plants, including several species of water crowfoot and pondweed as well as supporting salmon and lamprey (sea and river) spawning and nursery areas. The greatest extent of habitat is found in coastal and flood plain grazing marsh, though in many areas this is species poor.

Source: Solway Basin Natural Area profile

7.2 Priority habitats

The Government's new strategy for biodiversity in England, Biodiversity 2020, replaces the previous Biodiversity Action Plan (BAP) led approach. Priority habitats and species are identified in Biodiversity 2020, but references to BAP priority habitats and species, and previous national targets have been removed. Biodiversity Action Plans remain a useful source of guidance and information. More information about Biodiversity 2020 can be found at; www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/englandsbiodiversitystrategy2011.aspx.

The NCA contains the following areas of mapped priority habitats (as mapped by National Inventories). Footnotes denote local/expert interpretation. This will be used to inform future national inventory updates.

Priority habitat	Area (ha)	% of NCA
Coastal and flood plain grazing marsh	9,460	10
Lowland raised bog	2,903	3
Broadleaved mixed and yew woodland (broad habitat)	2,409	2
Coastal sand dunes	260	<1
Purple moor grass and rush pasture	53	<1
Lowland meadows	37	<1
Lowland heathland	33	<1
Coastal vegetated shingle	22	<1
Maritime cliff and slope	21	<1
Mudflats	9	<1
Lowland dry acid grassland	6	<1
Upland heathland	5	<1
Saline lagoons	2	<1
Fens (1)	0	0

Source: Natural England (2011)

Please note: Natural England SSSI data indicates that, subject to natural change, there are approximately 3,320 ha of salt marsh in this NCA.

1 This figure is believed to be an underestimate.

7.3 Key species and assemblages of species

- Maps showing locations of Priority Habitats are available at: http://magic.defra.gov.uk/website/magic/
- Maps showing locations of S41 species are available at http://data.nbn.org.uk/

8. Settlement and development patterns

8.1 Settlement pattern

The principal settlement in the NCA is Carlisle; the administrative centre of Cumbria. The original town is Roman in origin and is associated with Hadrian's Wall. The legacy of the Roman period can still be seen in the settlement pattern in the NCA with the Roman road network that starts at the harbour of Maryport, and running along the edge of elevated ground for much of its length through the NCA linking the main towns of Maryport, Wigton, Carlisle and Brampton. The Roman settlement pattern declined after the 4th century with the current pattern developing from the 10th century onwards when Carlisle became a strategic asset and was consequently fortified. Settlement through the Middle Ages was heavily influenced by the area's role as a border with Scotland, the influence of the monasteries at Lannercost and Abbeytown, and more generally the farmstead rural landscape. The arrival of the railway in the 1800s resulted in the development of some formerly smaller rural settlements as seaside resorts, such as Silloth.

Source: Solway Basin Countryside Character Area description; Countryside Quality Counts (2003)

8.2 Main settlements

The main settlements are Carlisle, Wigton, Silloth, and Maryport. In addition Wetheral and Brampton are located on the boundary of the NCA. The total estimated population for this NCA (derived from ONS 2001 census data) is: 120,459.

Source: Solway Basin Countryside Character Area description; Countryside Quality Counts (2003)

8.3 Local vernacular and building materials

The use of easily worked red St Bees Sandstone is a common element of the building style throughout the NCA, both in rural and urban areas, and shares a common vernacular with parts of adjoining NCAs in particular the Eden Valley and the West Cumbria Coastal Plain. Along the coast between Silloth and Maryport there is also an influence of cobbles in the building style, while in the inner Solway the use of 'clay dabbin' as a building material is a long, though now declined, tradition.

Source:Solway Basin Countryside Character Area description; Countryside Quality Counts (2003)

9. Key historic sites and features

9.1 Origin of historic features

Recent findings near Carlisle trace the origin of occupation back to the Neolithic; however, it is the Roman period which has the strongest influence on the identity and history of the area. The NCA is crossed by features associated with the northern-most frontier of the Roman Empire, now recognised as the Roman Frontier World Heritage Site including Hadrian's Wall itself as well as a series of mile fortlets, larger forts and features such as salt pans. The landscape was heavily influenced by medieval monastic activity and by its position of the being the 'debatable lands' – an administrative no-man's land – that once separated England from Scotland and was dominated by the 'border rievers'. This has left a legacy of abbey ruins, fortified farmsteads and a nucleated rural settlement pattern as well as the field patterns and areas of ridge and furrow that are a key feature of the rural landscape. The most recent features of the historical landscape are again associated with conflict, the Second World War, in the presence of a number of airfields now largely adapted to light industrial uses.

Source: Countryside Quality Counts Draft Historic profile, ountryside Character Area description

9.2 Designated historic assets

This NCA has the following historic designations:

- 1 Registered Park and Garden covering 28 ha
- 1 Registered Battlefield covering 346 ha
- 143 Scheduled Monuments
- 1,209 Listed Buildings
- 2 World Heritage Sites

Source: Natural England (2010)

More information is available at the following address:

- http://www.english-heritage.org.uk/caring/heritage-at-risk/
- http://www.english-heritage.org.uk/professional/protection/process/national-heritage-list-for-england/

10. Recreation and access

10.1 Public access

- Five per cent of the NCA 5,270 ha is classified as being publically accessible.
- There are 747 km of public rights of way at a density of 1 km per km^2.
- There is 1 National Trail within the NCA; Hadrian's Wall Path National Trail extending just under 45 km.

Sources: Natural England (2010)

The table below shows the breakdown of land which is publically accessible in perpetuity:

Access designation	Area (ha)	% of NCA
National Trust (accessible all year)	3	<1
Common Land	2,762	3
Country Parks	0	0
CROW Access Land (Section 4 and 16)	4,063	4
CROW Section 15	89	<1
Village Greens	102	<1
Doorstep Greens	5	<1
Forestry Commission Walkers Welcome Grants	20	<1
Local Nature Reserves (LNR)	7	<1
Millennium Greens	1	<1
Accessible National Nature Reserves (NNR)	1,196	1
Agri-environment Scheme Access	2	<1
Woods for People	853	1

Sources: Natural England (2011)

Please note: Common Land refers to land included in the 1965 commons register; CROW = Countryside and Rights of Way Act 2000; OC and RCL = Open Country and Registered Common Land.

11. Experiential qualities

11.1 Tranquillity

Based on the CPRE map of tranquillity (2006) there are quite extensive tranquil areas in the NCA with the highest tranquillity along the Solway coastal strip and to the east of Longtown. The least tranquil areas are quite tightly associated with the principal urban centres such as Carlisle, Wigton and Brampton and the principal arterial routes that link them and cross the NCA, including the M6 corridor.

A breakdown of tranquillity values for this NCA is detailed in the table below:

Tranquillity	Tranquillity Score
Highest value within NCA	114
Lowest value within NCA	-88
Mean value within NCA	10

Sources: CPRE (2006)

More information is available at the following address:
http://www.cpre.org.uk/what-we-do/countryside/tranquil-places/in-depth/item/1688-how-we-mapped-tranquillity

11.2 Intrusion

The 2007 Intrusion Map (CPRE) shows the extent to which rural landscapes are 'intruded on' from urban development, noise (primarily traffic noise), and other sources of visual and auditory intrusion. This shows that disturbance is mainly associated with the trunk road and motorway network that cross the NCA, with a peak in disturbance around Carlisle where east-west transport routes link to and cross the north-south course of the M6. A breakdown of intrusion values for this NCA is detailed in the table below.

Intrusion category	1960s (%)	1990s (%)	2007 (%)	Percentage change (1960s-2007)
Disturbed	14	24	26	12
Undisturbed	81	72	71	-10
Urban	2	2	2	<1

Sources: CPRE (2007)

Notable trends from the 1960s to 2007 are a 10 per cent move from undisturbed to disturbed associated with increased traffic.

More information is available at the following address:
http://www.cpre.org.uk/resources/countryside/tranquil-places

12 Data sources

- British Geological Survey (2006)
- Natural Area Profiles, Natural England (published by English Nature 1993-1998)
- Countryside Character Descriptions, Natural England (regional volumes published by Countryside Commission/Countryside Agency 1998/1999)
- Joint Character Area GIS boundaries, Natural England (data created 2001)
- National Parks and AONBs GIS boundaries, Natural England (2006)
- Heritage Coast Boundaries, Natural England (2006)
- Agricultural Census June Survey, Defra (2000,2009)
- National Inventory of Woodland & Trees, Forestry Commission (2003)
- Countryside Quality Counts Draft Historic Profiles, English Heritage (2004)*
- Ancient Woodland Inventory, Natural England (2003)
- Priority Habitats GIS data, Natural England (March 2011)
- Special Areas of Conservation data, Natural England (data accessed in March 2011)
- Special Protection Areas data, Natural England (data accessed in March 2011)
- Ramsar sites data, Natural England (data accessed in March 2011)
- Sites of Special Scientific Interest, Natural England (data accessed in March 2011)
- Detailed River Network, Environment Agency (2008)
- Source protection zones, Environment Agency (2005)
- Registered Common Land GIS data, Natural England (2004)
- Open Country GIS data, Natural England (2004)
- Public Rights of Way Density, Defra (2011)
- National Trails, Natural England (2006)
- National Tranquillity Mapping data, CPRE (2007)
- Intrusion map data, CPRE (2007)
- Registered Battlefields, English Heritage (2005)
- Record of Scheduled Monuments, English Heritage (2006)
- Registered Parks and Gardens, English Heritage (2006)
- World Heritage Sites, English Heritage (2006)
- Incorporates Historic Landscape Characterisation and work for preliminary Historic Farmstead Character Statements (English Heritage/Countryside Agency 2006)Detailed River Network, Environment Agency (2008)

Please note all figures contained within the report have been rounded to the nearest unit. For this reason proportion figures will not (in all) cases add up to 100%. The convention <1 has been used to denote values less than a whole unit.

Supporting document 2: Landscape change

Recent changes and trends

Trees and woodlands

- Woodland cover is generally low, with most to be found in the area north and east of Carlisle. Of the woodland present about 23 per cent is ancient woodland with the rest more recent. Between 1999 and 2003 Woodland Grant scheme coverage of the ancient woodland resource increased from 19 per cent to 48 per cent suggesting improvements in woodland management.

- Since the 1940s there has been an increase in woodland cover on a number of the mosses in the western part of the NCA, however, moss land restorations in the past decade have returned many of these areas to open habitats. Overall despite open habitat restorations in the NCA there has been a net increase in woodland cover across the landscape.

- In recent years new markets have created demand for woodfuel biomass which is stimulating woodland management and creation.

- Dutch elm disease has, and continues to affect woodlands with mature elm being reduced as a component of woodland communities, while airborne pollution has been implicated in the decline of important woodland lichen communities.

Boundary features

- The estimated boundary length for the NCA is 7,615 km over half of which is hedgerow with lesser extents of ditches and kests (earthbank boundaries). Of this length the area managed under agri-environment schemes increased from 15 per cent in 2003 to 27 per cent in 2011.

- Management of boundary features has changed with more boundaries reinforced by fencing and mechanically managed rather than managed by hand. Hedges managed in the traditional Cumberland hedgelaying style have decreased as have the extents of kested banks.

Agriculture

- Between 2000 and 2009 there was broadly stable agricultural land use with the exception of 'other crop types' which increased from 319 ha to 1,477 ha which is likely to be attributable to the increased use of maize as a crop for stock feed.

- Between 2000 and 2009 there was a consolidation of dairy production into fewer, more extensive holdings. Over recent decades a change in sheep management has occurred with increased numbers off-wintered from upland areas in the area. Changes in agricultural policy have caused some changes in stock management, for example loss of some subsidies, and increased need for movement testing of cattle, have lead to a decrease in cattle numbers summer grazing some marshes, affecting their vegetation structure.

- Many species associated with the agricultural landscape during the breeding season including lapwing, skylark, grey partridge, corn bunting (now locally extinct) and yellow wagtail have declined in number across the NCA in tandem with agricultural intensification in the latter decades of the 20th century.

- However, migratory species such as pink-footed and barnacle geese and whooper swan which use pastures in the winter have increased.

Settlement and development

- Development pressure has caused some changes to parts of the Solway Basin, including increases in residential development in and around urban areas. The transport network has seen the upgrading of a number of routes, most significantly the M6 corridor which crosses the NCA just to the east of Carlisle. Routes around Carlisle have also been upgraded in recent years including a bypass to the north of the city.

- Across the Solway Basin the most apparent change of recent years has been the increase in wind farm developments, both within the Solway Basin itself and in the surrounding upland areas and the part of the Irish Sea visible from the NCA. These developments have taken the form of both multi-turbine and, increasingly, single 'farm-scale' turbine developments. Conversely some major landmarks, such as the power station at Chapelcross in Dumfries have been removed.

- In the rural part of the NCA a significant part of recent industrial development has involved reuse of brownfield sites, in particular former wartime airfields which have been adapted to alternative uses including wind farms, industrial areas and a radar station.

Semi-natural habitat

- The SSSI area in favourable or recovering condition has increased to 89 per cent in 2011 from about 50 per cent in 2003 indicating a general improvement in management of designated sites. This improvement has been seen across the

In recent years the demand for renewable energy has introduced a growing number of wind turbines to the Solway skyline.

range of SSSI; however, a large proportion of sites remaining in unfavourable condition are lowland raised bogs. Visually the most extensive changes have been seen on some of the lowland raised bogs where restoration has taken place with resultant decreases of cover of secondary woodland and an increase in wetland species. Recent years have also seen the cessation of peat harvesting from some sites and their return to more natural vegetation.

- Unimproved semi-natural grasslands have declined through the latter half of the 20th century as agricultural management has intensified and sites have been subject to reseeding and increased nutrient levels. Some habitat specialist species have been restored such as marsh fritillary butterfly which had declined to local extinction in the late 1990s.

- Locally invasive species are an increasing issue with Himalayan balsam a particular issue along watercourses.

Historic features

- In rural areas most farm buildings were considered intact in 2003 though some had been converted. Since that time Agri-environment funding has seen many remaining under active management and some restored. None the less there remains a continued loss of some building types, in particular clay dabbin buildings which require specialist building techniques.

- Along the outer Solway coast some sites are being lost to coastal erosion, for example the Roman cemetery at Beckfoot.

Coast and rivers

- Coastal processes of erosion and deposition are continuing to shape the coast. At Dubmill point to Beckfoot sea defences have been built to protect the coastal road. Further north coastal defences have been strengthened at Skinburness. Grune Point, the northernmost point on the outer Solway, continues to realign in response to modification of sediment supply with erosion of the western shore and deposition on the east.

In recent years the demand for renewable energy has introduced a growing number of wind turbines to the Solway skyline.

- In recent years the dune system of the outer Solway coast has seen a decline in direct damage caused by unmanaged access, such as by vehicles, allowing stabilisation of sand dunes. Recent declines in coastal grazing have also seen changes in vegetation to those associated with ungrazed systems.

- In the inner Solway there are areas of erosion and deposition, but as a whole there has been an increase in salt marsh extent, this is most prevalent in the inner most part of the Solway to the east of the Bowness-on-Solway, where Rockcliffe marsh has both expanded and risen in response to sediment deposition.

- A number of species characteristic of the coastal zone have seen declines in recent years, in particular breeding waders on the salt marshes, and wintering waders on the intertidal flats. However, species such as barnacle geese and whooper swan have increased.

- Measures implemented to improve water quality in recent years have included the upgrading of waste water treatment facilities discharging into both coastal waters and the river system.

- Recent years have seen increased instances of flooding in the rivers systems, resulting in the upgrading of flood defences in the Carlisle area.

Once extinct in the wild in Cumbria, the marsh fritillary is now restored as part of the Solway landscape.

Drivers of change

Climate change

- Climate change is likely to be a major driver of change in the Solway Basin, the NCA's low-lying character and network of coastal and wetland sites are likely to be especially vulnerable to change. Projections suggest that the NCA is likely to see increases in summer and winter temperatures, an increase in winter rainfall but a decrease in summer rainfall, and an increase in the number and intensity of storm events. Rainfall is likely to be focused into fewer events of higher intensity.

- Key changes for agriculture are likely to be improved conditions for arable crops, a lengthened growing season, and reduced water availability which may affect the way the landscape is agriculturally managed.

- Along the coast there may be increased dynamism of coastal processes along coastal margins, increased erosion along tidal watercourses, increased frequency and intensity of storm flooding events, reductions in water quality related to decreasing quality of fluvial inputs, increased sedimentation on marshes. These changes may result in increased risk to coastal historic assets and increased demands for coastal defences around settlements and infrastructure with consequent impacts on coastal sediment movement and costal habitats and the species they support.

- Changes in climate may affect SPA species composition in the Solway with particular changes in the populations of wintering birds as birds shift distribution to areas closer to breeding grounds which have formerly been unsuitable in winter.

- Inland wetlands are likely to experience lower summer water levels and consequent decreases in water quality, increases in CO_2 emissions from dried out peat, increased risk of flooding events in low-lying areas and a risk of saline intrusion into coastal freshwater wetlands.

- Recreational impact may include increased desirability to visitors associated with increased summer temperatures and drying out of green infrastructure as well as more flooding along watercourses.

Other key drivers

- Ongoing development pressures, both for residential and business use. In the short term, promotion of low carbon energy sources, coupled with the areas high wind resource, are likely to see an increase in demand for wind turbines in and around the NCA. This includes both farm/community-scale and commercial-scale developments.

- Over stabilisation of sand dunes may threaten some species and lead to changing character with an increase in scrub encroachment.

- Colonisation and increases in populations of invasive non-native species such as grey squirrel, signal crayfish and Himalayan balsam may impact on semi-natural habitats and important native species.

- Colonisation and spread of tree pests and diseases such as *Chalara* and *Phytophera* continue to pose a risk to woodlands of all types.

- In the coastal areas increased coastal access provision may increase visitor use of and pressure on the coastal zone, particularly along the outer Solway coast.

- Flood management policy prioritising resources to residential property and key infrastructure is likely to draw funding away from agricultural areas, which may have particular implications in what is a predominantly rural, low-lying and flat landscape with large areas of farmland close to sea level.

Climate change with its projected impacts on sea level and storminess will continue to drive change along the Solway Coast.

Supporting document 3: Analysis supporting Statements of Environmental Opportunity

The following analysis section focuses on a selection of the key provisioning, regulating and cultural ecosystem goods and services for this NCA. These are underpinned by supporting services such as photosynthesis, nutrient cycling, soil formation and evapo-transpiration. Supporting services perform an essential role in ensuring the availability of all ecosystem services.

Biodiversity and geodiversity are crucial in supporting the full range of ecosystem services provided by this landscape. Wildlife and geologically-rich landscapes are also of cultural value and are included in this section of the analysis. This analysis shows the projected impact of Statements of Environmental Opportunity on the value of nominated ecosystem services within this landscape.

Securing appropriate management of the coast benefits both farming and wildlife.

Statement of Environmental Opportunity	Ecosystem service: Food provision	Timber provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Regulating water quality	Regulating water flow	Regulating soil quality	Regulating soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Sense of place / Inspiration	Sense of history	Tranquillity	Recreation	Biodiversity	Geodiversity
SEO 1: Conserve and enhance the designated coastal landscapes and the diverse range of habitats of the Solway coast, managing the internationally important coastal and estuary systems, including the intertidal flats, salt marshes and sand dunes, for the species they support, their geomorphology, recreation and tranquillity value and the flood risk protection they provide, in order to aid adaptation to the effects of climate change and enhance their importance in the local economy.	↗ ***	↔ ***	↔ ***	↗ **	↔ ***	↑ ***	↗ **	↗ **	↑ ***	↑ ***	↗ ***	↗ **	↑ ***	↑ ***	↗ ***	↑ ***	↑ ***	↑ ***	↑ ***
SEO 2: Manage and restore the freshwater wetland landscape of the Solway Basin, including internationally important raised bogs and rivers with their associated fens, lakes, riparian woodlands and channels, for the important habitats they provide, their contribution to landscape character, the environmental record and historical assets they hold, and to manage flood risk and maintain water quality.	↗ ***	↔ ***	↑ ***	↔ ***	↗ ***	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↗ ***	↗ **	↗ ***	↑ ***	↗ **	↑ ***	↗ ***	↑ ***	↗ ***
SEO 3: Work with landowners and land managers to protect, enhance and strengthen the network of farmland features; create and expand farmland habitats to enhance biodiversity and improve soil and water quality; strengthen the resilience of habitats to climate change; enhance landscape character; and support a diverse rural economy.	↑ ***	↑ ***	↑ ***	↗ ***	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↑ ***	↗ ***	↔ ***	↗ ***	↗ ***	↗ ***	↗ ***	↑ ***	↔ ***
SEO 4: Conserve and promote the historic landscape and settlement character, including the many heritage assets linked to the area's history as a disputed boundary zone, such as the World Heritage Site of Hadrian's Wall, promote education and understanding through interpretation, enhance recreation opportunities and ensure that the design of new development enhances the character of the area.	↗ **	↗ **	↗ **	↗ **	↗ **	↗ **	↑ ***	↑ ***	↗ **	↑ ***	↗ ***	↔ ***	↔ ***	↗ ***	↑ ***	↗ ***	↑ ***	↗ **	↔ ***

Note: Arrows shown in the table above indicate anticipated impact on service delivery ↑=Increase ↗ =Slight Increase ↔=No change ↘ =Slight Decrease ↓=Decrease.
Asterisks denote confidence in projection (*low **medium***high) ○ =symbol denotes where insufficient information on the likely impact is available .

Dark plum =National Importance; Mid plum =Regional Importance; Light plum =Local Importance

Landscape attributes

Landscape attribute	Justification for selection
The low-lying and open coastal landscape of the outer Solway coast with extensive intertidal sand flats and cobble skears grading into beaches of sand and shingle backed by a system of sand dunes.	■ Solway Coast Area of Outstanding Natural Beauty (AONB) designated landscape along the coast and estuary. ■ The extensive and nationally important SSSI dune system hosting rare plants and animals. ■ The open vista to the northern Irish Sea and iconic views across the Solway Firth to Criffel in Dumfries and to the Lake District. ■ Important for quiet open air recreation in particular walking, beach going, and golf. ■ Dynamic intertidal landscape constantly changing with the tide and the light. ■ Coastal fisheries for cockles, mussels, and shrimp supported by the high-quality coastal environment. ■ Presence of intertidal rocky skears of glacially deposited cobbles, supporting honeycomb worm reefs, shellfish beds and acting as the feeding grounds for many birds.
The open and expansive estuarine landscape of the inner Solway with extensive salt marshes and intertidal flats.	■ AONB designated landscape. ■ SSSI and SAC salt marsh and intertidal systems of national and international importance. ■ An area of international importance for waders and wildfowl including large flocks of geese in winter. ■ An expansive and semi-natural landscape subject to a shared grazing management regime established centuries ago. ■ A landscape of high tranquillity. ■ A nationally important palaeo-environmental record of past sea level change.
The rich and diverse built history, much of which is related to conflict, from Roman times onwards.	■ Visible remains of Hadrian's Wall with World Heritage Site designation. ■ Long standing history as an area of border conflict for example fortified farmsteads ■ Diverse building styles dominated by St Bees Sandstone imported from adjacent areas but locally utilizing a range of materials including river cobbles, beach cobbles and local clay. ■ The fortified cathedral city of Carlisle, guarding a crossing over the Eden, with its historic buildings and city walls built of local sandstone. ■ Presence of a suite of Second World War airfields.

Landscape attribute	Justification for selection
The lowland wetland environment, particularly the extensive areas of enclosed grazing marsh and suite of lowland raised mosses and rivers.	■ The most extensive suite of surviving lowland raised mosses in England including many of SSSI and SAC status. ■ The juxtaposition of reclaimed grazing marsh and other pastoral farmland with contrasting lowland raised bogs is distinctive. ■ Lowland raised bogs hold important records of the environment since the last ice age and store large amounts of carbon. ■ The presence of a suite of lowland wetland habitats many of national importance including valley mires, kettle hole lakes and rivers. ■ Extensive areas of grazing marsh that are an important agricultural asset supporting dairy and meat production as well as being the most extensive priority habitat in the lower parts of the Solway basin.
Broad rivers corridors with a fundamental role in shaping the area's history and their special biodiversity.	■ The crossing of the River Eden led to the establishment of the cathedral city of Carlisle. ■ River corridors to the south and east became main transport corridors. ■ Rivers and associated valley woodland corridors of SAC and SSSI status. ■ Rivers home, to many notable species including salmon, lamprey, otters and beds of water crowfoot. ■ Ancient woodlands in upland fringe incised river valleys with nationally important plant and lichen communities. ■ The river flood plains provide the bulk of the agricultural land of the area.
Mixed farming landscape with pasture and arable management in fields bounded by hedges.	■ Agriculture is the dominant land use of the rural landscape. Pastoral systems are most common but there is a significant area of arable land resulting in the retention of a mixed farming landscape. ■ Away from the open coast a landscape structure characterised by the presence of relatively small fields with generally maintained boundary hedges that reflect the evolution of the landscape over time.
Low woodland cover (five percent of the NCA) but locally important on the eastern and southern margins of the NCA.	■ Woodland cover on the coastal plain is minimal with trees being largely restricted to occasional hedgerow standards. ■ Low woodland cover increases the expansive and open feel to the landscape in the lower parts of the Solway Basin. ■ Native broadleaved woodland is generally restricted to steeper slopes along incised river corridors, in particular on the footslopes of the Cumbria High Fells along the southern margins of the NCA and to the east of the M6 corridor. ■ Some large conifer plantations especially north of Carlisle. ■ Ancient woodland comprises 21 per cent of all woodland.

Landscape opportunities

- Maintain and enhance the coastal habitats of the NCA, in particular sand dunes, shingle, sand flats and intertidal reefs of the outer Solway estuary and the salt marshes, and mudflats of the inner Solway estuary. Maintain and enhance key sites for important but vulnerable coastal species, such as wintering waders and wildfowl, breeding waders, and honeycomb worm reefs.

- Promote sustainable management of coastal fisheries and shell fisheries supported by a healthy environment.

- Plan for and proactively seek opportunities to enhance coastal habitats alongside coastal adaptation programmes.

- Enhance environmentally sensitive access provision to enable the environmental assets of the NCA to better support its economy including coastal access, the Hadrian's Wall Path and the network of historic sites and nature reserves.

- Protect and restore areas of lowland peatland, such as Bowness Common, Glasson Moss, Drumbrugh Moss, Wedholme Flow, Solway Moss, Oulton Moss, Scaleby Moss, Salta Moss, White Moss, Bolton Fell Moss, and Walton Moss.

- Protect and restore areas of species rich grassland including surviving meadows and pastures, such as around Broad Dales, Salta moss, Thornhill Moss.

The peat bogs of the Solway are the most intact in England supporting many specialist species and locking away significant carbon reserves.

- Protect and restore rivers and their riparian habitats, in particular those in the catchments of the Rivers Eden, Esk and Sark.
- Restore areas of flood plain wetland such as the Holme Dub.
- Maintain and restore geomorphologic features and processes and raise awareness of them with particular reference to coastal and lowland wetland systems and the glacial landform.
- Re-naturalise canalised watercourses them, make them more active, create more wetland, wet pastures, and thus make more of a contribution to the landscape, geomorphology, biodiversity particularly in the lower stretches of the Waver, Wampool and Wiza catchments.
- Maintain and restore boundary features, such as kested hedge banks (on the outer Solway coast), ditches with hedges (in the coastal plain), and hedges (elsewhere throughout), keeping the relationship between boundary features and the variations in local geology and topography.
- Promote sustainable land use practices and address sources of pollution.
- Conserve and enhance the important sites and features linked to cultural heritage and their surrounding cultural landscape with particular reference to Hadrian's Wall World Heritage Site, the historic town of Carlisle, Lanercost Priory and Holme Cultram Abbey.
- Provide improved access, interpretation and educational facilities to increase visitor experience of, understanding of, and enjoyment of the NCAs natural and historic heritage, and engage the local community in its future management.
- Embed local vernacular styles such as use of red St Bees Sandstone, cobbles and clay dabbin in planning policy as appropriate.
- Promote links between a healthy environment and sustainable economic growth particularly around Carlisle. Plan for climate change adaptation including provision for species movement, changes to the coastline, and documentation of heritage at risk.
- Support adaptation of farm businesses to a changing climate by securing systems that are economically sustainable under increasingly variable climatic conditions and are less dependent on resource intensive systems such as pump drainage and intensively managed watercourses.
- Enhance the quality of woodland in the NCA by restoring plantation ancient woodland sites to native species cover, connecting riparian woodlands, removing woodlands on lowland raised bogs, ensuring under-managed woodland is bought into management and planting more woodland in appropriate places.
- Support populations of farmland birds on land under arable management.

Ecosystem service analysis

The following section shows the analysis used to determine key Ecosystem Service opportunities within the area. These opportunities have been combined with the analysis of landscape opportunities to create Statements of Environmental Opportunity.

Please note that the following analysis is based upon available data and current understanding of ecosystem services. It does not represent a comprehensive local assessment. Quality and quantity of data for each service is variable locally and many of the services listed are not yet fully researched or understood. Therefore analysis and opportunities may change upon publication of further evidence and better understanding of the inter-relationship between services at a local level.

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision	Extensive coverage of pastoral and arable agriculture Extensive areas of grazed salt marshes Intertidal habitats supporting shellfish populations Fertile soils Relatively high rainfall Mild climate	The majority of the NCA is made up of Grade 3 agricultural soils, with lower grades (4 and 5) associated with areas of wet peaty soils in valley bottoms or on peat bogs. The higher quality Grade 2 land is restricted to areas of free draining soils on elevated ground such as around Wigton and to the east of Carlisle. In these areas arable cropping is more prevalent. Food production in the NCA is dominated by pastoral farming systems for meat and dairy. There are also significant areas of cropped land (19 per cent of the agricultural area) mainly on mineral soils. Mixed farming systems have generally declined in recent years as farm businesses have specialised although areas of both arable and pastoral management are widespread across the landscape. The salt marshes of the Solway estuary are generally grazed with cattle during the summer months and sheep from the uplands during the winter. Summer grazing on the marshes by livestock, releases inland grasslands to be managed for silage production. **Continued over...**	Regional	Generally pastoral farms are managed under an intensive regime with artificial fertilisers and slurry applications used to maximise productivity. Silage production dominates, with generally three cuts taken between April and September followed by aftermath grazing. Cattle are housed indoors for much of the winter with pastures being grazed by sheep. Slurry collected from animals housed indoors is spread throughout the year when ground conditions allow. A heavy reliance on artificial fertilisers to enhance plant growth can deplete the levels of foodstuffs afforded to soil-dwelling fauna within grassland systems with consequences for soil structure. The spreading of slurry at periods of high rainfall and on waterlogged or frozen ground can result in nutrients entering watercourses causing diffuse pollution. In lower catchment areas with where the water table is closer to the surface of the ground compaction can affect soil and water quality, this is a particular risk where stock numbers are relatively high. **Continued over...**	Encourage sustainable farming practices to continue the production of food and contribute to the economy while also seeking to reduce the impact on water and soil quality while providing opportunities for biodiversity and pollination Promote sustainable management of coastal fisheries and shell fisheries supported by a healthy environment. Seek opportunities to link farm produce with AONB identity and develop local markets for produce.	**Food provision** **Water Availability** **Regulating water quality** **Climate regulation** **Sense of place/ inspiration** **Biodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Food provision continued		**...continued from previous** In the coastal zone traditional fisheries play a variable role in the rural economy. For example, shellfisheries for cockles and mussels and shrimping in the Silloth channel are based upon the harvesting of wild stocks. Both cockle and mussel fisheries vary from year to year in line with spat fall, stock establishment and growth. In recent years experimental aquaculture has developed to consider the viability of oyster and mussel production within the Solway estuary.		**...continued from previous** Recent economic drivers have seen some holdings moving away from exclusively pastoral systems. In some instances this has been coupled with a move from dairy systems to beef and sheep production. Increasing the proportion of the land given over to cropping systems has potential increase efficiency of food production where commercial crops are being produced. If farm businesses seek to adopt a wider range of farming types then there may be opportunities to benefit provision of ecosystem services alongside these changes. Where conversion from pasture is being considered the principles of precision farming should be followed, allowing efficient management targeted at a fine scale. Within the pastoral system there may be opportunities for improving ecosystem services, allowing continued food provision but within a more sustainable framework. These opportunities might include, reducing the intensity of agricultural systems, where this is viable, implementing more precise faming, and focusing provision on the most suitable areas.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Timber provision	Woodland cover Three sawmills	The NCA contains 4,763 ha of woodland (5 per cent of the total area), of which 1,022 ha are ancient woodland composed of 474 ha ancient semi-natural and 549 ha planted ancient woodland site (PAWS). Post Second World War conifer plantations are a significant feature in some parts of the NCA, particularly north and east of Carlisle.	Local	There is also potential to increase the cover of native woodland by replanting with native species when non-native plantations are being harvested. Where timber is provided by native species biodiversity in general may benefit, particularly where woodland stands link areas of ancient woodland, such as along the River Lyne and Esk. A by-product of developing a timber resource of broad leaved species would be important dead wood habitat and the non- or limited intervention management associated with hard-wood timber supports a range of species. There is potential to restore ancient woodland through conversion of plantations on ancient woodland sites. All woodland requires management to produce multiple benefits. Woodland creation and timber production would often particularly benefit areas of river corridor, where woodland presence can help to slow runoff rates regulating flooding and soil erosion and, through shading, can lower water temperatures which allows increased oxygenation of water benefiting fish and other aquatic animals. Because timber takes a considerable time to develop as a crop, climate change should be considered when deciding upon suitable species for planting. Novel diseases pose a significant long term threat to timber production with diseases of elm, ash and larch affecting trees in Northern England. In some areas deer populations and non-native grey squirrel are a pest of timber production limiting regeneration and requiring management to ensure commercial outputs. In the short term, timber could also be sourced as a by-product of the restoration of lowland raised bogs, a number of which are in poor condition because of issues that include excessive tree cover.	Seek opportunities to increase woodland cover particularly in the eastern and southern parts of the NCA. Seek opportunities to protect, buffer and connect surviving areas of ancient woodland. Seek opportunities to buffer rivers. Seek opportunities to restore native woodlands and open habitats from non-native plantations. Promote woodland management in line with UK Forestry Standards. Where appropriate, include suitable access provision for a range of abilities to allow visitors the opportunities to access and enjoy the natural environment. Monitor and seek co-ordinated management of pest species and diseases.	**Timber provision** **Regulating soil erosion** **Regulating water flow** **Regulating water quality** **Climate Regulation** **Sense of place/ inspiration** **Biodiversity** **Recreation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Water availability	Surface water catchment and groundwater aquifers	The majority of the NCA does not overlie any major aquifers with the exception of its south-western end where the North Cumbria Aquifer has a 'water available' Catchment Abstraction Management Status. Surface water resources in the NCA generally have a 'water available status' with the exception of the River Ellen which has 'no water available'.[4] Water is abstracted from catchments upstream of the NCA for a variety of purposes, including industrial use, public water supply, farming, private water supply, hydropower and bottling. On the Solway Plain a number of farms and other water users, such as golf courses, abstract water from underground aquifers in drift deposits which generally have a high recharge potential. [4] *The Derwent, West Cumbria and Duddon Catchment Abstraction Management Strategy*, Environment Agency (2007); *The Eden and Esk Catchment Abstraction Management Strategy*, Environment Agency (2006).	Regional	With the exception of the Waver–Wampool catchments, which are largely self contained in the NCA, the other river systems have their catchments upstream of the NCA and cross the NCA to discharge into the Solway Firth. Influencing water availability in the catchments that cross the NCA would necessitate actions in the upper catchment NCAs including the Cumbria High Fells, Orton Fells, North Pennines and Border Moors and Forests. In the Waver–Wampool catchment and adjoining smaller waterways both surface water and ground water aquifers are used by agriculture and amenity users. Combinations of high average rainfall, areas of free draining soils and under surface drift deposits which are also free draining give high water availability for many areas. However, climate change impacts, including more variable rainfall patterns, may affect surface water availability in the future. In the medium to long term increased impoundment of rainwater and utilisation of underground aquifers may be of increased importance in the support of sustainable rural business including agricultural units. However, it will be important to ensure that any increased utilisation of underground aquifers does not negatively impact on surface water availability, particularly given the large number of nationally and internationally important sites in the NCA that are surface water dependent, and that utilisation remains at sustainable levels and does not lead to over abstraction. Increased reliance on local water sources would also reduce pressure on water supplies from upper catchment sources which may benefit other water users.	Promote sustainable use of local water sources. Seek upper catchment measures for more consistent water availability. Identify opportunities for more efficient water management such as rain water harvesting.	**Water availability** **Food production** **Regulating water flow** **Regulating water quality** **Regulating soil quality** **Regulating soil erosion** **Biodiversity**
Genetic diversity	NA	NA	NA	NA	NA	**NA**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biomass energy	Woodland cover	Management of land in the NCA for biomass production is increasing. Main contributors include poor quality material produced as a by-product of timber production, and material generated as part of open habitat restoration programmes. There is potential for increased provision liked to new markets and technologies.	Local	At a commercial scale the existing woodland cover (5 per cent) offers relatively low potential for the provision of biomass through bringing unmanaged woodland under management or as a by-product of commercial timber production. However, in parts of the NCA there is potential to develop biomass linked to the wood-fired power stations at Lockerbie in Dumfries, which is directly linked to the NCA by the M6/A74, and at Workington. These plants provide a commercial market for woodfuel products in easy access of the NCA. In the short term source wood would come from plantation conifers which are a locally common feature in parts of the NCA, particularly on the mineral soils north and east of Carlisle, or material from sites being restored to open habitats. However, in the medium to long term they could provide a market for other woodland types, either planted as part of woodland expansion programmes or replacing non-native plantations at harvesting. The NCA has generally high potential yield for short rotation coppice while potential miscanthus yield is generally medium, though higher along the coastal strip and a corridor between Carlisle and Gretna. **Continued over...**	Seek opportunities to link under-managed woodlands with commercial and domestic markets for woodfuel. Seek opportunities to establish woodlands in areas such as riparian corridors and linking ancient woodlands where they provide added benefits. Seek opportunities to support restoration of open habitats especially on the lowland raised bogs by clear felling and marketing wood. Seek opportunities to use biomass production to support farm business diversification.	**Biomass energy** **Biodiversity** **Regulating water quality** **Regulating water flow** **Climate regulation** **Sense of place/ inspiration** **Tranquillity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biomass energy continued				**...continued from previous** As a biomass crop short rotation willow coppice is established south of Carlisle but biomass crops would be a new land use in many parts of this NCA with the potential for both positive and negative impacts on the NCA. For information on the potential landscape impacts of biomass plantings within the NCA, refer to the tables on the Natural England website ww.naturalengland.org.uk/ourwork/farming/funding/ecs/sitings/areas/default.aspx. Other biomass energy sources include anaerobic digestion utilising green waste and farm produce such as maize and grass silage. The recent opening of an anaerobic digestion plant near Silloth provides a local market for this produce which may provide an alternative market for farm businesses looking to diversify or change their business model. Locally there is potential to provide biomass for domestic markets from the re-establishment of local management of underutilised woodlands for woodfuel. This approach can make use of both native and non-native wood and can be a local driver for small-scale plantings in areas which benefit a range of services such as biodiversity and climate regulation.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Climate regulation	Lowland raised bogs, salt marshes, carbon rich soils, areas of woodland and extensive estuarine mudflats	Soil carbon levels are generally low (0–5 per cent), reflecting the mineral soils covering 80 per cent of the NCA. Soil carbon is likely to be higher under the NCA's 9,500 ha of coastal and flood plain grazing marsh, 2,900 ha of lowland raised bog and other wetlands and its estuarine mudflats and intertidal areas on the Solway coast with which the loamy and clayey soils of coastal flats with naturally high groundwater (10 per cent of NCA), salt marsh soils (3 per cent of NCA), raised bog peat soils (3 per cent of NCA), and fen peat soils (1 per cent of NCA) are likely to be associated. Carbon storage is also provided by the 4,500 ha of woodland within the NCA (5 per cent of its area).	International	The restoration and management of peat bogs has potential to reduce the loss of nationally important carbon storage capacity and reduce emissions from degraded peat soils. It will be particularly important to conserve any areas of deep peat soils and also the peaty or organic soils of the naturally wet very acid sandy soils (1 per cent of NCA) and the loamy and clayey flood plain soils with naturally high groundwater (2 per cent of NCA). Peat harvesting for the horticultural trade continues on some bog sites affecting the carbon balance. Where agriculture is present on peaty soils, intensive management can often result in the reduction of stored soil carbon through peat wastage and soil erosion, particularly where land is ploughed for grassland reseeding or arable cropping. Management to reduce carbon loss includes reversion of high risk arable land to pasture and management which promotes the return of organic material to the soil. Many of the peatland sites in the NCA are subject to restoration management, in the main driven by biodiversity considerations. This will make important contributions to climate regulation, both by securing the storage of carbon in peat and preventing its release as carbon dioxide and by enabling the sequestration of carbon dioxide from the atmosphere. Carbon storage will also be provided by the 4,763 ha of woodland within the NCA (5 per cent of its area). The extensive areas of accreting salt marsh and mudflat provide a valuable store of greenhouse gases.	Seek opportunities to maintain carbon storage and increase carbon sequestration by protecting and restoring peat bogs and other peaty soils, also by maintaining and expanding salt marshes. Conserve organic and, in particular, peaty soils, restoring lowland raised bogs and other lowland wetlands and managing agriculture on peaty soils to minimise peat wastage and increase soil carbon levels. Work with the farming community on the agricultural land of the coastal plain, seeking opportunities to establish sustainable grazing regimes which allow for enhanced carbon storage. Increase woodland cover, particularly in the upland fringes of the NCA.	**Climate regulation** **Regulating water quality** **Regulating coastal erosion and flooding** **Biodiversity** **Sense of place/ inspiration** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water quality	Semi-natural wetland habitats, including riparian buffers	The ecological status of river waters and estuaries is generally moderate or poor. Of the rivers the chemical status is good but ecological status is moderate, failing to achieve good condition in the River Ellen and moderate in the smaller watercourses of the Derwent River Basin Management area.[5] In the Solway-Tweed River Basin area, which includes most of the main rivers in the NCA, the rivers Eden, Sark, Waver and Wampool have a chemical status which is moderate. The River Esk is classified as moderate to poor. The chemical status of groundwater is good in many areas but poor along the Eden and Ellen catchments. The NCA includes three designated bathing water beaches. In recent years two of these have passed water quality standards however the third has experienced some failures which are attributable to nutrient loads following storm events The catchments of the rivers Waver and Wampool are Priority Catchments for Catchment Sensitive Farming. Soil erosion is identified as an issue within these catchments. Soil erosion can carry pollutants and sediment into watercourses - see also regulating soil erosion. High phosphate levels in rivers are an issue, attributable both to soil erosion and to high levels of inorganic phosphate application to farmland and inappropriate storage of manure close to watercourses or pathways to them.	Local	Water quality within many of the main rivers in the NCA is determined by land management practices in upper catchment NCAs, limiting the scope of measures that can be taken here to influence main river issues. Diffuse pollution arising from livestock accessing watercourses directly and the disposal of farm waste on fields has been identified as a priority issue affecting water quality, particularly in the Lower River Waver catchment. Pressure on land to receive waste can be reduced through measures such as, reducing stocking density, timing of operations and farm infrastructure. While generally beneficial these measures would be likely to result in short-term decreases in some services such as food provision, however, impacts in the longer term would likely be neutral or positive. Other pollution prevention measures targeting both farm infrastructure and land management would not affect short term food provision. These include covering slurry areas to reduce high nutrient runoff entering watercourses, covering yards (to prevent rain water increasing the volume of material to be stored), increasing slurry storage capacity, and better management of point source points of pollution such as around gateways. Regular soil sampling to promote a better understanding of soil nutrient status and potential is also recommended. In recent years waste water treatment has been improved at a number of sites in the Solway Basin reducing point source discharges from domestic sources into watercourses and transitional waters. However, some issues with septic system discharges remain.	Work with the farming community to ensure applications of artificial fertiliser and slurry are well targeted and account for infield nutrient analysis. Seek opportunities to reduce impacts on bathing waters by reducing diffuse pollution entering watercourses. Support measures to reduce nutrient loading from identified point source discharges for example by covering yards, increasing slurry storage and addressing faulty septic systems. Where possible establish soil trapping buffers of vegetation in areas of high hydraulic connectivity. Seek opportunities to stabilise erosion-prone slopes by establishing tree cover particularly in the more upland parts of the NCA.	**Regulating water quality** **Food production** **Regulating soil quality** **Regulating soil erosion** **Biodiversity** **Sense of place/ inspiration** **Recreation** **Geodiversity**

[5] www.environment-agency.gov.uk/homeandleisure/37793.aspx

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating water flow	Semi-natural wetland habitats Riparian buffers on farmland and urban areas Large upland catchments of the NCAs main rivers	The main rivers within the NCA are grouped into two districts for the purposes of flood management - the Derwent in the west of the NCA, which includes the River Ellen, and the Solway-Tweed which includes the Waver and Wampool systems, the Eden catchment and the Esk and Sark systems.[6] The River Ellen within the Derwent CFMP discharges into the Solway Firth at Maryport. It is a predominantly rural catchment and has low to moderate flood risk. The River Eden has its headwaters in the Cumbria High Fells and Yorkshire Dales where steep gradients, high rainfall and relatively impermeable geology combine to produce large and rapid run-off. The headwaters of the Esk and Sark lie in the border uplands of both England and Scotland. In contrast to the upland parts of the river catchments, the Eden, Esk and Sark catchments within this NCA are characterised by wide flood plains which can provide storage capacity on agricultural land when rivers are high. 504 ha of farmland in the Waver–Wampool catchments is pump drained. The NCA's major settlement, Carlisle, is subject to significant river flood risk from the River Eden and its tributary rivers, and experienced major flooding in January 2005 and November 2009.	Regional	The rural character of much of the NCA provides potential for managing land to reduce run-off and for further flood storage although this may impact on agricultural productivity. Securing beneficial flood storage for Carlisle would involve increasing the capacity of flood plain land upstream of Carlisle to store floodwater and woodland planting to reduce peak flows. Given the limited length of the River Eden in this NCA compared to that in the upstream Eden Valley NCA and other NCAs around the Eden headwaters many measures would need to take place in the latter area. Locally measures such as the restoration of lowland raised bogs can reduce water loss at periods of high rainfall, with consequent benefits for surrounding agricultural land. Much of the agricultural land in the lower parts of the Solway Basin is reclaimed from lowland wetland and flood plain habitats. With climate change impacts predicted to include more intense rainfall events flooding of low-lying land is likely to increase in future years unless adaptation measures are instigated throughout entire catchment. These could include increased capacity for flood storage in the low-lying parts of the catchment and measures to reduce peak flows from upland tributaries.	Support measures to reduce peak flows from upper catchment NCAs such as the Eden Valley, North Pennines, Cumbria High Fells and Tyne Gap and Hadrian's Wall by restoring the ability of upland habitats to intercept and store increased volumes of precipitation. Seek areas of water storage in the flood plain of the Eden catchment above Carlisle. Manage surface water run-off to reduce river peak flows.	**Regulating water flow** **Regulating water quality** **Climate regulation** **Regulating coastal erosion and flooding** **Regulating soil erosion** **Biodiversity** **Geodiversity**

[6] www.environment-agency.gov.uk/homeandleisure/37793.aspx; and http://gis.sepa.org.uk/rbmp/

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality	Agricultural land	This NCA has 12 main soilscape types: ■ Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (49 per cent of the NCA). ■ Freely draining slightly acid loamy soils (13 per cent). ■ Loamy and clayey soils of coastal flats with naturally high groundwater (10 per cent). ■ Slightly acid loamy and clayey soils with impeded drainage (6 per cent). ■ Freely draining slightly acid sandy soils (4 per cent). ■ Slowly permeable seasonally wet acid loamy and clayey soils (4 per cent). ■ Raised bog peat soils (3 per cent). ■ Salt marsh soils (3 per cent). ■ Freely draining flood plain soils (2 per cent). ■ Loamy and clayey flood plain soils with naturally high groundwater (2 per cent). ■ Fen peat soils (1 per cent). ■ Naturally wet very acid sandy and loamy soils (1 per cent).	Local	Those soil types covering 10 per cent or more of the NCA are described below. The lowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils are the dominant soils in the NCA and are mainly managed as part of pastoral systems. These soils may suffer compaction and/or capping as they are easily damaged when wet. This can lead to increasingly poor water infiltration and diffuse pollution as a result of surface water run-off. Management measures, such as reducing trampling and less intensive cropping, that increase organic matter levels in soils can help reduce these problems. The freely draining slightly acid loamy soils are associated with both arable and pastoral management. These soils allow water infiltration and have potential for increased organic matter levels through management interventions. They may be valuable for recharging the North Cumbria Aquifer and groundwaters more generally, requiring the maintenance of good structural conditions to aid water infiltration and the matching of nutrients to needs to prevent pollution of the underlying aquifer. The loamy and clayey soils of coastal flats with naturally high groundwater are mainly managed as pasture. These are the soils of low-lying reclaimed land. They have a high agricultural potential but accessing this potential is dependent on protecting the soils from river and sea flooding, saline intrusion (locally some soils are saline and at risk of structural damage where drained) and locally on the continued ability to pump drain. **Continued over...**	Seek opportunities to establish sustainable land management regimes which protect and enhance the soil resource, such as by reducing ploughing on erosion prone slopes, allowing development of organic soil content and increasing use of natural nitrogen sources such as legumes. Protect and enhance salt marshes allowing them to capture silts and develop organic soils.	**Regulating soil quality** **Food production** **Regulating water quality** **Regulating water flow** **Climate regulation** **Biodiversity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil quality continued				**...continued from previous** These soils help protect other inland soils and are increasingly under threat of loss from sea level rise. Where there is a high silt/fine sand content compaction and/or capping may be an issue which may be reduced by increasing soil organic matter content. Agricultural use of these soils in the medium to long term will be increasingly difficult with climate change affecting sea levels and rainfall patterns, however, short term measures to protect these soils from over use now, such as reducing management intensity, may protect them as an agricultural resource in the long term.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating soil erosion	Agricultural land Vegetation along watercourses	The catchments of the rivers Waver and Wampool are priority catchments for Catchment Sensitive Farming. Soil erosion is identified as an issue within these catchments, particularly due to increased maize cropping, especially on steeper slopes, and structural damage to waterlogged soils from livestock and farm vehicles. The soils that cover 67 per cent of this NCA are not susceptible to erosion.	Regional	Of the erosion-prone soils, the freely draining slightly acid loamy soils and the freely draining slightly acid sandy soils are especially at risk where vegetation is removed or where organic matter levels are low after continuous cultivation. When left bare they are also at risk of wind erosion, especially in the case of freely draining slightly acid loamy soils. In the NCA these are the soil types most often found in association with arable cropping. The naturally wet very acid sandy and loamy soils are also light and susceptible to wind erosion and some are also easily eroded by water if heavily trafficked or after heavy rain. The slightly acid loamy and clayey soils with impeded drainage are easily compacted by machinery or livestock if accessed when wet and are prone to capping or slaking, increasing the risks of soil erosion by surface water run-off, especially on steeper slopes. The raised bog peat soils and fen peat soils are permeable and therefore have a generally low risk of water erosion, particularly where they are managed as part of semi-natural vegetation systems. However, where they are managed as pasture they can be compacted by stock and where they are cultivated they are susceptible to loss during flooding. Salt marsh soils may be lost through coastal erosion, including from sea level rise. At present there is a net accretion of salt marsh soils in the area fed by material delivered to the Solway estuary both by the river systems and coastal processes. Encouraging sustainable land management practices aimed at protecting soils at risk of erosion will also aid regulation of soil quality and improve water quality.	Along watercourses manage areas of erosion to reduce soil loss through in-field management and soft engineering. Enhance riparian corridors by increasing riparian vegetation to reduce sediment transport rates to, and along, watercourses. Work with the farming community to adapt to sustainable land management regimes such as stock management within areas with high soil erosion risk and where soils are prone to compaction. Seek to reduce ploughing on erosion-prone slopes by establishing permanent pastures. Where appropriate seek opportunities to stabilise erosion-prone slopes by establishing tree cover. Maintain function of salt marshes to limit coastal erosion by securing appropriate grazing regimes.	**Regulating soil erosion** **Regulating soil quality** **Regulating water quality** **Food provision** **Recreation** **Sense of place/ inspiration** **Biodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Pollination	Hedgerows Riparian grassland Ancient woodland Roadside verges Gardens Pollinating insects	Away from the coastal margin and lowland raised bogs his NCA on the whole offers relatively poor habitat for pollinating insects, although the areas of semi natural habitat support wildflowers provide an important source of nectar. Nectar sources may also be provided by gardens of the built up areas.	Local	At the current time there is low dependence on pollinator services from the agricultural sector in this NCA. However, should agricultural systems change in the future as a consequence of climate change adaptation, this would change. Pollination service will be important in the urban fringe areas where local produce is grown in allotments and gardens. Pollinating insects are supported by a range of semi-natural habitats including coastal sand dunes and upper salt marshes, lowland raised bogs and meadows. However, away from the coast many of these are present as isolated pockets in the landscape. Improving the condition of hedges and road verges by gapping up and replacing dead trees, and establishing management regimes that allow hedgerows and verges to flower would increase pollination resource but also improve connectivity between more extensive areas of habitat and benefit sense of place and history experience. There are potential nectar sources from the marginal riparian habitats along the waterways and there are agri-environment scheme options designed to increase pollinator habitat for both the benefit of pollinator function and farmland biodiversity including breed birds which need insect rich habitats for their chicks.	Create, restore and maintain semi-natural habitats such as flood plain grazing marsh, coastal grassland and hedgerows. Encourage sustainable farming practices such as uncropped field margins and planting of pollen and nectar mixes that will also enhance landscape character and increase landscape connectivity. Encourage partnership working with a range of organisations to manage boundary features and road side verges so that they produce a range of flowering species and form a network of nectar sources.	**Pollination** **Food production** **Pest regulation** **Biodiversity** **Sense of place / inspiration**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Pest regulation	Flood plain grazing marsh Hedgerows Ancient woodland Riparian grassland Roadside verges	A variety of semi natural habitats support populations of pest-regulating species (invertebrates, birds and mammals). Away from the coastal margin and lowland raised bogs his NCA on the whole offers relatively poor habitat for pest regulators due to the fragmented distribution of semi-natural sites.	Local	Semi-natural habitats within the NCA are fragmented. The existing field boundary hedgerows are sparse and increasing diversity in species and structure of field margins will increase the ability for these areas to support populations of pest-regulating species. Supporting pest regulation reduces dependency on artificial pesticides and herbicides and may become increasingly important if climate change leads to adaptation of agricultural systems.	Encourage sustainable farming practices to manage existing semi-natural habitats and create new areas of habitat; mainly hedgerows, woodlands, flood plain grazing marsh and riparian grassland along waterways. Seek opportunities to improve the network of semi-natural habitats across the NCA should be sought.	**Pest regulation** **Food production** **Pollination** **Biodiversity**
Regulating coastal erosion and flooding	Semi-natural habitats of the coastal zone	The Shoreline Management Plan 2 (SMP2) policy identifies the preferred approach to coastal management. This NCA forms part of 'sub-cell 11e' of the SMP2.[7] Most of the coast is rural but there are a number of small settlements along the coastline and the port town of Silloth on the outer Solway coast. The Solway estuary has an exceptional tidal range resulting in large extents of intertidal habitats and a highly dynamic system. North of Dubmill Point, including Morecambe Bay and the inner Solway Firth, the shoreline of this NCA is internationally designated for its coastal habitats and species. To the north of Maryport, the coastline is within the Hadrian's Wall World Heritage Site and sections of coast also lie within the Solway Coast Area of Outstanding Natural Beauty. **Continued over...**	Regional	Along the outer Solway coast there is a south to north movement of sediments with the beaches that form the coastal defence being sustained by material (both natural and industrial waste) originating in the West Cumbria Coastal Plain NCA to the south. The presence of this barrier beach has allowed the development of the agriculturally important Solway Plain and allowing it to be sustained will be important in protecting agricultural land into the future. From Grune Point into the inner estuary this sediment source decreases in importance with increasing levels of sediment being transported to the Solway from the river networks which drain a large part of north and east Cumbria and Dumfries. The coastline from Maryport to Grune Point is dynamic with both areas of erosion and deposition. From Silloth to Skinburness a lack of sediment has resulted in the shore being defended to limit erosion. From Skinburness northwards, sediment budgets are neutral, however, the lack of sediment arriving from the south is resulting in erosion at the base of the Grune Point which is re-depositing at its tip resulting in a changing coastline. **Continued over...**	Identify opportunities for managed adaptation of the coast to adapt to the impacts of climate change, particularly around the inner Solway, where impacts are likely to be highest because of the combination of coastal and fluvial process at work here. Ensure natural dynamic coastal processes can continue wherever possible along the outer Solway coast.	**Regulating coastal erosion and flooding** **Climate regulation** **Biodiversity** **Sense of place/ inspiration** **Recreation** **Geodiversity**

[7] See http://mycoastline.org/index.php/shoreline-management/smp2 for more information.

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Regulating coastal erosion and flooding continued		**..continued from previous.** The Environment Agency's measures for this stretch of coast can be grouped into three categories: ■ The rural open coast between Maryport and Grune Point the long term plan set out in the SMP recommends a managed realignment policy. This allows for a naturally evolving shoreline, enabling a supply of sediment to build beaches and protect urbanised areas of coast and conserves the environmental status of these areas. ■ The urbanised open coast between Maryport and Grune Point. Maryport and Silloth are key centres and continued protection of these areas will remain necessary into the long term as will some smaller settlements, including Allonby. In this area the SMP policy advocates a hold the line approach. ■ Inner estuary coast from Grune Point eastwards to the River Sark - The long term SMP for this area is a managed realignment policy allowing the shoreline to continue to evolve naturally as much as possible. Allowing for a combination of expected future sea level rise and increased storminess this would see salt marshes continuing to grow, the return of low-lying areas to salt marsh, and continued accretion of material in the inner estuary to act as a natural defence to inland areas.		**...continued from previous.** These areas of erosion and deposition affect communities and sites of historic interest, climate change impacts are likely to increase the risk to assets in the future. Although it remains a dynamic system from Grune Point eastwards, the Solway Estuary is generally accreting. The sand dune and salt marsh systems of the Solway coast form an important coastal defence protecting inland areas from tidal erosion and flooding. Being higher than the adjacent areas inland the sand dunes of the outer Solway act as a barrier and protect lower lying inland areas for being flooded by storm surges. In the inner estuary the salt marshes perform a similar function but at a lower tidal height, however, the vegetation structure on the marshes also performs an important function greatly reducing the tidal energy of large tides and therefore reducing the degree of erosion. Tidal flooding is caused by storm surge and wave action during times of high tides. This is exacerbated when combined with high rainfall causing flood flows in the rivers entering the estuary. In the Solway this can be exacerbated when onshore winds prevent the estuary from fully draining during low tide cycles, increasing the volume of water in the estuary over subsequent high tides. Because of the area's location, aspect and low-lying geography, he Solway Estuary concentrates tidal surges and this along with the large rainwater catchment tidal flooding will be an ongoing risk in the area. This is likely to be increased by climate change impacts including sea level rise, increased storminess and increased intensity of rainfall events. In most areas this will particularly affect agricultural land but some low-lying residential areas are also at risk.	Maintain, extend and enhance the function of areas of coastal habitats, in particular sand dunes and salt marsh, to act as a coastal defence. Encourage further research to understand processes to enable well informed management decisions in the future. Ensure that coastal adaptation programmes enhance the biodiversity and landscape character of the Solway Firth.	

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of place/ inspiration	Views to the uplands Expansive and dynamic coastal and intertidal environment Hadrian's Wall and other features of the built historic environment Open and gently rolling farmed landscape Geodiversity	The open panoramic landscape dominated by pastoral land management, framed by distant uplands and cradling the intertidal expanses of the Solway Firth provide a strong sense of place common to the whole of the NCA. This has led to part of the area being designated AONB. Local features such as Hadrian's Wall and the other key sites of the historic landscape, the daily movements of birds around the Solway estuary and the unique suite of wetland sites and the mixed farmland landscape with hedge bounded fields reinforce the sense of place.	National	In the western part of the area, including the Solway Coast AONB, a sense of place is provided by the flat, open and largely managed pastoral and estuarine landscape. The Solway Firth is a unique and dominant feature, consisting of extensive intertidal mudflats and open salt marshes that line the river channels while the Irish Sea coast of the outer estuary is characterised by low cliffs, sand and pebble beaches with sand dunes and raised beaches. Distinctive raised peat bogs provide an element of contrast amid the intensively managed pasture which is the predominant land cover of the inland plain and coastal fringe area. Settlements along the coast, which include Victorian coastal resorts, have followed a linear pattern while further inland dispersed nucleated settlements have grown around the core of a set of farm buildings. New large-scale development is a distinguishable feature of the Carlisle urban fringe. Along the Solway coast the dynamic coastal environment provides a sense of inspiration and escapism with long and expansive views to the Irish Sea and across the Solway Firth to the mountains of Dumfries, added to in winter the spectacle of waders and wildfowl moving around the estuary. **Continued over...**	Seek opportunities to raise awareness of the sense of place defining the coastal landscape of the Solway Coast AONB and its sensitivities. Seek opportunities to improve understanding of features such as Hadrian's Wall and the development of communities with reference to their historic landscapes. Seek opportunities to maintain the character of the different landscape types (coastal, reclaimed lowlands, and upland foothills) in the NCA by maintaining local variations in vernacular architecture, field boundary type varying tree cover and key views. Seek opportunities to restore areas of semi-natural habitat, such as lowland raised bogs, salt marshes and coastal dunes. Seek opportunities to encourage appropriate access to natural environments, and to promote the calming and restorative effect that contact with tranquil, sensory and inspirational environments have on visitors' health and wellbeing.	**Sense of place/ inspiration** **Sense of history** **Recreation** **Biodiversity** **Tranquillity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of place/ inspiration continued				**..continued from previous.** Inland, to the south of the Maryport to Carlisle road and particularly in the area east of Carlisle, the character changes to one of an open upland-fringe landscape. Mixed farms gradually give way to upland pasture systems in an expansive landscape of wet pastures separated by stone walls or incised and wooded river corridors. Here feelings of inspiration and escapism are likely to be associated with the visually striking remains of forts and settlements along the course of Hadrian's Wall which serve as a constant reminder of the historically strategic importance of the area and the long panoramic views. The area of the Solway Firth provided the setting of Sir Walter Scott's Redgauntlet (1824) and Dickens visited and wrote about the Solway coast in 1857. The area around Wigton also provided the setting for several novels by Melvyn Bragg who was born and raised in the town. In addition, a number of 19th-century artists were attracted to the area by the seascapes and the quality of light including Samuel Bough, Robert Salmon, Joseph Heard and, more recently, A. J. Carter Wood.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history	Historic features including Carlisle with its city walls, cathedral and castle The World Heritage Site associated with Hadrian's Wall Holme Cultram Abbey and Lanercost Priory Narrow strip fields on higher ground Larger fields on reclaimed and enclosed land Kested banks along the open coast Urban architecture of settlements **Continued over...**	Within the World Heritage Site of Hadrian's Wall there has been little recent change in site condition although some features are at risk from coastal erosion. In most of its length in the NCA parts of the wall itself, and its associated buildings, have been lost throughout its history with the stonework incorporated into other buildings. Some sections of wall are present in the eastern parts of the NCA, but elsewhere only associated earthworks survive. Reminders of intermittent border conflict in the 14th to 16th centuries is characterised by surviving fortified houses (including pele towers). 154 sites feature on English Heritage's At Risk Register, including many associated with the period of Roman occupation. Some built heritage sites, such as Holme Cultram Abbey, have been damaged in recent years and are subject to restoration programmes. Structural landscape features, such as boundaries ditches, kests and hedges are generally stable in extent.	International	Archaeological sites in the NCA reflect a number of different periods from the Neolithic to the Second World War, and include a high number of Heritage at Risk sites. In the area the threats to these sites are varied but include lack of knowledge of sites, coastal erosion, general neglect and lack of awareness of appropriate management, inappropriate agricultural management, and lack of traditional skills to carry out restorations. A sense of how the land was sequentially adapted for agriculture over time is evident in the patterns of drainage ditches, hedgerows and stone-faced hedgebanks (kests) of the rural landscape. Early settlements on higher ground were surrounded by small, and often narrow, rectilinear fields, generally bordered by hedges, except on the outer coast where stone-faced kested banks are more typical. Larger-scale rectilinear field patterns are associated with later reclamation of low-lying wetlands and areas of land enclosure. These areas are bounded by hedges and moving inland occasional some hedgerow trees become more frequent. A mixture of local stone has traditionally been used as building material including red sandstone, limestone, cobbles, and Welsh and Cumbrian slate, reflecting the varied history of the area, local skills and particular trade links. Of particular local note are the clay-walled buildings, known as 'clay dabbins' which are to be found on the Solway Plain. **Continued over...**	Document heritage features at risk from coastal change, and seek ex-situ preservation where appropriate. Seek opportunities to increase heritage skills for restoration for example clay 'dabbin' building techniques. Seek opportunities to increase awareness of appropriate management for heritage assets. Seek opportunities to raise awareness of historic features themselves through improved interpretation and educational information. Raise awareness of the links between the built heritage and the development of the landscape. Seek opportunities to improve access links between sites of historical, cultural and natural interest to increase awareness of the relationship between different heritage assets.	**Sense of history** **Sense of place/ inspiration** **Recreation** **Biodiversity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Sense of history continued	**..continued from previous.** Settlement patterns and site names including a number relating to Viking settlement Vernacular styles reflecting local geodiversity			**..continued from previous.** These have declined greatly in recent years as cheaper building materials have become available and knowledge of how to maintain clay walled buildings has declined, for example the importance of using limewash mortar rather than concrete, as the latter corrodes the clay. Many of the larger settlements have architecture patterns traceable to particular periods in their development, such as the Victorian seaside town of Silloth and the extensive Georgian architecture of Carlisle. Oral and cultural traditions also provide a sense of history. In addition to place names, many of which are Viking in origin, the persistence of traditional fisheries maintains a direct cultural link to the area's past. Of particular note is the tradition of 'haaf netting' for salmon in the river mouths of the Solway Firth. This technique has a Viking origin and retains Viking technology, phraseology and equipment. Generic land management practices and the loss of local skills are a threat to the long-term maintenance of the historic assets of the area, for example clay dabbin building skills are almost lost while much field boundary maintenance no longer follows traditional management practice. In addition poorly documented sites are at threat from loss through inappropriate management, for example some roman sites are managed as part of arable systems and other sites such as some mile forts, which should be present, are undocumented. Maintaining a strong sense of history throughout the landscape will require raising awareness both of key assets and their value and securing increased capacity to deliver appropriate management in to the future.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Tranquillity	The open rural landscape of the coastal zone The open and expansive rural landscape of the areas along the Scottish border	Tranquillity remains a significant feature of this NCA despite a slight reduction in areas of undisturbed land from 81 per cent in the 1960s to 71 per cent in 2007, according to the CPRE Intrusion Map.	Regional	Characteristics of the landscape that are particularly important in conveying a sense of tranquillity are the extensive coastal landscapes that have a remote and isolated feel and are away from the major transport routes. These include the accessible beaches and sand dunes on the outer Solway coast, the open salt marsh landscape of the inner Solway with its unmodified marshes and creeks, and the wide views from the exposed Solway Basin to the Dumfries and Galloway coast, the Cumbria High Fells and across the Irish Sea. East of the major route ways that run through the NCA around Carlisle the open rural landscape also affords high levels of tranquillity. Here the history of border conflict which reduced development through the Middle Ages has, in part, helped maintain an open rural landscape with limited settlement affording long views to the uplands and sea in an upland-fringe setting.	Seek opportunities to protect areas providing tranquil experiences, especially the coastal zone. Seek solutions to issues arising from disturbing recreational activities in tranquil areas. Promote the calming and restorative effect that contact with tranquil and sensory environments has on peoples' health and wellbeing.	**Tranquillity** **Sense of place/ inspiration** **Sense of history** **Biodiversity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Recreation	Rights of way network Hadrian's Wall Path National Trail Cycleways Open access land including sites with dedicated access provision Nature reserves	The NCA offers a network of rights of way totalling 747 km at a density of 0.76 km per sq km. Open access land covers 4,063 ha or 4.1 per cent of the NCA including a number of marshes along the Solway coast, a large proportion of the sand dune coast and the lowland raised bogs. Hadrian's Wall Path and cycle way and Cumbria Coastal Way are long-distance routes which cross the area. This has been one of the first areas in the county to receive formal coastal access provision.	National	There are almost 45 km of the Hadrian's Wall Path and stretches of accessible coastline including sand and pebble beaches with sand dunes. There has been an increase in recreational day visitors to the Solway coast, and caravan sites and chalet developments between Silloth and Maryport are a reflection of the coast's continuing popularity. The open character of the sand dune coast is popular with walkers and supports 'links' golf courses used by both residents and visitors for recreation. As well as open access land and public rights of way a number of public open spaces and nature reserves provide recreational access. In some areas increased recreational use may conflict with other assets. In particular disturbance of breeding and wintering birds on the Solway estuary, and damage to sensitive sand dune habitats has been identified as an area of concern. With demand for recreational access likely to increase in the future access provision will increasingly need to take active measures to minimise the risk of impact on features that are part of the area's sense of place.	Where environmental assets are sensitive to disturbance seek opportunities to manage recreational activities to minimise impacts. Seek opportunities to provide interpretation of the landscape and its many features, enabling visitors to understand, value and enjoy its character. Seek opportunities to enhance the network of national and regional and local footpaths, and cycle routes crossing the NCA and increase links to natural and cultural heritage sites. Seek opportunities to enhance access to the local environment close to where people live and work, allowing local communities to benefit from the health and social rewards it affords them. Develop opportunities to promote sustainable tourism supporting a local green economy, recognising the value to the local economy that visitors experiencing the NCAs heritage assets bring.	**Recreation** **Sense of place/ inspiration** **Sense of history** **Tranquillity** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity	Extensive network of semi-natural habitats Lowland raised bogs and other lowland wetlands of the coastal plain Rivers and woodlands in the eastern part of the NCA Arable farmland	Priority habitats within the NCA include 9,500 ha of coastal and flood plain grazing marsh, 3,300 ha of salt marsh 2,900 ha of lowland raised bog and 260 ha of sand dunes as well as lesser extents of a number of other habitats. The NCA contains five SAC, one SPA, 1 Ramsar site and 8,000 ha are nationally designated as SSSI. 89 per cent of SSSI are in favourable or unfavourable recovering condition while the remainder is in unfavourable no change or declining condition. Large extents of priority habitat are outside the designated sites. The area supports nationally and regionally important populations of many species. Many such as natterjack toads, breeding and wintering waders, wintering wildfowl and coastal plants are associated with the designated site series. However, others, such as farmland birds, are associated with the wider landscape. This latter group have generally declined in recent decades. The salt marshes forming the coastal fringe of the inner Solway are among the least modified in England with complete transitions from pioneer marsh to neutral grasslands apparent in many areas. Most marshes are sheep and cattle grazed. The extent of the marshes varies with erosion and deposition caused by moving river channels, but generally the marshes are accreting material, particularly in the innermost most basin of the Solway. **Continued over...**	International	The area is exceptional for its biodiversity associated with a range of lowland habitats. These are important both in their own right, as key assets of local sense of place and in many cases as the support for other services. On the salt marshes of the inner Solway the grazing regime is important for maintaining the habitat for wildfowl and wading birds, while the few ungrazed marshes tend to be more floristically diverse. Key actions such as retaining grazing systems that provide the conditions for key species and allow the natural development of the marshes, and managing recreational use, will be important in maintaining the value of the marshes into the future. On the open outer Solway the coast is dominated by sandy beaches and sand dunes, including both mobile and fixed dune types hosting a range of communities. As well as their biodiversity these dunes provide the first line of coastal defence away from the coastal settlements and are an important recreational asset used for walking and golf. It will be important to continue to allow dynamic coastal processes, secure appropriate grazing regimes and manage recreational access to the dunes if they are to continue to fulfil this varied role as biodiversity asset, recreational asset and flood defence. The reefs of the outer Solway provide a food resource for wintering waders, and support a commercial mussel fishery. These areas are at risk from disturbance and trampling and while they often 'look after themselves', raising awareness of this sensitivity may be appropriate. **Continued over...**	For all key semi-natural habitats but in particular coastal and lowland wetland habitats, seek opportunities to protect, restore and enhance their extent and quality. Seek targeted management of key issues such as grazing on sand dunes, point sources of pollution on rivers and hydrological restoration of lowland raised bogs. Enhance connectivity of habitats within the NCA and as a link to adjacent NCAs, particularly in the coastal zone and along rivers and other watercourses. Seek opportunities to manage arable crops to provide year-round requirements for declining farmland birds, including provision of summer and winter food sources and nesting sites. Seek management of lowland wetlands and pasture that delivers benefits both biodiversity and sustainable farm businesses, in particular measures that support key species such as breeding waders, and reduces nutrient loading of watercourses. **Continued over...**	**Biodiversity** **Food provision** **Regulating water quality** **Regulating water flow** **Regulating coastal erosion and flooding** **Tranquillity** **Recreation** **Sense of place/ inspiration** **Climate regulation** **Geodiversity**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity continued		**... continued from previous.** The marshes are characterised in winter by large numbers of geese including the world population of Svalbard-breeding barnacle goose, and in summer by breeding gulls, terns and waders with important populations of natterjack toads present on some marshes. The SSSI sand dunes of the outer Solway coast are generally in good condition but many other areas are under grazed or managed as arable land. These dunes are important for a number of species including natterjack toads. Along the other Solway coast a series of exposed rocky skears, formed from eroded glacial drumlins, support important reefs of honey comb worm and mussels. The suite of surviving lowland raised mires in the NCA, are among the most extensive and highest quality in England. As well as being a significant biodiversity asset these bogs are also a significant climate change regulator and historical record. In good condition these mires are characterised by sphagnum mosses, cotton grasses and heather and are also important for their fauna. Although much degraded from their former state they remain an important refuge for species such as white-faced darter, and large heath butterfly. **Continued over...**		**... continued from previous.** Little of the surviving lowland raised mire is in favourable condition because of past degradation; however, a number of the larger mires are now being restored. Key actions to restore other sites will include the restoration of site hydrology which generally involves the removal of recently established woodland and scrub and work to block drains on the moss surface. On some sites species reintroductions may be appropriate for specialist species to facilitate recolonisation. Generally increasing awareness of the valuable role these mosses perform through appropriate access provision would also be desirable. In the rivers of the eastern part of the NCA many actions to secure healthy aquatic biodiversity will have to take place in upstream NCAs but actions here will also be important. These include maintaining and restoring areas of riparian habitat, including woodland where appropriate, along rivers and other watercourses, targeting areas of pollution (both diffuse and point source) for better nutrient and sediment management and maintaining areas used as spawning sites by fish. The NCA has experienced some changes in the agricultural practices of grassland management and animal husbandry which has led to a reduction in the habitat diversity of the Solway farmland. Among the coastal and flood plain grazing marshes are some particularity rich grasslands that support marsh fritillary which has been re established following extinction in the 1990s. **Continued over...**	**... continued from previous.** Seek opportunities to restore populations of key species such as natterjack toad. Seek opportunities to recreate transitional habitats in the coastal zone. Promote sustainable management of coastal fisheries and sensitive access to the coastal environment. Seek opportunities to protect enhance, buffer and connect surviving areas of ancient woodland particularly east of Carlisle. Ensure that biodiversity gains are secured as part of programmes aimed at improving other ecosystem services, through the development of programmes that incorporate biodiversity into design. Use nature reserves and other local green spaces, to encourage communities to become more involved in biodiversity through recreation and volunteering activities close to where they live and work.	

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Biodiversity continued		**... continued from previous.** The eastern part of the NCA includes the lower reaches of the rivers Eden, Esk, Sark and their tributaries. These support a range of species including Atlantic salmon, brook, river and sea lamprey and are in many areas flanked by woodland, particularly on steeper slopes. Much of the lower lying Solway Basin is coastal and flood plain grazing marsh. Widely modified and, as Grade 3 agricultural land, an important agricultural asset, some areas continue to be important for a range of specialist species including breeding waders but as a whole populations have decreased, and in the case of species such as the corncrake, become extinct. Of regional importance are the arable species associated with the farmed landscape. Corn bunting, tree sparrow, grey partridge, yellow wagtail and lapwing have declined in line with the intensification of management in the late 20th century, and in the case of corn bunting to local extinction with yellow wagtail likely to follow.		**... continued from previous.** Restoring the biodiversity of the low-lying wetland areas will be especially challenging requiring the bringing together of species needs with a pastoral agricultural system that has become more intensive in recent decades. Key steps will include restoration of less intensive land management regimes where feasible, developing systems that are less reliant on artificial inputs and restoring areas of seasonal flooding. To make this sustainable will need new management regimes to be economically viable in both the short and long terms. Restoring arable biodiversity will require adaptation of arable systems to allow provision of nesting sites and year-round food supply for key bird species and the ability for arable plants to flower and set seed. This will need to be done in a way that is economically viable and will probably depend on the availability of agri-environment scheme funding. Invasive non-native species are a threat to native species diversity in many areas with Himalayan balsam a particular issue along many watercourses, and pitcher plants on a number of lowland raised mires. Co-ordinating management of invasive species will be critical if they are not to develop as an increased issue, with species such as Himalayan balsam (which causes water quality as well as biodiversity issues) requiring whole catchment coordination if management to be effective.		

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Geodiversity	SSSI and Local Geological Sites Peat bogs Intertidal environment Local building stones	There are five SSSI notified for their geological interest in this NCA and 13 local geological sites (Geological Heritage Sites). Peat-forming bogs and dynamic intertidal environments are both examples of dynamic geomorphological processes, with the former also maintaining an important palaeo-environmental record. Generally peat bogs are in declining condition due to past exploitation and consequent degradation, though some sites are now being restored. The functioning of the intertidal environment is relatively unmodified. A variety of local building stones have been used to develop a local vernacular.	National	Of the SSSI sites, Jockie's Syke is of particular importance for its floral and faunal fossil assemblage of Carboniferous age. This site yields the most diverse fossil assemblages in the Barren Red Measures (Middle Carboniferous) of the Canonbie Coalfield. The extent of lowland raised bogs of the NCA makes a significant contribution to the national and international resource. Supporting opportunities to restore peatlands to re-establish their geomorphological function and as a recorder of palaeo-archaeological change in the form of pollen, plant macrofossils stretching back up to 8,000 years, will also restore their biodiversity and carbon sequestering role while providing a potential source of timber for biomass in the short term. Past periods of lower sea levels are evidenced by a submerged forest of uncertain (although likely early Holocene c.9000 BP) date in Allonby Bay. Early Holocene raised beach deposits relate to a period of far higher sea levels during the post-glacial period, reaching a peak around 6,500 years ago during the mid-Holocene marine transgression. The salt marshes of the Solway have an exceptional geomorphology including the finest example in Britain of terraced marshes, a consequence of creek migration, and isostatic uplift, and exceptional erosional edges where marine and fluvial processes combine forming cliffs up to 3 m high. The continued geomorphological function of salt marshes will support their biodiversity and maintain their carbon sink function. **Continued over...**	Raise awareness of the geodiversity of the NCA and its links with the development and management of the landscape and the use of local building stones. Promote and interpret the geodiversity in order to increase visitor engagement, understanding and enjoyment of the geological heritage of the area. Restore lowland raised bogs and where possible raise awareness of their importance and provide suitable access for education. Seek dynamic coastal environments, which are appreciated for their geomorphologic processes and sedimentary value such as unmodified salt marsh.	**Geodiversity** **Biodiversity** **Food provision** **Tranquillity** **Sense of place/ inspiration** **Recreation**

Service	Assets/attributes: main contributors to service	State	Main beneficiary	Analysis	Opportunities	Principal services offered by opportunities
Geodiversity continued				**...continued from previous.** In the intertidal zone the cobble skears that are the remains of glacial drumlins are an important feature as they form the substrate on which biogenic reefs of honeycomb worm and mussels establish. The latter are of particular significance supporting a traditional mussel fishery and are a key food resource for the wintering birds, particularly oystercatcher and knot. A mixture of local stone has traditionally been used as building material including red sandstone, limestone, cobbles, and Welsh and Cumbrian slate.		

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