

Geology of the Lincolnshire Wolds



Fossilised sponge, preserved in flint.

KEY

Superficial Geology

- Alluvium**
 A fine fertile silt left during a period of flood in a river valley.
- Blown Sand**
 Towards the end of the Ice Age, there was little vegetation to prevent strong winds from the west picking up fine sand and blowing it across large areas of north Lincolnshire.
- Gravel**
 During milder periods of climate between the ice advances across the region, melting ice-sheets fed vast rivers that swept pebbles, gravels and sand down many valleys of our present day rivers.
- Glacial Till**
 (previously called boulder clay)
 During the coldest parts of the Ice Ages, great ice-sheets buried much of Lincolnshire, leaving behind a mass of ground-up rocks and boulders that the ice had carried from as far away as Scotland and Norway. Some of these erratic boulders are large and distinctive.

Solid Geology

- Late Cretaceous Chalk Group**
 At about 90 million years ago, this youngest solid rock in the county forms the highest parts of the Wolds. It is made almost entirely from the remains of microscopic marine creatures, fossil sea-urchins and shell debris including oysters. It also includes bands of both nodular and tabular flints.
- Early Cretaceous Tealby Series**
 A variable mixture of grey silty clays that were used locally for brick-making, with the iron-rich sandy limestone and ironstone formerly used as building stone. The large fossil shells can often be seen on weathered surfaces of walls and buildings.
- Early Cretaceous Spilsby Series**
 At its thickest in the southern Wolds, the Spilsby Sandstone contains the unusual green mineral glauconite which has a blue-green colour when fresh, but weathers to a khaki-green and rusty colour. Rare fossil ammonites show that this deposit was formed in a shallow sea about 140 million years ago, during the change from the Jurassic to the Cretaceous period. Claxby Ironstone has been mined as an iron-ore in the Nettleton and Claxby area.
- Jurassic Clays**
 Composed of organic-rich claystone and the source of much of the North Sea oil, these clays are extensively used in brick making and cement manufacture. These clays were formed about 150 million years ago from deposits in a deep, stagnant ocean.



Unusual Spilsby Sandstone outcrop

AREAS OF INTEREST

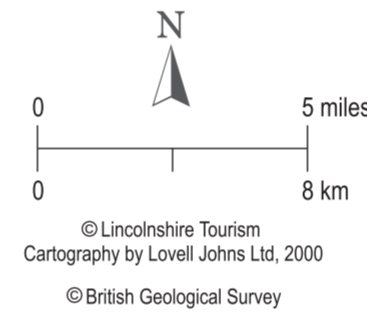
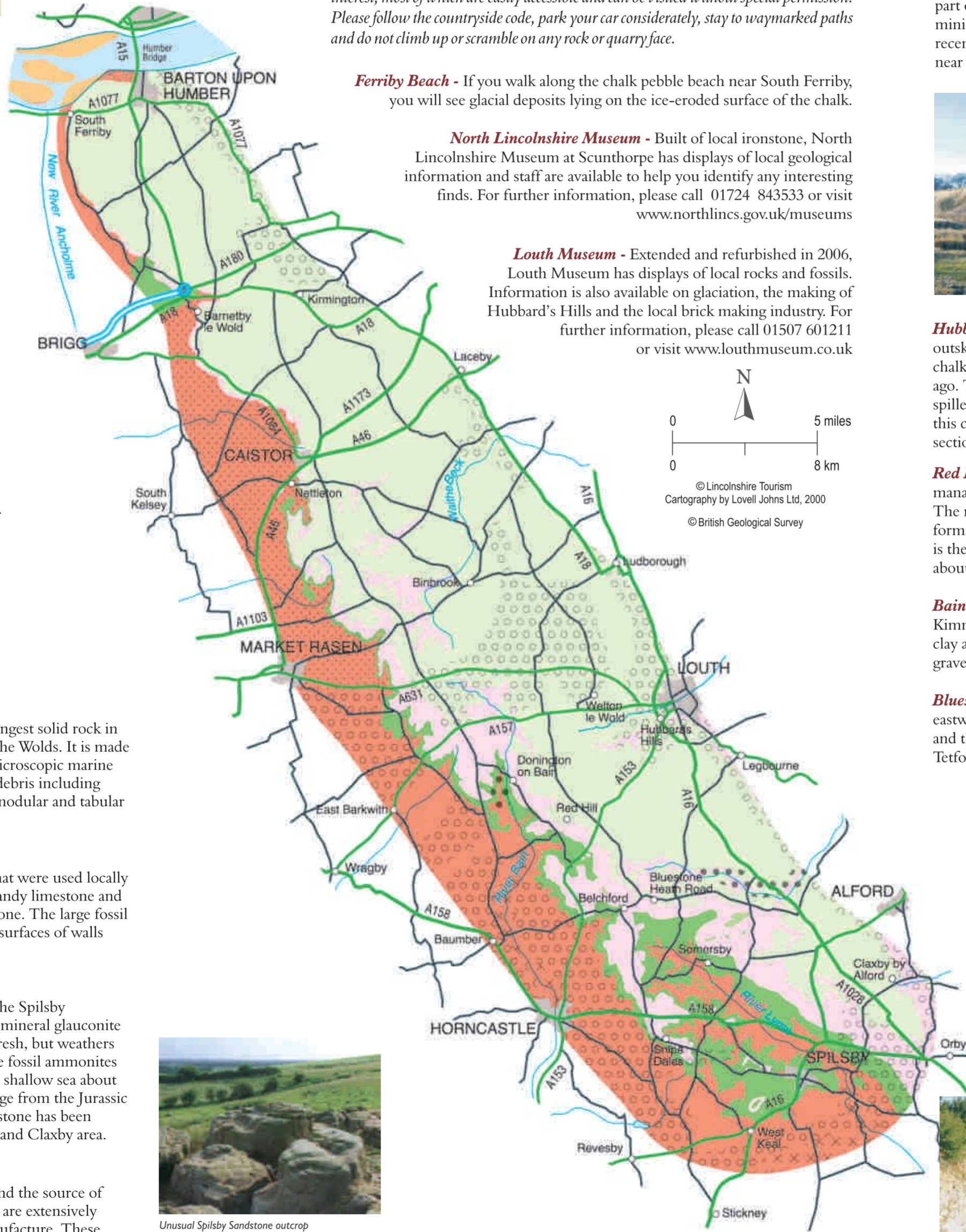
One of the best ways of understanding the geology and glacial processes that have formed the Lincolnshire Wolds is to visit

the area. Look at the landscape and the villages, where local stone can often be found in the churches and older buildings. Here is a list of sites that illustrate some points of interest, most of which are easily accessible and can be visited without special permission. Please follow the countryside code, park your car considerately, stay to waymarked paths and do not climb up or scramble on any rock or quarry face.

Ferriby Beach - If you walk along the chalk pebble beach near South Ferriby, you will see glacial deposits lying on the ice-eroded surface of the chalk.

North Lincolnshire Museum - Built of local ironstone, North Lincolnshire Museum at Scunthorpe has displays of local geological information and staff are available to help you identify any interesting finds. For further information, please call 01724 843533 or visit www.northlincs.gov.uk/museums

Louth Museum - Extended and refurbished in 2006, Louth Museum has displays of local rocks and fossils. Information is also available on glaciation, the making of Hubbard's Hills and the local brick making industry. For further information, please call 01507 601211 or visit www.louthmuseum.co.uk



Nettleton - To the south of Nettleton is some of the most dramatic scenery in the Wolds. From Nettleton Top, 114 metres above sea level, views to the west show the Jurassic Limestone ridge of Lincolnshire and occasionally the Pennines. Within this area, remains of bricked up tunnel entrances can be seen. These formed part of the open-cast and gallery ironstone mining that took place between 1929-1968. A recently disused chalk quarry can also be seen near the old ironstone workings.



Welton le Wold Quarry - This area was commercially quarried for sands and gravels until the 1970s and is nationally important as this is the maximum limit that the last ice-sheet extended into Lincolnshire. On the eastern side of the road is the Lincolnshire Wildlife Trust Reserve. The quarry on the western side is in private ownership but access may be arranged by contacting the Lincolnshire Wolds Countryside Service in advance.

Hubbard's Hills - The spectacular steep-sided and sinuous valley on the outskirts of Louth is approximately 40 metres deep. It was cut through the chalk by torrents of glacial melt-water during the last ice age about 20,000 years ago. The ice that dammed the Hallington valley created a lake that eventually spilled over into the Welton valley as a waterfall. Over a short period of time this cut back along the line of the Hubbard's Hills valley to form the gorge section of the present day valley.

Red Hill Nature Reserve - Situated above Goulceby, Red Hill is owned and managed by the Lincolnshire Wildlife Trust and Lincolnshire County Council. The most spectacular feature of the reserve is the exposure of the Red Chalk, a formation that only occurs in Norfolk, Lincolnshire and Yorkshire. The colour is the result of iron-rich mud that washed off nearby land into a tropical sea about 100 million years ago.

Bain Valley - The floor of this valley, where Donington on Bain nestles, has Kimmeridge Clay overlain with glacial melt-water sands and gravels. Both the clay and gravel have been exploited over the centuries for brick making and gravel extraction.

Bluestone Heath Road - This ancient route follows the chalk ridge south eastward, with rounded outlier hills of Rasin Hill and Gaumer Hill to the west and the Spilsby Sandstone ridge beyond. The settlements of Belchford and Tetford nestle in the vale beneath the chalk ridge.

Somersby Quarry - This small outcrop of Spilsby Sandstone shows perfectly the softness of this stone and its khaki-green colour when exposed to weathering. Although this quarry is now disused, stone has been used from here to repair nearby Somersby Church.



Snipe Dales Nature Reserve and Country Park - Between Horncastle and Spilsby, this southern edge of the Wolds consists of steep sided valleys fretted by streams. Owned and managed by Lincolnshire County Council and the Lincolnshire Wildlife Trust, Snipe Dales is at the junction of the Spilsby Sandstone and the Kimmeridge Clay where spring lines give rise to wet flushes and small streams.



Mill Hill Quarry Nature Reserve
 Owned and managed by the Lincolnshire Wildlife Trust, the reserve is situated near Claxby-by-Alford. This disused chalk pit shows beds low in the Welton Chalk Formation comprising thin silty marl seams and flint bands in nodular, intensely burrowed white chalk. The site has the remains of a Bronze Age round barrow, a long vanished post-mill and two surviving old lime kilns, one of which has been restored.



St Andrew's, Colceby

From the high point above Old Bolingbroke, the chalk cliffs of Hunstanton in Norfolk can be seen, their red and white strata evidence of the continuation of the chalk from the Wolds into East Anglia.



Erratic carried by the ice from the North York Moors to Welton le Wold

The southern part of the Wolds is different again, with rocks of the Tealby Series and Spilsby Sandstone. The river valleys have cut through the soft sandstone and into the Kimmeridge Clay, and are overlain with till and gravels. Some villages within this area had their own brick works and small quarries for building stone. The area between Horncastle and Spilsby, known locally as the Spilsby Crescent, is made almost entirely of sandstone.

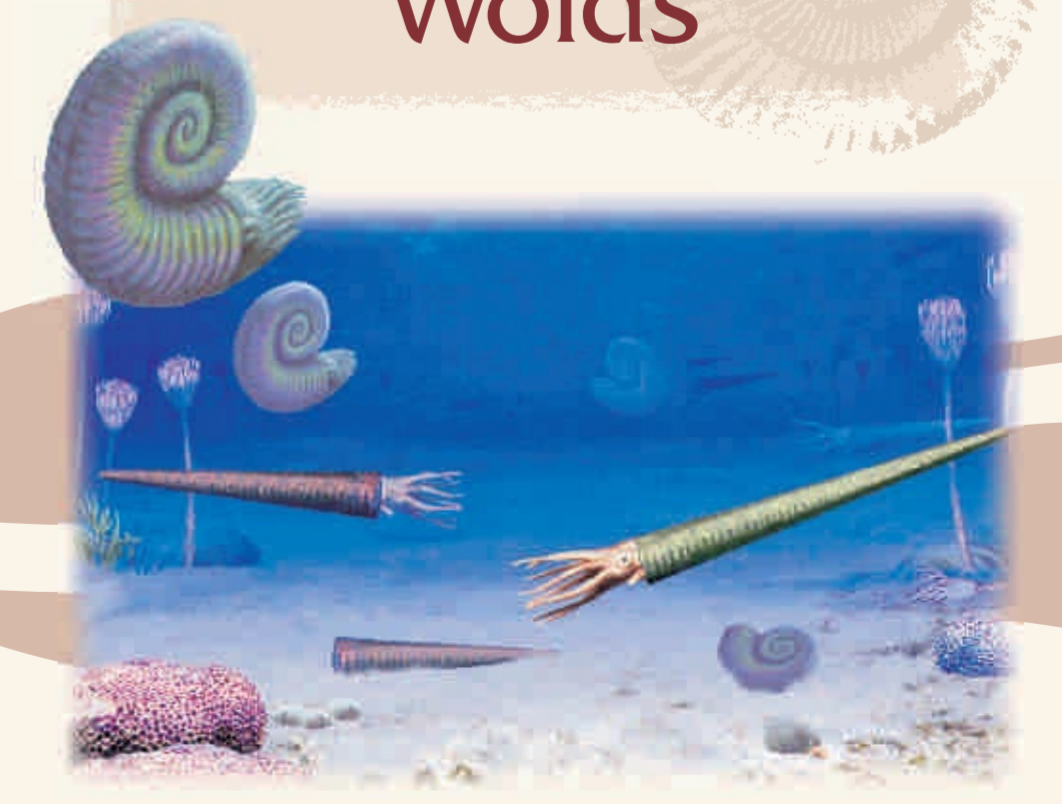
From being under a sub-tropical sea, then covered by ice, to eventually becoming the highest ground in eastern England between Yorkshire and Kent, the Wolds landscape that we see today has undergone immense change. The rolling chalk uplands form the main and highest part of the Wolds. The soils here are thin and flinty and during the autumn months, after ploughing, the colour variations within a hillside or a field are clearly visible.

The western edge of the Wolds is quite different from the rolling chalk uplands, with a Late Jurassic Elisham Sandstone lens deposit within the Kimmeridge Clay to the area north of Caistor. The area between Caistor and North Willingham contains outcrops of the Tealby Series and the landscape is dominated by the steep scarp edge, marked in places by remains of ironstone mining, areas of rough, damp grassland and drystone walls. At the foot of the scarp, the Kimmeridge Clay is overlain by blown sand, deposited towards the end of the last Ice Age.

LANDSCAPE & GEOLOGY

WONDERS of the WOLDS

Geology of the Lincolnshire Wolds



One of a series of leaflets to help you get to know the Lincolnshire Wolds. Produced by the Lincolnshire Wolds Countryside Services and the Lincolnshire Geodiversity Group

GLACIATION

Two million years ago the world climate began to cool, causing the growth of massive ice-caps and glaciers in polar and northern latitudes. Between half a million and 300,000 years ago, during the Anglian glaciation, ice sheets reached as far south as present day North London and Cardiff. Even the highest part of the Wolds lay beneath a thick sheet of ice grinding slowly south, eroding massive quantities of chalk, flints and carrying other further travelled rocks. When the ice melted, they were left as 'erratics' in the glacial till and meltwater gravels spread over large parts of the East Midlands and East Anglia.

With the melting of the ice, the Wolds first experienced cold tundra conditions before the climate became milder. It even reached a few degrees warmer than now, with a sea-level several metres higher than at present, cutting chalk and sandstone cliffs along the eastern side of the Wolds from Kirmington to West Keston.

It began to get colder again around 15,000 years ago, marking the beginning of the Devensian glaciation. This time ice-sheets only reached the north and east of Lincolnshire, bringing distinctive erratics from Norway, Scotland and Northern England. Ice blocked the Humber near Wintertingham and pushed down the eastern side of the Wolds, burying the former cliffs with till, and extending as far south as East Keston and Stokenham. For much of the next 100,000 years the Wolds stood above the ice, experiencing severe tundra conditions, with snow and melt-waters seasonally cutting valleys into rocks that were permanently frozen below the surface. Most of the deep, dry valleys and steep sided open-ended gorges, including Hubbard's Hills, were formed at this time. By 10,000 years ago the ice had melted away and the post-glacial rise in sea-level created the North Sea, drowning the coniferous and deciduous forests that had grown on the till east and south of the Wolds.

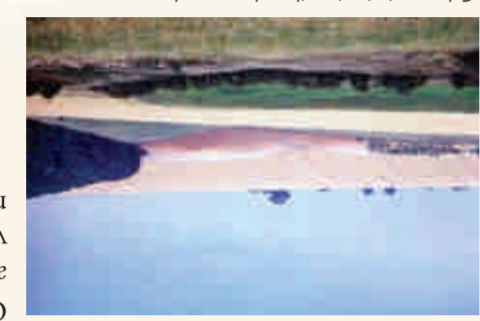


Bluestone Heath valley modified by glacial action
Gunner Hill, a chalk capped outlier - off the Bluestone Heath Road

SOILS & LAND-USE

The soils and land-use patterns of the Lincolnshire Wolds are a close reflection of the area's complex solid and superficial geology. The plateau tops are dominated by light, chalky soils whereas the valley sides may show striking variations in colour and texture. In the south-east, the glacial tills give rise to heavy, seasonally waterlogged soils although in the Lynn Valley, the Spilsby Sandstone provides the base material for well-drained sandy loams. On the floor of the Bain Valley, glacial sands and gravels produce deep, coarse permeable loams, however the impermeable Kimmeridge Clays, which lie below, can give rise locally to areas with a high water table.

The vast majority of the Lincolnshire Wolds is high grade agricultural land, concentrated on the plateau tops where productivity is good but constrained by the thin, drought prone chalk soils. Most of these areas are in permanent arable use whilst the valley floors, with their heavy and sometimes waterlogged soils, are often under woodland or pasture. The low grade agricultural land, mainly along the north west scarp face, is under rough pasture and scrub. Overall, more than 80% of the Wolds are in arable use, the main crops being winter wheat, winter barley, oil seed rape, beans and linseed.



Dry stone wall of Tealby Limestone - south of Nettleton

INTRODUCTION

The Lincolnshire Wolds combines a dramatic western scarp, rolling chalk uplands with steep-sided dry valleys and former sea cliffs on the eastern edge.

The basis of this diverse landscape lies beneath our feet: the geology. Rocks, such as chalk, limestone and sandstone which form the solid geology, were laid down mostly in the Cretaceous period from 145 - 65 million years ago. The surface deposits, or superficial geology, are made up of sands, gravels and glacial till (previously called boulder clay) that overlay the solid geology. These belong to the Pleistocene era and were mainly deposited during the Ice Ages, from 1 million - 10,000 years ago in Lincolnshire.



Red Hill Nature Reserve (insert - close-up of red chalk)

A guided geology walk

LINCOLNSHIRE GEODIVERSITY GROUP

The Lincolnshire Geodiversity Group is part of the Greater Lincolnshire Nature Partnership and consists of volunteers with an interest in the geology and landforms of the county. Members include museum staff, professional geologists, local authority representatives, earth science and wildlife enthusiasts. The group encourages a greater awareness of geodiversity, to improve the protection and educational value of locally important geological sites and by working with partners to implement the Lincolnshire Geodiversity Action Plan.

For more information contact: Lincolnshire Geodiversity Group, Greater Lincolnshire Nature Partnership, Banovall House, Manor House Street, Horncastle, Lincolnshire LN9 5HF
Tel: 01507 528398 www.glnp.org.uk

GeoConservationUK is the national organisation that represents and supports local geology and geodiversity groups. www.GeoConservationUK.org.uk

THE LINCOLNSHIRE WOLDS
The Lincolnshire Wolds is a nationally important and cherished landscape. Part of it was designated an Area of Outstanding Natural Beauty (AONB) in 1973. Covering an area of 558 square kilometres or 216 square miles, the AONB contains the highest ground in eastern England between Yorkshire and Kent, rising to over 150m along its western edge. Rolling chalk hills and areas of sandstone and clay underlie this attractive landscape.

The Lincolnshire Wolds have been inhabited since prehistoric times and the appearance of the countryside today has been greatly influenced by past and present agricultural practices.

A Countryside Service helps to protect and enhance the landscape through partnership projects with local landowners, farmers, parish councils, businesses and residents of the Wolds.



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