GeoEssex
Promoting the geology and landscape of Essex

# Tendring District Council
# Report on Local Geological Sites


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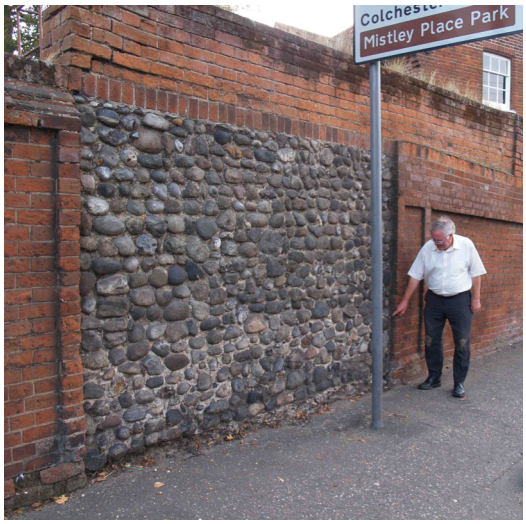


GeoEssex Promoting the geology and landscape of Essex

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***Cover photographs:***

Collecting fossils on the beach at The Naze. *Photo: G. Lucy*

Copperas Road, Brightlingsea, commemorating the former copperas industry. *Photo: G. Lucy*

The cobble wall at Mistley. *Photo: G. Lucy*

# 1. Introduction

The rocks beneath the Essex landscape are a record of the county's prehistory. They provide evidence for ancient rivers, volcanoes, deserts, glaciers and deep seas. Some rocks also contain remarkable fossils, from subtropical sharks and crocodiles to Ice Age hippos and mammoths. The geology of Essex is a story that stretches back over 100 million years.

## GeoEssex

GeoEssex is the primary source of information about the geology and physical landscape of Essex. The GeoEssex team, or 'Steering Group', consists of professional and amateur geologists, representatives from local authorities, geological and natural history societies, and from Natural England, the Government's nature conservation body.

GeoEssex promotes geology in all its aspects, from quarries, cliffs and boulders to spas, springs and building stones. The fascinating and often magical world of geology is all around us, if only we know where to look.

A primary task of GeoEssex is to identify the best places in Essex to find out about the Earth's distant past and the landscape processes going on today. These sites are called Local Geological Sites, or LoGS (formerly called Regionally Important Geological Sites or RIGS).

GeoEssex aims to advocate and represent geodiversity in planning processes and other initiatives.

**Colne Point Shingle Spit (part of Colne Estuary SSSI).**

Colne Point is the best example in Essex of a shingle spit.

*Photo: G. Lucy*

## Geodiversity

**What is geodiversity and why is it important?**

Geodiversity is an integral part of the natural environment. It is the variety of rocks, fossils, minerals, landforms and soil, and all the natural processes that shape the landscape.

The only record of the history of our planet lies in the rocks beneath our feet. Here, and only here, can we trace the cycles of change that have shaped the Earth in the past, and that will continue to do so in the future. This is particularly true in Essex, where the record of climate change during the Ice Age is preserved in our quarries and coastal cliffs. The record is unique and much of it is surprisingly fragile.

Apart from the obvious benefits of providing mineral resources such as sand, gravel, chalk and clay, the diversity of the geology is what shapes the landscape, influencing soils, and in turn influencing all of our habitats and species. Geodiversity also has a cultural role to play, influencing the character of our built environment through building stones, providing inspiration to art, and helping to define where we live and our 'sense of place'. It is the link between geology, landscape, nature and people.

## Local and national Geodiversity Action Plans

The UK Geodiversity Action Plan (UKGAP) sets out a shared framework for geodiversity action across the UK. It establishes a common aim, themes and targets which link national, regional and local activities. It encompasses how geodiversity can inspire people and what needs to happen to conserve Britain's geodiversity. The Plan for Essex has been drawn up within this framework.

A Local Geodiversity Action Plan (LGAP) has been produced for Essex. It sets out a framework for geodiversity action in Essex. It is an essential document to conserve the County's geodiversity.

The Essex Local Geodiversity Action Plan aims to:

- *Identify, conserve and enhance the best sites that represent the geological history of an area in a scientific, educational, recreational and cultural setting.*
- *Promote geological sites and make geoconservation relevant to people.*
- *Provide a local geodiversity audit (an audit of sites and skills).*
- *Influence local planning policy.*

## 2. The Geology of Essex

Compared to most other parts of Britain the rocks of Essex and adjoining counties are young in geological terms. Even the oldest surface rock in Essex (the Chalk) is only about 80 million years old. Much older rocks are, however, present at depth. We have some idea about these ancient rocks because of the records of boreholes that have been sunk in search of coal and oil.

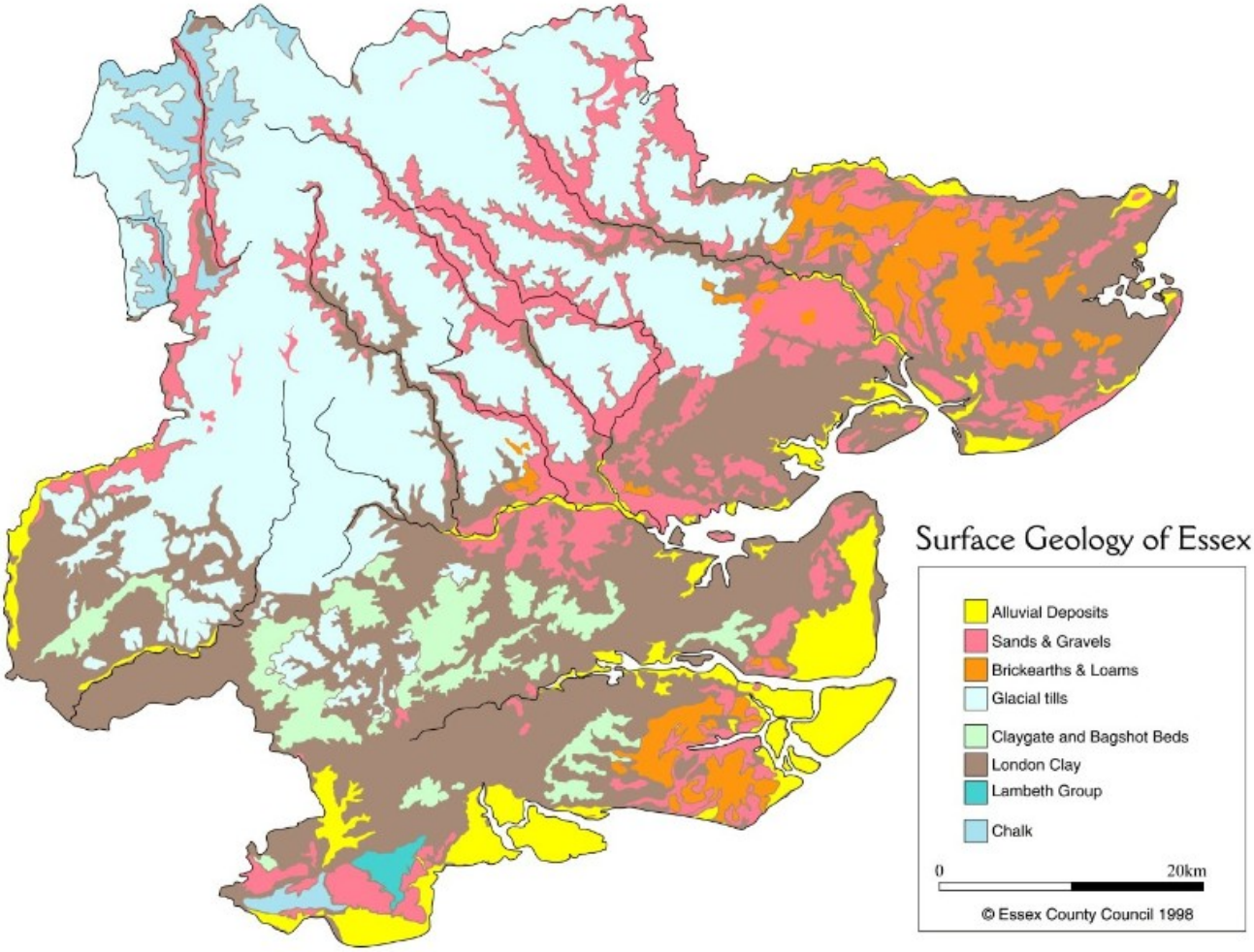
The surface rocks of Essex that were formed before the Ice Age (from the Chalk to the Red Crag) are described as the 'bedrock' or 'solid' geology. Much of this bedrock geology is concealed beneath the deposits left behind by glaciers and rivers during the Ice Age. The material laid down during the Ice Age is known as 'Superficial' or 'drift' deposits.

| Era | Period or Epoch | | Approx. age in millions of years | Geological formations in Essex |
|---|---|---|---|---|
| Caenozoic | Quaternary Ice Age | Holocene | 0.01 | Recent peat and alluvium |
| | | Pleistocene | 0.45 | River terrace deposits and brickearth (loess) |
| | | | | Boulder clay (till) and glacial gravel |
| | | | 1 | Kesgrave (Thames) sands and gravels |
| | | | | Norwich Crag (Chillesford Sand) |
| | | | 2.4 | Red Crag |
| | Pliocene | | 10 | *No evidence of rocks of this age in Essex but derived Miocene and Pliocene fossils are found in the Red Crag* |
| | Miocene | | | |
| | Oligocene | | 20 | |
| | Eocene | | 50 | Bagshot Sand |
| | | | | Claygate Beds |
| | | | | London Clay (includes the Harwich Formation) |
| | Palaeocene | | 55 | Lambeth Group (Woolwich and Reading Beds) |
| | | | | Thanet Sand |
| Mesozoic | Cretaceous | | 80 | Chalk |
| | | | 100 | Gault and Upper Greensand (Beneath Essex) |
| | Jurassic | | 150 | *No evidence of rocks of these ages beneath Essex with the exception of Jurassic Oxford Clay in a graben (a sunken part of the crust bordered by faults) beneath East Tilbury.* |
| | Triassic | | 220 | |
| Palaeozoic | Permian | | 250 | |
| | Carboniferous | | 300 | |
| | Devonian | | 400 | Shales and mudstones dating from these periods occur at depth (about 300 meters) beneath Essex |
| | Silurian | | 420 | |
| | Ordovician | | 450 | *No evidence beneath Essex, however, boreholes have not been drilled deep enough to confirm.* |
| | Cambrian | | 500 | |
| Pre-Cambrian | Precambrian | | Age of Earth 4,600 | |

## Geological Map of Essex

Geological map of Essex showing all the rocks exposed at the surface - bedrock and superficial deposits. An example of a superficial deposit is boulder clay or glacial till left behind by the Anglian Ice Sheet during the Ice Age (shown in pale blue).

Map based on published maps with the permission of the British Geological Survey



# Essex through geological time

It is difficult to know where to begin with our geological story but the earliest evidence we have is the hard rocks deep beneath Essex that were formed some 400 million years ago in the Silurian and Devonian periods (part of the Palaeozoic era) and form what is known as the 'Palaeozoic basement' of Essex.

***Deserts to Dinosaurs***

- For a very long time (and before the age of the dinosaurs) these hard Silurian and Devonian rocks formed the surface of the land that was eventually to become Essex. During the Permian and Triassic periods Essex was a desert upland in the middle of a vast continent known as Pangea.
- By 200 million years ago, at the start of the Jurassic period, tropical seas had spread around this land forming a dinosaur-infested, forested island.

***Buried Island***

- If you could dig down 1000 feet (300 metres) under Essex you would reach the hard rocks of that dinosaur island.
- All trace of forests and animals from this time have been swept away from the eroded surface of the island, so there are no dinosaur fossils in Essex.
- By 100 million years ago, in the Cretaceous period, the sea flooded across the island to spread **Gault** Clay and **Greensand**. The sea then deepened to deposit hundreds of metres of soft white limestone known as **Chalk** all over the island as well as much of what is now Britain.

***Pebbles and Clay***

- The North Atlantic Ocean, which did not previously exist, began to open out to the west, the land of Essex lifted, chalk hills were worn down and flints were eroded out. Billions of these flints were tumbled on beaches to form layers of sand and beautifully-rounded pebbles across our area.
- Around 50 million years ago, in the Eocene period, a deep sea fed by muddy rivers spread across what is now Essex and London depositing a great thickness of clay known as **London Clay** on the sea floor, together with the remains of many plants such as palms and cinnamon, and animals including birds, sharks, turtles, and tiny horses. Atlantic volcanoes poured their ash into this sea.

***The Alps and the Thames***

- Colliding continents pushed up the Alpine mountain chain, bending the crust to form the vale of the Thames river system through mid Essex. About 2.4 million years ago offshore sandbanks formed red shelly sandstone layers across north Essex known as the **Red Crag**.
- Global cooling led to the present Ice Age, with many warm periods such as the one we are in right now. As the sea retreated, the ancestral River Thames spread a succession of flint-rich river gravels across the middle of Essex, through Harlow, Chelmsford and Colchester, and out across the area where the North Sea is now, and an early Medway flowed across eastern Essex to join the Thames in Tendring.

***Ice and people cover Essex***

- During an exceptionally cold stage 450,000 years ago a gigantic ice sheet covered most of Britain and Essex as far south as Hornchurch. The moving ice diverted the Thames towards its present-day course and dumped its load of boulder clay, or till, on top of these old Thames gravels.
- During the past million years of the Ice Age, there have been numerous cold and warm stages and humans have migrated to and from Essex, together with the animals they have hunted. They have left thousands of flint tools and tool-making debris on the banks of the ever-changing Thames and its tributaries.

# 3. Background to Geological Site designation in Tendring

## What is special about Essex Geodiversity?

Essex is an area of predominantly subdued relief with gentle slopes, the result of its underlying geology of soft, relatively young rocks. These generally yield fertile soils. The result is an attractive 'lived in' landscape dominated by arable agriculture, but still retaining forested and heathland areas, particularly where gravels and sands, many of glacial and fluvial origin, have yielded poorer soils.

Although lacking the more dramatic geology and landforms of many 'hard rock' areas, Essex geology and geomorphology is still of great interest, possessing abundant evidence of the huge environmental and biodiversity changes that our area has witnessed over the last 100 million years. Among the key themes are dramatic and sometimes long-lasting changes in the distribution of land and sea, major shifts in climate, and mass species extinctions. Many of these phenomena are of great relevance today, and so an understanding of our past is essential in interpreting the challenges to come.

## Geodiversity's influence on Essex's development

Essex's geodiversity has exerted a major influence on land use, agriculture and landscape:

The distribution of less fertile ancient river and glacial gravels has been a major influence on historical land use, resulting in the preservation through to the present day of extensive tracts of woodland and to a lesser extent heathland, in a predominantly arable county. These are of great significance both for biodiversity and recreation.

The chalky boulder clay, or till, found north and west of Chelmsford is highly suitable for cereal cultivation, especially wheat. London Clay outcrops south of Chelmsford, providing soils less suitable for arable agriculture and more suited to pasture. The brickearth of the Tendring district is the basis of the rich agricultural land of this peninsula.

In earlier times rivers penetrating deep inland, together with proximity to the Continent, provided a succession of invaders and colonisers – from Palaeolithic peoples, through to Roman, Viking and Saxon - with easy access.

The deposits of the ancestral Thames and its tributaries have provided Essex with a source of gravel and sand for construction since Roman times. A special kind of gravel naturally cemented by iron called ferricrete was used extensively as a building stone and is found in many medieval churches.

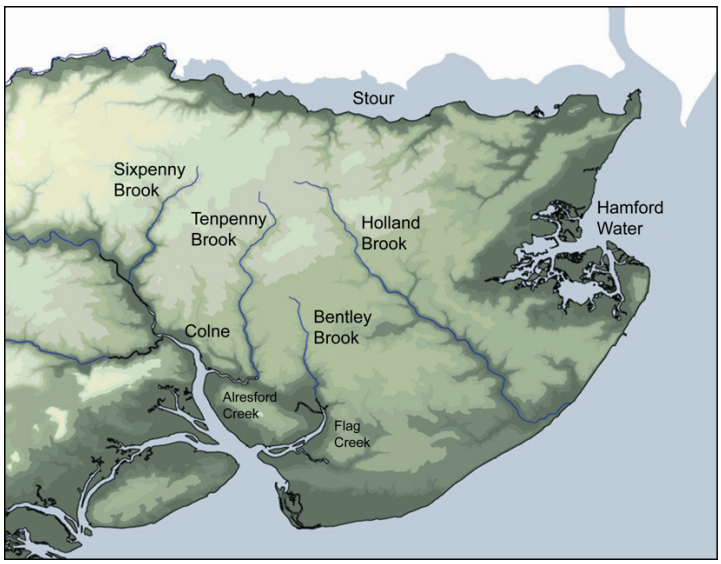
## The geology of Tendring District

Tendring may seem to be a rather quiet, unexciting area geologically, except perhaps for the magnificent outcrop of Red Crag at Walton-on-the–Naze, but it has a goodly number of other gems. These show that the area is important and interesting geologically, contributing to the cause of earthquakes, witnessing tropical seas, volcanic eruptions and ice sheets.

The bedrock geology of the district is London Clay, laid down on the floor of a subtropical sea in the Eocene period some 50 million years ago. There are several coastal exposures of London Clay which are of national importance which have yielded fossils which can be seen in museums around the country. Overlying the London Clay, particularly at The Naze, is the Red Crag, a sandy deposit full of fossil shells. It was laid down in the early Pleistocene epoch about 2.4 million years ago and is evidence of the advance of a shallow sea onto the eroded remnants of a London Clay land surface.

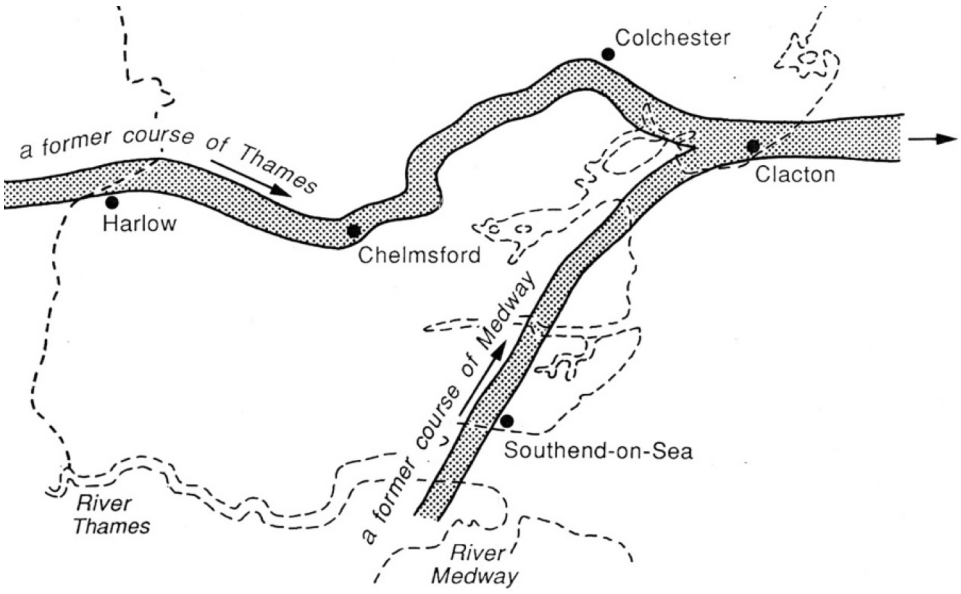
Also of great importance scientifically are the 'superficial' or 'drift' deposits that blanket the district on top of the bedrock. Tendring is the area where an early course of the River Medway joined an early course of the Thames prior to the arrival of the Anglian Ice Sheet in Essex. When the ice sheet blocked the course of the Thames upstream, it diverted the river to the south where it joined the Medway in the Southend area. A combined Thames-Medway River then flowed across the Tendring peninsula. The result was a complex series of sands and gravels charting the prehistory of this area over hundreds of thousands of years. The full story is described in the *Tendring Geodiversity Characterisation Report* produced for Tendring Council in 2009.

Tendring has a large number of geological Sites of Special Scientific Interest (SSSIs) for such a small area, which testifies to the District's importance. In addition to these are numerous non-statutory geological sites which are the subject of this present report (see Part 7).



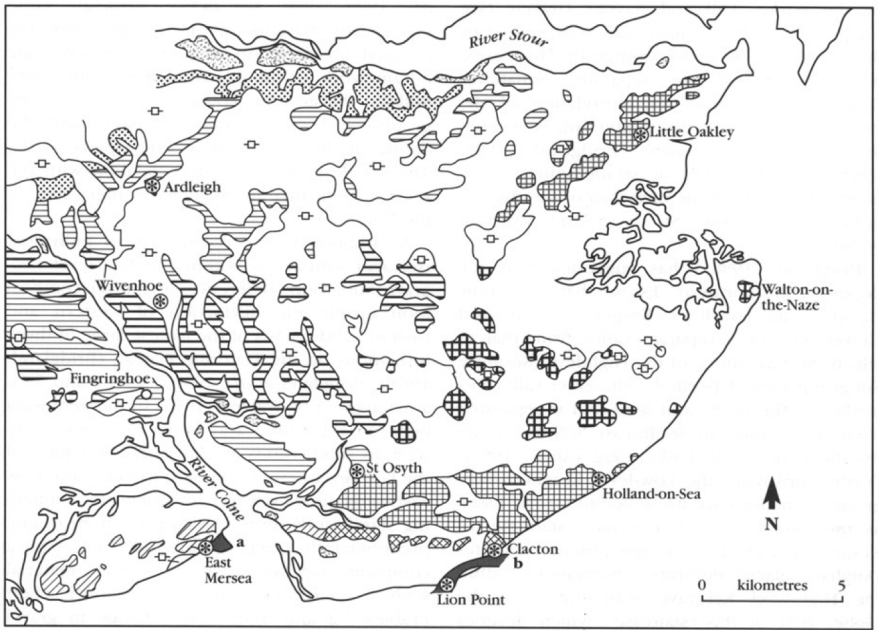

**The topography of the Tendring district.**

From the *Tendring Geodiversity Characterisation Report* (2009)




**Above:** Former courses of the Thames and the Medway before the arrival of the Anglian ice sheet in Essex. The ice sheet diverted the Thames to its present course and a combined 'Thames-Medway' river then flowed northeast along the former course of the Medway. (from Lucy 1999).

**Below:** Map showing the complex patchwork of gravels of different ages laid down by these rivers in the Tendring district. These gravels each have distinctly different proportions of rock types depending on the catchment of the rivers that deposited them. Study of these gravels enables geologists to build up a surprisingly detailed picture of the Essex landscape during the Ice Age. (from Bridgland, 1994).



## Geodiversity and National Planning Policy

The importance of geodiversity as an integral part of nature conservation and the planning system is reflected in The National Planning Policy Framework (NPPF), and in legislation – Wildlife & Countryside Act 1981 and Countryside and Rights of Way Act 2000.

The NPPF states that:

(1) "the planning system should contribute to and enhance the natural and local environment by protecting and enhancing valued landscapes, geological conservation interests and soils" (Paragraph 109);

(2) "local planning authorities should set criteria based policies against which proposals for any development on or affecting protected wildlife or geodiversity sites or landscape areas will be judged" (Paragraph 113); and

(3) "to minimise impacts on biodiversity and geodiversity, planning policies should aim to prevent harm to geological conservation interests" (Paragraph 117).

## Site designations

The most important geodiversity sites have been declared as **Sites of Special Scientific Interest** (SSSIs) which are statutorily protected for their scientific importance.

The next tier of geodiversity sites are known as **Local Geological Sites** (LoGS) These have replaced the earlier 'Regionally Important Geological Sites' (RIGS) terminology in line with government guidance.

Local Geological Sites (LoGS) are broadly equivalent to Local Wildlife (species and habitats) Sites ('LoWS') but have a broader remit as they can be designated for their scientific, educational, historical and recreational benefits. Typical Essex LoGS include quarries, pits, walls, boulders, cliffs, springs, and river meanders. Local Wildlife Sites and Local Geological Sites are both designed to provide a system of locally-valued, non-statutory sites.

Most importantly, the NPPF gives Local Geological Sites a weighting equal to Local Wildlife Sites, and both are collectively referred to as 'Local Sites'. However, in actuality the attention and priority afforded to the designation and management of LoGS has historically lagged, and continues to lag well behind that of LoWS.


**Tooth of the giant shark Carcharocles megalodon from Dovercourt.**

This fossil was collected in the 19th century and is in the collection of the Natural History Museum, London. *Photo © G. Lucy*

# 4. Objectives of current report

## Supporting Local Planning Authorities

*"Local and neighbourhood plans and planning decisions have the potential to affect biodiversity or geodiversity outside as well as inside designated areas of importance for biodiversity or geodiversity"* (extract from: www.gov.uk/guidance/natural-environment)

Biodiversity protection is familiar to planning authorities but geodiversity less so. This report will assist planning authorities in meeting their obligations under the National Policy Planning Framework and helping them identify potential development impacts on LoGS.

GeoEssex is therefore seeking to help Local Planning Authorities fulfil their responsibilities with respect to geodiversity.

Further guidance on statutory obligations is given in Circular 06/2005 (*Biodiversity and Geological Conservation*). Geodiversity should be therefore included alongside biodiversity in local authorities' Local Plans. Identifying these non-statutory sites therefore helps local authorities to meet their obligations.

LoGS can also contribute to *sustainability* programmes by providing information about a key element of the environment that contributes to our natural heritage. In addition, the *awareness raising* and *education* function fits well with the principle of community involvement and enabling people to regain their sense of place.

**Wrabness Brickearth Cliffs and Foreshore LoGS.**
Here can be seen a low cliff of brickearth dating from about 200,000 years ago containing the bones of mammoths that lived in this area at that time.

*Photo © G. Lucy*

# 5. Site selection

## Site selection and notification to planning authorities

LoGS in Essex are identified by **GeoEssex**, a largely voluntary group composed of representatives from the major Essex geological and conservation bodies and supported by the Essex Field Club, Essex Wildlife Trust, Natural England and Essex County Council (Place Services). The site selection process is based on clearly defined criteria (see below) and includes scientific, educational, historical and aesthetic values. When selecting sites GeoEssex aims to gain the support of landowners whenever possible. The majority of LoGS are on private land and site selection does not infer any right of access.

Like LoWS, proposed LoGS are presented to the Local Sites Partnership (chaired by Essex Wildlife Trust) for endorsement and then passed to local authorities for inclusion in their Local Plans. Local authorities receive a citation and boundary map.

The sites selected as LoGS in the Tendring district are summarised below, together with a list of other sites which are potential LoGS. Other sites may be identified in the future, occasioned by housing or other development and restoration following mineral extraction.

## Site protection

Like their biodiversity counterparts, LoGS have no statutory protection and the conservation and management of individual sites relies heavily on the support of landowners. Inclusion within local plans also forms a vital role in the protection of LoGS. An example of a comprehensive natural environment policy incorporating geodiversity can be provided on request.

It is recommended that the Local Sites Partnership (c/o Essex Wildlife Trust) should be consulted if any development is proposed that would affect a LoGS.

**Cliffs at Wrabness**
Showing distinct bands of volcanic ash from volcanoes in Scotland.

*Photo © G. Lucy*

## Site Assessment Criteria

The assessment criteria used for identifying LoGS are based on DEFRA document *Local Sites: Guidance on their identification, selection and site management* (2006). The guidance states that assessment is a matter of judgement but must be based on an understanding of geological principles and processes, and the distribution and abundance of the resource (national, regional and local). Those sites selected must be 'of substantive importance to the geodiversity of the local area'.

There are four value categories: scientific, educational, historical and aesthetic. A site qualifies for notification as a Local Geological Site if it fulfils the criteria under one or more of these categories. Each site is also given a site assessment score. This score is not a measure of the site's value or importance but a relative assessment of the usefulness of the site in promoting geodiversity.

## Land Ownership Notification

Where the landowner is identified as a public body eg. a local authority, Forestry Commission etc., notification is by letter to that authority. For sites under private ownership, where the landowner can be identified, they will be informed by letter.

*Photo © Essex Field Club. Reproduced from the Essex Naturalist Volume 21 (1925).*

**Life in the Eocene rainforest**

The first skeleton ever found of *Hyracotherium*, the earliest ancestor of the horse, was unearthed at Harwich in the 19th century by a worker in the Harwich Cement Industry. It is no larger than a small dog, had toes instead of hooves, and lived in the rainforest on the shores of the London Clay Sea some 50 million years ago. This fossil gives us a glimpse of the early evolution of mammals following extinction of the dinosaurs.

The skull and the rest of the skeleton is now in the Natural History Museum, London.

# 6. Additional sources of information

**Scientific literature**
If a LoGS has been referred to in the scientific literature these references are of given in the LoGS citation. If a site has been referred to in the scientific literature this means that the site is of historical interest and some of these sites will have potential for research.

**Interpretation**
If a site is accessible or simply visible to the general public, it is the aim of GeoEssex to provide interpretive information where possible and practical. This could be in the form of interpretive boards or leaflets. Such interpretation will be with the cooperation of landowners and other interested parties.

**GeoEssex** www.geoessex.org.uk
Background geological information for Essex, together with a selection of sites in each district (SSSIs and public accessible sites) can be found on the GeoEssex website

**Essex Field Club** www.essexfieldclub.org.uk
The Essex Field Club, founded in 1880, exists to promote the study of the county's natural history, and includes geology amongst its many activities. The club has a centre for Biodiversity and Geodiversity in Wat Tyler Country Park at Pitsea, near Basildon. It is open to the public most weekends. Their website provides comprehensive data on a large number of wildlife and geological sites which can be searched in a number of ways. Details of several hundred geological sites across Essex can be found here which includes LoGS and potential LoGS.

**British Geological Survey** www.bgs.ac.uk
Other geological resources, maps and borehole information are available on the website of the British Geological Survey.

**Essex Rock & Mineral Society** www.erms.org.
The Essex Rock and Mineral Society, founded in 1967, is the club for Essex amateur geological enthusiasts.

**GeoEast**
GeoEast is the East of England Geodiversity Partnership. It is a partnership of organisations active in conserving and promoting Earth heritage in this region.

**Earth Heritage Magazine** www.earthheritage.org.uk
Earth Heritage magazine is produced for the geological and landscape community by Natural England, Scottish Natural Heritage, the Countryside Council for Wales.

**Geologists' Association** www.geologistsassociation.org.uk
The Geologists' Association, founded in 1858, is Britain's largest society for amateur geologists.

**Quaternary Research Association** https://www.qra.org.uk
The Quaternary Research Association researches 'Ice Age' geology, palaeobiology and Palaeolithic archaeology and has published several field guides covering many sites in southern and Eastern Essex.

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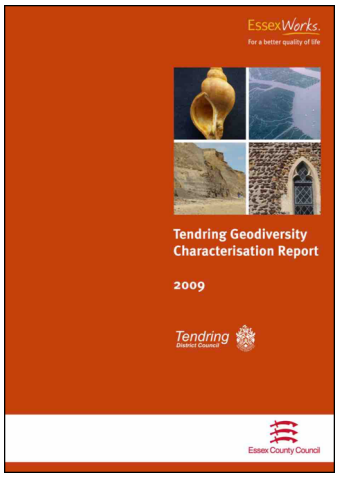


The Tendring Geodiversity Characterisation Report

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# 7. List of geological sites

The following is a representative list of geological sites in the district. For completeness it includes geological SSSIs but these sites are statutory sites and do not form part of this report.

The list gives an idea of the range of sites that can qualify as Local Geological Sites (LoGS). It includes those LoGS that have already been approved by the Local Sites Partnership.

## Sites of Special Scientific Interest (SSSIs)

**ARDLEIGH. Ardleigh Gravel Pit SSSI (Martells Quarry) (TM 053 280)**
Working quarry revealing Ardleigh Gravel from the early Thames containing beds of organic clay with cold-climate plants and ice wedges. It also contains beds containing temperate plants dating from an un-named interglacial stage about 550,000 years ago. On top of the Ardleigh Gravel is the Martells Gravel deposited by a local river and covered with an ancient warm-climate soil horizon (the Valley Farm Soil) overprinted with a cold climate soil (the Barham Soil).

**CLACTON. Clacton Cliffs (part of Clacton Cliffs and Foreshore SSSI) (TM 173 143)**
The Clacton Cliffs and Foreshore SSSI, as it is known, is a complex series of sediment-filled channels which intersect, but bear no relation to, the present coastline and consist of three separate sites. The two

main sites are where the channels were formerly exposed - the cliffs and foreshore at Clacton (TM 173 143), and the foreshore at Lion Point, Jaywick (TM 146 128). The third site is between the two at Clacton Golf Course (TM 156 134). A further site (not part of the SSSI) is the former Butlins holiday camp. Clacton is one of the principal prehistoric sites in Europe and a site of considerable international importance. However, there are no current exposures as the geology now lies beneath the grass, ornamental gardens and beach shingle. The site was discovered by the geologist John Brown in 1830s when the cliffs were still eroding. A channel deposit of the Thames-Medway River about 400,000 years old was then exposed in cliffs yielding bones of lion, rhinoceros and elephant. It is the type site of the famous 'Clactonian' flint industry which is based on flint flakes and cores, but no hand-axes. It is also the site of discovery of the tip of a yew spear, one of the oldest wooden artefacts in the world.

**HARWICH. Harwich Foreshore SSSI (TM 263 320)**
This locality is particularly important as the best exposure of the 'Harwich Stone Band', the most distinctive of the ash bands in the Harwich Formation at the base of the London Clay which contains volcanic ash from explosive volcanic eruptions in Scotland during Eocene times some 50 million years ago. The stone band makes this part of the coast the only naturally occurring rocky shore along the entire distance between Norfolk and Kent and may even be the reason for the existence of the Harwich peninsula. The foreshore is also of prime importance for London Clay fossils, particularly for fossil fruits and seeds from the Eocene rainforest. Also found are fossil sharks' teeth amongst the beach shingle.

**HOLLAND-ON-SEA. Holland-on-Sea Cliff SSSI (TM 211 166)**
About 450,000 years ago the ancestral Thames was blocked by ice causing it to alter its course and adopt the route we know today. The gravel in the cliff at Holland-on-Sea dates from just before and just after the Thames was diverted (Lower Holland Gravel and Upper Holland Gravel). Holland-on-Sea lies within the area of confluence of the Thames and the Medway at this time, some 450,000 years ago. Sections of gravel are now obscured by grass and hidden behind beach huts.

**LITTLE OAKLEY. Little Oakley Channel SSSI (TM 223 294)**
Beneath Little Oakley is Oakley Gravel which is part of the Kesgrave Sands and Gravels, laid down by the pre-diversion Thames at the point where it may have been joined by the early River Medway. Beneath one particular field is a channel cut into this gravel and filled with sediments that contain numerous fossils, including the bones of rhinoceros, giant deer, hyaena and horse. There are also freshwater shells and a fine pollen record, which has enabled geologists to reconstruct the flora and fauna of this distant period of the Ice Age. Although the channel's exact age is still not known it is thought to be about 575,000 years old. The channel was first discovered during sewer excavations in 1939. In the 1980s a major excavation was undertaken but these trenches were backfilled and there is now no indication on the surface that this strip on the edge of a farm field is one of the most important geological sites in Essex.

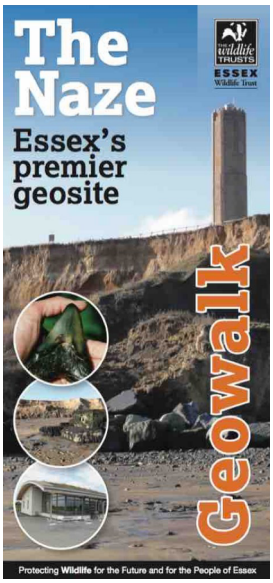
**ST. OSYTH. Colne Point Shingle Spit (part of Colne Estuary SSSI) (TM 108 125)**
Colne Point is the best example in Essex of a shingle spit. The spit is 4 kilometres (2.5 miles) long and is nearly all that remains of a much larger area that existed in the 19th century but has now mostly been developed by the seaside holiday industry. It is of great interest for studying the movement of shingle and the development of shingle structures. It is an Essex Wildlife Trust reserve. Day permits to visit are available from the Trust.

**ST. OSYTH. St. Osyth Gravel Pit SSSI (TM 120 174)**
About 450,000 years ago a catastrophic change affected the Thames causing it to alter its course and adopt the route we know today. The deposits at St. Osyth Pit reveal just how rapid the diversion was as the Thames suddenly ceased to flow through central Essex as a result of being blocked upstream in Hertfordshire and west Essex by the Anglian ice sheet. Gravel of the same age is present in the cliff at Holland-on-Sea. St. Osyth lies upstream from the confluence with the Thames and Medway rivers whereas Holland lies within the area of the confluence. The gravel at St. Osyth pit is of two types: the Lower St. Osyth Gravel, which dates from just before the Thames was diverted, and above this is the Upper St. Osyth Gravel which was laid down after the Thames had disappeared from the area. No gravel is currently visible at the SSSI. Permission to visit is required from the land owners.

**ST. OSYTH. St. Osyth Marsh (part of Colne Estuary SSSI) (TM 090 144 to TM 130 126)**
St. Osyth Marsh is important for studying changes in salt marsh growth and is one of only a few marsh areas in Britain to have been dated (4,300 years). The characteristic assemblage of features - creeks, saltpans and salt marsh cliff - are all present here, and reflect the maturity of the marsh system. The saltpans have been intensively researched by geomorphologists, and provide much information relating to the formation and development of this unique coastal landform. St. Osyth Marsh is also one of the few places in Britain where the development of wave-built protective beach ridges called cheniers has been described fully. Here the cheniers consist mostly of sand and gravel, unlike those further south on the Dengie peninsula which are made up almost entirely of shells.

**WALTON-ON-THE-NAZE. The Naze Cliffs SSSI (TM 266 235)**
The finest geological site in Essex. Classic cliff section in London Clay, Red Crag, brickearth and Thames Gravel (Cooks Green Gravel). Volcanic ash bands and faults in London Clay. Classic rotational landslips. Diverse fauna of fossils from Red Crag and London Clay. Site of international importance. Geowalk guide guide available from GeoEssex or the visitor centre.

**WRABNESS. Wrabness London Clay Cliffs and Foreshore (part of Stour Estuary SSSI) (TM 172 323)**
The London Clay cliffs on the River Stour at Wrabness are the highest vertical cliffs in Essex and consist of the upper part of the Eocene Harwich Formation and the lower few metres of the Walton Member of the London Clay. They provide the best onshore exposure of the Harwich Formation. The Wrabness cliffs are of particular interest because they contain a complete sequence of bands of volcanic ash, which probably originated from volcanoes in Scotland. These ash bands are present from the Harwich Stone Band to the top of the formation. Over 30 separate ash layers occur throughout some 10 metres of clay and silty clay, which was deposited in a subtropical sea about 50 million years ago. The site has also yielded an important fossil flora (preserved in concretions).




The Naze Geowalk guide (2018)

# Local Geological Sites (LoGS)

*Sites agreed by Local Sites Partnership to date.*

**BEAUMONT. Beaumont Red Crag Outlier (TM 180 246)**
An isolated patch, or outlier, of Red Crag, about a quarter of a square mile in size, caps the top of the hill occupied by Beaumont Hall. It is one of the few fragments of a once continuous deposit of Red Crag across north Essex that has been almost entirely destroyed by erosion. The Red Crag in this part of Essex consists of loose sand with abundant fossil shells and the fossils of other marine animals that lived in the Red Crag Sea that existed about 2 million years ago. Fossil shells are visible on footpaths and in stream banks hereabouts. The geologist John Brown published a list of fossils from here in 1846. Private land. Access only available on public footpaths.

**MISTLEY. Mistley Cobble Wall (TM 11741 31822)**
On the south side of Mistley High Street, east of the Post Office, is a brick wall with a section composed entirely of rounded cobbles. Here can be seen numerous 'exotic' rock types such as granite, dolerite and gneiss. There are even several cobbles of rhomb-porphyry, a rock type from the Oslo region of Norway. These rock types are typical of those found in local glacial deposits but the high number of exotic rocks in such a small section of wall is extremely unusual. It has now been established from written records and oral testimonies that these rocks were brought to Mistley from Norway in ballast in trading ships in the early 19th century.

**MISTLEY HEATH. Furze Hill Gravel Pit (TM 122 309)**
The disused gravel pit at Furze Hill has a few minor exposures of Waldringfield Gravel, the oldest deposit in

Essex from the former course of the River Thames and at least 650,000 years old. A coarse, iron-stained gravel can be seen in small excavations made by rabbits, and pebbles from the gravel are on the paths and in the roots of fallen trees. The gravel appears to contain a high proportion of 'exotic' pebbles that clearly have been carried some distance by the Thames, such as well-rounded pebbles of white vein quartz (from North Wales?). The wood is privately owned but publicly accessible and the Essex Way, a long distance public footpath, runs along the northern boundary.

**WRABNESS. Wrabness Brickearth Cliffs and Foreshore. (TM 163 319 to TM 170 322)**
Brickearth dating from an interglacial stage of the Ice Age is exposed in the low cliff and foreshore eastwards from Wrabness sluice to beyond Wrabness Point. The brickearth has yielded bones of elephant and mammoth and has produced these fossils since at least the beginning of the eighteenth century. Fossils have, however, always been difficult to find and are often in a very friable condition requiring great skill to extract and conserve them. The brickearth is thought to belong to an interglacial stage that corresponds with Marine Isotope Stage 7 (approximately 200,000 years old).

## Other sites of geological interest in the district.

(Some of these sites are being considered as potential LoGS).

**ARDLEIGH. St. Mary's Church (TM 053 295)**
Ardleigh church has a variety of colour from a diversity of local building materials in an attractive patchwork. The church has a medieval tower and south porch but most of the rest is nineteenth century. The finest craftsmanship is knapped flint flushwork, imported probably from Suffolk but there are numerous erratics, providing geological interest. The erratic cobbles are no doubt from local fields or gravel pits and almost certainly come from the local Ardleigh Gravel, laid down by an ancestor of the Thames about 550,000 years ago. Particularly noticeable are the cobbles of ferricrete, a local iron-rich conglomerate of flint pebbles.

**BEAUMONT. Beaumont Quay Limekiln (TM 190 240)**
The circular brick limekiln at Beaumont Quay is the only complete limekiln surviving in Essex. The quay was built in 1832 but the limekiln was almost certainly added later, probably in 1869-70. It was disused by the early 1920s. Limekilns were usually built in chalk quarries to be close to the raw material for making lime but in coastal areas more permanent and substantial kilns were built in harbours and wharfs where chalk and coal for the kiln could be brought in by sea. Owned by Essex County Council and publicly accessible.

**The Beaumont Quay Limekiln**
The only surviving limekiln in Essex
*Photo © G. Lucy*

**BEAUMONT. Gravel Wood (TM 162 253)**
Gravel Wood is so named because it contains shallow former gravel pits which are now ponds. The gravel is probably Wivenhoe Gravel (deposited on the northern bank of Wivenhoe Gravel Thames). The gravel is currently only visible with difficulty in the stream that runs through the wood. The gravel is overlain by a layer of 'cover loam', a sandy, silty clay that covers much of the Tendring peninsula. This cover loam, or loess, is readily visible in the root plates of fallen trees. The wood is owned by Essex County Council and is actively managed as a coppice woodland. It is publicly accessible.

**BRIGHTLINGSEA. Brightlingsea Copperas Works (site of) (TM 087 161)**
The copperas industry is commemorated by road sign for Copperas Road. The copperas industry was an important industry in 18th century Essex. It involved gathering of pyrite nodules (known as 'copperas stones') from beaches, where they had been washed out of the London Clay, and then allowing them to oxidise for several months in open vats. This lengthy and hazardous industrial process converted the nodules to ferrous sulphate (green vitriol), which was an essential chemical for making dyes, ink, and several industrial chemicals such as sulphuric acid. Historical site only.

**DOVERCOURT. Gants Pit (site of) (TM 240 313)**
Gants Pit in Dovercourt is famous as the richest site for Palaeolithic hand-axes in Essex. It was situated on the west side of the junction of the main Harwich Road and Parkeston Road. The pit ceased working in the 1920s and the site is now levelled and occupied by Spring Meadow Primary School and playing field. A total of 208 hand axes have come from this pit. Some of them were large and beautiful, and many were magnificently worked. The mammal bones found represented species such as beaver, rhinoceros, straight-tusked elephant, fallow deer, red deer and ox (aurochs). The gravel that contained the implements and bones appears to be a local terrace gravel from the Stour valley, banked up against the much older Oakley Gravel, which is of Thames-Medway origin.

**GREAT BENTLEY. St. Mary's Church (TM 108 217)**
The parish church of Great Bentley stands on the west side of the largest village green in Essex. The church is unusual as it is largely constructed of ferricrete, an iron-cemented gravel that was quarried locally. This stone, which makes a remarkably durable building material, was formed within local Ice Age gravels as an 'iron pan', which can be up to a metre in thickness, at the level of the groundwater table. Ferricrete is one of the few building stones native to Essex.

**Great Bentley Church**
An unusual example of a building constructed almost entirely from ferricrete.

*Photo © G. Lucy*

**GREAT CLACTON. St. John's Church (TM 176 165)**
The church of St.John the Baptist at Great Clacton is a local landmark with a short, pyramidal spire. The building has Norman origins and is notable because it is constructed almost entirely from septarian nodules, or 'septaria' from the London Clay. These nodules were no doubt collected locally from the foreshore and are one of the few building stones native to Essex.

**GREAT CLACTON. Sarsen stone**
The geologist A.E. Salter, in his landmark paper *Sarsen, basalt and other boulders in Essex*, published in the Essex Naturalist in 1914, referred to a large erratic boulder at Great Clacton but its precise location is not known. He described it as a sarsen stone 4'x3'x1' in size and so it should be possible to establish its whereabouts. Apart from the sarsen stone at Ramsey, this is the only other natural erratic boulder known from the Tendring district.

**HARWICH. Beacon Cliff (TM 262 317)**
In 1704 the naturalist Samuel Dale described a cliff of sand containing fossils at Beacon Cliff, Harwich that appears to be the first record of the East Anglian Crag deposits in the scientific literature. The fossiliferous sand is now known as the Red Crag but unfortunately this exposure, which lay on top of the London Clay,

was lost due to coastal erosion in the 19th century. The cliff was illustrated by Dale in 1730. Site also has great historical significance, as it was here that the London Clay nodules were collected for the Harwich Roman Cement industry and the associated discovery of Eocene fossil mammals, including the first discovery in the world of the earliest ancestor of the horse.

**HARWICH. The Harwich Borehole (site of) (TM 259 328)**
In the early 19th century the lack of good drinking water had long been a complaint among Harwich residents. Following several failures the sinking of an ambitious new borehole was commenced in 1854. In November 1857, three years after the work had commenced, the borehole had been carried through the Chalk, the Upper Greensand and the Gault into the hard, slate-like basement rocks of Essex. Although no satisfactory water supply was obtained from this borehole, and it was to be several more years before a good supply was found for the town, the borehole had reached a depth of over 300 metres (1,000 feet) and proved to be of great value to science. The hard basement rocks of Essex - dating from the Silurian period and about 420 million years old - had been revealed for the first time. The site was by the harbour, near the pier, just west of the former Great Eastern Hotel. An historical site only.

**KIRBY LE SOKEN. Hamford Water National Nature Reserve (TM 267 238 approx)**
Hamford Water is a large, shallow inlet between Walton-on-the-Naze and Dovercourt with an interesting complex of saltmarsh, sandbanks and tidal creeks. It is unusual as it is similar to an estuary but is only fed by a few small streams and not a major river as elsewhere on the Essex coast. Extensive saltmarsh covers one third of the area. There are several islands of London Clay that protrude above the level of the marsh such as Skippers Island, which is an Essex Wildlife Trust nature reserve. Hamford Water is internationally important for wildlife, particularly breeding birds, and most of the area is a National Nature Reserve.

The Hamford Water embayment - a depression in the London Clay bedrock – is filled with marine sediment, and demonstrates the influence of the surrounding geological features on the 'estuarine' processes. Normal estuaries on flat lands develop a funnel shape that is controlled by the energy of waves and tides. Hamford Water cannot do that because of the rising ground and the lack of river valleys; it is consequently short and fat. The mouth is constricted by The Naze, Horsey Island, Foulton Hall Corner and Pye Sand. Lose any one of these and the tidal energy would destroy the saltmarsh at the site.

**KIRBY-LE-SOKEN. Soken Wood (TM 220 223)**
Soken Wood is a relatively new native broadleaved woodland created in November 2000. Because of the wood's close proximity to The Naze, which is rich in fossil plants from the London Clay, part of the site has been planted up with exotic species of prehistoric origin. The trees planted are stands of monkey-puzzle and ginkgo, with individual specimens of witch hazel, magnolia, oriental plane, tulip tree and dawn redwood. Soken Wood is owned by The Woodland Trust and is open at all times. There is an information board

**LITTLE OAKLEY. Harmer's Red Crag pit (site of)**
The existence of shelly Red Crag capping the high ground at Little Oakley has been known since at least the 1860s but it was not until the remarkable work of amateur geologist Frederick Harmer (1835-1923) in the early years of the twentieth century, that the site received any attention. Harmer reopened a shallow pit to the east of the village near Foulton Hall and sieved the sand for fossil shells over a period of several years. The result of these efforts was his two volume work *'The Pliocene Mollusca of Great Britain'* published in 1919 in which he states that over 600 different species of mollusc were found in this pit (nearly 400 of the species illustrated in the book are from Little Oakley). Harmer's work has shown the extraordinarily rich molluscan fauna of the Red Crag sea. Harmer records that all of the fossils came from 'an area of twenty yards square' and says that they were obtained 'during many years labour, and by the sifting and examination of something like 200 tons of material'. Harmer's pit has long ago been filled in but the site is of great historical interest as one of Britain's most prolific fossil localities.

**RAMSEY. Copperas Bay and Copperas Wood (TM 199 312)**
The copperas industry is commemorated in the name of Copperas Wood and Copperas Bay but information on this industry is lacking in the publicity for Copperas Wood, which is an Essex Wildlife Trust reserve.
A copperas works is marked as 'Copperas House' on the 1882 geological map (based on an 1838 original plate) and the exact site may have been where Copperas Wood Farm now is (TM 204 318).

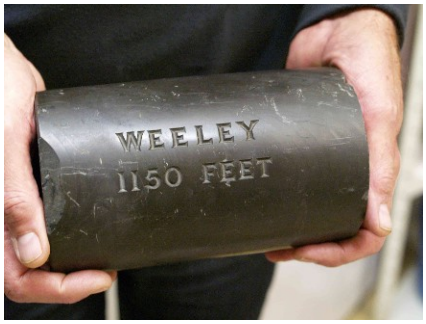
**RAMSEY. Hill House Sarsen Stone (TM 2014 2964)**
Sarsen stone about 1 metre (3 feet) tall stands on the roadside by the boundary wall of Hill House. This is one of only two sarsen stones that are known to exist in Tendring District. The other was reported at Great Clacton but unfortunately cannot now be located.

**The Hill House sarsen stone**
Sarsens are boulders of extremely hard sandstone that occur on the Chalk land surface in Southern England, particularly in Wiltshire where they have been used to build Stonehenge. They were formed at a time of great warmth, about 55 million years ago, when sandy strata on top of the Chalk was cemented by silca (quartz). This layer was extremely resistant to erosion but it eventually broke up into boulders we now call sarsens. This example may have originated from the Chalk landscape of Kent and brought here by the River Medway.
*Photo © G. Lucy*

**ST. OSYTH. St.Osyth Priory Gatehouse (TM 121 157)**
Erected in 1481, the battlemented gatehouse of St. Osyth Priory is one of the finest examples in Britain of the use of flint 'flushwork'. Flushwork is the name given to the technique of setting 'knapped' flints (flints skilfully worked to produce a flat face) into a wall, often in intricate patterns alongside another stone such as limestone. St. Osyth's Priory is privately owned and no longer open to the public but the gatehouse can be viewed from the green open space between the gatehouse and the road where there is also car parking.

**THORPE LE SOKEN. Dakings Pit (TM 155 233)**
A rich assemblage of Palaeolithic artefacts has been recovered from this overgrown pit in the garden of Hillhouse Farm. The deposits are mapped as Cooks Green Gravel (laid down by the Thames-Medway River 600,000 years ago) but it has been suggested that the gravel may be a post-Anglian deposit of the nearby Holland Brook. In 1970 a 3 metre wide face was cleaned at the north-east end. The pit is historically important; archaeologists such as Leakey, Oakley, Warren and Wymer carried out research here from 1933 to 1970.

**WEELEY. Site of Weeley borehole. (TM 14737 21833)**
In the latter part of the nineteenth century, the discovery of a deep coalfield near Dover stimulated the search for coal in East Anglia. The Eastern Counties Coal Boring and Development Syndicate was formed for this purpose and they sunk a borehole at Weeley in 1896, their previous borehole being at Stutton on the Suffolk side of the Stour estuary. The borehole penetrated the deep Palaeozoic basement rocks at a depth of over 330 metres (1,100 feet) and continued to 372 metres (1,221 feet) before the project was finally abandoned. The basement was found to be Silurian rocks (approx. 420 million years old) and not the younger Carboniferous coal measures that had been hoped for. Directors and shareholders had invested a considerable amount of money in the venture but the syndicate was finally wound up a year or so later.




**The Weeley core**
A core of hard rock of Silurian age from the bottom of the Weeley borehole that was sunk in 1896 in search of coal. This section, from the collection of Colchester Natural History Museum, has been carved with the depth it came from below ground level . *Photo © G. Lucy*