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Mineral Resource Information in Support of National, Regional and Local Planning Suffolk

Commissioned Report CR/03/076N



BRITISH GEOLOGICAL SURVEY

COMMISSIONED REPORT CR/03/076N

Mineral Resource Information in Support of National, Regional and Local Planning Suffolk

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Contents

1	Introduction	1
1.1	Resources and Reserves	1
1.2	Environmental designations	2
2	Sand and gravel	3
2.1	Superficial deposits	3
2.2	Glaciofluvial sand and gravel	4
2.3	Glacial sand and gravel (fluvioglacial deposits)	5
2.4	River sand and gravel (terrace and sub-alluvial deposits)	5
2.5	Head gravels.....	5
2.6	Blown sand.....	6
2.7	Beach sand and gravel.....	6
2.8	Bedrock sand and gravel	6
3	Brick clay.....	7
4	Chalk.....	8
5	Building Stone	9
6	Peat.....	9
7	Hydrocarbons.....	10
7.1	Conventional Oil and Gas	10
7.2	Coalbed Methane (CBM) potential	10
8	Aims and limitations.....	10
9	Planning permissions for mineral extraction.....	11
	Appendix 1	12
	Contact addresses:	12
	Topographic base	12

1 Introduction

This report is one of a series prepared by the British Geological Survey for various administrative areas in England for the Office of the Deputy Prime Minister's research project *Mineral Resource Information in Support of National, Regional and Local Planning*.

The accompanying map relates to the county of Suffolk and delineates the mineral resources of current, or potential, economic interest in the area and the sites where minerals are or have been worked. It also relates these to national planning designations, which may represent constraints on the extraction of minerals.

Three major elements of information are presented:

- the geological distribution and importance of mineral resources;
- the extent of mineral planning permissions and the location of current mineral workings, and
- the extent of selected, nationally-designated planning constraints.

This wide range of information, much of which is scattered and not always available in a consistent and convenient form, is presented on a digitally-generated summary map on the scale of 1:100 000. This scale is convenient for the overall display of the data and allows for a legible topographic base on which to depict the information. However, all the data are held digitally at larger scales using a Geographical Information System (GIS), which allows easy revision, updating and customisation of the information together with its possible integration with other datasets. The information will form part of a *Summary of the Mineral Resources of the East of England Region*.

The purpose of the work is to assist all interested parties involved in the preparation and review of development plans, both in relation to the extraction of minerals and the protection of mineral resources from sterilisation. It provides a knowledge base, in a consistent format, on the nature and extent of mineral resources and the environmental constraints, which may affect their extraction. An important objective is to provide baseline data for the long term. The results may also provide a starting point for discussions on specific planning proposals for mineral extraction or on proposals, which may sterilise resources.

It is anticipated that the maps and report will also provide valuable background data for a much wider audience, including the different sectors of the minerals industry, other agencies and authorities (e.g. The Planning Inspectorate Agency, the Environment Agency, the Countryside Agency and English Nature), environmental interests and the general public.

Basic mineral resource information is essential to support mineral exploration and development activities, for resource management and land-use planning, and to establish baseline data for environmental impact studies and environmental guidelines. It also enables a more sustainable pattern and standard of development to be achieved by valuing mineral resources as national assets.

The mineral resources covered are sand and gravel, brick clay, hydrocarbons, building stone, chalk and peat.

1.1 RESOURCES AND RESERVES

Mineral resources are natural concentrations of minerals, or bodies of rock that are, or may become, of potential economic interest as a basis for the extraction of a commodity. They will exhibit physical and/or chemical properties that make them suitable for specific uses and be present in sufficient quantity to be of intrinsic economic interest. Areas that are of potential

economic interest as sources of minerals change with time as new uses are developed, product specifications change, recovery technology is improved or more competitive sources become available.

That part of a mineral resource, which has been fully evaluated and is commercially viable, to work is called a mineral reserve. In the context of land-use planning, the term mineral reserve should strictly be further limited to those minerals for which a valid planning permission for extraction exists (i.e. permitted reserves). Without a valid planning consent, no mineral working can take place and consequently the inherent economic value of the mineral resource cannot be released and resulting wealth created. The ultimate fate of a mineral reserve is to be either physically worked out or to be made non-viable by changing economic circumstances.

Mineral resources defined on the map delineate areas within which potentially workable mineral may occur. These areas are not of uniform potential and also take no account of planning constraints that may limit their working. The economic potential of individual sites can only be proved by a detailed evaluation programme. Such an investigation is an essential precursor to submitting a planning application for mineral working. Extensive areas are shown as having no mineral resource potential, but some isolated mineral workings may occur in these areas. The presence of these operations generally reflects local or specific situations.

1.2 ENVIRONMENTAL DESIGNATIONS

The map shows the extent of selected, nationally-designated planning constraints as defined for the purposes of this study. These are defined on a common national basis and therefore represent a consistent degree of constraint across the country. No interpretation should be made from the map with regard to the relative importance of the constraints, either in relation to mineral development proposals or in relation to each other. Users should consult policy guidelines issued by the relevant Government department, statutory agency or local authority.

The constraints shown on the map are:

- National nature conservation designations - National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI)
- International nature designations – Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites
- Scheduled Monuments
- Norfolk Broads (part)
- Dedham Vale (part) and Suffolk Coast and Heath Areas of Outstanding Natural Beauty (AONB)
- Heritage Coast

Mineral development may also be constrained by many other factors not shown on the maps, including local landscape designations, considerations relating to the protection of other resources, such as groundwater, and local amenity or environmental concerns, such as noise, traffic and visual impact. These have been excluded because the constraint is not defined on a national basis or the information is not generally available. The extent or degree of relevance of such constraints can be ascertained from the relevant statutory agency or the appropriate Mineral Planning Authority.

2 Sand and gravel

Sand and gravel are defined on the basis of particle size rather than composition. In current commercial usage, the term 'gravel' is used for material that is coarser than 5 mm, with a maximum size of 40 mm, and the term 'sand' for the material that is finer, but coarser than 0.075 mm. Most sand and gravel is composed of particles that are rich in silica (quartz, quartzite and flint), but other rock types may occur locally. The principal uses of sand are as fine aggregate in concrete, mortar and asphalt. The main use of gravel is as coarse aggregate in concrete. Substantial quantities of sand and gravel may also be used for constructional fill.

Between 1979 and 2001 annual production in Suffolk has varied between 3.1 million and 1.8 million tonnes and the county remains an important source of sand and gravel for the construction industry. Recent production is shown on the graph (Figure 1) and permitted reserves are estimated at nearly 14 million tonnes.

Sand and gravel resources occur in a variety of geological environments. In Suffolk these resources occur mainly within superficial or 'drift' deposits, subdivided into river sand and gravel, glacial deposits, head deposits, bedrock sand and gravel, blown sand and beach deposits.

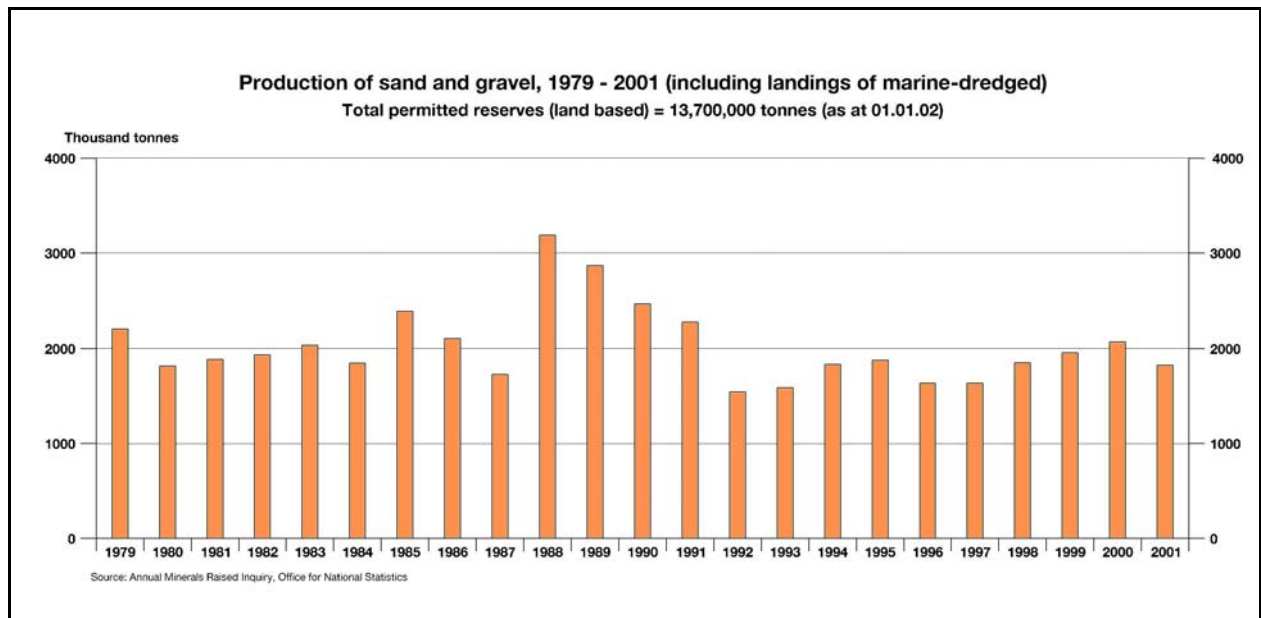


Figure 1 Sand and gravel production in Suffolk

2.1 SUPERFICIAL DEPOSITS

Parts of the areas assessed for sand and gravel by BGS resource surveys are identified on the map. Resources shown here are taken from these maps where available. In these areas, the possible extent of sand and gravel concealed beneath other material is shown. These indicated resources were defined by overburden to mineral ratios. Outside these areas, available data are more limited. Generally, only exposed sand and gravel is defined, although sub-alluvial inferred resources of sand and gravel occurring beneath modern river flood plains may be extensive in some places. Narrow (< 200 m) spreads of sub-alluvial deposits are mainly excluded from the map. Their limited width is likely to preclude economic working of any sand and gravel present.

2.2 GLACIOFLUVIAL SAND AND GRAVEL

This unit broadly corresponds to the Kesgrave Formation (includes the Bytham and Ingham sand and gravels in the north of county) and its equivalents and is one of the most widespread and significant aggregate resources in Suffolk. At the base of the unit unfossiliferous marine sands of the Norwich Crag Formation may locally have been included within the unit during surveying. It is also probable that in parts of the area the upper part of the unit has been reworked by meltwaters issuing from the Anglian ice-sheet but such reworking has not significantly modified the composition of the deposits.

The deposits form a semi-continuous sheet across the county comprising 5-15 m of clean pale coloured sands and pebbly sands with subordinate gravels. The clasts present are rounded quartz, quartzite and well-rounded flint in sub-equal proportions together with small amounts of angular-nodular flint and rare volcanic lithologies. The sand fraction is sharp; predominantly medium-angular to sub-angular quartz with flint, although locally the incorporation of significant quantities of sand from the underlying more mature marine Crag deposits increases the content of rounded and coarse sand grains. A series of levels aligned southwest - northeast have been identified within the Formation; these fall south-eastwards across the county and become progressively younger in age. A reddened soil horizon comprising 1-2 m of grey-red mottled silty clay cryoturbated together with sand and loessic silt is commonly found as a capping on several of these levels even when they are buried beneath younger deposits.

The upper parts of the Kesgrave Formation generally lie above the watertable but at depth the deposits may be saturated especially where they rest directly on impermeable Tertiary clays.

The deposits were laid down during successive cold phases between about 1.5 and 0.5 million years B.P. (up to the beginning of the Anglian glaciation) in braided rivers; the main swathe represents ancestral deposits of the River Thames which formerly flowed northeast across the area.



Figure 2 Kesgrave Formation sands and gravels, Waldringfield Heath

2.3 GLACIAL SAND AND GRAVEL (FLUVIOGLACIAL DEPOSITS)

This category comprises waterlain sands and gravels deposited in close proximity to the Anglian ice-sheet which was the most extensive of the Quaternary glaciations in East Anglia and covered most of Suffolk; its limit broadly corresponds to the dashed line on the map. In Suffolk these deposits have been termed the Barham Sands and Gravels.

These deposits mainly occur on top of the sheet of till (boulder clay) and on the shoulders of the existing valleys indicating early downcutting along the present lines of drainage that were established by the Anglian glaciation. The deposits tend to form as discrete patches and channel infills, they are best developed in the northwest of the county especially where chalk bedrock is present. The deposits locally reach 15 m thick where they infill channels on the sides of the modern valleys but generally they are less than 5 m thick. Gravel predominates and is variably clayey and sandy. The deposits are commonly very variable in grain size, poorly sorted and can contain interbeds of glacial silt, clay, and till. The abundance of clay and its oxidation leads to orange-red coloration of most deposits. The clasts are predominantly angular-nodular flint and chalk. Other material includes rounded quartz, quartzite and flint derived from the Kesgrave Formation and Jurassic sedimentary rocks reflecting a derivation from the northwest.

2.4 RIVER SAND AND GRAVEL (TERRACE AND SUB-ALLUVIAL DEPOSITS)

Since the Anglian glaciation the present day drainage pattern has become established. Terraced river deposits occur at several levels in most of the major valleys in the county flanking the present floodplain.

The deposits commonly comprise sequences of sands and gravels around 3-6 m in thickness and with a sheet-like body geometry. The basal contact is usually gently scalloped but locally the deposits infill deep channels. Compositionally the deposits reflect their derivation from glacial and fluvio-glacial deposits up-stream and up-slope. Locally they are overlain by fine-grained alluvial and loessic deposits (brickearth). The terrace deposits are commonly dry in their upper parts and saturated to the base. They are post-Anglian in age and were deposited under cold periglacial climatic conditions.

Sub-alluvial gravels are encountered beneath the alluvium of the major valleys throughout the county. The deposits are compositionally similar to the river terrace deposits, indeed some are their downstream equivalents where they pass below OD. They were mainly laid down during periods of deep downcutting during the ultimate Devensian cold phase when sea-levels fell to at least -100 m OD. The subsequent rise in sea-level enabled silting up of these river channels producing thick overlying alluvial deposits (silty clays, peat). The deposits rest on an irregular channelled surface and are thus of very variable thickness; locally 5-10 m of deposits are present, but they are commonly thinner. These deposits are always saturated and require wet working.

2.5 HEAD GRAVELS

These comprise gravelly deposits that have been involved in mass movement downslope to their present position. Such movement commonly takes place under cold climatic conditions when vegetation is sparse and frozen ground leads to increased run off. The gravel is commonly mixed with other lithologies present on the slope and so the resulting lithologies are very variable; most contain significant clay contents and are only suitable for working as hoggin. The clast composition reflects that of the parent material. The deposits often accumulate as lobes or fans which are then dissected by subsequent downcutting.

2.6 BLOWN SAND

This is generally composed of clean, well-sorted, fine to medium grained sand and comprises sub-rounded to well-rounded quartz grains. These deposits are largely Recent in age, resulting from aeolian reworking of adjacent dry beaches. The most favourable sites for blown sand accumulation in Suffolk are along the coast. Deposits are generally thin, mostly less than 2 m, but locally up to 5 m thick and occur mainly as dunes but also as thin linear spreads of sand. The most extensive areas occur on the coast around Lowestoft.

2.7 BEACH SAND AND GRAVEL

Included in this category are deposits marked on BGS maps as 'Shoreface and Beach Deposits', 'Storm Beach Deposits' and a variety of raised beach deposits. Typically these occur as accumulations of sand and gravel restricted to the modern coast and a relatively narrow belt of country adjacent to it. Typically the shingle is composed of 10 to 15 mm diameter clasts of well-rounded flint with subordinate quartz and quartzite, with a matrix of medium grained sand. The most extensive deposits of this type are found to the south of Aldeburgh, at Orford Ness.



Figure 3 Beach shingle, Orford Ness

2.8 BEDROCK SAND AND GRAVEL

Sand and gravel, of varying quality, are extracted from members of the Pliocene Coralline, Red and Norwich Crag formations.

Two members of the uppermost Norwich Crag Formation are exploited, the Westleton Gravel member and the Chillesford Sand member. The former represents a series of gravel-rich fossil shoreline deposits, whilst the underlying Chillesford Sands, composed of yellow-brown, well-sorted, fine to medium grained, micaceous, quartz sands, are thought to have been deposited as

tidal sand flats. The Westleton Gravel is extracted for aggregate whilst the Chillesford Sand is used as building sand.

The Red Crag Formation is composed of medium to coarse grained, poorly-sorted shelly sand that was deposited in an open marine environment. It is exploited mainly as a poor quality aggregate material, as fill and for track and footpath repairs.

The Coralline Crag Formation is composed of a series of shelly calcarenites and shelly sands and has been worked both for building stone and as coarse aggregate for trackway and footpath repairs.



Figure 4 Westleton Beds, north of Sizewell

3 Brick clay

‘Brick clay’ is the term used to describe clay and shale used predominantly in the manufacture of bricks and, to a lesser extent, roof tiles and clay pipes. These clays may sometimes be used in cement making, as a source of constructional fill and for lining and sealing landfill sites. The suitability of a clay for the manufacture of bricks depends principally on its behaviour during shaping, drying and firing. This will dictate the properties of the fired brick such as strength and frost resistance and, importantly, its architectural appearance.

Most facing bricks, engineering bricks and related clay-based building products are manufactured in large automated factories. These represent a high capital investment and are increasingly dependent, therefore, on raw materials with predictable and consistent firing characteristics in order to achieve high yields of saleable products. Blending different clays to achieve improved durability and to provide a range of fired colours and textures is an increasingly common feature of the brick industry. Continuity of supply of consistent raw materials is of paramount importance.

A relatively small brick manufacturing site at Aldeburgh uses clays from the Chillesford Clay Member of the Norwich Crag Formation to produce the characteristic 'Aldeburgh Red' brick which is valued for restoration work as well as for the construction of new quality buildings. The Chillesford Clay forms a thin (3 – 6 m) deposit of pale grey or orange/buff sandy clays. Extraction is on a small scale at Chillesford and the material is transported to Aldeburgh to make the red-fired bricks. A small amount of the underlying Chillesford Sand is dug to face the bricks.

Until recently large amounts of Quaternary Lowestoft Till (Chalky Boulder Clay) has been extracted for use as a raw material in cement manufacture at Masons Cement Works, Great Blakenham. The works closed, however, in 1999 and the former clay pit has now been restored. In addition clay from the Lowestoft Till at the former Gisleham Brick and Pipe Works, has been used for other non-brick manufacturing purposes, including the construction of flood defences.

Although the outcrop of Tertiary age London Clay is extensive in the south-east of the county, this clay is not shown as a resource since it is generally unsuitable for use in modern brickmaking processes. This is due the presence of relatively high levels of the clay mineral montmorillonite.



Figure 5 Chillesford Clay and Sand, Hill Farm, near Aldeburgh

4 Chalk

Chalk is a relatively soft, fine-grained, white limestone consisting mostly of the debris of planktonic algae. The Chalk is of Upper Cretaceous age and occurs extensively in eastern and southern England where it forms an important resource of 'limestone raw materials'.

The White Chalk Subgroup (formerly known as the Middle and Upper Chalk) occurs extensively in the western half of the county, although much of the outcrop is concealed by a thick cover of superficial deposits. Over much of the county it is around 250 m in thickness and is grey or white coloured, with layers of flint. This part of the sequence is generally of high purity (93 – 98% CaCO_3), in contrast to the underlying Grey Chalk Subgroup (formerly Lower Chalk), which is

expected to be mainly of lower purity (<93% CaCO₃) due to the numerous calcareous mudstone (marl) bands.

Until recently the Chalk was extracted on a large scale for cement manufacture at Masons Cement Works, Great Blakenham. This quarry, however, closed in 1999 and the site is now used for landfill. Chalk is currently extracted at several sites in the county, but on a relatively small scale, for the production of agricultural lime.



Figure 6 The quarry at Masons Cement Works, Great Blakenham. Now used for landfill

5 Building Stone

The Cretaceous and Tertiary rocks have provided a limited range of building stones for local use. The succession contains no freestones and therefore much of the building stone found in the county (principally Lincolnshire Limestone-Barnack Stone etc) was imported into the area from medieval times onwards. The Upper Cretaceous chalk yielded both chalk block stone (or Clunch) as well as flint for building purposes, the latter being the most common building stone in the county. The Tertiary succession provided concretionary limestones (or Septarian nodules) and occasional fossiliferous limestones, as at Sutton (Bryozoan Rock), for local building. Pebbles of flint and other more exotic lithologies, derived from the glacial drift, were frequently used for building purposes. No building stone quarries are currently operating in the county.

6 Peat

Peat is an unconsolidated deposit of plant remains in a water saturated environment such as a bog or fen. Bogs occur in areas where they are dependent on rainfall for supply of water and the vegetation is characterised by acid tolerant plant communities of which the genus *Sphagnum* is

dominant. The two main types of bog are (i) raised bogs, characteristic of flat underlying topography and found on low plains and broad valley floors and (ii) blanket bogs which occur mainly in upland areas where conditions are suitably cool and wet. Many lowland raised bogs have been designated as sites of international and national conservation status. 98% of the peat extracted in the UK is used as growing media by amateur and professional gardeners.

In north-west Suffolk there are peat deposits similar to those in Lincolnshire and Cambridgeshire. These represent 2 main groups, the Lower Peat and the Nordelph Peat. The older Lower Peat infills erosional depressions in older superficial deposits or in the bedrock and is thus of variable thickness, from 10 cm at the Fen margin up to 1.7 m in some boreholes. This peat is thought to have been deposited from 6000 B.P. up until the Neolithic. This is overlain by the Nordelph Peat which is much more extensive and ranges in thickness from 10 cm at the Fen margin up to 5 m in some boreholes. Its formation dates from 4000 B.P. up to the early 19th century. Extensive peat shrinkage has occurred due to the network of artificial drainage systems in the Fens, reducing the original area of coverage.

7 Hydrocarbons

7.1 CONVENTIONAL OIL AND GAS

To the north of the Variscan Front in southern Britain, the county of Suffolk occupies a tract of land beneath which Palaeozoic basement, forming part of the northern margin of the ancient London-Brabant Massif, lies at relatively shallow depths. Mesozoic rocks are relatively thin, with Chalk and Tertiary rocks mostly at crop over the western and eastern halves of the county respectively.

No seismic lines have been acquired in the county and Superior Oil in 1964 drilled the only two hydrocarbon exploration wells in the county at Lakenheath and Four Ashes. The former proved thin Triassic rocks overlying Silurian rocks, the latter Gault upon Devonian rocks. The wells were plugged and abandoned as dry upon completion. By mid-2002, there was no licensed acreage in the county, which appears to have little or no hydrocarbon potential.

7.2 COALBED METHANE (CBM) POTENTIAL

Strata of Silurian age form the majority of the pre-Permian and Mesozoic basement to the county of Suffolk. A small patch of Devonian rocks has been proved in the area of the Four Ashes borehole that have been connected with similar rocks encountered in the Breckles and Rocklands boreholes to the north in Norfolk. To date, no boreholes drilled in the county have encountered Westphalian Lower to Middle Coal Measures. The nearest occurrences of these strata in the pre-Permian subcrop are found some 10 kms to the north-east around Somerton in Norfolk and just offshore to the east.

Although deposits of Tertiary age London Clay are encountered in the south-east of county, Jurassic and Cretaceous rocks crop out at surface across the rest of the county. There is therefore thought to be little or no likelihood of lignite occurrences in the county. Consequently, it is thought that the county shows little CBM development potential.

8 Aims and limitations

The purpose of the maps in this series is to show the broad distribution of those mineral resources which may be of current or potential economic interest and to relate these to selected

nationally-recognised planning designations. The maps are intended to assist in the consideration and preparation of development plan policies in respect of mineral extraction and the protection of important mineral resources against sterilisation. They bring together a wide range of information, much of which is scattered and not always available in a convenient form.

The maps have been produced by collation and interpretation of mineral resource data principally held by the British Geological Survey. Information on the extent of mineral planning permissions has been obtained from the relevant Mineral Planning Authority (MPA). Some of these permissions may have lapsed or expired. The status of individual areas can be ascertained from the appropriate MPA. Location information on national planning designations has been obtained from the appropriate statutory body (Countryside Agency, English Nature and English Heritage). For further information the relevant body should be contacted.

The mineral resource data presented are based on the best available information, but are not comprehensive and their quality is variable. The inferred boundaries shown are, therefore, approximate. Mineral resources defined on the map delineate areas within which potentially workable minerals may occur. These areas are not of uniform potential and also take no account of planning constraints that may limit their working. The economic potential of specific sites can only be proved by a detailed evaluation programme. Such an investigation is an essential precursor to submitting a planning application for mineral working. Extensive areas are shown as having no mineral resource potential, but some isolated mineral workings may occur in these areas. The presence of these operations generally reflect very local or specific situations.

The maps are intended for general consideration of mineral issues and not as a source of detailed information on specific sites. The maps should not be used to determine individual planning applications or in taking other decisions on the acquisition or use of a particular piece of land, although they may give useful background information which sets a specific proposal within context

9 Planning permissions for mineral extraction

The extent of all known extant and non-extant planning permissions for the extraction of minerals is shown on the map, irrespective of their current planning or operational status. The polygons were either supplied as digital files by Suffolk County Council or digitised by BGS from Plotting Sheets and other documents supplied by Suffolk County Council. Any queries regarding the sites shown should be directed to the authority at the address shown below. The polygons cover active, former and restored mineral workings and, occasionally, unworked deposits.

Planning Permissions represent areas where a commercial decision to work mineral has been made, a successful application has been dealt with through the provisions of the Town and Country Planning legislation and the permitted reserve will have been depleted to a greater or lesser extent. The current planning status is not qualified on the map but is available in the underlying database.

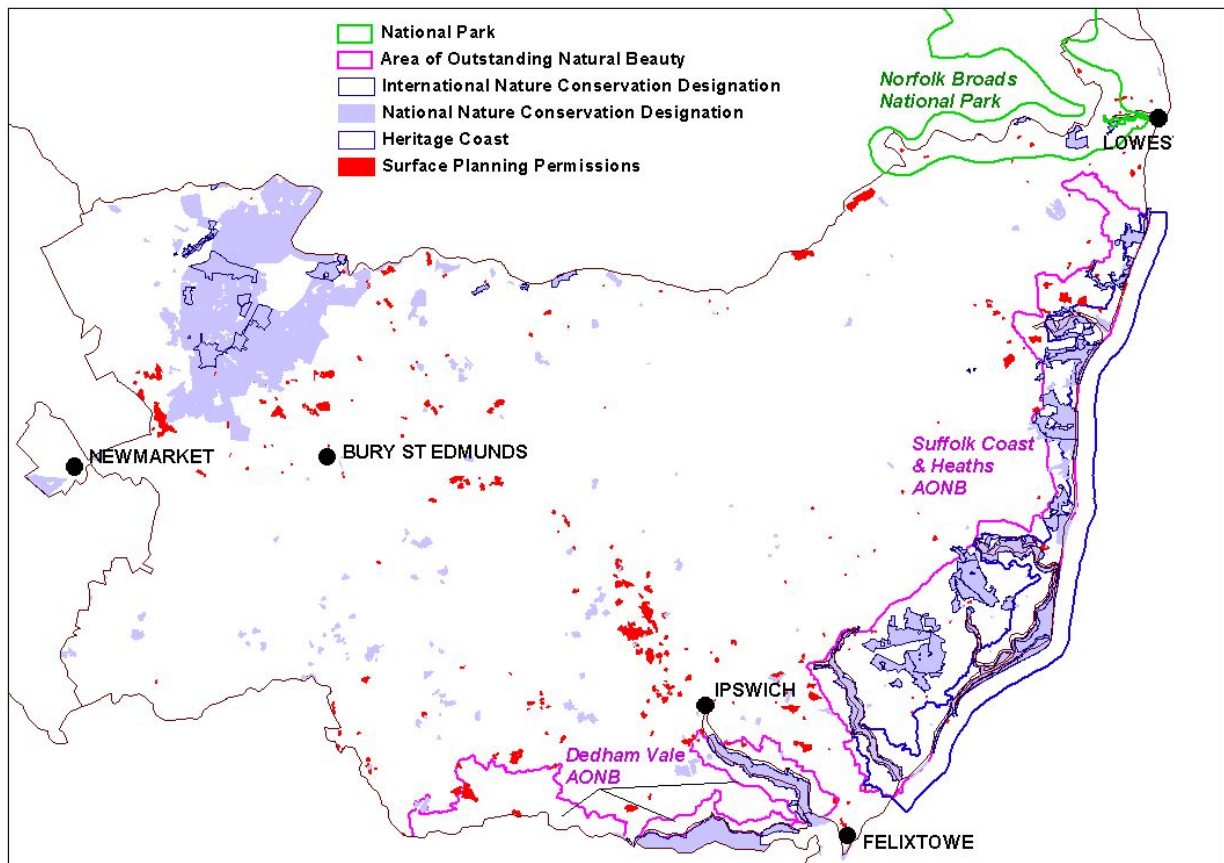


Figure 7 Surface mineral planning permissions and landscape and nature conservation designations in Suffolk

Appendix 1

CONTACT ADDRESSES:

Suffolk County Council, Environment and Transport Department, St Edmund House, County Hall, Ipswich IP4 1LZ, Tel: 01473 583000, Fax: 01473 288221, Webpage: www.suffolkcc.gov.uk

Topographic base

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English Nature - Digital SSSI, NNR, SPA, SAC and Ramsar boundaries © English Nature 2003.

Contact address: English Nature, Northminster House, Northminster, Peterborough, PE1 1UA, Tel: 01733 455000, Fax: 01733 455103, Web page: www.english-nature.org.uk.

English Heritage - Positions of Scheduled Monuments at 15 August 2001.

The majority of monuments are plotted using a centred NGR symbol. Consequently the actual area and/or length of a monument protected by the legal constraints of scheduling cannot be represented here. Monuments scheduled since that date are not accounted for. © English Heritage.

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