

British Geological Survey
NATURAL ENVIRONMENTAL RESEARCH COUNCIL

LINCOLNSHIRE
Mineral Resource Information in Support of National, Regional and Local Planning
Mineral Resources (North)
Scale 1:100 000

Compiled by D.J. Harrison, P.J. Henney, D.G. Cameron, E.J. Steadman, S.F. Hobbs, D.J. Evans, G.K. Lott, E.L. Bartlett and D.E. Highley.
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Digital cartography by N.A. Spencer, British Geological Survey, Published 2002.

This map comprises part of a summary of the Mineral Resources of the East Midlands Region.
For more information see www.mineralsUK.com

BIBLIOGRAPHIC REFERENCE
National, D.J. and others. 2002. Mineral Resource Information for National, Regional and Local Planning. Lincolnshire. British Geological Survey Commissioned Report CR02/126N.

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SAND & GRAVEL

Superficial deposits

- Sub-alluvial: Inferred resources
- Sub-alluvial: Indicated resources in areas assessed by BGS
- River Terrace deposits
- Glaciofluvial deposits
- Glaciofluvial deposits: Concealed (only in areas assessed by BGS)
- Blown sand
- Blown sand: Concealed
- Shore/Beach deposits

Boundary of area assessed for sand and gravel at the indicated resource level

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 loving peat communities of which the Sphagnum is dominant. The main types of bog are (i) raised bogs, characteristic of flat underlying topography and found on peat and broad water floors and (ii) blanket bogs which occur mainly in upland areas where conditions are suitable cool and wet. Many lowland raised bogs have been degraded as sites of mineral and national conservation status. Some 98 per cent of the peat extracted in the UK is used as growing media by amateur and professional gardeners. There is an extraction of peat in Lincolnshire but resources occur in both the north and south of the county.

COAL

A deep mine coal resource has been identified by UK Coal on the Nottinghamshire/Lincolnshire border, the so-called Whitwell Prospect Area. However, a deep mine licence has been withdrawn.

LIMESTONE

Lincolnshire Limestone

CHALK

Higher purity chalk (>97% CaCO₃)
Lower purity chalk (<93% CaCO₃)

Approximate western boundary of extensive drift cover

Concealed higher purity chalk (>97% CaCO₃)
Concealed lower purity chalk (<93% CaCO₃)

COAL LICENCE AREAS (as at 01.08.00)

Source: The Coal Authority

Deep mine (withdrawn)

MINERAL PLANNING PERMISSION (as at 01.01.02)

Source: Mineral Planning Authorities

- Surface planning permission (valid and expired)
- Underground planning permission other than coal (valid and expired)
- Planning permission for ironstone and overlying minerals

MINERAL WORKINGS

Greentwell Active site
Branston Inactive (including yet to be worked), worked-out and/or restored site

Mineral commodity

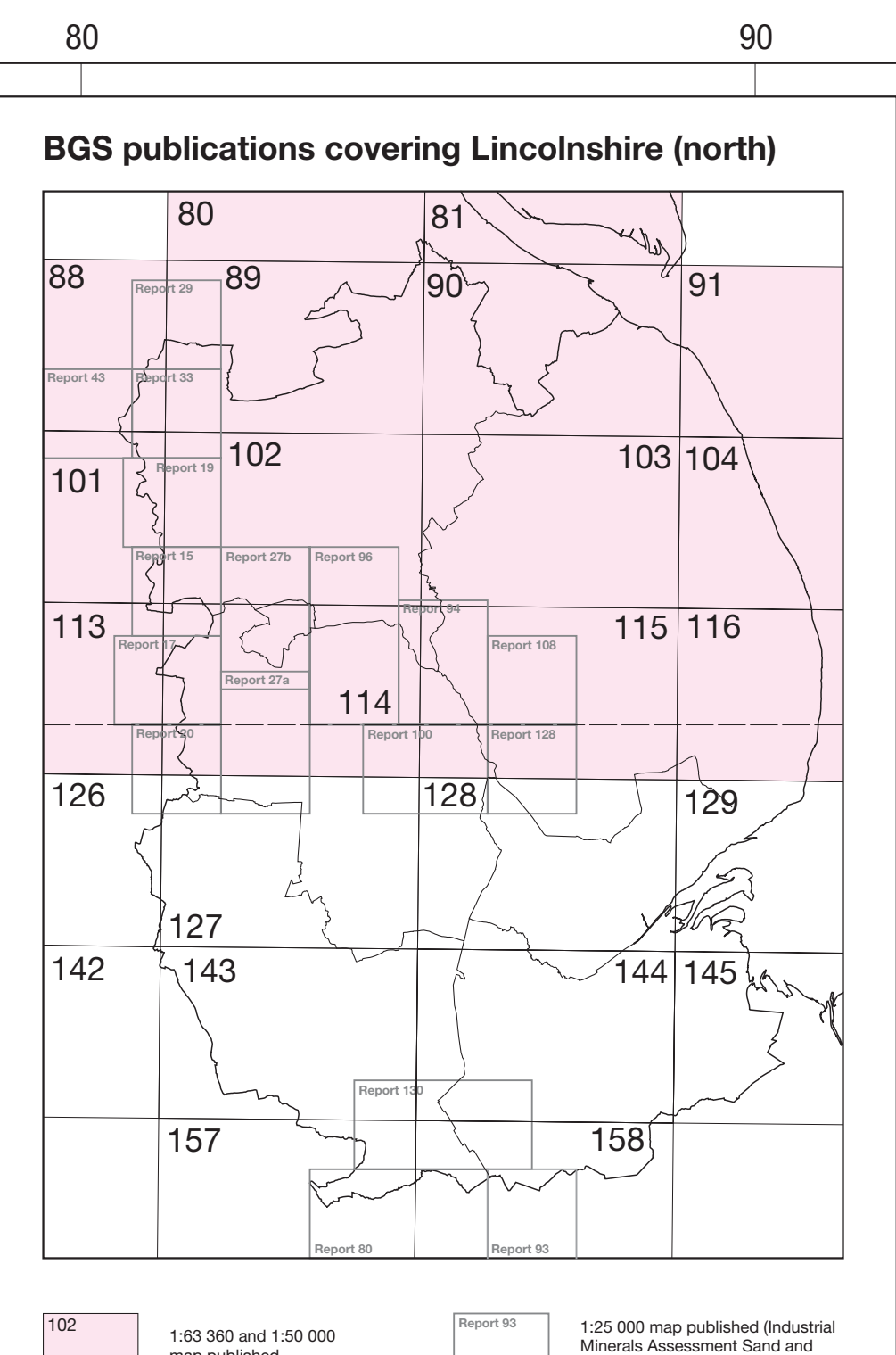
Lst	Limestone	Gas	Natural Gas	Istn	Ironstone
SIS	Silica Sand	Ch	Chalk	Sec	Secondary Aggregate
Oil	Oil	Sg	Sand and Gravel		

ENVIRONMENTAL DESIGNATIONS

- National nature conservation designations (SSSIs and NNRs)
- International nature conservation designations (SACs, SPAs and Ramsar sites)
- Area of Outstanding Natural Beauty (AONB): Lincolnshire Wolds
- Scheduled Monument

ADMINISTRATIVE AREAS

- Mineral Planning Authority
- District



1:100 000 map published under the National Assessment Sand and Gravel Resource (NAGS) scheme.

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LIMESTONE

The Lincolnshire Limestone Formation of Middle Jurassic age (inferior Oolite) is a major limestone unit in Lincolnshire. Its outcrop runs north to south through Lincoln and Grantham, forming the prominent escarpment of Lincoln Edge. It has long been a source of building stone, but is also a valuable resource of crushed rock aggregates. It is currently worked for aggregates at the small to medium-scale quarries, mostly between Blyth and Lincoln, and several also produce agricultural lime and small amounts of building stone. Crushed Lincolnshire Limestone provides aggregates which are of relatively low strength and with poor resistance to frost damage (they have moderate or high values of water absorption). They are, therefore, generally only suitable for use as a constructional fill or as a sub-base roadstone material.

The Lincolnshire Limestone Formation is about 30 m thick and is commonly divided into two parts, the Lower and Upper Lincolnshire Limestone. The formation is dominated by limestone of variable lithology, thickness and distribution, with some silty, sandy or sandy beds. The lower Lincolnshire Limestone is dominated by the grained limestone, blockish limestone and oolitic limestone and the Upper Lincolnshire Limestone by more blockish, oolitic limestone. The variable lithology results in varying chemical properties and the limestone do not form a high purity limestone resource. Even the purest limestone beds are likely to contain less than 97 per cent CaCO₃.

CHALK

Chalk is a relatively soft, fine-grained, white limestone, consisting mostly of the debris from planktonic algae. The Chalk of Upper Cretaceous age and occurs extensively in eastern and southern England where it forms an important resource of limestone sea material. In Lincolnshire, the Chalk is harder and contains less moisture than the Chalk in southern England and hence it is of value as aggregate, but only for less demanding applications, such as fill and sub-base roadstone.

Chalk is currently extracted from five quarries in the county, for industrial purposes, including making lime, production for steel manufacture and industrial fills, for constructional purposes and agricultural use. The Lincolnshire Wolds are marked by numerous small disused chalk quarries where the Chalk has been dug for local use as agricultural lime and hard core. Over much of Lincolnshire and particularly east of Louth, the Chalk is overlain by extensive drift deposits which thicken towards the east of the county.

The Chalk in Lincolnshire is divided into five distinct formations: the Fenby Chalk, with a red-coloured chalk at the base; the Hunston Formation, or Red Chalk; the Welton Chalk; the Burnham Chalk; and the Farnborough Chalk. The most obvious difference between the formations is in the occurrence of flint. The Fenby and Farnborough chalks are flint-free, while the Welton Chalk and the Burnham Chalk are characterised by flint nodules and bands. Much of the Chalk contains numerous partings and bands of calcareous mudstone marls, although there are fewer and more widespread mudstones in the Burnham and Welton chalks. Consequently, the part of the sequence is thought to be of higher purity (generally >97 per cent CaCO₃) than the overlying Farnborough Chalk and the underlying Fenby Chalk which are expected to be made of medium purity (80 per cent CaCO₃) due to the numerous mudstone bands. The also correct is, however, variable depending on the flint content. The Burnham and Farnborough chalks are concealed beneath drift which thicken towards the coast.

IRONSTONE

The Jurassic Melbourn Rock Formation consists principally of an iron-rich, fossiliferous limestone which weathers to a deep brown colour. It is relatively resistant to erosion and in areas where the formation has a high iron content it has been quarried away as a source of ironstone. It has also been worked on a small scale for building stone and lime. Relatively large scale iron extraction took place from around 1870 to about 1900. The ironstone bed is about 2-3 m thick. The ironstone quality with local variations in iron content. This was worked extensively to produce further sale in Northamptonshire. In Lincolnshire the formation is only about 2 m thick with an average grade of 30 to 35 per cent iron. This is below the 30 to 35 per cent typical of the workable ironstone in other parts of the Midlands.

Other notable ironstone outcrops in the north-west of the county. These are the Frodingham Ironstone of Lower Jurassic age and the Clayby Ironstone of Lower Cretaceous age. The former has been extensively exploited in the Southcoates area on the northern boundary of the former county, and the latter on a much smaller scale near Caistor. Both are of extremely low grade (between 20 and 30 per cent iron), but production from the Frodingham ironstone only ceased in 1988.

Technological and economic changes within the UK iron and steel industry has led to the demise of the sedimentary ironstone as a source of iron and it is unlikely that the ironstone in Lincolnshire will have any future commercial value. For this reason they are not shown as a resource on the map. However, there remain planning permissions granted for the extraction of ironstone and overlying minerals within the county. This gives an indication of the maximum extent of working.

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SAND AND GRAVEL

Sand and gravel are defined on the basis of particle size rather than composition. In current 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 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, mainly limestone, 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. Sand and gravel is the most important source of aggregate in Lincolnshire and production was some 3 million tonnes in 2000.

Areas assessed for sand and gravel by BGS are identified on the map and the resources here are taken from these maps. In these areas the possible concealed extent of sand and gravel beneath 80 (boulder clay) and alluvium is shown. Outside these areas, available data are more limited. Only exposed sand and gravel is defined. There are some differences in the classification of sand and gravel deposits between map sheets.

Sub-alluvial and River Terrace deposits

The main sources of these materials in Lincolnshire are Quaternary and Recent age deposits in the valleys of the Trent, Great Ouse and Great Ouse, where generally clean, well-sorted sands and gravels rest on weathered bedrock. Resources occur in both raised river terrace sequences flanking the modern floodplains and in flood plain terrace deposits associated with, and underlying, present day alluvium. This sequence of deposits is best developed along the River Trent with an association of terrace deposits formed at heights up to 30 m above OD, representing accumulations of sand and gravel in response to falling sea level post-glacial times. The gravel content is highly variable and medium grained sand generally forms at least 50 per cent of the deposits. Individuals mapped sites include, going from west to east, the Balderton, Fifehead, Boston and Sleaford sands and gravels. The Balderton deposits are mostly between 5 and 7 m thick and have roughly equal proportions of gravel and sand. The gravel consists mostly of quartz and pebbles with minor flint. The Fifehead and Sleaford deposits are generally much thinner (1 to 3 m), the sand to gravel ratio is more variable and the pebbles consist mostly of locally sourced limestone, sandstone and flint. The Boston deposits are generally sandy with only about 5 per cent gravel, again comprised mainly of limestone fragments. Resource assessment data suggest that the Fifehead sand and gravel has little mineral potential compared to the Sleaford and Boston deposits which are considered to be more promising. Some of the types of deposits are known as the Fen Gravels. This deposit, up to 3 m thick, consists of a thin layer of sand and gravel with flint nodules. It forms a discontinuous spread at the edge of the fen and extends up the present day valleys. The sand and gravels were deposited as coarsening fans from streams draining from the uplands to the west and are largely of late Quaternary age. The base surface dips seaward under the younger superficial deposits, and towards the North Sea, they become finer grained, containing less sand, and pass into deposits containing more silt.

Blown sand

These deposits are generally composed of fine to medium grained sand with a mean fine (<75 microns) content of around 8 per cent. The sand comprises sub-rounded to well rounded quartz grains. The deposits are believed to be largely of late Quaternary age resulting from aeolian reworking of fluvial and glacial/alluvial sands. The most favourable sites for blown sand accumulation are along the lower slopes of major west-facing escarpments. Deposits are generally no more than 2 m thick and occur as both recognizable dunes and as thin linear spreads of sand, mainly in northern and eastern Lincolnshire. These deposits are important as a source of mortar and building sands.

Beach sand and gravel

These deposits mapped as the products of deposition by glacial meltwaters and are nowadays more commonly labelled on BGS maps as glaciofluvial deposits, a more accurate description of their origin. The sequence of these deposits is complex with mappable units commonly exhibiting intricate relationships. Bodies of sand and gravel may occur as sheet- or delta-like layers above till deposits or as elongate, irregular masses within the till sequence. Areas of locally concealed, and thus unknown, bodies of sand and gravel may occur around the margins of till and other drift deposits. These deposits include the individually mapped Eagle Moor sand and gravel which occur throughout the county and which can reach thicknesses of up to 5 m. Borehole logs show that this deposit comprises about 60 per cent sand, consisting of the medium grained, sub-rounded to well rounded, quartz and quartzite, with 30 per cent sand of similar composition and 10 per cent flint. The gravel component also includes mudstone fragments, sub-angular flint and chert.

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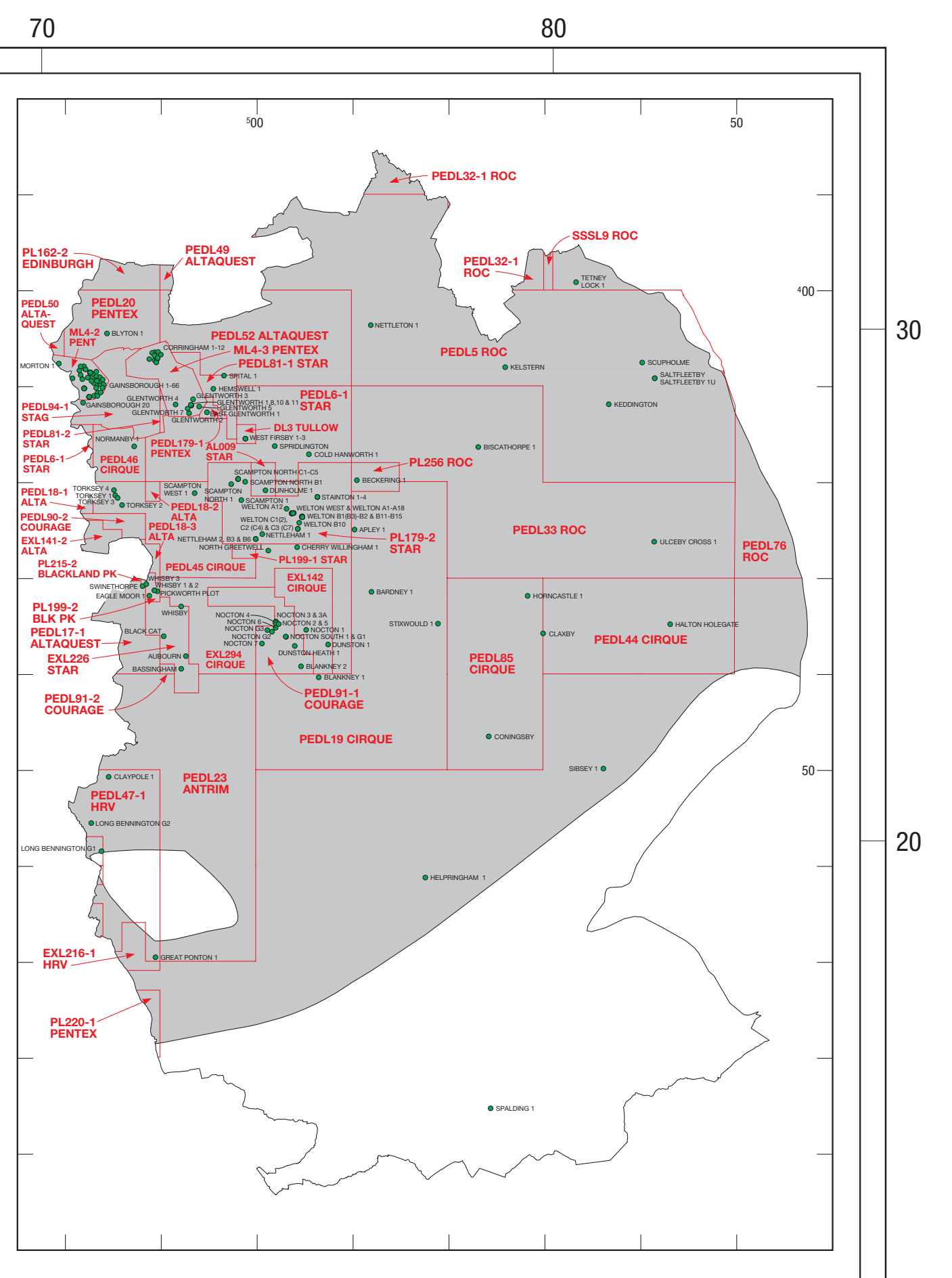
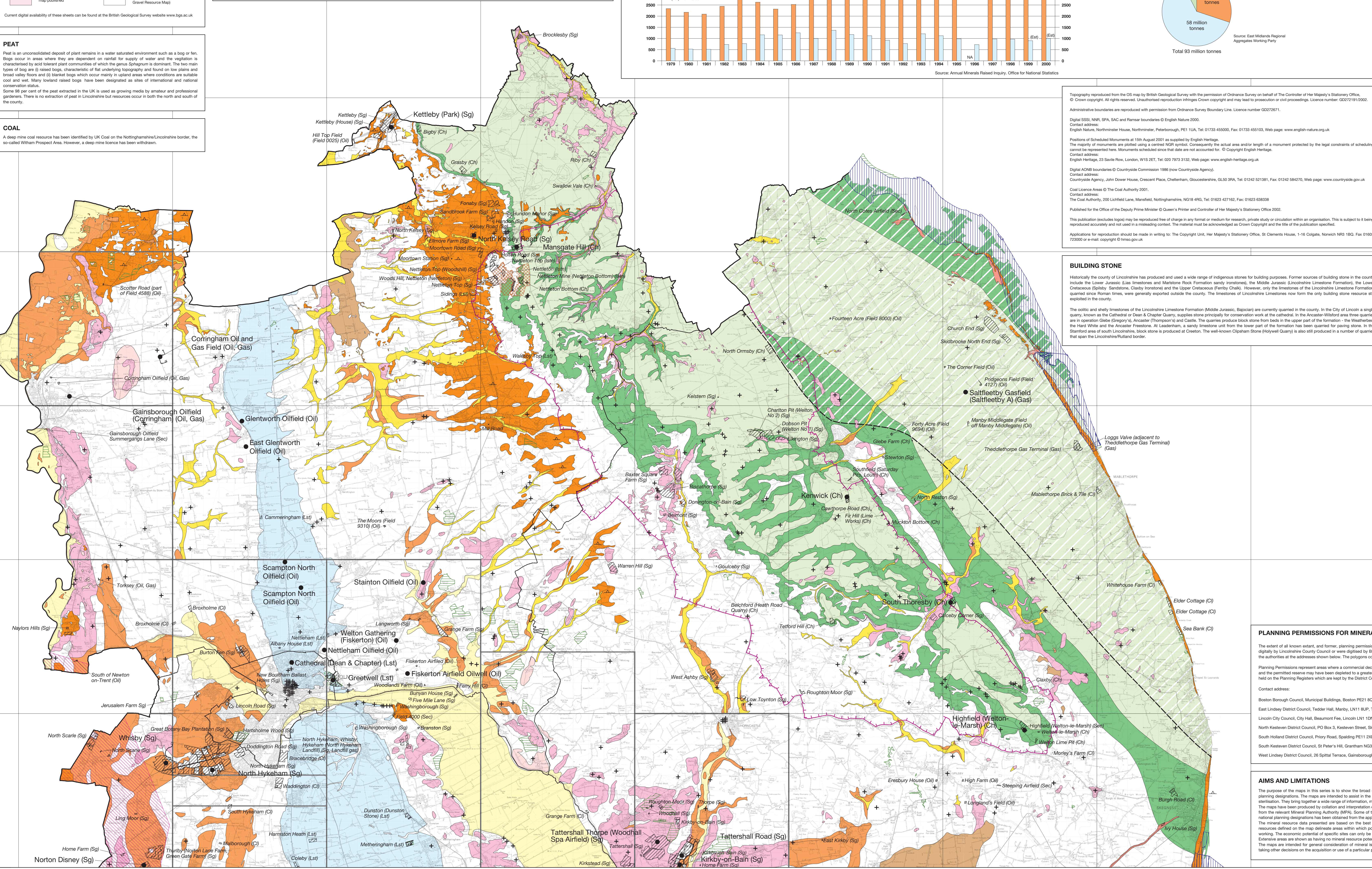
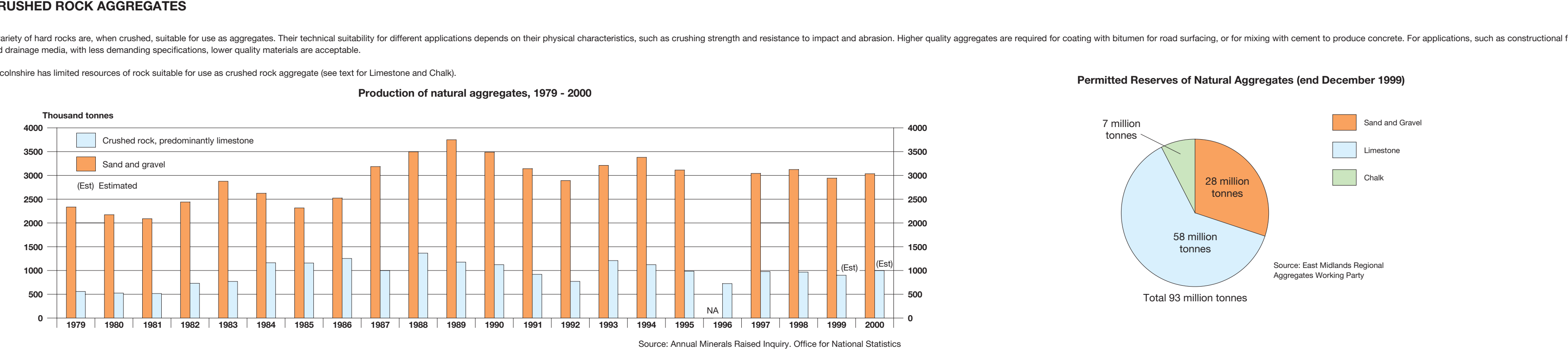
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CRUSHED ROCK AGGREGATES

A variety of hard rocks, when crushed, suitable for use as aggregates. Their technical suitability for different applications depends on their physical characteristics, such as crushing strength and resistance to impact and abrasion. Higher quality aggregates are required for coating with bitumen for road surfacing, or for mixing with cement to produce concrete. For applications, such as constructional fill and drainage works, less demanding aggregates, lower quality materials are acceptable.

Lincolnshire has limited resources of rock suitable for use as crushed rock aggregate (see also Lincolnshire and Chalk).



HYDROCARBONS

Conventional Oil and Gas

The significant number of exploration wells (see inset map) and the existence of a dense network of seismic reflection surveys, illustrates that in some areas, Lincolnshire has been intensively explored for oil and gas since before the Second World War. This has led to many discovery wells and the development of a number of producing oilfields in the county. To date, 17 oilfields and 6 major gas condensate fields have been developed, with eleven of these now in full production. Total production for each field is shown in the table below.

Name of Oilfield	Field Type (oil or gas)	Operator at time of discovery	Current operator	Discovery Date	Production started	Production ceased	Total production (barrels) - end to 2000
Ebecking	Oil	British Gas	Star Energy	1990	No details available	No details available	0
Ebecking (North)	Oil	BP	Parflex	1959	1964	1964	100,000
Coldharbour	Oil	Cardiff	Star Energy	Sept 1987	Sept 1988	Sept 1998	5,000
Conington	Oil	BP	Parflex	1958	1959	7 ceased	78,000
Graby Warren	Oil	Edin. Oil & Gas	Parflex	May 1986	Oct 1987	Feb 1993	78,000
East Gwentworth	Oil	BP	Parflex	Mar 1987	Feb 1993	Feb 1993	10,000
Fiskerton Airfield	Oil	Crucac	Crucac	Nov 1997	Aug 1998	Aug 1998	43,000
Gainsborough	Oil	BP	Parflex	1959	1959	1959	100,000
Glentworth	Oil	Cardiff	ROC Oil (UK) Ltd	Jan 1991	Sept 1998	Sept 1998	10,000
Huddington	Oil	Cardiff	ROC Oil (UK) Ltd	Mar 1993	Oct 1995	Oct 1995	191,000
Newton-on-Trent	Oil	Terraviva	AltaQuest	Apr 1998	Sept 1998	Suspended	3,000
Salfleet	Gas	ROC Oil (UK) Ltd	ROC Oil (UK) Ltd	Oct 1997	Dec 1999	Dec 1999	0.3 bbl
Scampton	Oil	BP	Star Energy	Nov 1985	Aug 1996	7 ceased	4,000
Scampton North	Oil	BP	Star Energy	Oct 1985	Feb 1989	Feb 1989	175,000
Stanton	Oil	BP	Star Energy	Jun 1987	Jan 1987	Jan 1987	23,000
Turkey	Oil	BP	Parflex	1982	1983	Closed production	1,887,000
Welton	Oil	BP	Star Energy	Feb 1981	Nov 1984	Nov 1984	1,887,000
West Finby	Oil	Tulw	Tulw	Jan 1988	Aug 1991	Aug 1991	146,000
Whisby	Oil	East Midlands Oil & Gas	Blackrock	Jan 1985	May 1990	May 1990	32,000
Total							3,427,000

Exploration to date indicates that the best potential for the discovery of oil in coal seams in the county. In recent years exploration in the East Midlands has been dominated by operators such as ROC Oil (UK) Ltd (formerly Cardifac), who developed a large acreage position in the county that has led to large tracts of the county being currently licensed for oil and gas exploration (see inset map). They have enjoyed significant success in the identification of many small scale accumulations around the major gas condensate fields in the county and the major gas condensate discovery by ROC Oil (UK) Ltd at Salfleet has drawn attention to the north and north-east of the county and it is likely that there will be further oil and gas discoveries in the future. This appears to be limited oil and gas prospectivity in the south and south-eastern parts of the county.

Coalbed Methane

The term coalbed methane is used here to refer to the extraction of methane via boreholes from coal seams rather than in abandoned or active coal mines. This is methane extracted from porous areas, or coal seams above or below abandoned or working coal seams. The best of coalbed methane in the coal seams of Lincolnshire are relatively low (1.5-3.5 m³ methane/m³ coal), with average measurements in the wells of 1.8 and 1.9 m³ of 0.1 and 1.7 m³ methane/m³ coal respectively. In the USA, coalbed methane production is from coal containing 1 or more m³ methane/m³ coal. This coalbed methane development from virgin coal seams in Lincolnshire is not economic at the moment, a point reinforced by the fact that no coalbed methane wells have been drilled in the county to date. Future coalbed methane potential will depend upon favourable changes in the economic situation. In such circumstances the Coal Measures beneath the Vale of Trent provide the best prospects. Future potential rights exist in the north of the county if the coals are present at depth. The concealed Coal Measures of the Vale of Wharfedale and those in the east of the county probably represent poorer prospects.

Licensing

The Department of Trade and Industry grants licences for exclusive rights to explore and exploit oil and gas offshore within Great Britain. The rights to explore and exploit oil and gas onshore are not included in any rights of access, and the licensees must also obtain any consent under current legislation, including planning permission.

PLANNING PERMISSIONS FOR MINERAL EXTRACTION

The extent of all known active, and former, 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 digitally by Lincolnshire County Council or were digitised by BGS from Planning Orders and other documents supplied by Lincolnshire County Council. Any queries regarding the extent of planning permissions are held on the Planning Register which are kept by the District Councils.

Contact address:
Boston Borough Council, Municipal Buildings, Boston PE21 8QR, Tel: 01205 314200, Fax: 01205 364604
East Lindsey District Council, Tudor Hall, Marley, LN11 8UP, Tel: 01507 601111, Fax: 01507 602006
Lincoln City Council, City Hall, Broadway, Lincoln LN1 1BN, Tel: 01522 641444
North East Lincolnshire Council, 80 Broad St, Immingham, Lincoln LN4 1JL, Tel: 01522 414444, Fax: 01522 419556
South Holland District Council, Priory Road, Spalding PE11 2NE, Tel: 01775 761141, Fax: 01775 711253
South Kesteven District Council, St Peter's Hill, Grantham MK21 6PZ, Tel: 01476 406880
West Lindsey District Council, 26 Station Terrace, Gainsborough, DN21 2HS, Tel: 01427 615411, Fax: 01427 610623

AIMS AND LIMITATIONS

The purpose of this map 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 map is intended to assist in the consideration and preparation of development plans and the protection of important mineral resources against identification. They bring together a wide range of information, much of which is scattered and not always available in a convenient form.

The mineral resource information presented here is based on the best available information, but is not comprehensive and there are important boundaries shown. Therefore, appropriate mineral resource details are shown in areas where the appropriate statutory bodies (County Aggregates Agency, English Nature and English Heritage). For further information the relevant body should be contacted.

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