British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

OFFICE OF THE
DEPUTY PRIME MINISTER

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

Hertfordshire and Northwest London Boroughs

British Geological Survey Commissioned Report CR/03/075/N

A J Benham, A N Morigi, A J Bloodworth, D G Cameron, N A Spencer, D J Evans, G K Lott, and D E Highley

Keyworth, Nottingham 2003

BRITISH GEOLOGICAL SURVEY
TECHNICAL REPORT CR/03/075/N
Mineral Resources Series

Mineral Resource Information for Development Plans: Hertfordshire and Northwest London Boroughs

A J Benham, A N Morigi, A J Bloodworth, D G Cameron, N A Spencer,
D J Evans, G K Lott, and D E Highley

This report accompanies the 1:100 000 scale map: Hertfordshire and Northwest London Boroughs

Bibliographical reference:
Benham, A J, Morigi, A N, Bloodworth, A J, Cameron D G, Spencer, N A, Evans, D J, Lott, G K and Highley, D E. 2003. Mineral Resource Information in Support of National, Regional and Local Planning: Hertfordshire and Northwest London Boroughs *BGS Commissioned Report CR/03/075N.*

Cover photograph:
Sarratt Church, Sarratt, Rickmansworth, Hertfordshire partly made from Puddingstone, flint and brick

BRITISH GEOLOGICAL SURVEY

The full range of Survey publications is available from the BGS Sales Desk at the Survey headquarters, Keyworth, Nottingham. The more popular maps and books may be purchased from BGS-approved stockists and agents and over the counter at the Bookshop, Gallery 37, Natural History Museum (Earth Galleries), Cromwell Road, London. Sales desks are also located at the BGS London Information Office, and at Murchison House, Edinburgh. The London Information Office maintains a reference collection of BGS publications including maps for consultation. Some BGS books and reports may also be obtained from the Stationery Office Publications Centre or from the Stationery Office bookshops and agents.

The Survey publishes an annual catalogue of maps, which lists published material and contains index maps for several of the BGS series.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as its basic research projects. It also undertakes programmes of British technical aid in geology in developing countries as arranged by the Department for International Development and other agencies.

The British Geological Survey is a component body of the Natural Environment Research Council.

British Geological Survey Offices

Keyworth, Nottingham NG12 5GG
☎ 0115–936 3100 Fax 0115–936 3200
e-mail: sales @bgs.ac.uk www.bgs.ac.uk
BGS Internet Shop:
www.british-geological-survey.co.uk

Murchison House, West Mains Road,
Edinburgh EH9 3LA
☎ 0131–667 1000 Fax 0131–668 2683

London Information Office at the Natural History Museum (Earth Galleries),
Exhibition Road, South Kensington,
London SW7 2DE
☎ 020–7589 4090 Fax 020–7584 8270
☎ 020–7942 5344/45

Forde House, Park Five Business Centre,
Harrier Way, Sowton, Exeter, Devon EX2 7HU
☎ 01392–445271 Fax 01392–445371

Geological Survey of Northern Ireland, 20 College Gardens,
Belfast BT9 6BS
☎ 028–9066 6595 Fax 028–9066 2835

Maclean Building, Crowmarsh Gifford, Wallingford,
Oxfordshire OX10 8BB
☎ 01491–838800 Fax 01491–692345

Parent Body
Natural Environment Research Council
Polaris House, North Star Avenue,
Swindon, Wiltshire SN2 1EU
☎ 01793–411500 Fax 01793–411501

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 Hertfordshire and the London Boroughs of Barnet, Enfield, Harrow and Hillingdon, 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, building stone, and chalk.

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, recover 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 mineral reserves is to be either physically worked out or to be made non-viable by changing economic circumstances.

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:

- Part of the Chilterns Area of Outstanding Natural Beauty (AONB)
- National nature conservation designations - 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

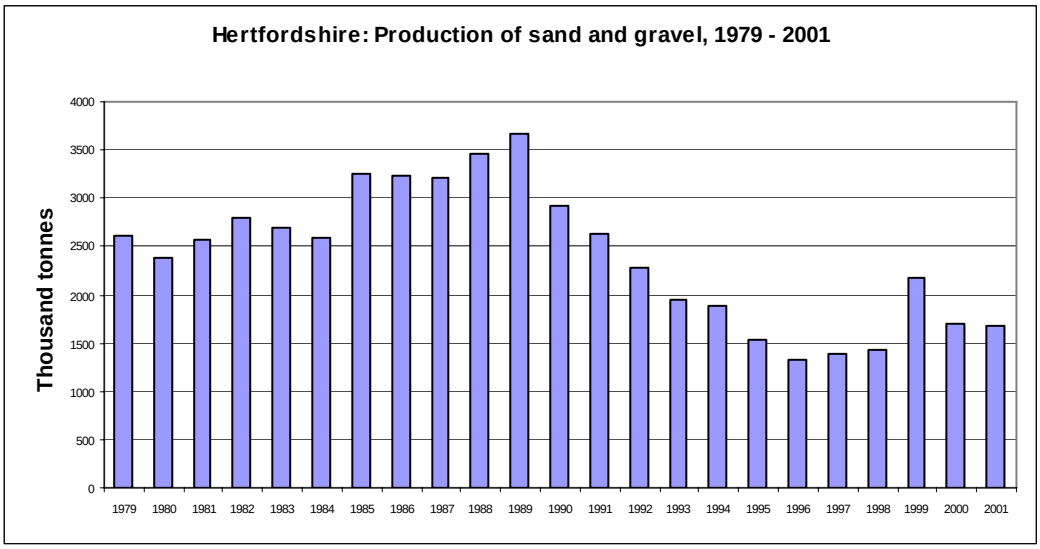
Mineral development may also be constrained by many other factors not shown on the maps, including local landscape designations, considerations relating to the protection of other resources, such as groundwater, and local amenity or environmental concerns, such as noise, traffic and visual impact. These 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.

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 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 construction fill.

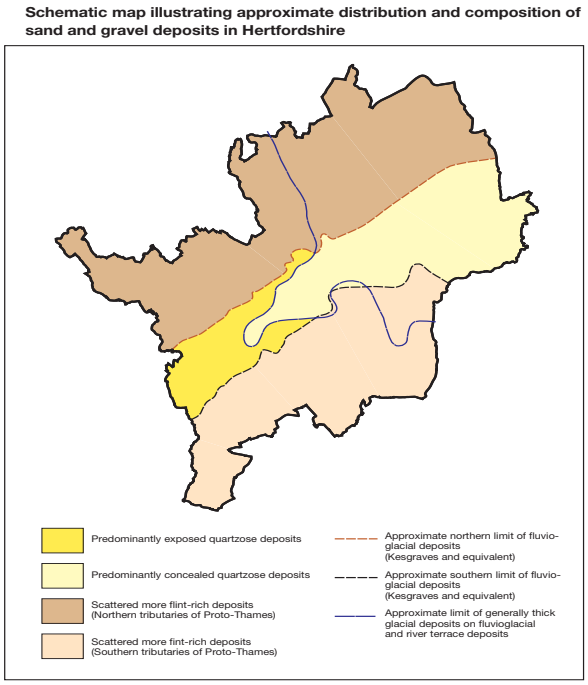
Hertfordshire produced almost 1.7 million tonnes of sand and gravel in 2001 and has estimated permitted reserves of just over 10 million tonnes. Recent production figures are shown on the graph below.



Source: Annual Minerals Raised Inquiry, Office for National Statistics

Sand and gravel resources occur in a variety of geological environments. In Hertfordshire these resources occur within the category of superficial or 'drift' deposits, subdivided into fluvioglacial sand and gravel, glacial sand and gravel, river terrace deposits, and sub-alluvial deposits.

A schematic map illustrating the distribution and composition of sand and gravel deposits in Hertfordshire and Northwest London Boroughs may be seen below.



Superficial deposits

Parts of the area 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 till and/ or 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 resources of sand and gravel occurring beneath modern river flood plains may be extensive in some places. In addition, 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.

Fluvioglacial sand and gravel

These are the most widespread sand and gravel deposits. They broadly correspond to the Westmill Gravel and Westland Green Gravel formations in Hertfordshire and their downstream equivalent in Essex and Suffolk, the Kesgrave Formation. The deposits were laid down during successive cold phases between about 1.5 and 0.5 million years BP (up to the beginning of the Anglian Glaciation) in braided rivers; the main swathe represents ancestral deposits of the River Thames which formerly flowed north east across the area. It is probable that locally 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.

The blue line shown on the map divides two distinct areas in which the unit occurs. To the north of the line the deposits are overlain by substantial thicknesses (up to 20 m, average 8 m) of Anglian glacigenic deposits (mainly till), whilst to the south they are present at, or near, surface.

Glacial sand and gravel

This category comprises water-lain sands and gravels deposited in close proximity to the Anglian ice-sheet that covered most of the northern half of Hertfordshire.

These deposits reach thicknesses of between 2–8 m when fringing the fluvioglacial Kesgrave Formation in the centre of the county, but increase in thickness further to the north and north-west where they reach on average between 20–30 m within incised river valleys. In the Hitchin and Letchworth area glacial sand and gravel deposits reach up to 80 m in thickness within the deeply incised Cam buried valley. Deposits are commonly located along the valleys of the rivers Lea and Mimram, and in patches on the high ground around Datchworth. They generally rest on bedrock, but in places are underlain by till. Extensive glacial sand and gravel deposits are present in the Stevenage area where they lie on the eroded surface of the White Chalk Subgroup. More patchily distributed deposits are located further to the east in the Standon area where the deposits thin and occur with fluvioglacial Kesgrave Formation.

Sand and gravel pit in Hertfordshire, also showing area of restored land © Hanson Aggregates, Teston Road, Offham, Kent ME19 5PF

The deposits are comprised of approximately equal quantities of sand and gravel (48 and 42 per cent respectively), with the remainder fines. Cobbles occur sporadically throughout the deposit and the gravel is composed of approximately equal proportions of fine and coarse grades. In the sand fraction, medium-sand predominates over approximately equal proportions of fine and coarse grade material. The clasts are predominantly angular and nodular flint with minor angular and rounded quartzite pebbles from the Triassic Kidderminster Formation (formerly Bunter Pebble Beds) of the Midlands and minor vein-quartz pebbles.

Left, **Solution pipes in chalk infilled with sand and gravel**

River terrace deposits

Post-Anglian river terrace deposits occur at several levels in most of the major valleys in the county flanking the present floodplain. They are generally dry in their upper parts and saturated at their bases. These deposits comprise sequences of sands and gravels typically 3-6 m in thickness with sheet-like geometry and sub-horizontal upper surfaces. Compositionally, the main component of the gravels is flint, although they may locally contain a small percentage of quartz and quartzite reworked from the fluvioglacial sand and gravel.

In south Hertfordshire, Pre-Anglian tributaries flowing northwards into the early Thames laid down spreads of fluvial deposits on higher ground. However, since these gravels contain fewer non-flint pebbles than the coeval fluvioglacial sand and gravels they have been classified as river terrace deposits with which they are compositionally similar.

Sub-alluvial gravel

Sub-alluvial gravels are encountered beneath the alluvium of the major valleys throughout the county. They were mainly laid down during periods of deep downcutting during the last major glaciation (Devensian) when sea-levels fell to at least 100 m below the present level. The subsequent rise in sea-level enabled silting up of these river channels producing the overlying alluvial deposits (silty clays, peat). The gravels 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 generally similar in composition to river terrace gravels, however they are saturated and would require wet working if they were exploited. Deposits of sub-alluvial gravels occur within the valley of the rivers Mimram, Ver and Colne, in the St Albans and Hemel Hempstead areas. Gravels have been extensively worked in the Colne and Ver valleys and resources have in many cases already been exhausted.

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 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.

The sole remaining brickworks in Hertfordshire is located at Bovingdon near Hemel Hempstead. This is a relatively small works that produces mechanically made, 'soft-mud' facing bricks, although about 20 per cent of production is in the form of hand-made stock bricks. The bricks are made from the mottled clays of the Reading Formation and Clay-with-Flints. These deposits are broadly similar, although varied, in composition because one (Clay-with-Flints) is largely derived from the other: they are therefore shown as a single resource. However, the occurrence at Bovingdon is exceptional rather than typical. For this reason, and because of their patchy occurrence and variable nature and thickness (up to 20 m), these deposits are shown as a resource in the Hemel Hempstead area only.

BUILDING STONE

The Cretaceous and Tertiary successions of Hertfordshire have yielded a limited number of stones for building purposes. Both Chalk block and flint nodules from the Upper Cretaceous have been extensively used in the past for local building purposes.

Quartz-cemented sandstones (or Sarsen stones), together with the conglomeratic beds of the Tertiary succession (Hertfordshire Puddingstone) were also once widely worked for building material and are found extensively in older buildings in the county (e.g. at Sarrat Church, left). There are no building stone quarries currently operating.

Left, **Hertfordshire Puddingstone, flint and brick construction at Sarrat Church, Sarratt, Rickmansworth**

CHALK

Chalk is a relatively soft, fine-grained, white limestone, consisting mostly of the debris of planktonic algae. It occurs as bedrock throughout most of the county and generally crops out above the 90 m contour in the north and north-west of the county, especially in the Chiltern uplands where the land rises to over 160 m. Much of this higher ground falls within the Chilterns Area of Outstanding Natural Beauty (AONB). Elsewhere in the county, younger rocks and superficial deposits conceal the chalk.

The White Chalk Subgroup (formerly Middle and Upper Chalk) varies from 60 m to about 79 m thick in central Hertfordshire and comprises higher purity material (93-98 per cent $CaCO_3$ excluding chalk with flint) than the underlying Grey Chalk. Layers of large flint nodules are common in the White Chalk Subgroup. The White Chalk Subgroup occurs as bedrock under most of the county north of a line running through Watford and Hertford, although much of it is covered by superficial deposits. South of this line, Chalk crops out only along the sides of the valleys of the rivers Lea and Ash near Hertford, and the Colne valley.

The Grey Chalk Subgroup (formerly Lower Chalk) crops out in the north and far west of the county. It generally contains more interbedded calcareous mudstone than the overlying White Chalk and is of lower purity (generally <93 per cent $CaCO_3$). It has been worked in the county in the past as a raw material for cement manufacture.

Although in the past there were many sites working chalk, essentially for local use, there are currently only three working chalk quarries in Hertfordshire, Anstey, Bedwell, and Codicote quarries produced a combined total of 31,000 tonnes of chalk in 2000.

The Chalk is a major aquifer and is the most important source of groundwater in the county.

HYDROCARBONS

Conventional oil and gas

Hertfordshire, overlying the London Brabant Massif, has shallow basement and only a relatively thin Mesozoic cover containing thin reservoir facies and source rocks, that if present, have not been buried deep enough for hydrocarbon generation. Palaeogene deposits

of the London Basin crop out along the south-eastern areas of the county. No boreholes drilled in the county and immediate surrounds have encountered Lower to Middle Coal Measures. The nearest such occurrence of these rocks is some 35 kilometres to the west. The absence of such source rocks means that Hertfordshire appears to offer little or no hydrocarbon potential.

Few seismic lines have been acquired in the county and the Tring and Ashwell hydrocarbon exploration boreholes both only just lie within the county. To early 2002 there were no licence blocks wholly located within the county, with PEDL36 (operated by CANUK) extending into the extreme N of the county from the neighbouring counties of Cambridgeshire and Essex . As of July 2002 this license appeared to have been relinquished.

Coalbed methane potential

The county shows negligible coal bed methane development potential.

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.

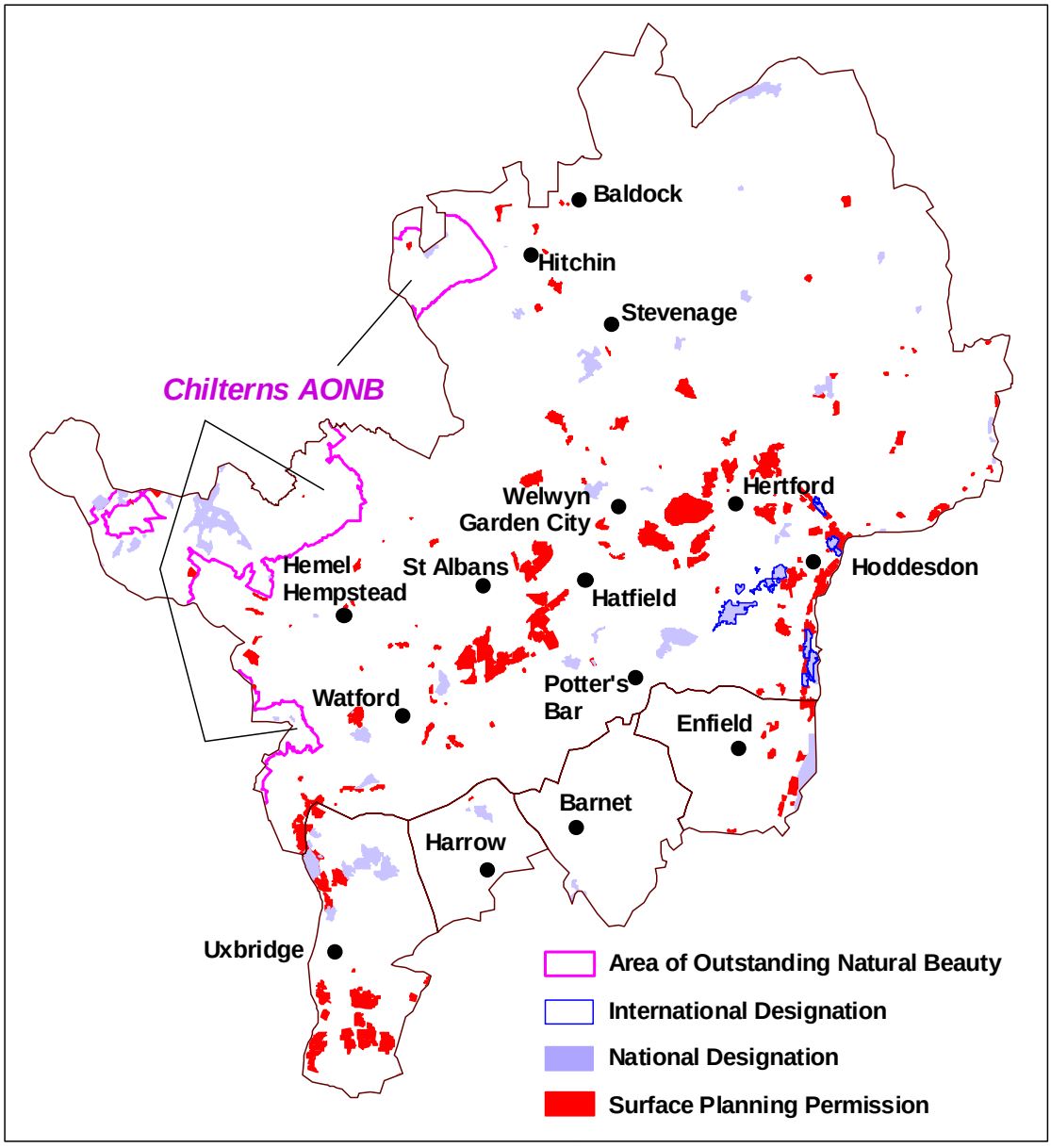
The mineral resource data presented are based on the best available information, but are not comprehensive and their quality is variable. The inferred boundaries shown are, therefore, approximate. Mineral resources defined on the map delineate areas within which potentially workable minerals may occur. 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 reflects 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.

PLANNING PERMISSION FOR THE EXTRACTION OF MINERALS

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 digitally supplied by Hertfordshire County Council and were also digitised by BGS from plotting sheets. Any queries regarding the sites shown should be directed to these authorities at the addresses 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.



Hertfordshire and the Northwest London Boroughs showing surface planning permissions, International Designations (SAC, SPA and Ramsar) and National Designations (SSSI, NNR and AONB)

Contact addresses

Hertfordshire County Council, Environment Department, County Hall, Hertford SG13 8DN, Tel: 01992 556265, Fax: 01992 556202, Web page: www.hertscc.gov.uk

London Borough of Barnet, Environmental Services Department, Barnet House, 1255 High Road, Whetstone, London N20 0EJ, Tel: 020 8359 2000, Fax: 020 8359 4616, Web page: www.barnet.gov.uk

London Borough of Enfield, Environmental Services Department, PO Box 53, Civic Centre, Silver Street, Enfield EN1 3XE, Tel: 020 8379 3811, Web page: www.enfield.gov.uk

London Borough of Harrow, Environment, Planning and Transportation Division, PO Box 37, Civic Centre, Harrow, HA1 2UY, Tel: 020 8863 5611, Fax: 020 8424 1551, Web page: www.harrow.gov.uk

London Borough of Hillingdon, Planning Services, Civic Centre, Uxbridge UB8 1UW, Tel: 01895 250111, Fax: 01895 556202, Web page: www.hillingdon.gov.uk

TOPOGRAPHIC BASE

Constraint information published on the accompanying map has been provided from the various agencies listed below, any enquires on this information should be addressed to the relevant agency:

English Nature - Digital SSSI, 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 15th August 2002.

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. © Copyright English Heritage.

Contact address: English Heritage, 23 Savile Row, London, WS1 2ET, Tel: 020 7973 3132, Web page: www.english-heritage.org.uk/.

Countryside Agency - Digital AONB boundaries © Countryside Commission 1986.

Contact address: Countryside Agency, John Dower House, Crescent Place, Cheltenham, Gloucestershire, GL50 3RA, Tel: 01242 521381, Fax: 01242 584270, Web page: www.countryside.gov.uk/.

Published for the Office of the Deputy Prime Minister.