



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



**Office of the
Deputy Prime Minister**

Creating sustainable communities

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

Somerset (comprising Somerset,
North Somerset, Bath and North
East Somerset, the City of
Bristol, and part of Exmoor
National Park).

Commissioned Report CR/04/214N



BRITISH GEOLOGICAL SURVEY

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Somerset

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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 Somerset, comprising Somerset, North Somerset, Bath and North East Somerset, and the City of Bristol, 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
- 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 South West 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 peat, sand and gravel, crushed rock aggregate, high-PSV sandstone, building stone, fuller's earth, and hydrocarbons.

1.1 RESOURCES AND RESERVES

Mineral resources are natural concentrations of minerals or bodies of rock (or fluids such as oil and gas) that are, or may become, of potential interest as a basis for the economic extraction of a mineral product. They exhibit physical and/or chemical properties that make them suitable for

specific uses and are 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 markets decline or expand, 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 mineral reserves 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 also 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:

- Part of the Exmoor National Park
- 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
- Heritage Coast
- Areas of Outstanding Natural Beauty (AONB) – Mendip Hills, Quantock Hills, and parts of Cotswolds, North Wessex Downs, Cranborne Chase and Blackdown Hills
- Scheduled Monuments

Mineral development may also be constrained by many other factors not shown on the map, 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 Peat

Peat is an unconsolidated deposit of plant remains in a water-saturated environment, such as a bog or fen, and of persistently high moisture content. There are two fundamental types of peatland in Britain; fens and bogs.

Fens occur in waterlogged locations where they receive nutrient in water from the surrounding catchment as well as rainfall.

Bogs occur in areas where they are largely dependent on rainfall for supply of water. Bog vegetation is characterised by acid tolerant plant communities in which the genus *Sphagnum* is the dominant component. There are two main types of acid bog peatlands in Britain. Raised bogs are characteristic of flat underlying topography and so are found mainly on low plains or broad valley floors. Blanket bogs occur in areas that are sufficiently cool and wet to allow the accumulation of peat on all but the steepest slopes. They occur in upland areas. A number of lowland raised bogs have been designated as sites of international and national conservation importance.

Amateur and professional gardeners use some 98 per cent of the peat extracted in Britain as a growing medium. Commercial peat extraction is based on raised bogs and there are extensive planning permissions for peat extraction in Somerset. In terms of the Somerset minerals industry, peat extraction is second only in economic importance to the quarrying in the Mendips. Like the quarrying industry it is well established, but it was in the 1960s and early 1970s that significant expansion took place in the areas being worked, and as a result, many planning permissions date from that time. Somerset has the second largest area in England with permission for peat extraction, although much of that area is no longer active. The annual UK market for peat is approximately three million m³ of which two million m³ is UK sourced. Somerset supplies 9%, or approximately 300,000 m³, of product per annum.

Peat extraction in Somerset is limited to two Peat Production Zones (PPZs) based upon Westhay Moor to the north and Walton, Meare, Shapwick and Westhay Heath to the south. In October 1999 it was estimated that the extant permissions allowed for the extraction of 2.15 million m³ of saleable peat. At current rates of extraction this would amount to 12 years production. It is considered that, given no further provision, current production levels could be maintained until 2005 when production would begin to decline slowly.

3 Sand and gravel

Sand and gravel are defined on the basis of particle size rather than composition. In current commercial practice, following the introduction of new European Standards from 1st January 2004, the term 'gravel' (or more correctly, 'coarse aggregate') is used for general and concrete applications to define particles between 4 and 80 mm, and the term 'sand' for material that is finer than 4 mm, but coarser than 0.063 mm. For use in asphalt, 2 mm is now the break point between coarse and fine aggregate. Most commercial 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.

Sand and gravel resources occur in a variety of geological environments. In Somerset these resources occur within the category of superficial or 'drift' deposits, subdivided into River Terrace deposits, Sub-alluvial gravel deposits and Blown sand deposits, and Bedrock deposits.

Resources are limited and there is virtually no land-won production of sand and gravel and no reported permitted reserves.

3.1 SUPERFICIAL DEPOSITS

In Somerset, the occurrence of superficial deposits is generally limited. Somerset obtains much of its sand and gravel from dredged material in the Bristol Channel. This material is landed at Avonmouth and Bridgwater. The central Somerset Levels contain extensive, but relatively thin deposits of sub-alluvial gravels and river terrace gravels beneath floodplain alluvium. These deposits have mostly been excluded from the map since they are below sea level and their variable thickness is likely to preclude economic working of any sand and gravel present. Generally, only exposed sand and gravel is defined, although sub-alluvial resources of sand and gravel occurring beneath modern river flood plains may occur in some places. Narrow (< 200 m) spreads of sub-alluvial deposits are mainly excluded from the map.

3.1.1 River Terrace Deposits

River terrace deposits represent the eroded remnants of formerly more extensive, relatively gravel-rich alluvial deposits laid down by rivers flowing at higher elevations than today. Individual river terraces may vary both in thickness and composition. Compositionally, the river terrace gravels contain varying quantities of Devonian sandstone, flint, chert, slate and quartz together with sand and occasional silt and clay. The exact distribution of these deposits is complicated due to their gradational transition into Head and Alluvium and therefore thickness measurements are somewhat unreliable. In the Taunton area, these deposits have been measured at between 1.5 and 2.7 m thick. There is little information concerning the thickness of river terrace deposits elsewhere. River terrace deposits are not currently worked anywhere in the area.

3.1.2 Sub-alluvial Gravel

Sub-alluvial gravels are generally similar in composition to river terrace gravels. In Somerset they are between 0.5 and 2 m thick, although occasionally greater thicknesses are known. They are not currently worked anywhere in Somerset. Thin sub-alluvial gravels occur within the floodplain of the River Parrett as well as the River Tone, through Bridgwater and Taunton respectively. Further deposits occur to the south and south-east of Langport, and in the vicinity of Glastonbury and Street where they follow the course of the River Brue. Sub-alluvial gravels in eastern parts of Somerset are generally thin (0.9 – 2 m) and composed of clayey sandy gravel with abundant limestone pebbles. They are mostly unsuitable for aggregate use. Thin sub-alluvial gravel deposits are found beneath floodplain alluvium over an extensive area of the central Somerset Levels, however, these lie below sea level and are unlikely to be worked.

3.2 BEDROCK SAND DEPOSITS

3.2.1 Budleigh Salterton Pebble Beds Formation

The Lower Triassic Budleigh Salterton Pebble Beds Formation is a reddish brown, moderately to well-cemented, poorly sorted, clast supported conglomerate. The clasts consist largely of grey and pink Carboniferous limestone, purple Devonian sandstone, and vein quartz. The formation was formerly worked at several quarries in the Minehead district, where limestone pebbles were picked out from the unit and used for lime production.

The formation is currently worked at Capton (for building stone) and at two sites at Whiteball, near Wellington on the Somerset/Devon boundary. Whiteball East, the site that is entirely in Somerset, has been dormant for some years but was temporarily reactivated and yielded

significant quantities of sand in 1996/97. Sand is also extracted from a site which straddles the Devon/Somerset border, Whiteball West, with extractive operations taking place in Devon and processing in Somerset. At depth, the formation is an important aquifer in the central and southern half of Somerset.

4 Crushed rock aggregate

A variety of hard rocks are, 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 media, with less demanding specifications, lower quality materials are acceptable.

4.1 LIMESTONE

Somerset is a nationally important source of crushed rock aggregates, predominantly from the Lower Carboniferous limestones of the Mendip Hills. About 15 million tonnes of limestone was quarried in Somerset in 2003 and this represents around 21 per cent of the total production in England. The major producing units are situated in the eastern Mendips at Torr Works and Whatley Quarry (plate 1). Both are currently producing around 5 million tonnes of limestone aggregate a year and are rail-linked. Almost 70 per cent of the output from both quarries is transported to London and southeast England by rail.



Plate 1. Whatley Quarry, Mendips.

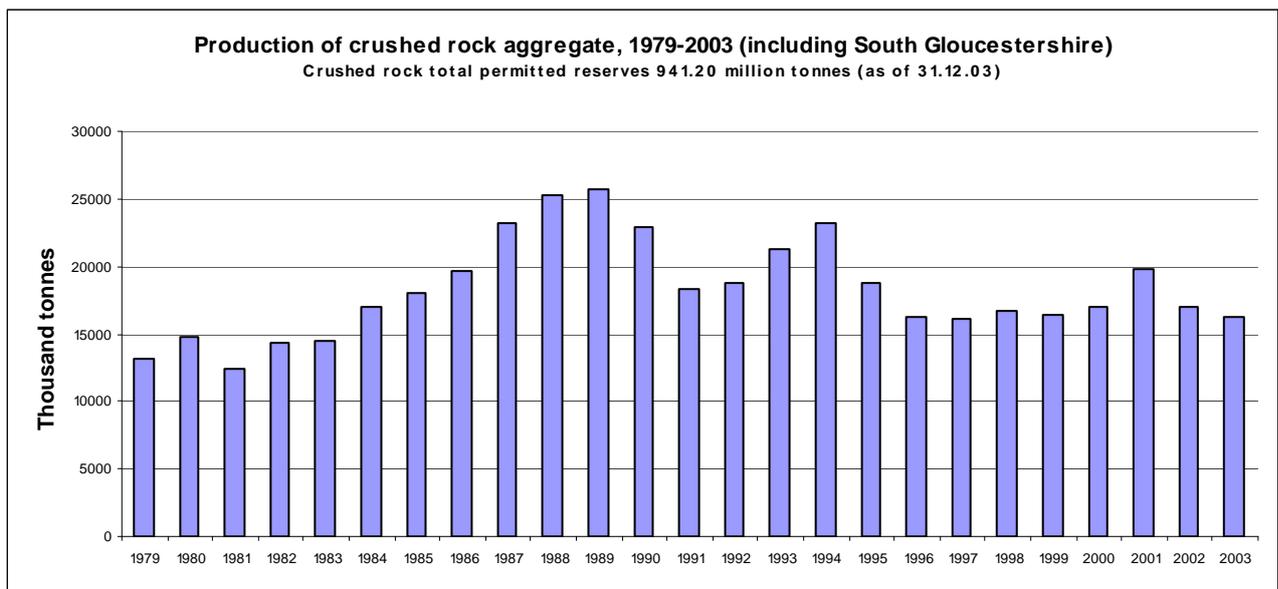
Limestones are a significant component of the geology of Somerset, with examples from Carboniferous to Jurassic age. However, large scale extraction of limestone is restricted to those of Lower Carboniferous age.

Carboniferous limestones form the broad ridge of the Mendip Hills that extends from Frome westwards to Weston-super-Mare. The Mendip sequence comprises a thick series of shelf type limestones that are divided into a number of stratigraphical divisions (formations), but there is little stratigraphical and regional variation in the aggregate properties of the limestones. All formations, with the exception of the shale-dominated Lower Limestone Shale, form resources of roadstone and concreting aggregate. In addition, the Carboniferous Limestone contains some horizons of relatively pure limestone and large areas of the Mendips are underlain by considerable thicknesses of high purity limestone resources. The most consistently pure limestones (generally averaging over 98.5 per cent CaCO_3) are to be found within the Burrington Oolite, but high purity limestones are also present within the Gully Oolite, Birnbeck Limestone, Vallis Limestone, Clifton Down Limestone and Hotwells Limestone. These deposits, however, are mostly not of the highest chemical grade and are unlikely to be as consistently pure as certain Carboniferous limestones elsewhere in the UK, such as the Peak District of Derbyshire. Industrial grade limestones for lime production are quarried from the Burrington Oolite at Battscombe Quarry, Cheddar.

The quality of the limestone resources of the Mendip Hills and their ease and economy of working may be affected by a number of geological factors, which are often of only local significance. Steeply dipping strata are common, particularly along the northern flanks of the Mendips and this feature, together with the tectonic thrusting and other faulting, often results in stability problems during quarrying. Other factors include the presence of waste deposits (clay-filled fissures, chert, overburden etc) and alteration of the rocks by dolomitisation and mineralisation. A further important consideration is the hydrogeological characteristics of the rocks.

Limestones are also developed within the Upper Inferior Oolite of Jurassic age and have been worked for centuries on a small scale for building stone (the 'Doulting Stone') or for low quality aggregate use such as constructional fill. The limestones are massive and coarse-grained and have a maximum thickness of less than 20 m. In several of the large east Mendip quarries the Inferior Oolite occurs as several metres of 'overburden' on the Carboniferous Limestone. These relatively soft, porous limestones are generally dumped as waste, although some has in the past been used in the manufacture of reconstituted stone or concrete products.

Dolomitic Conglomerate, of Triassic Age, is found adjacent to many of the high purity Carboniferous limestones in the Mendips area. The rock is composed of fragments of this limestone cemented together. The rock is often well indurated and was occasionally worked as a building stone. However, the proximity of the more suitable Carboniferous limestone means that it is unlikely to constitute a future resource.



Source: Annual Minerals Raised Inquiry, Office for National Statistics

4.2 IGNEOUS ROCK

Silurian rocks form the core of the Mendip Hills and andesite and tuff of the Coalbrookdale Formation crops out in an area near Stoke St Michael. This andesite is a good material for road surfacing since, below the zone of weathering, it is strong, durable and resistant to polishing with a high PSV value (55-60), and it is also non-porous and non-calcareous.

The quarry at Moons Hill currently produces material for road surfacing together with material for concrete block manufacture. Finer material is used as fill.

4.3 SANDSTONE

The suitability of a sandstone for aggregate use mainly depends on its strength and durability. Many sandstones are too weak and porous to be used, other than as a source of constructional fill. However, more indurated and higher strength sandstones are suitable for more demanding aggregate uses, such as concrete aggregate and roadstone.

The variations in the aggregate properties (and thus aggregate potential) of sandstones are related to differences in composition, grain size, texture, colour, burial history, tectonic setting, metamorphism and weathering. Individual sandstones also vary in thickness and lateral persistence. In general, older more indurated sandstones exhibit higher strengths, except where they are weathered. Compositional differences, both of sand grains and the matrix, give rise to a range of rock names under the general heading of sandstone. Hard sandstone containing mineral and rock fragments cemented in a clay matrix is referred to as greywacke. This rock is typically highly resistant to polishing (very high PSVs), due to the range in hardness of the constituent grains, which results in a high degree of surface roughness. In addition, where greywackes have been affected by tectonic compression their strength and abrasion resistance has often been substantially improved. They are, therefore, particularly valued as sources of high quality, skid-resistant aggregates used for road surfacing (so-called high specification aggregates), which are the premium products of the crushed rock quarrying industry.

The sandstones of Somerset vary considerably, both in grain-size and in quartz content, ranging from quartzites, with a high quartz content, to greywackes. In places, the greywackes have the geotechnical characteristics of low Aggregate Abrasion Value (AAV < 8) and high Polished Stone Value (PSV > 60), which make them suitable for use as road surfacing material. In most

cases, the individual sandstone beds occur together with beds of mudstone, slate or siltstone, and the feasibility of economic high-PSV sandstone production is dependent on the removal of the finer material and/or the selection of those more sandstone-rich parts of the succession.

The Middle Devonian Hangman Grit Formation is likely to include much high-PSV material, but this is not worked at present. High PSV material may also occur in late Devonian Pickwell Down Sandstone Formation and Baggy Sandstone Formation. The late Devonian/early Carboniferous Pilton Shale Formation contains thick developments of sandstone. These units are actively worked for road-surfacing materials in Devon but are not currently worked in Somerset.

The late Carboniferous Crackington Formation has a considerable area of outcrop in western Somerset, trending into central and north Devon. Much of the formation is dominated by mudstone, with thin interbeds of turbiditic sandstone. In places, there are substantial developments of sandstone, with individual beds exceeding one metre in thickness. These are actively worked for high-quality sandstone just over the county border in Devon where it has proved possible to screen out much of the mudstone and/or siltstone content. The formation is not currently worked in Somerset. The sandstones of the Crackington Formation show consistently high PSV figures across the whole area of outcrop. The distribution of high PSV sandstones is shown in Figure 1 below.

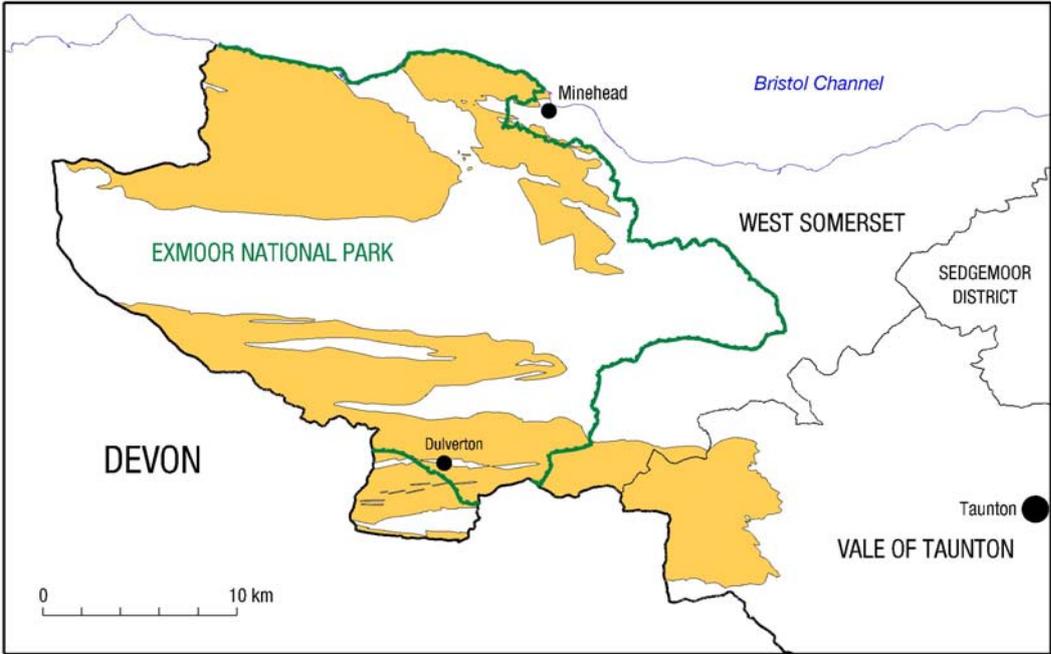


Figure 1. Distribution of high PSV sandstones in western Somerset.

Mapping of these sandstones across central, west and north Somerset is very variable in quality. On some older BGS map sheets, individual sandstone units are not distinguished. Even where the extent of sandstone bodies is recorded, further work is required to assess their aggregate quality. Because data on these resources in Somerset are so inconsistent in quality, it has been decided to show them as a small-scale inset map, rather than on the face of the main map. The Carboniferous Mangotsfield Member, part of the Pennant Sandstone Formation, crops out in a limited area near Bristol. This unit has a high PSV and would be suitable for roadstone, however, much of the resource has been sterilised by urban development. The only areas that are still accessible occur east of Clevedon and northwest of Midsomer Norton (figure 2).

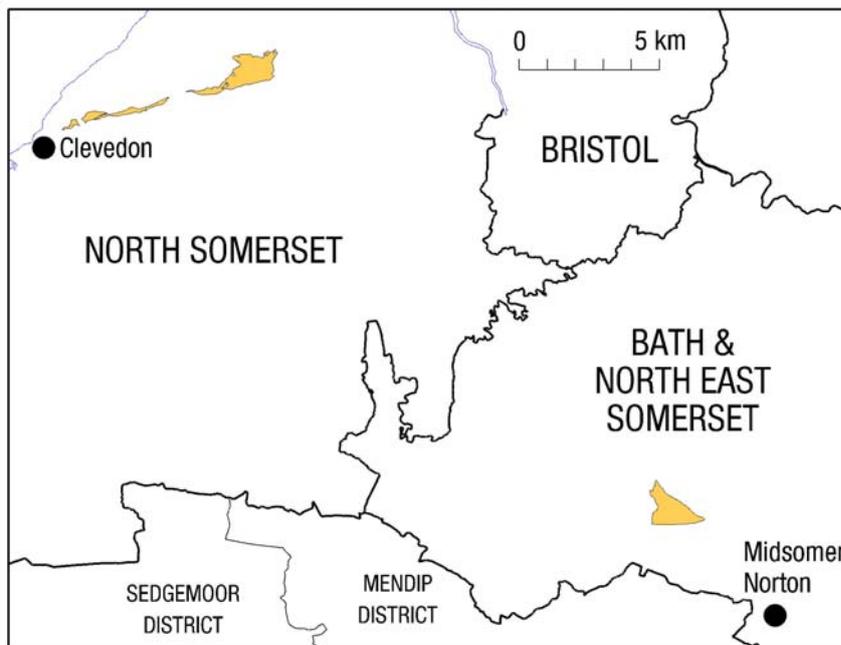


Figure 2. Distribution of high PSV sandstones in northern Somerset.

5 Building stone

A wide range of rock types is used as a source of building stone. The suitability of particular rock types depends not only on aesthetic qualities, such as colour and textural consistency but also on factors such as strength and durability, and commercial considerations such as the size of block or slab that can be extracted. A continuing supply of building stone from a variety of sources is important for new building and the repair and maintenance of historic buildings. Building stone operations range from small sites supplying local markets, to larger concerns that trade across Britain and sometimes overseas.

Historically the area has produced and used a wide range of stones for building purposes, and although there are many different rock units still of local importance for uses such as in repair work, many of the stones worked in the past are no longer considered resources due to better performance and availability of alternative materials.

The oldest rocks in the county are Devonian sandstones of the Exmoor–Minehead–Quantock areas. These were extensively quarried locally as at Conygar and Triscombe. The slaty lithologies of the Devonian (Ilfracombe and Morte slates) have been extensively worked for building and roofing material at Treborough, Milverton, Ashbrittle and Oakhampton. Some local workings of Devonian limestones are seen at Cothelstone.

In the Mendip and Bristol areas, Carboniferous limestones are worked for aggregate and lime, but in the past were also quarried for building stone at Cheddar, Battscombe and along the Avon Gorge. The limestone is also currently worked at Gurney Slade for building stone. Carboniferous Pennant Sandstone was quarried at Temple Cloud and Stanton Drew, but the most important Pennant quarries were those of the Bristol area at Brandon Hill, Hanham, Conham, Stapleton and Fishponds.

The Permo-Triassic succession has yielded several distinctive building stones, coarse-grained red, grey and yellow breccias quarried at Draycott, Easton, East Horrington, Gillhams and Holt; reddened sandstones quarried at Stowey, Moorledge, Staunton, Alcombe, Deer Park (Dunster)

and Luccombe; fine, grey sandstones of the Mercia Mudstone Group (North Curry Sandstone) were worked at Knapp and Trull. A single red sandstone quarry currently operates at Capton.

In central Somerset, the white and grey limestones of the Lower Jurassic Blue Lias Formation (Lias Group) are an important local resource and are quarried for building and paving stone over much of their outcrop area. The top of the Blue Lias Formation is marked on the map where it is known and indicated by a dashed line where its precise outcrop has not yet been confirmed by modern mapping. Several quarries were concentrated in the Street – Somerton area, and also around Keynsham and Saltford. Six quarries currently produce Lias building limestone in the area. Blue Lias limestone was also worked at Tout Quarry for the production of natural hydraulic lime. This material is slaked with water and mixed with fine aggregate to form a mortar that is able to 'breathe', thereby allowing internal moisture to quickly evaporate from the surface of walls; it can also yield to micro movements of the stonework due to daily changes in temperature and humidity. This type of mortar is used in the repair and restoration of historic buildings, as well as in some new building projects. However, production of natural hydraulic lime in Somerset ceased in 2003.

Some of the more distinctive stones in the Lias Group are the ferruginous yellow-brown limestones of the Middle Lias from quarries at Moolham and South Petherton. In the North Perrot and Ham Hill areas, a ferruginous, coarsely shelly limestone from the Upper Lias, known as the Ham Hill Stone, has been worked since 1455. It is currently worked in two quarries at Ham Hill near Montacute.

Middle Jurassic limestones have been quarried over much of their outcrop and particularly in the areas surrounding the Mendips. The limestones of the Inferior Oolite Group were worked at Bruton, Hadspen, Doulting and Dundry. The limestone was mainly used as a dimension stone, for example at Wells Cathedral. Three quarries currently produce stone from the Group, including the Doulting Quarry (Plate 2).

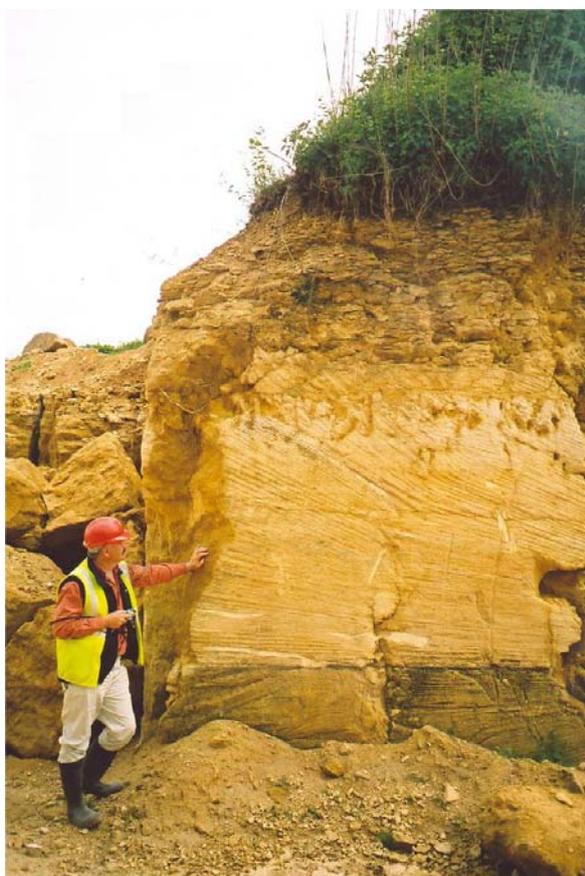


Plate 2. Limestone of the Inferior Oolite Group quarried at Doulting for building stone.

In the Bath area, Great Oolite Group limestones were formerly worked in at least forty quarries or mines, notably around Combe Down, Westwood and Monkton Farleigh. Currently only three mines are working the Great Oolite limestones in the area. The thinly bedded limestones of the Forest Marble were worked extensively for roofing stone along their outcrop, as at Henstridge, Redlynch and Upton Noble. The limestones are still worked near Henstridge where they supply building and walling needs, mostly in Dorset. At present there is interest in the stone roofing material for certain buildings for aesthetic reasons and due to its high resistance to weathering. This is likely to mean that the formation remains an important resource in future years.

The limestones of the Upper Jurassic Corallian Group were worked east of Wincanton at Cucklington.

Lower Cretaceous rocks including glauconitic sandstones, were worked for building stone around Penselwood and in the Chard area. In the Blackdown Hills nodules of chert from the succession were also commonly used as local building materials.

6 Fuller's Earth

The term 'fuller's earth' is used to describe clays composed essentially of the clay mineral Ca-smectite, which exhibits a unique combination of properties on which its many industrial applications are based. Ca-smectite can be easily converted into Na-smectite (bentonite) by a simple sodium-exchange process, which greatly expands its range of uses. Fuller's earth deposits were formed by the alteration of volcanic ash deposited in seawater. The accumulation and preservation of volcanic ash into thick beds involved a complex set of geological processes and consequently fuller's earth deposits of potential economic interest have a very restricted distribution in Britain.

Fuller's earth was worked in the Bath area as early as Roman times. More recent production was centred on the Combe Hay Mine, south of Bath, where a 2.4 m thick bed was mined. The mine closed in 1979 because of the high costs of underground extraction.

In contrast to the fuller's earth resources that occur elsewhere in Britain, which are Lower Cretaceous age, the Bath deposits occur in sediments of Middle Jurassic age. Smectitic clays have been recognised at a number of horizons in Jurassic sediments in England but true fuller's earth is confined to a single bed (the Fuller's Earth Bed) up to 3.3 m thick, which occurs between 3 m and 10 m below the top of the Fuller's Earth Formation and the base of the Great Oolite Formation. The grade of the Bath fuller's earth is relatively low compared with deposits in the Lower Cretaceous. The mean smectite content is about 60 per cent, with calcite being the main impurity. The fuller's earth would not be acceptable for many industrial applications but produced an acceptable granular absorbent.

The extent of the Fuller's Earth Bed is relatively well defined, particularly to the south of Bath, where resources in the Wellow outlier amount to several million tonnes. The eastern limit of the fuller's earth is not known, however, east of the River Avon, where it has been proved in boreholes, it is of lower quality than at Combe Hay. The northern limit is approximate. In sharp contrast to the fuller's earth resources in Lower Cretaceous sediments, those in Jurassic rocks in the Bath areas are very extensive, although they are of comparatively low grade. However, underground mining is unlikely to prove viable in the foreseeable future and surface extraction would be difficult because of the high overburden thicknesses.

7 Chalk

Chalk is a relatively soft, fine-grained, white limestone, consisting mostly of the debris of planktonic algae. In Somerset chalk crops out only in a small area in the south of the county near Chard. Although there are no quarries working chalk in Somerset, it is an important resource elsewhere in the country where it is used for agricultural lime, low grade aggregate and fill, and as a source of flints and blockstone ('clunch') for local building purposes. It is also an important groundwater aquifer.

8 Hydrocarbons

8.1 CONVENTIONAL OIL AND GAS

The county straddles the Variscan Front of southern Britain. Palaeozoic rocks subcrop beneath a variable cover of Permian and Mesozoic rocks ranging up to Lower Cretaceous in age. Palaeozoic strata include Westphalian Coal Measures and are in part strongly folded and affected by southerly dipping thrusts that complicate the geology.

The county is on the north-western margin of the Wessex-Channel Basin which persisted from Permian to early Palaeogene times. To the southeast, this basin has produced significant quantities of hydrocarbons, mainly from deeply buried Jurassic source rocks. Over most of the county, the Palaeozoic basement lies at shallow depths beneath a relatively thin Mesozoic cover. As such, Mesozoic rocks forming potential source rocks are thin and have almost certainly not been buried deep enough to generate hydrocarbons. This suggests relatively poor hydrocarbon prospectivity. Charging of any prospective structure would be reliant upon long oil migration pathways across the main basin bounding faults from the thicker and more deeply buried source rocks developed within the main Wessex Basin to the southeast.

Seismic exploration has concentrated mainly around the southern and eastern fringes of the area but to date, no hydrocarbon exploration wells have been drilled. There is one active hydrocarbon exploration licence, PEDL111 operated by Sonorex, which was awarded during the 10th Onshore Licensing Round and lies to the west of Bristol, straddling the River Severn and into South Wales.

Lower Lias shales (the Kilve Shales of the *bucklandi* zone) occurring in the central part of the county contain significant proportions of organic matter that may yield oil on treatment. A borehole sunk near Kilve Priory in 1923 showed an oil content of 40 gallons (182 litres) to the volumetric ton (1.15 cubic metres). Retorts for the distillation of oil from the shales were built at Kilve and produced oil for a short time in the early 1920s.

8.2 ABANDONED MINE METHANE (AMM), COAL MINE METHANE (CMM) AND COALBED METHANE (CBM) POTENTIAL

Coal seams in the county are numerous and thin. They have often been extensively mined. They are generally high rank, volatile bituminous coals. Many of them have strong coking properties; at one time over 40% of the output was used in the gas industry. The gas content of the seams is not known, but is believed to be low. However, with the exception of the Lower-Middle Coal Measures on the southern margin of the Somerset Coalfield, there was an almost complete absence of 'firedamp' (methane) in the majority of mines.

8.2.1 Abandoned Mine Methane (AMM)

AMM might be seen as having potential as the counties have historical mine workings. However, as the majority of mines had little or no gas and required continuous pumping to avoid flooding (which ceased in 1973), the prospects for mine gas drainage are perceived as poor. In many cases, the mineshafts were also backfilled with colliery waste.

8.2.2 Coal Mine Methane (CMM)

With no active pits in the area, there is no potential for the development of CMM production in the Somerset-Bristol Coalfield.

8.2.3 Coalbed Methane (CBM)

The term coalbed methane is used here to refer to the extraction of methane via boreholes from coal seams other than in abandoned or active coal mines. It thus includes the extraction from unmined areas, or coal seams above or below abandoned or working mines. However, the potential for coalbed methane development from virgin coal seams in Somerset is very low because of the low methane content.

9 Coal

The Bristol-Somerset Coalfield is mostly concealed beneath Permian to Mesozoic cover of variable thickness. With an area of some 836 km², the coalfield is structurally complex. It is divided by major Variscan fold and thrust structures and falls naturally into four parts: the Radstock and Pensford synclines (jointly referred to as the Somerset Coalfield), the Nailsea syncline forms a small coalfield geologically continuous with the Somerset Coalfield, and the Severn Coalfield, which is a substantial area of coal partially underlying the River Severn to the west of Bristol. Further small basins occur at Clapton-in-Gordano and Barrow Gurney. The Bristol/Somerset Coalfield has a long history of mining dating back to Roman times and reached its peak in the early 20th Century. In 1948, coal was mined at 15 National Coal Board collieries. All mining ceased in 1973.

10 Other minerals

10.1 EVAPORITE MINERALS

10.1.1 Celestite

Celestite (strontium sulphate, SrSO₄) is the main source of strontium. The only deposits that have been of commercial importance in the UK occur in the Bristol area. The most recent workings were in South Gloucestershire and production ceased at Yate in 1991 due to the exhaustion of reserves. Celestite was also produced in the area to the south of Bristol in the past from small, shallow pits. There are, however, no operational workings.

Nodular and disseminated celestite occurs as the Severnside Evaporate Bed near the top of the Mercia Mudstone Group, at the unconformity of the Mercia Mudstone with the underlying Palaeozoic rocks (mainly Coal Measures). Celestite also occurs in veins and as infillings of redistributed celestite both in the Mercia Mudstone and underlying rocks.

10.1.2 Halite

Halite, or rock salt, (NaCl) was discovered in a borehole drilled for coal near Puriton, in Somerset in 1910 at a depth of 183 m. Brine was extracted for 11 years from this area before the works finally closed in 1922. The Somerset saltfield was also explored between Puriton and Wedmore where deep boreholes have shown that salt beds occur through as much as 107 m of strata. The main salt-bearing layers are encountered between depths of 694 – 742 m. The Somerset salt is probably equivalent to the Triassic Dorset Halite Formation, which just extends into the western part of the county. It is unlikely that the salt-bearing strata in Somerset will ever be worked as a source of salt due to its more widespread occurrence elsewhere in England. However, salt beds may be used to develop cavities for the storage of natural gas, where they are of sufficient thickness (>100 m).

10.1.3 Gypsum

Gypsum, (calcium sulphate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), has been produced in the past from veins and nodules within the Triassic mudstones of the Watchet coast. No workings exist in the area today, although one site near Somerton was permitted for the extraction of alabaster, a form of massive gypsum used for carving ornaments and monuments.

10.2 IRONSTONE

Iron, present as hematite and goethite, was formerly worked at several quarries to the south of Bristol where umber, yellow ochre and ochre was extracted for use as a pigment. The deposits were formed from iron-bearing waters descending from the overlying Triassic rocks and emplaced, for example, in cavities and fissures in the Carboniferous Limestone. One of the largest deposits of hematite occurred in Pennant Sandstone in the Coalpit Heath Basin of the Bristol Coalfield. Minor quarrying of low-grade iron ore also formerly occurred at a few other places in Somerset, for example from the Permo-Triassic Luccombe Breccia Formation in the Porlock Basin, near Minehead. All forms of iron extraction have, however, long been abandoned. Ironstone is not considered a resource in Somerset and is not shown on the map face.

11 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.

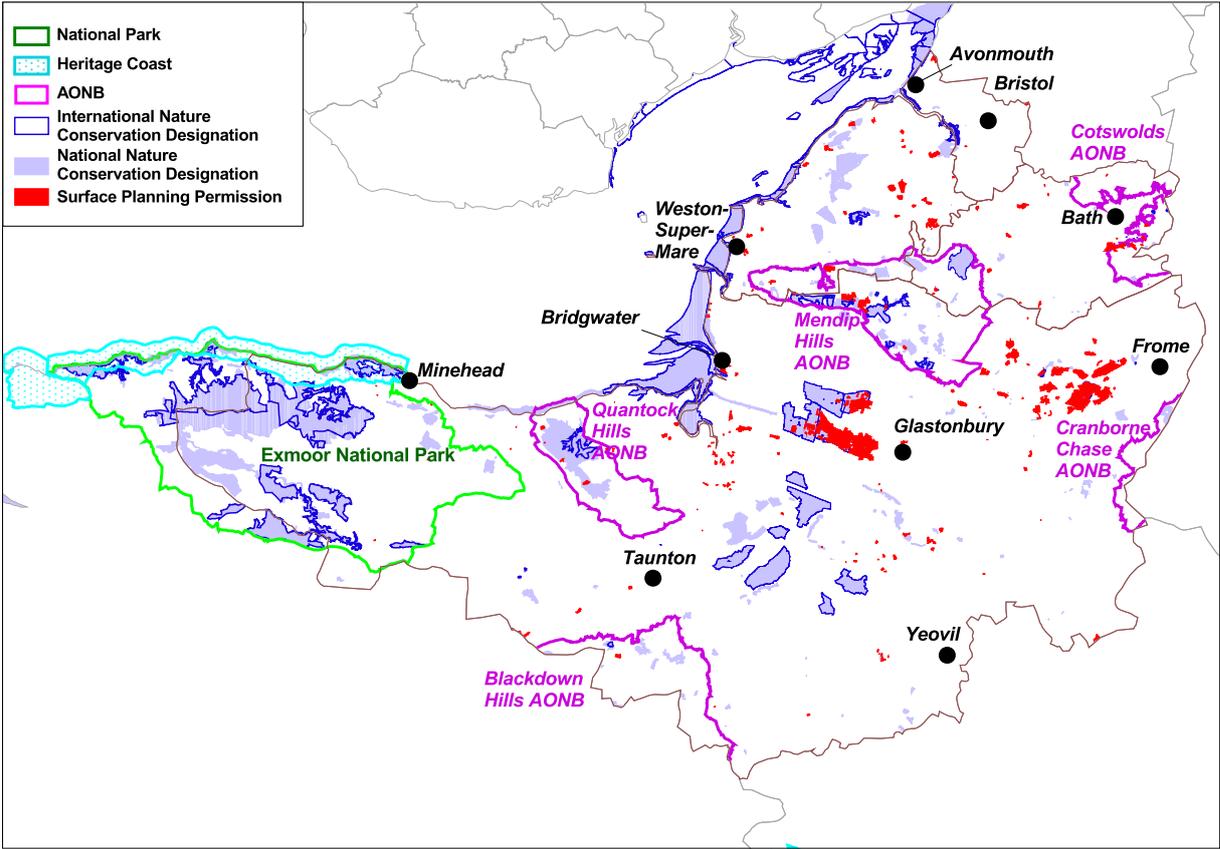


Figure 3. Surface planning permissions and landscape and nature conservation designations in Somerset.

12 Planning permissions 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 digitised by BGS from plotting sheets and other documents supplied by various authorities and in addition, digital data was supplied by Somerset County Council. In addition, planning permission information was digitally acquired from Ministry of Housing and Local Government maps for the area and incorporated in the data. This data has been checked and amended by the local authorities listed below. 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.

Contact addresses:

Somerset County Council, Environment & Property Department, County Hall, Taunton TA1 4DY, Tel: 01823 355455, Fax: 01823 355113, web address: www.somerset.gov.uk

Bath and North East Somerset County Council, Planning & Development Services Department, Riverside, Temple Street, Keynsham, Bristol BS31 1LA, Tel: 01225 394100, Fax: 01225 394199, web address: www.bathnes.gov.uk

Bristol City Council, Planning Department, Brunel House, St George's Road, Bristol BS1 5UY, Tel: 0117 922 3000, Fax: 0117 922 3886, web address: www.bristol-city.gov.uk

North Somerset Council, Directorate of Planning & Environment, PO Box 143, Somerset House, Oxford Street, Weston-Super-Mare BS23 1TG, Tel: 01934 888888, Fax: 01934 888693, web address: www.n-somerset.gov.uk

Exmoor National Park, Planning and Community Department, Exmoor House, Dulverton TA22 9HL, Tel: 01398 323665, Fax: 01398 323150, we address: www.exmoor-nationalpark.gov.uk

Appendix

TOPOGRAPHIC BASE

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CONSTRAINT INFORMATION

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 and NNR boundaries © English Nature 2004.

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 25th September 2003

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, W1S 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/

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