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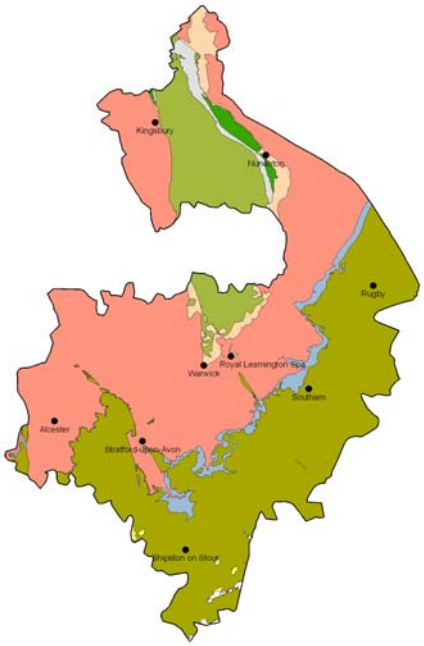
NATURAL ENVIRONMENT RESEARCH COUNCIL

Minerals Safeguarding Areas for Warwickshire

Economic Minerals Programme

Open Report OR/08/065



BRITISH GEOLOGICAL SURVEY

ECONOMIC MINERALS PROGRAMME

OPEN REPORT OR/08/065

Minerals Safeguarding Areas for Warwickshire

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List of abbreviations

BGS	British Geological Survey
BRITPITS	BGS's database of mines and quarries
CLG	Communities and Local Government
DPD	Development Plan Documents
DTLR	Department of Transport, Local Government and the Regions (predecessor of CLG and Department for Transport)
ESRI	Company which supplies the GIS software used in this project
GIS	Geographical Information System
IMAU	Industrial Minerals Assessment Unit (Mineral Assessment Reports)
LDD	Local Development Documents
LDF	Local Development Framework
MCA	Mineral Consultation Area
MPA	Mineral Planning Authority
MPG	Minerals Planning Guidance
MPS	Mineral Planning Statement (replaces some MPGs)
MSA	Mineral Safeguarding Area
MWDF	Minerals and Waste Development Framework
NERC	Natural Environmental Research Council
ODPM	Office of the Deputy Prime Minister (predecessor of CLG)
PPS	Planning Policy Statement
WCC	Warwickshire County Council

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Summary

This report describes work carried out by the British Geological Survey on behalf of Warwickshire County Council to delineate its Minerals Safeguarding Areas. This is in accordance with the methodology outlined in *"A guide to mineral safeguarding in England"* (McEvoy et al., 2007), which is in line with the Communities and Local Government document, Mineral Policy Statement 1: Planning and Minerals. This was released in November 2006 and it introduces the obligation on all Mineral Planning Authorities to define Minerals Safeguarding Areas.

The work involved the provision of maps showing the extent of individual mineral resources in Warwickshire and creating Minerals Safeguarding Areas for each mineral resource. These were provided in digital form for use within a geographical information system.

1 Introduction

Warwickshire County Council (WCC) commissioned the British Geological Survey (BGS) to delineate its Mineral Safeguarding Areas (MSAs). This will assist the review of their Minerals Local Plan documents to fit into the new Minerals and Waste Development Framework (MWDF).

1.1 PLANNING CONTEXT

WCC is in the process of producing their MWDF. This will replace their current Minerals Local Plan. This review is in accordance with reforms to the planning system under the Planning and Compulsory Purchase Act 2004 and specifically, guidance within Planning Policy Statement 12: Local Spatial Planning (CLG, 2008). Box 1 outlines the general policy, planning and guidance for the safeguarding of minerals.

Box 1 Policy and planning for safeguarding minerals

National policy

Minerals Policy Statement 1: Planning for Minerals (CLG, 2006) outlines the national policy for safeguarding minerals resources. It requires Mineral Planning Authorities in England to define **Mineral Safeguarding Areas** in their local development framework documents. In two-tier planning areas, **Mineral Consultation Areas** may also be defined and these should be based on the Mineral Safeguarding Areas. Where Mineral Consultation Areas are shown, consultation between the district and county is compulsory when a non-mineral planning application falls within those areas. Mineral Safeguarding Areas and Mineral Consultation Areas should be shown on the adopted proposal maps at the county and district level, indicating where there are significant mineral resources subject to safeguarding policies.

Key documents
Minerals Policy Statement 1: Planning for Minerals (CLG, 2006)
Minerals Policy Statement 1: Practice guide (CLG, 2006)
Minerals Planning Guidance 10: Provision of raw material for the cement industry (ODPM, 1991)

Local planning

Planning Policy Statement 12: Local Spatial Planning (CLG, 2008) outlines the policies that should be taken in to account by local planning authorities in the preparation of local development frameworks and minerals and waste development documents. The local development framework (LDF) comprises local development documents (LDDs), which include development plan documents (DPDs). These, together with the regional spatial strategy (RSS), provide the essential framework for planning in a local planning authority's area. The key development plan documents are:

- Core strategy, which may include a key diagram spatially outlining the broad strategy;
- Site specific allocations of land;
- Adopted proposals map, which illustrates the spatial extent of policies on an Ordnance Survey map or similar; and
- Area action plans (where needed);

Each Mineral Planning Authority is required to prepare minerals and waste development plan documents as part of their MWDF. It is stated in PPS12 that *'spatial planning is…critical in relation to economic growth and regeneration by…providing a robust basis for assessing the need for, and providing supporting infrastructure and natural resources for economic development'* (Para 2.5).

Reference is made in PPS12 to mineral safeguarding. In two tier authority areas, *'district planning authorities should include on their adopted proposals map, minerals and waste matters including safeguarding areas'* (Para 8.2).

Key document Planning Policy Statement 12: Local Spatial Planning (CLG, 2008) (continued)

(continued)

Guidance

Mineral Safeguarding Areas should be based upon the best available geological and minerals resource information (Minerals Policy Statement 1: Practice guide, Para 32). 'A guide to mineral safeguarding in England' has been published with the support of the Communities and Local Government. This provides guidance on how current mineral safeguarding policy can be complied with. The guide outlines a step by step methodology for defining Mineral Safeguarding Areas.

Key document

A guide to mineral safeguarding in England (McEvoy et al., 2007)

1.2 KEY DEFINITIONS

Boxes 2 and 3 provide explanations of some of the important terms used throughout the report. A list of abbreviations used commonly in this report can be found on page i.

Box 2 Mineral Safeguarding Areas (MSAs)

MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The level of information used to prove the existence of a mineral resource can vary from geological mapping to more in depth geological investigations.

Defining MSAs carries no presumption for extraction and there is no presumption that any areas within MSAs will ultimately be environmentally acceptable for mineral extraction. Areas of Search, Preferred Areas, and Specific Sites are designated for that purpose; to indicate to mineral operators and others the places where mineral extraction is most likely to take place.

The purpose of MSAs is to ensure that mineral resources are adequately and effectively considered in land-use planning decisions, so that like other finite resources, they are not needlessly sterilised, compromising the ability of future generations to meet their needs. Mineral Safeguarding Areas will make relevant parties aware of the presence of mineral resources and will make specific local planning policies applicable to those areas.

All Mineral Planning Authorities, both unitary and two-tier authorities, must include policies and proposals to safeguard mineral resources within MSAs and show them in their Development Plan Documents (DPDs), to alert prospective applicants for planning permission to the existence of valuable mineral resources and to show where specific local mineral safeguarding policies apply. In two-tier authorities, the Mineral Planning Authorities must pass information on the location of MSAs to the district councils and districts are obliged to ensure that they are shown in appropriate district Local Development Documents (LDDs).

Source: 'A guide to mineral safeguarding areas in England' (McEvoy et al., 2007)

Box 3 Mineral Consultation Areas (MCAs)

MCAs are a mechanism that aims to ensure that in two-tier authority areas consultation takes place between county and district planning authorities when mineral interests could be compromised by non-mineral development. The definition of MCAs is not obligatory, but consultation within an MCA is. They are a useful additional method of supporting mineral safeguarding by facilitating discussion between respective authorities.

MCAs also give an additional measure of safeguarding to sites relating to minerals infrastructure, such as wharves and railheads that cannot be protected by MSAs which should only be defined to protect the resource itself.

MCAs can be updated more easily than MSAs as their statutory basis is outside that of the development framework. They can therefore be responsive to the latest information on geology and mineral economics. A regularly updated and used set of MCAs can complement the protection of mineral interest facilitated by MSAs.

Source: 'A guide to mineral safeguarding areas in England' (McEvoy et al., 2007)

2 Project objectives

The objectives of the project are:

- To provide a five-year band 1 seat licence to WCC for the BGS mineral resource digital data.
- To supply paper maps and Adobe PDF documents to WCC showing the mineral resources, Mineral Safeguarding Areas within the MPA. These maps will be based on BGS geological line work, amended where appropriate based on information obtained from the regional geologist and consultation with industry and other stakeholders including WCC.
- To provide 'ESRI' shapefiles defining the Mineral Safeguarding Areas and Mineral Consultation Areas for use in a GIS to WCC.
- To produce a short report documenting methodologies used, a review of the consultation process and reasoning behind decisions to include or exclude certain resources for safeguarding.

2.1 LIMITATIONS

Box 4 Mineral resource classification and data quality

Mineral resources are natural concentrations of minerals which might now, or in the foreseeable future, be of economic value. The identification and delineation of mineral resources is imprecise as it is limited by the quantity and quality of data currently available and involves predicting what might or might not become economic to work in the future. The pattern of demand for minerals is continually evolving due to changing economic, technical and environmental factors. The economic potential of mineral resources is not static, but it changes with time.

The mineral resource maps are derived from geological linework forming part of the national 1:50 000 scale digital coverage DiGMapGB-50 from the British Geological Survey (BGS). This dataset is based on surveys carried at 6-inch or 1:10 000 scales, and acquired at different times. Whilst every effort has been made to ensure consistency of approach across the county, the level of detail reflects in part the age of the mapping, with more recent surveys placing greater emphasis on subdivision and characterisation of the deposits.

3 Method

This section provides an overview of the method used to delineate MSAs for WCC.

MSAs were defined in Warwickshire in accordance with the methodology outlined in 'A guide to mineral safeguarding in England' (McEvoy et al., 2007). Part 1 of the guide outlines a six-step approach to creating an effective system of mineral safeguarding. The scope of this project is limited to steps 1-3 and 6 (Box 5) and is related to producing the spatial maps. Creation of the associated policies (steps 4 and 5) are beyond the scope of this report. Decisions relating to the sizes and shape of MSAs have been fully justified in this report. A summary of the geological units included or excluded from the MSAs can be found in Appendix 3.

<table>
<tr><th colspan="3">Box 5 Step by step approach to creating an effective safeguarding system for minerals</th></tr>
<tr><td>Step 1</td><td>Assess what is the best geological and resource information available.</td><td rowspan="3">Use the best geological and mineral resource information.

Refine resources in discussion with industry.

Account for sterilisation by proximal development.</td></tr>
<tr><td>Step 2</td><td>Decide which minerals within the MPA may become of economic importance in the foreseeable future.</td></tr>
<tr><td>Step 3</td><td>Decide how the physical extent of the resource areas to be safeguarded should be determined.</td></tr>
<tr><td>Step 6</td><td colspan="2">Decide whether MCAs should be defined in addition to MSAs to ensure that mineral interests are taken into account when considering proposals for non-minerals development.</td></tr>
</table>

Source: A guide to mineral safeguarding in England (McEvoy et al., 2007)

The following steps were used as a basis for the project:

3.1 An assessment of the best available geological knowledge

3.2 Consultation with industry

3.3 Determination of proximal development buffers

3.4 Decide whether to define MCAs in addition to MSAs

3.5 Final decisions for defining MSAs (and MCAs if appropriate)

3.1 ASSESSMENT OF THE BEST AVAILABLE GEOLOGICAL KNOWLEDGE

This was conducted in accordance with Step 1 of 'A guide to mineral safeguarding in England' (McEvoy et al., 2007) in order to identify the current and possible future economic mineral resources within Warwickshire.

- All relevant BGS published literature relating to Warwickshire was reviewed by an economic geologist. This included the most recent geological maps, the economic geology section of the accompanying sheet memoirs or sheet descriptions and an Industrial Minerals Assessment Unit report. The published BGS 'County Mineral Resource Map' for Warwickshire (Appendix 4, Figure A1) and the relevant regional geology series were also used.

- Present economic resources and potential future resources were re-examined and discussed in detail with the regional geologist and other expert economic geologists at the BGS.
- Based on the assessment of the best available geological knowledge, six categories of mineral resources were considered of economic importance in the foreseeable future in Warwickshire, thus warranting safeguarding for future generations. Consultation maps showing proposed Mineral Safeguarding Maps were produced for each resource and these were used as the basis for consultation with industry (Appendix 4, Figures A2 to A7). Resources identified were:

  i) unconsolidated sand and gravel,

  ii) crushed rock aggregate,

  iii) coal,

  iv) brick clay,

  v) cement raw materials; and

  vi) building stone.

  MSAs were delineated for each resource category to enable separate policies to be associated with each, if necessary. This could reflect the different extraction techniques, resource importance within the county (which for example could allow prior extraction of a resource such as sand and gravel to be considered) and different exemption criteria.

  Historically ironstone, gypsum and agricultural lime were also identified as having been worked in the county. However in modern times they are considered unlikely to be used and are therefore currently unworthy of safeguarding.
- The consultation maps produced show the mineral resources extended 5 km beyond the MPA boundary. This is to ensure that resources just outside the county boundary would not be potentially sterilised by non-mineral developments close to the county border. It also enables a broader view of the size of possible adjacent deposits.

> *"Importantly, mineral resources do not stop at administrative boundaries and MPAs should attempt to consider resources which straddle other MPAs"* (Page 15).
>
> A guide to mineral safeguarding in England (McEvoy et al., 2007)

3.2 CONSULTATION WITH INDUSTRY

> *"MSAs can be defined objectively using the best available geological and minerals resource information, including that…made available by the industry…areas will generally need to be refined in discussion with the industry and other stakeholders"* (Para. 32).
>
> Minerals Policy Statement 1: Practice guide (CLG, 2006)

The identification and delineation of mineral resources changes with time and is dependant on economic influences, advances in technology and environmental factors. Consultation is important as commercial operators often have the best local knowledge about the quality and viability of currently exploited geological formations which may be considered mineral resources. An outline of the consultation process is provided below:

- A list of mineral operators and other stakeholders within the area was supplied by WCC. This was compared with BGS's 'BRITPITS' database of active and non-active quarries.
- Notification of the project was provided to these mineral operators by email or letter (Appendix 1). along with the relevant consultation maps showing proposed mineral safeguarding areas (Appendix 4, Figures A2 – A7).
- A subsequent follow up email or letter (Appendix 2) was provided inviting operators to comment and discuss criteria for the delineation of MSAs.
- Where possible, consultation appointments were arranged between BGS staff and industry in order to gain local information that may be used to refine MSAs and to provide local knowledge on which resources might become economic in the future. These appointments took the form of telephone discussions and/or on-site meetings.
- Additional information received through consultation enabled the project to supplement the best available geological knowledge. Comments received during the consultation exercise have been incorporated in the text and maps describing the individual mineral resources in the economic geology sections 5.2, 6.2, 7.2, 8.2, 9.2 and 10.2.
- In some cases discussions resulted in additional geological units to be considered which were not shown on the original consultation maps sent out. In these cases, new revised maps were put together to show the geographical extent of the resources discussed. (Appendix 4, Figures A8 and A9).

3.3 DETERMINATION OF PROXIMAL DEVELOPMENT BUFFERS

> *"…It should be kept in mind that, in addition to proposed development within a MSA, incompatible development that is allowed close to a MSA may also lead to sterilisation of part of the resource"* (Para 32).
>
> Minerals Policy Statement 1: Practice guide (CLG, 2006)

In order to safeguard a mineral resource in its entirety, and to account for the inexact nature of mapped geological boundaries, MSAs can be extended beyond the mineral resource boundary. This can be achieved by applying a buffer to the mineral resource outline. The purpose of the buffer is to safeguard the mineral resource from proximal development. The process used to determine suitable buffer sizes in Warwickshire is described as follows:

- On the basis of the examples provided in the case study section of 'A guide to mineral safeguarding in England' (McEvoy et al., 2007), a proximal development buffer size of 250 m was proposed for all mineral resources in Warwickshire which do not require blasting and those which may, a buffer of 500 m was proposed.
- The proximal development buffer size was discussed during consultation with industry for each specific resource. These were refined as shown in table 1. Justification for decisions can be found in the relevant section on each resource.
- The use of buffering in the delineation of MSAs resulted in a dataset that crossed the county boundary in some places. Therefore the resultant MSA dataset was clipped to the extent of the county.

Category	Buffer
Sand and gravel	250 m
Crushed rock	500 m
Coal: deep	400 m
shallow	250 m
Brick clay	250 m
Cement raw materials	250 m
Building stone	150 m

Table 1 MSA proximal development buffer distances

3.4 FINAL DECISIONS FOR DEFINING MINERAL SAFEGUARDING AREAS

Where appropriate the comments from industry consultation were incorporated and discussed with the BGS regional geologist and WCC. Final decisions for MSAs delineation were made by WCC in discussion with the BGS project team. It was important to ensure that the reasoning behind inclusion or exclusion of certain mineral resources could be fully justified. These decisions are specific to each mineral resource and are described more fully in sections 5.2, 6.2, 7.2, 8.2, 9.2 and 10.2. MSA maps were produced based on the outcome of these decisions as follows:

- The digital linework for the mineral resources identified and refined through this project were extracted from the existing mineral resource counties digital dataset and from DiGMapGB-50 and clipped to 5 km beyond the county boundary (described in section 3.1).
- Each mineral resource was buffered by the amount that was decided appropriate to avoid sterilisation by proximal development (described in section 3.3).
- The final dataset was clipped to the county boundary.
- Maps showing the MSA for each individual resource were produced (Figures A10 – A15). These are displayed together for the final map (Figure A16).
- Individual digital ESRI shapefiles for each MSA were provided to WCC.

3.5 MINERAL CONSULTATION AREAS

"MCAs are simply a mechanism which aims to ensure that in two-tier authority areas consultation takes place between county and district planning authorities when mineral interests could be compromised by proposed non-minerals development. The definition of MCAs is not obligatory but consultation within a defined MCA is." (Page 11).

A guide to mineral safeguarding in England (McEvoy et al., 2007)

In accordance with Step 6 of 'A guide to mineral safeguarding in England' (McEvoy et al., 2007) WCC decided that MCAs should not be defined in addition to MSAs for the following reasons:

- MCAs can give an additional measure of safeguarding to sites related to minerals infrastructure, that cannot be protected by MSAs. However, during consultation, no such sites outside the proposed MSAs were identified. Should MCAs be defined they would therefore be identical in size to MSAs.
- In accordance with published guidance, the obligatory consultation element of MCAs could be transferred to MSAs by a planning policy in a district council's DPD, worded along the following lines: *"planning permission will not be granted for any development within an MSA unless the MPA have been formally consulted on the proposal"*.
- MSAs can therefore fulfil the same role as MCAs. The districts should therefore already be familiar with the consultation process which they are obliged to follow if an application for non-mineral development is received within a MSA.
- A list of exemption criteria set out in policies to accompany the MSAs could avoid any increase in applications that require consideration on mineral safeguarding grounds. This list of exemptions would be more flexible and could be more easily updated than the proposals map (for example to reflect expanding urban boundaries or new factors affecting the economics of extraction). 'A guide to mineral safeguarding in England' (McEvoy et al., 2007) contains some suggestions for criteria for exemption which could be outlined in MWDF on Page 18, Figure 4, Note 2.

4 Overview of the economic mineral resources in Warwickshire

This section provides a brief summary of the geological mineral resources in Warwickshire from an economic perspective. It is intended to provide background to Sections 5 to 10. These sections discuss individual mineral resources in more detail including the decisions made about mineral safeguarding.

The mineral resources of Warwickshire occur in sedimentary and igneous rocks ranging from Precambrian to Quaternary in age. Historically, the majority of these units within the county have been worked for specific minerals including aggregate, coal, brick clays, cement raw materials, building stone. A geological sketch map (Figure 1) and accompanying legend (Figure 2) show the geological succession in Warwickshire and resources derived from the rocks.

The proximity of Warwickshire to the major West Midlands conurbation has historically led to a high demand for minerals from the county. That demand continues, particularly for construction raw materials. Aggregates (in the form of sand and gravel and crushed rock) now dominate minerals production in Warwickshire.

Sand and gravel extracted from the Quaternary deposits have been extensively exploited and form an important source of aggregate for asphalt and concrete. In 2007 Warwickshire produced 1.2 million tonnes of sand and gravel, which represents 12% of regional supply (ONS, 2007). The main units extracted are river terrace deposits from the valleys of the Tame and Avon along with some older (pre-glacial) deposits which occur around Warwick and Coventry. Glaciofluvial sand and gravel deposits also represent a valuable resource, particularly in the east of the county around Rugby and in the north west around Coleshill.

A regionally important resource of **hard rock** suitable for aggregate purposes is the Precambrian – Ordovician Nuneaton Inlier. The outcrop area of the inlier is small (approximately 15 km by 1.5 km), and much of the former resource is now worked-out or sterilised by urban development. The Precambrian volcanic rocks and overlying Cambrian sandstone were formerly an important source of high PSV roadstone for the Midlands and southern England. Roadstone and high specification aggregate are still produced from two quarries in Ordovician-age intrusions in the Cambrian shales which form the younger rocks of the inlier. The Jurassic Marlstone Rock Formation (formerly a source of iron ore) now constitutes a small, but locally important, source of Type 1 roadstone, fill and building stone.

Coal extraction from the narrow crop of the Warwickshire Coalfield in the northern part of the county began in Roman times. Deep mining and the exploitation of the concealed coalfield to the south and west only began in the latter part of the 19th Century, reaching its peak between the wars. Extraction has declined in recent times, with only one deep mine (Daw Mill) remaining in production. However, this mine is now the largest in the UK and produces around 3 million tonnes of coal per year. It supplies the region's power stations with high quality coal which can be blended with lower quality coal from other sources.

As elsewhere in the West Midlands region, the Carboniferous Etruria Formation (which forms part of the succession in the Warwickshire Coalfield) is an important raw material for the manufacture of **bricks**. It is currently extracted at Kingsbury and on the Warwickshire border at Wilnecote.

The Jurassic rocks in eastern Warwickshire provide **clay** resources for a large **cement** plant in Rugby (limestone in the form of chalk is imported from outside the county).

As in many other areas of England, the **building stone** industry was far more widespread in Warwickshire in the past than it is today. A wide variety of Triassic and Jurassic sandstones were formerly worked as building stones supplying fairly localised markets. The main exception to this is the Marlstone Rock Formation, also known as 'Hornton Stone'. In the past it has been exported all over the world and also favoured as a sculpting medium by several artists including Henry Moore. With changes in building methods and fashions, this building stone industry has contracted to a few small working quarries supplying a specialised market. This industry may be revived with increased necessity for matching stones for restorative works as recommended in recent guidance from English Heritage.

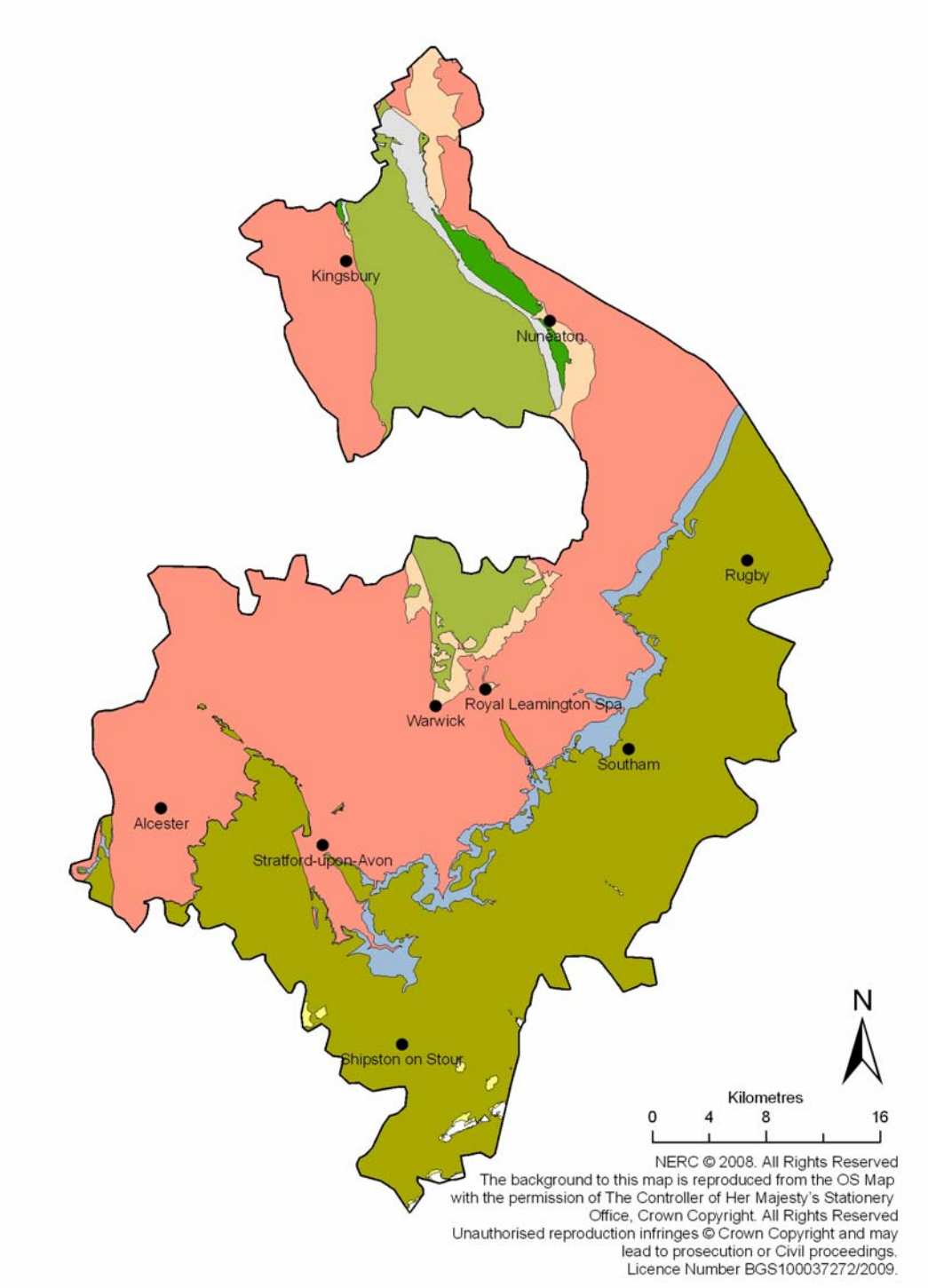

Figure 1 Sketch map showing the solid geology of Warwickshire
(For explanation of colours, see Figure 2).

Figure 2 Legend relating mineral commodities to Warwickshire geology. Materials not currently used in Warwickshire are shown in blue. Specific geological units within these groups are listed in table 2, in stratigraphic order (age, youngest first).

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Age	Thickness range (m)	Group	Geological unit name	on 1999 map	Sand & gravel	Brick clay	Cement	Crushed rock	Building stone	Coal	Alternative name
Quaternary		**Superficial (omitted from Figure 1 for clarity)**									
	0-20+		Glaciolacustrine deposits, Wolston Clay			x					
	0-10+		River terrace, sub-alluvial and glaciofluvial deposits	x	x						
Jurassic		**Great Oolite Group**									
	0-5		Sharp's Hill Formation						x		
	0-16		Chipping Norton Limestone Formation					x	x		
Jurassic		**Inferior Oolite Group**									
	0-11		Northampton Sand Formation		x				x		
	0-74		Birdlip Limestone Formation					x	x		
Jurassic		**Lias Group**									
	0-17		Bridport Sand Formation			x					Upper Lias
	25-111		Whitby Mudstone Formation			x					Upper Lias
	0-6		Marlstone Rock Formation	x				x	x		
	130-290		Charmouth Mudstone Formation			x					Lower Lias
	10-75		Blue Lias Formation (undifferentiated)	x			x		x		Lower Lias
	20-40+		Rugby Limestone Member (Blue Lias Formation)	x			x		x		Lower Lias
	20-30		Saltford Shale Member (Blue Lias Formation)	x					x		Lower Lias
	1.5-10		Wilmcote Limestone Member (Blue Lias Formation)	x			x		x		Lower Lias
Triassic		**Penarth Group**									
	0-5		Langport Member (Lilstock Formation)				x		x		White Lias
Triassic	110-600	**Mercia Mudstone Group**				x					
	0-10		Arden Sandstone Formation						x		
	20-60		Tarporley Siltstone Formation (Warwickshire equivalent)						x		
Triassic		**Sherwood Sandstone Group**									
	0-650		Bromsgrove Sandstone Formation		x	x			x		Keuper Sandstone, lower
	0-350		Wildmoor Sandstone Formation		x						Upper Mottled Sandstone
	0-375		Kidderminster Formation	x	x						Bunter Pebble Beds
	0-300		Poleworth Formation		x				x		Bunter Pebble Beds
Permian	1-10		Hopwas Breecia Formation		x						
Carboniferous		**Warwickshire Group**									Unconformity
	175		Ashow Formation			x			x		
	100		Kenilworth Sandstone Formation						x		
	90-275		Enville Member (Salop Formation)						x		Enville Formation

Age	Thickness range (m)	Group	Geological unit name	on 1999 map	Sand & gravel	Brick clay	Cement	Crushed rock	Building stone	Coal	Alternative name
Carboniferous		**Warwickshire Group (continued)**									
	110-274		Alveley Member (Salop Formation)			x			x		Keele Formation
	270-325		Whitacre Member (Salop Formation)			x			x		Coventry Sandstone, lower
	30-175		Halesowen Formation						x		Keele Formation
	0-250		Etruria Formation	x		x					Etruria Marl
Carboniferous		**Pennine Coal Meaures Group**									
	130-320		Pennine Middle Coal Measures Formation	x		x				x	
	100-150		Pennine Lower Coal Measures Formation	x		x				x	
		Unspecified group									
Devonian	152		Oldbury Farm Sandstone Formation					x			
Ordovician		**Unspecified group**									
	Jan-60		Midlands Minor Intrusive Suite	x				x	x		Diorite
Cambrian - Ordovician		**Stockingford Shale Group**						x			
	90		Merevale Shale Formation			x					
	250-300		Outwoods Shale Formation	x		x					
		Unspecified group									
	275		Hartshill Sandstone Formation	x				x	x		
Precambrian		**Charnian Supergroup**									
	130		Caldecote Volcanic Formation	x				x	x		Charnian volcanics

Table 2 Stratigraphic (age) order of all geological units referred to in the text. Crosses indicate which of the mineral category maps these units appear on.

5 Unconsolidated sand and gravel

This section describes in more detail the unconsolidated sand and gravel geological units in Warwickshire. These include those units which are currently considered to be mineral resources and those units which may be considered mineral resources in the future. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

The principal aggregate use of sand is as fine aggregate in concrete 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.

5.1 GEOLOGICAL DESCRIPTION

The unconsolidated sand and gravel resources of Warwickshire fall broadly into two categories which are very different in character, reflecting their different modes of deposition:

Superficial deposits of Quaternary age, deposited by rivers, or glaciers.

Unconsolidated bedrock sand and gravel deposits, of Triassic or Jurassic age.

This division is based on the different origin of the deposits, which influences their likely workable extent and yield, composition, particle size and need for processing, and ultimately their relative importance as an aggregate resource.

In general, these deposits are shown on the maps as their mapped surficial extent, and show no indication of thickness or quality of deposit. However, where more in-depth studies have been carried out (e.g. the BGS Industrial Mineral Assessment Unit reports from the 1970s and 1980s), resources are shown only where their thickness, quality and depth of overburden meet specific criteria. In these areas, mineral resources may therefore be shown beneath overburden.

5.1.1 Superficial deposits

River terrace deposits lie along the margins of rivers, particularly the Avon (which runs north east to south west across the county) and the Tame (northwest Warwickshire). These deposits usually consist of well sorted gravel deposits, typically 3 m thick but individual terraces may be up to 6 m thick. By inference **sub-alluvial deposits** are extensions of river terrace gravel beneath the alluvium. The material deposited in the river terraces is derived from the river catchment area, hence in Warwickshire the deposits from rivers flowing over the Triassic rocks incorporate chiefly quartz and quartzite pebbles and sand derived from the rocks of the Sherwood Sandstone Group and some Jurassic limestone clasts in the south east of the county. A small deposit of **alluvial fan gravels** near Stretton-on-Dunsmore has also been included in this category as they are likely to have similar characteristics and are derived from the same sources.

The deposits consist of a mixture of sand and gravel, in varying proportions, from which coarse and fine aggregates are produced by a process of washing and size separation. River terrace deposits represent one of the principal sand and gravel resources in the county. Extensive extraction has occurred where the terrace gravels are located close to urban areas. Most of the larger terrace deposits, however, have been worked at some time and several pits are still active in the river gravels of the Tame (east of Birmingham) and in the River Avon gravels near Bidford-on-Avon and near Stretton-on-Dunsmore.

Glaciofluvial sand and gravel deposits occur extensively in northern part of Warwickshire and extend patchily south as far as Snitterfield. The sand and gravel were deposited in contact with an ice sheet or in glacial outwash plains. They are usually associated with spreads of till (boulder clay) and may be interbedded within till, or infill hollows and channels scoured out by glacial action into the underlying rocks. The chaotic nature of their genesis results in deposits which are typically variable in extent, thickness and lithology. In Warwickshire, glacial deposits are generally sheet like, commonly 3-4 m thick, but may locally exceed 20 m thickness where they infill channels. Compositionally, they are mostly derived from erosion of local bedrock, and typically contain quartzite, Triassic and Carboniferous sandstone, Jurassic limestone and Cretaceous Chalk and flint clasts in a matrix of reddish sand with clay layers.

Locally named glaciofluvial deposits include the Wolston Sand and Gravel, Shawell Sand and Gravel, Anker Sand and Gravel and the Dunsmore Sand and Gravel in the east of the county.

The Baginton Sand and Gravel Formation is around 10 m thick and consists of predominantly well rounded pebbles of quartzite and quartz derived from local Triassic rocks. The upper part of the unit is generally sandy, consisting mostly of fine to medium-grained, clean, well-sorted quartz sand. The Hillmorton Sand and Gravel is a localised fluvial channel-fill deposit near Rugby which consists mostly of fine to medium sand with lenses of flint and quartzite gravel. These deposits outcrop around Coventry and Warwick and are mapped as glaciofluvial and are therefore included in this category, although they are now thought to represent pre-glacial river terrace deposits. They were deposited from river systems draining the pre-glacial land surface (Proto-Soar river).

5.1.2 Unconsolidated bedrock sand and gravel

Bedrock units are not currently worked for sand and gravel in Warwickshire, however the following units have been identified as having been historically worked for sand and gravel, and are a worked resource in other counties in the West Midlands.

The Jurassic **Northampton Sand Formation** (part of the Inferior Oolite Group) is a sandy, ooidal ironstone. It also contains ferruginous sandstones, limestones and mudstones. It is recorded as having been dug extensively for building sand in the past.

The **Bromsgrove Sandstone Formation** (formerly termed ‘Keuper Sandstone’) is part of the Triassic Sherwood Sandstone Group. It consists of red, brown and grey sandstones which are commonly pebbly; with interbedded red and brown siltstones and mudstones. This unit has been worked locally just west of Warwickshire near Birmingham.

The **Wilmore Sandstone Formation** (formerly termed ‘Upper Mottled Sandstone’) comprises bright orange-red to dark brick-red, fine- to medium-grained sandstones, with subordinate siltstone and mudstones. This unit has been worked near Coventry, just outside Warwickshire for fine grained foundry sand.

The **Kidderminster Formation** and the **Polesworth Formation** are part of the unit formerly termed ‘Bunter Pebble Beds. These are both pebble conglomerates and reddish brown sandstones. The Polesworth Formation is less well-cemented and also contains thin beds of red mudstones. Both units have been worked in the past where it is poorly cemented, mainly as a building sand or moulding sand. The conglomerates of the Kidderminster Formation are worked in the counties to the north east of Warwickshire.

Hopwas Breccia is a coarse breccia composed of locally derived quartzitic material and a few limestone clasts, interbedded with sandstones and subordinate mudstone beds, which has been worked very locally.

5.2 MINERAL SAFEGUARDING AREAS: DECISIONS AND JUSTIFICATIONS

For this section, please refer to:

Figure A1: 1999 published county mineral resource map for Warwickshire

Figure A2: Consultation map for unconsolidated sand and gravel in Warwickshire

Figure A10: Mineral Safeguarding Areas for unconsolidated sand and gravel in Warwickshire

Important factors in the economics of all aggregates include the amount of processing required to make a saleable product. Transport distances to the demand area and competition from alternative supplies are also important. In Warwickshire the sand and gravel currently extracted supplies the county and neighbouring market areas such as the eastern side of Birmingham, Tamworth and Coventry. Currently this low value, high bulk commodity can only economically transported 15-30 kilometres to its destination. However some aggregate is further processed in the county into higher value end products (such as rail sleepers) which may subsequently be distributed nationally.

All the superficial deposits shown on the consultation map have been included within the MSA using the linework from the newly updated sand and gravel resources digital dataset (2009). These deposits are currently considered to be mineral resources and while consultation highlighted the variable quality of particularly the glaciofluvial deposits, it is likely that these more marginal resources will become more important once higher quality resources become exhausted.

Of the unconsolidated bedrock units, only those belonging to the former 'Bunter Pebble Beds' (the **Kidderminster Formation** and the **Polesworth Formation**) **have been included in the Mineral Safeguarding Area**. Gravel derived from these units is currently worked in the neighbouring counties to the north east. In Warwickshire, some operators expressed past and potential future interest in this unit as a potential source of concrete aggregate.

The other units shown on the consultation map are not considered worth safeguarding, primarily as they are thought likely to be too consolidated, or too fine grained sand (insufficient gravel content).

5.2.1 Proximal development buffer

A **250 m** buffer around defined resources was applied to avoid future sterilisation by proximal development. It was not considered necessary to increase the buffer distance around the Kidderminster Formation and the Polesworth Formation to allow for protecting the down-dip resource beneath overburden.

Consultation responses with regards to the proximal development buffer varied from 100-250 m+. In general 250 m was suggested as a useful sized buffer to show on the proposals maps, although in practice it was recommended that they should be considered on a site by site basis. In addition, the following points were also recorded:

- In general due to the relatively small size of superficial sand and gravel deposits, extraction periods are likely to be shorter than for some other mineral resources.
- In some cases sand and gravel extraction has occurred within 50-100 m from a dwelling without the resource being sterilised by the development.
- Glaciofluvial deposits may often continue beneath overburden and so a larger buffer could include these resources.
- Glaciofluvial deposits often have fractal/feather edges. A larger buffer would 'smooth' out these edges and allow for mapping scale limitations.

6 Crushed rock

This section describes in more detail the geological units in Warwickshire which can produce rock suitable for crushing for aggregate purposes. These include those units which are currently considered to be mineral resources and those units which may be considered mineral resources in the future. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

The principle use for crushed rock is for roadstone and rail ballast. The value of crushed rock is dependent on its quality. This is defined by its hardness (aggregate abrasion and impact value, AAV, AIV), crushability (aggregate crushing value, ACV), and how skid resistant it is on road surfaces (polished stone value, PSV). The rocks near Nuneaton in the north of the county display relatively high quality in these respects. They have a PSV close to 60.

6.1 GEOLOGICAL DESCRIPTION

Rocks suitable for producing crushed rock are limited in extent in Warwickshire. They are restricted to some Jurassic limestones along the southern fringes of the county and a relatively small outcrop containing some Precambrian to Ordovician age rocks within a small area known as the Nuneaton Inlier. Within this area, the rocks have a steep south westerly regional dip of around 40° and form a narrow NW-SE elongated outcrop that extends for 18 km from Bedworth through Nuneaton to Atherstone. These include some of the few sources of high strength, hard rock for crushed-rock aggregates in central England.

The Jurassic limestones suitable for crushing in Warwickshire include the **Chipping Norton Limestone Formation,** which is an off-white to pale brown ooidal limestone. It contains shelly fragments, fine burrows, flakes of greenish grey mudstone, thin mudstone beds and trace lignite and fine-grained sand. It is thick-bedded and cross-bedded or massive. It is currently extracted at the southern tip of the county boundary at Flick Quarry. Beneath that is the **Birdlip Limestone Formation,** a pale honey coloured ooidal limestone, which varies from ferruginous, sandy or shelly to marly.

The **Marlstone Rock Formation** is a sandy, shelly and ooidal ferruginous limestone interbedded with ferruginous sandstone, and mudstones. Locally these form ironstones where the iron content is sufficiently high. Colloquially they are all termed ironstones. The Marlstone Rock Formation is worked in Warwickshire at Avon Hill quarry and there are many historic workings in that area. It is also worked just outside the county boundary.

The **Oldbury Farm Sandstone Formation** lies along the south-western edge of the Nuneaton Inlier. It consists of greyish green conglomerates, sandstones, siltstones and mudstones.

The rocks of the Nuneaton Inlier have been extensively quarried in the past. Two operational quarries remain at Griff and Mancetter, working the thin, Ordovician-age sills (igneous intrusions) of the **Midlands Minor Intrusive Suite.** These steeply dipping sills of diorite and lamprophyre are intruded into Cambrian aged **Stockingford Shales Group**. Contact metamorphism along the sill boundaries has baked the shales, so in some cases the baked shales may be hard enough to be used for crushed rock aggregate.

The **Hartshill Sandstone Formation** is exposed in a narrow belt running northwest southeast, approximately 4.5 km by 0.45 km between Nuneaton and Hartshill. The formation consists of hard, massively bedded, grey or purple-red hard sandstone with thin mudstone drapes to some of the sandstone beds. Although there no current active sites, it has been extensively quarried in the past for high quality aggregate.

The **Caldecote Volcanic Formation** forms the north-eastern limit of the Nuneaton Inlier, outcropping as a thin strip running northwest south east approximately 3.5 km by 0.35 km. It

consists of purplish grey, coarse and fine-grained, massive or stratified, volcanic ashes (tuffs) and tuffaceous siltstones.

6.2 MINERAL SAFEGUARDING AREAS: DECISIONS AND JUSTIFICATIONS

For this section, please refer to:

Figure A1: 1999 published Warwickshire county resource map.

Figure A3: Consultation map for crushed rock in Warwickshire.

Figure A11: Mineral Safeguarding Area map for crushed rock in Warwickshire.

All the units mentioned in the geological description section above (and shown on the consultation map) **have been included in the MSA**. This is due to their relative scarcity within the county and central England, which increases their regional importance. As with other low value, high bulk minerals, transport costs form a large part of their end price, so having a local supply of material is particularly important. Large areas to the east and south are largely devoid of comparable material. However, some operators consulted with did not express any interest in these resources. This was due to the limited extent of resources, constraints on the resources, or they controlled even higher quality resources elsewhere in England. Several of the units contain working quarries and associated infrastructure.

6.2.1 Proximal development buffer

All units included in the MSA were buffered using the recommended buffer of 500 m, for rock which may require blasting to extract, to avoid sterilisation of resources by proximal development.

7 Coal

This section describes in more detail the geological units which are considered to be coal resources in Warwickshire. These include those units which are currently considered to be mineral resources and those units which may be considered mineral resources in the future. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

Coal is a combustible rock made from plant remains. Depending on its quality it can be used as power station fuel to generate electricity, or if it is high enough quality, it can be used to fire blast furnaces for the metallurgical industries. Its quality is ranked by its calorific value (CV) which can vary from 15 MJ/kg for peat to 35 MJ/kg for anthracite. Impurities such as chlorine and sulphur are detrimental in coal as it causes corrosion and pollution.

Coal is extracted by surface or underground mining, depending on its proximity to the surface. However, where conditions and quality allow it may also be suitable for coal bed methane (CBM) extraction (exploiting the gas which is adsorbed onto the coal surface during coal formation usually via boreholes) or underground coal gasification (UCG) (initiating partial combustion of the coal seams *in situ* in order to drive off gases and produce heat).

Fireclays are often worked as a by-product of surface coal mining. They are beds of non-marine sedimentary clays called seatearths (fossil soils) that usually underlie a coal seam. Beds are typically thin (less than 1.5 m) and form a high quality resource suitable for making refractory products and buff-coloured facing bricks and pavers.

7.1 GEOLOGICAL DESCRIPTION AND COAL RESOURCE AREAS

In Warwickshire, coal is present as beds within the Pennine Lower and Middle Coal Measures formations in the north of the county. These formations lie in a north-south trending syncline, which deepens (plunges) to the south, resulting in the coal seams lying at increasing depth in that direction.

The outcrop of the exposed coalfield follows the northern and north-eastern perimeter of the syncline forming a narrow belt, typically no more than a kilometre wide. Within this belt, the coal-bearing strata are steeply inclined (8 to 50°) but dips moderate rapidly downdip. The succession is up to 190 m thick.

The Coal Measures Group comprises cyclical sequences of marine and non-marine mudstones and fluvial sandstones, with subordinate beds of coal, ironstone and fireclay. The **Pennine Lower and Middle Coal Measures formations** contain zones of relatively closely spaced, thick coals. The succession is up to 190 m thick, and includes seven named coal seams in the Lower Coal Measures Formation, and the important Thick Coal group of seams in the Middle Coal Measures Formation. Over the central and south-western part of the coalfield, the constituent leaves of the Thick Coal are either in contact or are separated by only thin 'dirt' (mud-rich coal) partings, giving a total seam thickness of up to 8.5 m. However, in the area of outcrop these seams split and are spread out over a vertical interval of between 25 and 35 m.

The coals are generally high-volatile, low-rank bituminous coals (British Coal Rank, 902), with a moisture content that is generally quite high (over 10 per cent). *In situ* average sulphur values range from less than 4 per cent by weight to less than 1.5 per cent. Average ash contents are less than 9 per cent by weight (air dried basis). Coal quality deteriorates slowly towards the south-east, with ash and chlorine increasing and calorific value and rank decreasing from north-west to south-east (Fulton, 1987; National Coal Board, 1957; 1985).

For the purpose of this study the spatial geological information for the coal measures formations is shown as coal resource areas in order to give a more relevant indication of their suitability as a coal resource. These resource areas were delineated in the 2006 study carried out by BGS for the Coal Authority (CR/06/159N). They are based on detailed examination of the stratigraphy to determine the vertical spacing, lateral continuity and thickness of coals:

- **Primary opencast coal resource area** comprises a relatively closely spaced succession of variable but generally thick coals. These coals typically occur within a certain discrete stratigraphic interval, which comprises the succession from the middle to upper part of the Pennine Lower Coal Measures to the Pennine Middle Coal Measures Formation.
- **Secondary opencast coal resource area** represents the area in which the coals are generally thinner and less concentrated in vertical and aerial distribution. The zone spans the lower part of the Pennine Lower Coal Measures Formation and parts of the Pennine Middle Coal Measures Formation.
- **Buried coals resource overlain by up to 50 m overburden:** In some areas, particularly downdip of the main area of mapped resources, coals are present in the subsurface covered by younger strata. This zone represents the area where these coals are overlain by less than 50 m of overburden. In this case the overburden is defined as bedrock and the thickness of superficial deposits is not considered here.
- **Underground coal resource area (greater than 50 m overburden):** These represent coals in the subsurface, buried by greater than 50 m of overburden. Again, the thickness of superficial deposits is not considered here.
- **Underground coal resource area (seams at least 2 m thick between 600 m and 1200 m depth):** These represent areas (within the 'Underground coal resource area,

greater than 50 m overburden') where boreholes indicate that coals of 2 m or greater thickness are present between the depths of 600-1200 m below surface.

7.2 MINERAL SAFEGUARDING AREAS: DECISIONS AND JUSTIFICATIONS

For this section, please refer to:

Figure A1: 1999 published Warwickshire county resource map.

Figure A4: Consultation map for coal in Warwickshire.

Figure A12: Mineral Safeguarding Area map for coal in Warwickshire

In Warwickshire there is currently one operational deep mine at Daw Mill. No surface mining has taken place since 1989. However historical small scale surface mining was undertaken along much of the length of the outcrop, up to the late 1980s.

Following consultation it was found necessary to treat shallow and deep coal as separate commodities because of the differences associated with their extraction techniques. These differences means different types of developments might sterilise the resources and the exemption criteria associated with an MSA for deep coal could be quite different from that for shallow coal. At this time, there is insufficient information to comment on the relative importance of Warwickshire coal as a possible resource of coal bed methane or underground coal gasification, although it is likely to only apply to the deep coal resource areas.

7.2.1 Shallow coal resources

Although the Warwickshire coalfield has not been exploited by surface mining since the late 1980s, these areas are still considered to be a mineral resource. Consultation showed there is current interest in the area. The calorific value of the coal in these areas makes it suitable for power station fuel or for blending with higher quality coal.

Primary and secondary opencast coal resource areas and buried coal resource overlain by up to 50 m overburden are included in the MSA for shallow coal as they were considered worthy of safeguarding. In other parts of the country, shallow coal over 100 m in depth has been extracted by surface mining methods, so therefore coal resources in Warwickshire defined as 'overlain by up to 50 m of overburden' should also be safeguarded in this category.

7.2.2 Deep coal resources

Deep coal operation at Daw Mill is the largest in England with a current annual output around three million tonnes. The majority of coal produced supplies the closest power stations in the Trent Valley and Oxfordshire and also as far north as Yorkshire. The high quality of the coal means that it is suitable for blending with lower quality sources from elsewhere. It is sold as lump coal for the domestic market. This coal resource is currently economic and of regional importance.

"Underground coal resource area (greater than 50 m overburden)" which includes the area identified as **"Underground coal resource area (seams at least 2 m thick between 600 m and 1200 m depth)" are included in the Deep coal MSA.** This is because of the regional importance of deep coal and its otherwise possible sterilisation by specific forms of development.

7.2.3 Proximal development buffer for shallow and deep coal resources

The **proposed 250 m buffer for surface coal** was not revised during consultation although smaller buffer distances of 100 to 200 metres were discussed with industry. Extraction methods would be likely to require blasting sufficiently rarely to not require the whole resource to be buffered by 500 m. However, it is recommended that individual applications be considered on a site by site basis. The overburden ratio increases rapidly downdip and is likely to preclude

significant workings beneath younger cover rocks. It is therefore not necessary to increase the buffer distance to allow for down dip extensions.

The **suggested buffer for deep coal resources is 500 m** to avoid sterilisation by very specific forms of proximal development. Currently under the Coal Act (1980) subsidence which occurs in coal mining areas and causes damage must be repaired by the operator. Important structures where absolutely no subsidence or tilting is allowed to occur therefore sterilises the coal beneath it, as a pillar of coal must be left to prevent subsidence. This is generally only true of either important historic buildings (which have already sterilised resource) or developments such as those involving high precision factories, gas pipelines or major railway lines. Exemption criteria in an associated policy could preclude this type of development on underground coal resources on mineral safeguarding grounds.

The proximal development buffer distance of 500 m was selected based on the industry practice known as the 'half depth rule'. Subsidence is negligible (using current extraction techniques) at a horizontal distance of 0.5 multiplied by the depth the coal is worked at. In Warwickshire the coal is currently worked at around 1000 m, so negligible subsidence occurs 500 m from the edge of underground mining. For this reason, the distance of 500 m over the whole resource area acts as an average distance, reflecting that some parts of the resource are shallower or deeper than 1000 m.

8 Brick clay

This section describes in more detail the brick clay geological units in Warwickshire. These include those units which are currently considered to be mineral resources and those units which may be considered mineral resources in the future. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

Brick clay is the term used to describe common clay used in the manufacture of structural clay products, such as bricks, pavers, clay tiles, and clay pipes. The suitability of a clay for the manufacture of structural clay products depends principally on its behaviour during shaping, drying and, most importantly, firing. This behaviour will dictate the final physical properties of the fired brick, as well as its aesthetic qualities. Modern brick manufacturing processes require raw materials with predictable and consistent firing properties, which can be achieved if needed by blending different clays. Generally clays with a high lime content are reduced in quality as a brick making material. The presence of lime (e.g. as limestone clasts) necessitates additional processing (fine grinding) in order to prevent 'blowing' when the brick is fired (where the lime clasts expand on heating and cause the brick to explode. Presence of such impurities can also cause weakening and discolouration of the bricks through weathering.

8.1 GEOLOGICAL DESCRIPTION

The geological units which have been used for brick in Warwickshire fall broadly into two categories which are very different in character, reflecting their different modes of deposition:

8.1.1 Superficial deposits

Glacial clays in Warwickshire have been used historically for brick making. The **glaciolacustrine deposits** occur patchily over parts of north-west Warwickshire. These types of deposits are laminated clays, deposited in a glacial lake environment. The **Wolston Clay** is a till (boulder clay) deposited by a glacier, which, due to the nature of its deposition, may have a highly variable grain size distribution and thickness.

8.1.2 Bedrock deposits

The clays of the Lias Group include the **Bridport Sand Formation**. Only the mudstone and siltstone parts of the formation have been shown on the consultation map (the rest of which is predominantly sandstone). As such, it has an extremely limited outcrop in the south west of Warwickshire. The **Whitby Mudstone Formation** lies beneath it along the southern Warwickshire county boundary. It consists of fossiliferous mudstones and siltstones. Some beds contain limestone or phosphatic nodules

The **Charmouth Mudstone Formation** forms a 5-10 km band across the south eastern edge of Warwickshire. It is predominantly dark grey and pale blueish grey laminated mudstones. The limestone parts of the formation have been excluded from the map. Locally it contains some limestone beds and also phosphatic or ironstone nodules. This unit is worked just south of Warwickshire at Wellacre Quarry.

The **Mercia Mudstone Group** is an extensive deposit covering much of Warwickshire. It consists mainly of red calcareous mudstones, with widespread thin beds of gypsum, and subordinate beds of sandstone and dolomitic siltstone. The parts mapped as sandstone or dolomitic siltstone are not shown on the consultation map. The Arden Brickworks just outside Warwickshire is now closed.

The **Bromsgrove Sandstone Formation** (formerly termed 'Keuper Sandstone') is dominantly red and cream-coloured sandstone, but also contains red and brown mudstones and is found in the north of Warwickshire. Only the parts of the formation which are mudstone have been shown on the map. The formation is worked just north of Warwickshire at Measham Quarry.

The **Ashow Formation** consists of red-brown mudstones with subordinate beds of sandstone. It outcrops around Kenilworth in the middle of Warwickshire, where it was worked until the late 1970s.

Two members from the Salop Formation have also been used for brick clay. These are the **Alveley Member** (formerly known as part of the 'Keele Formation') and the **Whitacre Member** (formerly termed the 'Coventry Sandstone') and both comprise red calcareous mudstones and sandstones. The Alveley Member has a very limited geographical extent in the north west of the county. The Whitacre Member is more extensive and outcrops in the central part of the Warwickshire coalfield basin. The sandstone part of this member is not shown on the map.

The **Etruria Formation** forms part of the Carboniferous sequence that crops out in the north west portion of the Warwickshire Coalfield and, as in neighbouring counties, has been worked extensively in the past. It consists of a sequence of predominantly red mottled mudstones with a few thin sandstones and conglomerates (known locally as 'espleys'). Brick clay working in Warwickshire is confined to a single site at Kingsbury in the north of the county. This site works Etruria Formation for the manufacture of facing bricks. It is also worked at Wilnecote just outside the county to the north of Kingsbury.

The **Pennine Lower and Middle Coal Measures** formations contain grey mudstones and siltstones which have in the past been used for brick making. Thin (usually less than 1.5 m thick) beds of fireclays suitable for making high quality refractory bricks often underlie the coal seams found within these formations. The sandstone parts of the formation are not shown on the map.

The **Outwoods Shale Formation** and the **Merevale Shale Formation** are both part of the Stockingford Shale Group. They outcrop around the edge of the Warwickshire coalfield basin in the north of the county and have been identified as a brick clay resource, although locally they may be baked by igneous intrusions (and would therefore require crushing and grinding before they could be used).

8.2 MINERAL SAFEGUARDING AREAS: DECISIONS AND JUSTIFICATIONS

For this section, please refer to:

Figure A1: 1999 published Warwickshire county resource map

Figure A5: Consultation map for brick clay in Warwickshire

Figure A8: Revised consultation map for brick clay in Warwickshire

Figure A13: Mineral Safeguarding Area map for brick clay in Warwickshire

MPS1 Annex 2 refers specifically to brick clay.

> "*Planning consideration…should take account of… the need for provision of brick clay from a number of different sources to enable appropriate blends to be made"* (Para. 3.4)
>
> Mineral Policy Statement 1 Annex 2: Brick clay (CLG, 2006)

It is particularly important to ensure a supply of high quality clays that can blended and used to make clay products. Modern brick making technology is highly capital intensive. This technology is increasingly dependent on clay raw materials with predictable and consistent forming and firing characteristics to achieve high yields of saleable products. The current economics of a brick clay deposit depend largely on its proximity to brick making facilities, to avoid large transportation costs.

The **MSA includes the Etruria Formation** because it is a nationally important brick clay resource in Warwickshire. The relative proportions of clay minerals within this formation, and low levels of impurities make it suitable for the manufacture of high-quality facing and engineering bricks, pavers and roofing and floor tiles. The characteristically high, but variable, iron content of the Etruria Formation allows the production of a wide range of fired colours. The Kinsbury Quarry makes blue bricks which are unique and therefore these are exported country-wide.

The **Bromsgrove Sandstone Formation is included** in the safeguarding area for brick clay, despite its inconsistent quality, because of the nearby presence of a modern brickworks at Measham, which is dependent on a local supply of raw material for blending with clay from other sources. It's proximity to the county boundary makes it worth safeguarding this formation within Warwickshire.

The **Ashow Formation**, **Alveley and Whitacre Member**s, **Pennine Lower and Middle Coal Measures formations, Outwoods Shale Formation** and **Merevale Shales are all included in the MSA**. Although these units are not currently worked in Warwickshire. Their relatively small aerial extent and location in the northern half of the county, close to the modern brickworks means a range of brick clays should be safeguarded for the future when perhaps high quality resources may become exhausted.

The superficial, glacial clays **(Glaciolacustrine deposits** and **Wolston Clay) units have been excluded.** Although these types of units have been recently worked in some more northerly parts of England for brick making, the small size, variability of deposits including the likelihood of limestone clasts in the deposits, make them unlikely to be economic for modern brick making purposes. Industry representatives did not consider these units worth safeguarding for the future.

The clays of the Lias Group **(Bridport Sand Formation, Whitby Mudstone Formation** and **Charmouth Mudstone Formation) have also been excluded** from the MSAs because they are considered to contain too high a lime content and other impurities for modern brick making.

The **Mercia Mudstone has been excluded** because of the variability of the deposit and its wide geographic extent. Those parts which may be suitable for brick making are likely to be sporadic and have not been distinguished by current geological mapping. It is thought unlikely that it would be

suitable as a modern brick making material without significant blending with a higher quality resource.

8.2.1 Proximal development buffers

The suggested **buffer of 250 m** was not revised during consultation and has been applied to the linework, in order to avoid future sterilisation by proximal development. The clays are extracted by scraping and no blasting is necessary, therefore a 250 m buffer is considered sufficient.

The steep dip of the Etruria Formation meant that it was not considered necessary to increase the buffer distance around it to protect the down-dip resource beneath overburden. The dip of other units was not considered due to their larger extent and lower quality in comparison.

9 Cement raw materials

This section describes in more detail the geological units in Warwickshire which can form the raw materials for cement manufacture. These include those units which are currently considered to be mineral resources and those units which may be considered mineral resources in the future. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

Portland cement clinker is manufactured by heating a homogenised, controlled mixture of calcareous and clayey raw materials to partial fusion. Small amounts of iron oxide and sand may be added to optimise the mix. The cement clinker formed is cooled and then finely ground typically with 5 per cent of gypsum or anhydrite. The calcareous raw material used is limestone, or chalk which typically accounts for 80-90 per cent of the raw mix. Clay or shale accounts for some 10-15 per cent and provides most of the silica, alumina and iron oxide.

9.1 GEOLOGICAL DESCRIPTION

The Rugby Limestone Member and Wilmcote Limestone Member are both part of the Blue Lias Formation. Where they have not been differentiated by mapping they are shown on the consultation map as ‘Blue Lias Formation’. The **Blue Lias Formation** is alternating beds of grey limestones and mudstones. It is limestone rich at the base of the formation with increasing mudstone intercallations towards the top of the formation. The **Rugby Limestone Member,** which forms the upper part of the Blue Lias formation is therefore predominantly grey mudstone. There are some thinly interbedded limestones typically less than 0.30 m thick. It outcrops in a strip (roughly 0.5-3 km wide) running SE-NW from Shipston-on-Stour to north of Rugby. The Rugby Limestone Member is currently worked at Southam to supply the Rugby cement works.

The lower part of the Blue Lias Formation is the **Wilmcote Limestone Member,** which is more limestone rich, but has a clayey, shelly base, with increasing clay laminations towards the top. It’s outcrop is limited to the south west of the county (west of Stratford-Upon-Avon). The area between Wilmcote and Bidford-on Avon also contains some Wilmcote Limestone Member, however this is not shown on the map because it has not been differentiated by mapping. The Wilmcote Limestone Member has been used historically on a small scale for local cement making.

The **Langport Member** (formerly termed ‘White Lias’) of the Lilstock Formation runs parallel to the Blue Lias Formation. It forms a thinner (0.1-0.5 km) strip running northeast-southwest (east of Coventry to south of Stratford-Upon-Avon). It consists of cream and grey limestones with calcareous mudstones towards the top.

9.2 MINERAL SAFEGUARDING AREAS: DECISIONS AND JUSTIFICATIONS

For this section, please refer to:

Figure A1: 1999 published Warwickshire county resource map

Figure A6: Consultation map for cement raw materials in Warwickshire

Figure A14: Mineral Safeguarding Area map for cement raw materials in Warwickshire

Despite relatively poor-quality limestone resources, Warwickshire has a long history of cement manufacture dating back to the early part of the last century. A large cement plant is currently operating in Rugby of which the clay raw materials is supplied by the quarry at Southam. Lime for the cement mix is in the form of chalk slurry, piped from Bedfordshire (since the 1960s). Previous to that the Langport Member limestone was used to supply the lime. Cement making is highly capital-intensive and cement plants are normally located close to the main limestone raw material. The Warwickshire industry is unusual in being remote from its limestone source. Cement from the Rugby plant supplies the counties to the east and south of Warwickshire and into London. It is therefore considered important on a regional to sub-national scale.

The clayey **Rugby Limestone Member** and **Blue Lias Formation** (in the north east) **are included in the MSA.** This is because it is currently worked at Southam to supply the Rugby Cement Works. The limestone beds are not considered pure enough to supply the calcareous raw material under the current economic climate (due to a high ratio of silica to lime).

The Langport Member is also included although it is not currently worked. It is harder than the over lying Blue Lias Formation and so would require processing (grinding). However its proximity to the Rugby cement works means that it could become economic in the future in order to maintain supply and is therefore worth safeguarding.

The **Wilmcote Limestone Member** has been excluded due to its distance from the Rugby plant and relatively small outcrop aerial extent. It's historic local use is not considered important enough on a county-wide scale to warrant safeguarding.

9.2.1 Proximal development buffers

The suggested **250 m buffer** was not revised during consultation and has been applied to the linework, in order to safeguard the units from proximal development. The limestones and clays are extracted by scraping and no blasting is necessary, therefore a 250 m buffer is considered sufficient to protect the resource from potential sterilisation.

10 Building Stone

This section describes in more detail the building stone mineral resources in Warwickshire. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

> *"English Heritage and the industry are encouraged to make MPAs aware of important sources of building stone that they consider should be safeguarded from other forms of development through policies in their LDDs."* (Para. 3.2)
>
> *"important historic quarries should be safeguarded as far as practicable."* (Para. 3.3)
>
> MPS1, Annex 3: Natural building and roofing stone

Historically building stone has been used extensively throughout the county. The aesthetic qualities of the stones used impart a distinctive local character to the county's historic buildings. However, only a very few sources of building stone are currently quarried in Warwickshire. In accordance with MPS1, Annex 3, building stones should be safeguarded for restoration and conservation of historic buildings.

10.1 GEOLOGICAL DESCRIPTION

Table 2 includes information on each of the units considered to have been used for building stone in Warwickshire.

Geological unit name	Use and distribution	Geographical extent	Brief geological description	Former/local names
Sharp's Hill Formation (Great Oolite Group)	Similar in character to the other limestones of the Great Oolite Group, which have all been extensively quarried. It has been used locally for building although it may have been sourced from adjacent counties.	Very limited outcrop, restricted to the south of Warwickshire.	Multicoloured variable sequence of greenish grey shelly limestones and mudstones, with some siltstones and sandstones.	Great Oolite Limestone, Sharp's Hill Beds.
Chipping Norton Limestone Formation (Great Ooolite Group)	A good quality freestone, this stone has been much sought after in the past for many buildings and monuments local to the outcrop. It has been quarried in the area since Roman times and there are many small disused quarries in the south of the county. There is an active quarry on the Warwickshire border with Oxfordshire.	Outcrop is limited to the very south of Warwickshire. Outcrop area increases southwards into Oxfordshire.	Off-white to pale brown ooidal limestone. Contains shelly fragments, fine burrows and flakes of greenish grey mudstone. Also contains thin mudstone beds and trace lignite and fine-grained sand. Thick-bedded and cross-bedded or massive, weathers to flaggy.	Cotswold stone.
Birdlip Limestone Formation	Used in walls along the southern county boundary. Many towns further south are built using this stone, where it imparts a 'classic' Cotswold character to settlements, including many churches and important buildings.	Small outcrop area straddling the county boundary directly south of Stratford-Upon-Avon, near Ilmington.	Pale honey coloured ooidal limestones of varying types; ferruginous, sandy, shelly and marly.	Lower Inferior Oolite Series, Cotswold stone.
Northampton Sand Formation	Used for local buildings and dry stone walling.	The outcrop follows the outside of the south eastern county boundary, only outcropping within the south of the county.	Yellowish grey shelly ferruginous limestones, reddish brown sandstones and greenish grey ooidal ironstone. The unit also includes lenses of mudstone.	Northampton Ironstone Beds.
Marlstone Rock Formation	Has been quarried for building stone since medieval times and has in the past been shipped all over the world. Many of the villages around the outcrop are built from the harder, less oxidised blocks from the lower part of the formation, e.g. Napton and Tysoe. Near Edgehill it is known as 'Hornton Stone'.	This deposit outcrops along the southern county boundary. The deposit is thicker south east of Edgehill due to the 'Edgehill syncline' which runs SE-NW through Banbury.	Sandy, shelly and ooidal ferruginous limestone interbedded with ferruginous sandstone, and mudstones. Locally these form ironstones where the iron content is sufficiently high. Colloquially these are all termed ironstones.	Marlstone Rock Bed, Hornton stone, Ironstone.

Geological unit name	Use and distribution	Geological extent	Brief geological description	Former/local names
Rugby Limestone Member (Blue Lias Formation)	Used in buildings and dry stone walls locally around its outcrop. Particular examples include Kineton village and Southam Church (where it is mixed with the Langport Member). The stone is not particularly weather resistant (suffers from exfoliation) and where it has been used for building corners it tends to fall apart.	A strip (roughly 0.5-3 km wide) running SE-NW from Shipston-on-Stour to north of Rugby. On the consultation map, it is shown as part of the Blue Lias Formation, where its constituent Members have not been differentiated.	Grey mudstone with thinly interbedded limestones typically less than 0.30 m thick. Sandstone is locally dominant and there are occasional traces of siltstone. The mudstone units have been removed from the consultation map.	Blue Lias.
Saltford Shale Member (Blue Lias Formation)	The use and distribution of these limestones is likely to be similar to limestones of the Blue Lias Formation.	Only the limestone-dominated part of this formation has been included on the consultation map. This lies near Wilmcote, north west of Stratford.	The part of the unit shown on the map is grey limestone. The main lithology type in the unit is grey mudstones with some limestone nodules. The mudstone units have been removed from the consultation map.	
Wilmcote Limestone Member (Blue Lias Formation)	Limited use, very local to the outcrop in the south west of the county and in the Avon valley. Used for cement, lithographic stone, flagstone and gravestones. Examples of villages partly built from this stone type include Bidford-on-Avon, Temple Grafton and Aston Cantlow.	Limited outcrop area in the south west of the county (west of Stratford-Upon-Avon). The area between Wilmcote and Bidford-on Avon also contains some of the Wilmcote Member, however this is not shown on the map because it has not been differentiated by mapping.	Alternating limestones and mudstones. It is more clayey and shelly at the base and more laminated ('paper shales') at the top. The Blue Lias Formation is more limestone rich at the base of the formation with increasing mudstone intercallations towards the top of the formation.	
Langport Member (Lilstock Formation)	Numerous quarries along its length, last worked at Lighthorn in the 1960s. Used extensively in the settlements along the limestone ridge, in some cases used off outcrop. Mostly for walling and some churches, including the Southam church (mixed with Blue Lias)	The outcrop runs northeast-southwest (east of Coventry to south of Stratford-Upon-Avon) in a thinner (0.1-0.5 km) strip roughly parallel to the Rugby Limestone Member.	Cream and grey limestones.	White Lias.

Geological unit name	Use and distribution	Geological extent	Brief geological description	Former/local names
Arden Sandstone Formation (Mercia Mudstone Group)	Although not used in many important buildings, it has been used extensively for local buildings and walling imparting character to villages, churches and farms in the area. Particular examples may be found in Henley-in-Arden, Shrewley and around Alcester and Wootton Wawen church.	Mainly in the west of the county, west of Warwick. Much smaller, patchy outcrops east of Leamington.	Greenish grey mudstones interbedded with paler coloured siltstones and varicoloured sandstones. Beds of conglomerate occur locally. The thicker sandstone units, composed of several individual beds, have a lenticular geometry. The mudstone units have been removed from the consultation map.	Keuper Sandstone, Shrewley Sandstone, Skerry Sandstone.
Basal part of the Mercia Mudstone Group (Tarporley Siltstone Formation equivalent)	A freestone used on eastern parts of Nuneaton particularly at Chilvers Coton. Several churches and town buildings were built of this stone. It was also used in the military barracks at Weedon (Buckinghamshire).	It lies in a narrow strip trending NW-SE through Nuneaton.	Interlaminated and interbedded grey-brown siltstones, mudstones and sandstones. Sandstone beds are generally less than 0.5 m thick, although units consisting of several individual sandstone beds, may reach over 5 m thick. Mudclast conglomerates are common.	Keuper 'Waterstones', Attleborough Stone
Bromsgrove Sandstone Formation (Sherwood Sandstone Group)	It makes a good freestone which has been used extensively for buildings throughout Warwick and Leamington, and along its outcrop, including several canal bridges and churches. It has also been widely used in Birmingham.	This unit extends from the north of the county down to Warwick, around the margins of the Warwickshire coalfield basin.	Sandstones, red, brown and grey, commonly pebbly or conglomeratic at the bases of beds, interbedded with red and brown siltstones and mudstones. The mudstone units have been removed from the consultation map.	Lower Keuper Sandstone, 'Warwick' Stone, White Triassic Sandstone.
Polesworth Formation (Sherwood Sandstone Group)	Generally too unconsolidated to be used as a building stone, however some of the more consolidated beds and large cobbles have been used in local farm buildings and walls.	Fairly limited outcrop in the very north of the county.	Poorly cemented, reddish-brown sandstone with thin beds of red mudstone and conglomerate.	Bunter Pebble Beds.
Ashow Formation (Warwickshire Group)	Generally poorly cemented, but it has been used locally where the there is a high enough proportion of sandstone, for example in Ashow village and Kenilworth common.	The surface extent is limited to the area immediately around Kenilworth and Warwick.	Locally thick red-brown and grey-green sandstone. Only the mapped sandstones are shown on the consultation map.	

Geological unit name	Use and distribution	Geological extent	Brief geological description	Former/local names
Kenilworth Sandstone Formation (Warwickshire Group)	Good quality durable freestone making it an important building stone. Has been worked extensively in the past. Kenilworth Castle is built from this stone.	The outcrop forms an arcuate shape around the north of Kenilworth in the middle of Warwickshire.	Red-brown sandstone with some thin beds of red mudstone. Conglomerate is locally present towards the base and lenses of breccia occur toward the top of the formation.	Gibbet Hill Conglomerate Group.
Enville Member (Salop Formation)	Previously worked north of the county border in Staffordshire. Used primarily for walling.	Outcrops in the northwest, outside of the Warwickshire county boundary.	Red mudstone and red-brown sandstone, locally pebbly with lenticular beds of conglomerate.	Enville Beds.
Alveley Member (Salop Formation)	Previously worked more extensively in neighbouring counties reflecting its outcrop extent. Capable of yielding large blocks where it outcrops in Worcestershire.	Extremely limited outcrop within Warwickshire. Restricted to a narrow band 300m long in the far north of the county.	Red mudstone and sandstone with thin *'Spirobis'* limestone beds. The mudstone units have been removed from the consultation map.	Keele Beds, upper part of Coventry Sandstone.
Whitacre Member (Salop Formation)	Many buildings in Coventry have been built from these thinly bedded red sandstones.	Forms the core of the Warwickshire coalfield basin. Only the thin sandstone beds have been shown on the consultation maps.	Red bed sequence of mudstones and sandstones (the proportion of sandstone increases towards the top of the formation). Thin '*Spirorbis*' limestones at some levels and conglomerates in uppermost part. The mudstone units have been removed from the consultation map.	Lower part of Coventry Sandstone, Meriden Formation.
Halesowen Formation	Used locally for building stone. Some large disused quarries near Kingsbury. The rock is relatively soft and friable. Often attacked by masonry bees.	Thin beds overlying the Coal Measures within the Warwickshire coalfield basin in the north of the county.	Thin beds of grey-green (locally red), micaceous sandstone, '*Spirorbis*' limestone beds and conglomerate.	Keele Formation, Meriden Formation.
Midlands Minor Intrusive Suite (hosted by Stockingford Shale Group)	Used locally for walling in Hartshill village. The shales have also been used where contact metamorphism with the intrusives has rendered them hard enough.	Northwest of Nuneaton in the in the north of the county, running northwest-southeast.	Numerous thin, steeply dipping sills of diorite and lamprophyre intruded into Stockingford Shales Group.	Diorite sills.

Geological unit name	Use and distribution	Geological extent	Brief geological description	Former/local names
Hartshill Sandstone Formation	Used locally for walling. Away from the outcrop it has been used for cladding St. John's church, Kenilworth.	Northwest of Nuneaton in the in the north of the county. A relatively thin surface extent of the deposit, running northwest southeast, approximately 4.5km x 0.45 km.	Grey to purple-red hard sandstone. Thin mudstones drape some of the sandstone beds.	Hartshill Quartzite.
Caldecote Volcanic Formation	Used locally for walling.	Northwest of Nuneaton in the in the north of the county. A relatively thin surface extent of the deposit, running northwest south east, approximately 3.5km x 0.35 km.	Grey, massive tuff containing some reworked lithic blocks with intercalations of grey to green, fine, well-laminated to massive tuffaceous mudstone, siltstone and sandstone.	Charnian volcanics.

Table 3 Geological units identified as building stones in Warwickshire.

10.2 MINERAL SAFEGUARDING AREAS: DECISIONS AND JUSTIFICATIONS

For this section, please refer to: Figure A1: 1999 published Warwickshire county resource map; Figure A7: Consultation map for building stone; Figure A9: Revised consultation map for building stone; Figure A15: Mineral Safeguarding Area map for building stone in Warwickshire.

All units identified during the consultation phase have been included in the MSA, except for the Enville Member of the Salop Formation because it does not outcrop within Warwickshire. The others were considered worth safeguarding in accordance with MPS1, Annex 3.

Mineral safeguarding decisions were based on the distribution of the stone use (how far from its source it has been used: locally, regionally, nationally), how extensively it was used or whether it was used for particular important buildings. For restoration and conservation work, it is generally considered favourable to use stone from the same source wherever possible. This is not only for aesthetic value, but using because using a different stone could result in more pronounced differential weathering either due to hardness differences or mineralogical reactions which may cause further damage. It is thus important to safeguard not only the stones that are considered to be high quality (in terms of durability etc) but also poorer quality stones because these are more likely to be needed for more regular reparation work.

10.2.1 Proximal development buffer

Following consultation it was decided that 150 m was an appropriate distance of buffer to avoid sterilisation of resources by proximal development. This reflects the typically intermittent and less intensive way in which building stone is likely to be worked in Warwickshire.

11 Conclusions

This study has provided Warwickshire County Council with a clearly defined and delineated set of Mineral Safeguarding Areas. The project has followed recommendations and guidance, where possible, from ‘A guide to mineral safeguarding in England’ (McEvoy et al., 2007) in support of MPS1.

A summary of each geological unit considered for inclusion in the Mineral Safeguarding Areas can be found in Appendix 3.

Paper maps and Adobe PDF documents were provided to Warwickshire County Council showing the considered mineral resources and Mineral Safeguarding Areas within the Mineral Planning Authority. The digital data was supplied in the form of ESRI shapefiles for use in a Geographical Information Systems. Warwickshire County Council licensed the BGS mineral resource linework for the county for this project.

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Appendix 1 Consultation letter with maps

Warwickshire County Council

Mineral Safeguarding Areas

Dear

Warwickshire County Council has asked the British Geological Survey (BGS) to assist them in delineating Mineral Safeguarding Areas (MSAs). The purpose of this correspondence is to inform you that this is taking place and that the BGS would be grateful if you would agree to help with this process as local knowledge is essential to the process.

MSAs will be delineated for each mineral resource in the county. A definition of MSAs is provided in Appendix 1 along with a list of related documents.

Consultation process

Consultation with industry and other stakeholders will be by letter, email, telephone and, where agreeable, onsite meetings. Specifically, the consultation aims to discuss:

- mineral resources and safeguarding
- local geological and operational considerations
- possible criteria for the delineation of MSAs

I will contact you shortly and if you agree to participate I will record any comments that you have on the content of the consultation maps and arrange meetings where appropriate. If you are not the most appropriate contact I would be grateful if you could forward this correspondence or let me know who I need to contact.

Please find enclosed the following consultation maps:

- Published map of the Mineral Resources of Warwickshire / West Midlands (1999)
- Brick clay consultation map
- Unconsolidated sand and gravel consultation map
- Coal consultation map (see Appendix 2 for further definitions)
- Crushed rock consultation map
- Cement Raw materials consultation map
- Building stone consultation map

I appreciate not all of these maps will be off interest to you, please disregard those that are not, but we want to make sure we give you the chance to comment on all minerals resources.

You will note that the individual mineral maps differ to those of the published map. The reason for this is that we taken the decision to include additional formations in their entirety at this stage of the process. Based on your local knowledge you may consider all or part of these formations

to be classed as mineral resources. We would appreciate your views on what should or should not be safeguarded and therefore could be excluded or included on the final map.

Please feel free to annotate the maps and return to me at the address on the letterhead, or highlight areas of concern that you may wish to discuss further with me. **The deadline for comments is the 13th February 2009. The BGS is planning a visit to Warwickshire in the week beginning 9th February 2009.**

Please do not hesitate to contact me should you require any further information or would like to discuss anything in more detail.

Yours sincerely

Sarah Hannis

Project Leader, Warwickshire Mineral Safeguarding Areas

British Geological Survey

Appendix 1

What are Mineral Safeguarding Areas (MSAs)

MSAs are areas of known mineral resources that are of sufficient economic or conservation value to warrant protection for generations to come. The level of information used to prove the existence of a mineral resource can vary from geological mapping to more in depth geological investigations. The BGS Mineral Resource maps, for example, shows the surface extent of mineral resources inferred from available geological information and can be used to identify resources, for the purpose of defining MSAs.

What is the purpose of MSAs?

The purpose of MSAs is to ensure that mineral resources are adequately and effectively considered in land-use planning decisions, so that like other finite resources, they are not needlessly sterilised, compromising the ability of future generations to meet their needs. Defining MSAs carries no presumption for extraction and there is no presumption that any areas within MSAs will ultimately be environmentally acceptable for mineral extraction. (Areas of search, preferred areas, and specific sites are designated for that purpose; to indicate to mineral operators and others the places where mineral extraction is most likely to take place). MSAs will make relevant parties aware of the presence of mineral resources and will make specific local planning policies applicable to those areas.

Documents of interest

Minerals Policy Statement 1 (MPS1)
http://www.communities.gov.uk/documents/planningandbuilding/pdf/152993.pdf

Planning and Minerals: Practice Guidance
http://www.communities.gov.uk/documents/planningandbuilding/pdf/153421.pdf

A Guide to Mineral Safeguarding
http://www.bgs.ac.uk/mineralsuk/downloads/guide_to_mineral_safeguarding_08.pdf

Appendix 2

Warwickshire coal consultation map.

The following categories are based on the published Coal Resource Appraisal Map for NW Leicestershire, S Derbyshire & Warwickshire (British Geological Survey, 2007)

Primary opencast coal resource area: comprises a relatively closely spaced succession of variable but generally thick coals. These coals typically occur within a certain discrete stratigraphic interval, which comprises the succession from the middle to upper part of the Pennine Lower Coal Measures Formation to the Pennine Middle Coal Measures Formation.

Secondary opencast coal resource area: represents the area in which the coals are generally thinner and less concentrated in vertical and aerial distribution. The zone spans the lower part of the Pennine Lower Coal Measures Formation and parts of the Pennine Middle Coal Measures Formation.

Buried coals resource overlain by up to 50 m overburden: In some areas, particularly downdip of the main area of mapped resources, coals are present in the subsurface covered by younger strata. This zone represents the area where these coals are overlain by less than 50 m of overburden. Coals in this zone have not been ranked as primary, secondary or tertiary. In this case the overburden is defined as bedrock; the thickness of superficial deposits is not considered here.

Underground coal resource area (seams at least 2 m thick between 600 m and 1200 m depth): These represent areas where boreholes indicate that coals of 2 m or greater thickness are present between the depths of 600-1200 m below surface.

Underground coal resource area (greater than 50 m overburden): These represent coals in the subsurface, buried by greater than 50 m of overburden. The thickness of superficial deposits is not considered here.

Appendix 2 Consultation follow up e-mail

Re: Consultation for Warwickshire Mineral Safeguarding Areas

Dear

I hope that you have received the consultation maps for Warwickshire Mineral Safeguarding Areas (MSAs) that I sent to you last week.

MSAs will be delineated for each mineral resource in the county. These are sand and gravel, crushed rock, coal, brick clay, cement raw materials and building stone. Consultation with key stakeholders is an important part of this delineation process. I hope you will agree to participate.

Would it be convenient to arrange a phone interview with you the week beginning 2nd February to discuss your views, please? If you would prefer to meet in person to discuss this, I will be in Warwickshire between 9th -13th February. Your local knowledge and insight into what may or may not be considered a resource in Warwickshire for the present and foreseeable future is very important to us.

Thank you for your time, I look forward to hearing from you soon,

Best regards,

Sarah Hannis

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Appendix 3 Geological units included in MSAs in Warwickshire.

Category / geological unit	Units shown on the consultation map	Units included in the MSA	Proposed proximal development buffer
Brick clay			250
Glaciolacustrine deposits	included	excluded	
Wolston Clay	included	excluded	
Bridport Sand Formation	included	excluded	
Whitby Mudstone Formation	included	excluded	
Charmouth Mudstone Formation	included	excluded	
Mercia Mudstone Group	included	excluded	
Bromsgrove Sandstone Formation	included	Brick clay MSA	
Ashow Formation	included	Brick clay MSA	
Aveley Member (Salop Formation)	included	Brick clay MSA	
Whitacre Member (Salop Formation)	included	Brick clay MSA	
Etruria Formation	included	Brick clay MSA	
Pennine Middle Coal Measures Formation	added following consultation	Brick clay MSA	
Pennine Lower Coal Measures Formation	included	Brick clay MSA	
Outwoods Shale Formation	included	Brick clay MSA	
Merevale Shale Formation	added following consultation	Brick clay MSA	
Sand and gravel			250
Sub-alluvial river terrace deposits	included	Sand and gravel MSA	
River terrace deposits	included	Sand and gravel MSA	
Glaciofluvial deposits	included	Sand and gravel MSA	
Northampton Sandstone Formation	included	excluded	
Bromsgrove Sandstone Formation	included	excluded	
Wildmoor Sandstone Formation	included	excluded	
Kidderminster Formation	included	Sand and gravel MSA	
Polesworth Formation	included	Sand and gravel MSA	
Hopwas Breccia Formation	included	excluded	

Category / geological unit	Units shown on the consultation map	Units included in the MSA	Proposed proximal development buffer
Crushed rock			500
Chipping Norton Limestone Formation	included	Crushed rock MSA	
Birdlip Limestone Formation	included	Crushed rock MSA	
Marlstone Rock Formation	included	Crushed rock MSA	
Oldbury Farm Sandstone Formation	included	Crushed rock MSA	
Midlands Minor Intrusive Suite	included	Crushed rock MSA	
Stockingford Shale Group (hosts Midlands Minor Intrusive Suite)	included	Crushed rock MSA	
Hartshill Sandstone Formation	included	Crushed rock MSA	
Caldecote Volcanic Formation	included	Crushed rock MSA	
Building stone			150
Sharp's Hill Formation	added following consultation	Building stone MSA	
Chipping Norton Limestone Formation	included	Building stone MSA	
Birdlip Limestone Formation	included	Building stone MSA	
Northampton Sand Formation	added	Building stone MSA	
Marlstone Rock Formation	included	Building stone MSA	
Blue Lias Formation (undifferentiated)	included	Building stone MSA	
Rugby Limestone Member (Blue Lias Formation)	included	Building stone MSA	
Saltford Shale Member (Blue Lias Formation)	included	Building stone MSA	
Wilmcote Limestone Member (Blue Lias Formation)	included	Building stone MSA	
Langport Member (Lilstock Formation)	included	Building stone MSA	
Arden Sandstone Formation	included	Building stone MSA	
Bromsgrove Sandstone Formation	included	Building stone MSA	
Polesworth Formation	included	Building stone MSA	
Ashow Formation	added following consultation	Building stone MSA	
Kenilworth Sandstone Formation	included	Building stone MSA	
Alveley Member (Salop Formation)	included	Building stone MSA	
Whitacre Member (Salop Formation)	included	Building stone MSA	

Category / geological unit	Units shown on the consultation map	Units included in the MSA	Proposed proximal development buffer
Halesowen Formation	included	Building stone MSA	
Midlands Minor Intrusive Suite	added following consultation	Building stone MSA	
Hartshill Sandstone Formation	included	Building stone MSA	
Caldecote Volcanic Formation	added following consultation	Building stone MSA	
Tarporley Siltstone Formation (Warwickshire equivalent)	added following consultation	Building stone MSA	
Cement raw materials			250
Blue Lias Formation (undifferentiated)	included	Cement raw materials MSA	
Rugby Limestone Member (Blue Lias Formation)	included	Cement raw materials MSA	
Wilmcote Limestone Member (Blue Lias Formation)	included	excluded	
Langport Member (Lilstock Formation)	included	excluded	
Coal			
Primary opencast coal resource area	included	Shallow coal MSA	250
Secondary opencast coal resource area	included	Shallow coal MSA	250
Buried coals resource overlain by up to 50 m overburden	included	Shallow coal MSA	250
Underground coal resource area (greater than 50 m overburden):	included	Deep coal MSA	500
Underground coal resource area (seams at least 2 m thick between 600 m and 1200 m depth):	included	Deep coal MSA	500

Table 4 Summary of the geological units included or excluded from MSAs in Warwickshire

Appendix 4 Maps

Published mineral resources map

Figure A1 Warwickshire Mineral Resources map (published 1999)

Consultation phase maps showing proposed Mineral Safeguarding Areas

Figure A2 Warwickshire - Unconsolidated sand and gravel

Figure A3 Warwickshire – Crushed rock

Figure A4 Warwickshire – Coal

Figure A5 Warwickshire – Brick clay

Figure A6 Warwickshire – Cement raw materials

Figure A7 Warwickshire – Building stone

Revised maps, following consultation showing any additional units identified

Figure A8 Warwickshire– Brick clay (revised)

Figure A9 Warwickshire – Building stone (revised)

Maps showing Mineral Safeguarding Areas for each mineral category

Figure A10 Warwickshire MSA - Unconsolidated sand and gravel

Figure A11 Warwickshire MSA – Crushed rock

Figure A12 Warwickshire MSA – Coal

Figure A13 Warwickshire MSA – Brick clay

Figure A14 Warwickshire MSA – Cement raw materials

Figure A15 Warwickshire MSA – Building stone

Final output map showing all Mineral Safeguarding Areas defined in Warwickshire

Figure A16 Warwickshire MSAs