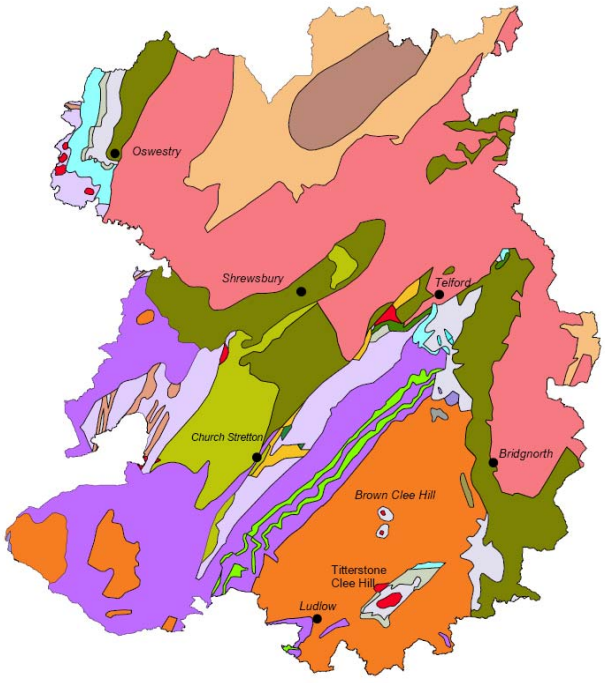
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Minerals Safeguarding Areas for Shropshire and Telford & Wrekin

Economic Minerals Programme

Open Report OR/08/045



BRITISH GEOLOGICAL SURVEY

ECONOMIC MINERALS PROGRAMME

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Front cover

Outline of MSAs produced for Shropshire

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BRITISH GEOLOGICAL SURVEY

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List of abbreviations

BGS	British Geological Survey
BRITPITS	BGS's database of mines and quarries
CLG	Communities and Local Government
CMB	Coal Map of Britain
CMRM	County Mineral Resource Map
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
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
SSC	Shropshire County Council
T&W	Telford & Wrekin Council

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We would like to thank all those who have given time to contribute to this project, including Shropshire County Council, Telford and Wrekin Council and representatives from industry within the Shropshire area.

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Summary

Minerals Policy Statement 1: Planning and Minerals (DCLG, November 2006) requires all Mineral Planning Authorities to define Mineral Safeguarding Areas (MSA's). This report describes work carried out by the British Geological Survey on behalf of Shropshire County Council and Telford & Wrekin Council to delineate Mineral Safeguarding Areas in Shropshire, Telford & Wrekin. The report uses the methodology outlined in *"A guide to mineral safeguarding in England"* (McEvoy et al., 2007).

Maps showing the extent of individual mineral resources in Shropshire and Telford & Wrekin have been prepared by the BGS. Minerals Safeguarding Areas have then been defined for each mineral resource. This data has been provided in digital form for use with a geographical information system.

Notes

i. Shropshire County Council and the county's five district / borough councils will be replaced by a single unitary authority in April 2009. All references to the County Council in this report are also intended to apply to the County Council's Unitary successor in title.

1 Introduction

Shropshire County Council (SCC) and Telford & Wrekin Council (T&W) have commissioned the British Geological Survey (BGS) to delineate Mineral Safeguarding Areas (MSAs) in Shropshire, Telford & Wrekin. This will provide an essential evidence base to assist the councils in safeguarding mineral resources in their respective areas, including through the formulation of new planning policies.

1.1 PLANNING CONTEXT

SCC and T&W are in the process of producing minerals development plan documents for their local development frameworks (LDF) which will replace the current joint Minerals Local Plan. The MSAs will be defined within the new LDFs. This 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 Development Frameworks (ODPM, 2004). 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** (MSAs) in their LDF documents. In two-tier planning areas, **Mineral Consultation Areas (MCAs)** may also be defined and these should be based on the MSAs . Where MCAs are shown, consultation between the district and county is compulsory when a non-mineral planning application falls within those areas. MSAs and MCAs 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.

Note: As Shropshire County Council will be replaced by a unitary authority in April 2009 the requirement to maintain MCAs for consultation with District Councils will no longer apply. However, the MSAs will continue to be used by the new unitary council in accordance with MPS1. T&W Council has been a unitary council since 1998.

Key documents

Minerals Policy Statement 1: Planning for Minerals including Annex 2: Brick clay and Annex 3: Natural building

and roofing stone (CLG, 2006)
Minerals Policy Statement 1: Practice guide (CLG, 2006)

Local planning

Planning Policy Statement 12: Local Development Frameworks (OPDM, 2004) outlines the policies that should be taken in to account by local planning authorities in the preparation of LDFs and minerals and waste development documents. The 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. The minerals core strategy development plan document "*should take account of the need to contribute appropriately to national, regional and local requirements at acceptable social, environmental and economic costs*", (Para 2.11).

In relation to minerals and waste development plan documents, the adopted proposals map must include *"Areas of significant mineral resources subject to safeguarding policies and Mineral Consultation Areas"*. In two-tier Planning Authority areas, district planning authorities must also include "*safeguarded areas and Mineral Consultation Areas"* on their adopted proposals maps. (Annex A2 and Para 2.22).

Key document Planning Policy Statement 12: Local Development Frameworks (ODPM, 2004)

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 by the BGS 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

Box 2 provides 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). This will alert prospective applicants for planning permission to the existence of valuable mineral resources and 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)

2 Project objectives

The objectives of the project are detailed below:

2.1 PHASE 1

The licensing of BGS mineral resource linework in ESRI shapefile format and provision of GIS generated maps showing the mineral resources in Shropshire MPA and Telford & Wrekin MPA) to use during consultation with stakeholders in Phase 2.

2.2 PHASE 2

Consultation (as appropriate) with the mineral industry and other stakeholders such as the district and borough councils and SCC and T&W, by means of letter, telephone, email and meetings. This consultation, conducted by BGS, identified which minerals warranted safeguarding and how the physical extent of the resource areas to be safeguarded should be determined. BGS then produced GIS (ESRI) generated maps showing the extent of MSAs within Shropshire, Telford & Wrekin. A short technical report with accompanying non-technical summary and maps (.pdf format) was also produced, detailing the work undertaken by BGS on behalf of SCC and T&WC. This included the results of the consultation process and an outline of the methodology used to define the MSAs.

2.3 LIMITATIONS

Box 3 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 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 mainly carried out 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 superficial deposits.

3 Methodology

This section provides an overview of the methodology used to delineate MSAs for SCC.

MSAs were defined in Shropshire and T&W 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 (Box 4) of the guide and is solely related to delineating MSAs. Creation of the associated safeguarding policies (steps 4 and 5) was outside the remit of this

project. This section details the rationale applied in deciding which minerals to safeguard and on the detailed extent of the MSAs. A summary of the geological units included in the MSAs is provided in Appendix 2.

Box 4 Step-by-step approach to creating an effective safeguarding system for minerals		
Step 1	Assess what is the best geological and resource information available.	Use the best geological and mineral resource information. Refine resources in discussion with industry. Account for sterilisation by proximal development.
Step 2	Decide which minerals within the MPA may become of economic importance in the foreseeable future.	
Step 3	Decide how the physical extent of the resource areas to be safeguarded should be determined.	

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

In line with the above step-by-step approach (Box 4), the project was carried out in four stages as follows:

- Assessment of the best available geological knowledge;
- Consultation with industry;
- Determination of proximal development buffers; and
- Final decisions for defining MSAs.

3.1 ASSESSMENT OF THE BEST AVAILABLE GEOLOGICAL KNOWLEDGE

This was conducted in order to identify the current and possible future economic mineral resources within Shropshire.

- All relevant BGS published literature relating to Shropshire and Telford & Wrekin was reviewed by a geologist. This included the most recent geological maps, the economic geology section of the accompanying sheet memoirs or sheet descriptions and the relevant Industrial Minerals Assessment Unit reports. The published BGS 'County Mineral Resource Map' for Shropshire (Map 1-2), DiGMapGB-50 digital linework, The Coal Map of Britain (CMB) and the relevant Regional Geology series were also used.
- Current economic resources and potential future resources were re-examined, where relevant, by a geologist and other expert economic geologists at the BGS.
- Based on the assessment of the best available geological knowledge, the following mineral resources were considered to be of economic importance in the foreseeable future in Shropshire and Telford & Wrekin, thus warranting safeguarding for future generations. Proposed Mineral Safeguarding Maps were produced at A0 for each resource and these were used as the basis for consultation with industry (Map 3-6). Resources identified were:
    - i) Sand and gravel (unconsolidated, from glacial and river deposits);
    - ii) Sand & gravel (from bedrock);
    - iii) Crushed rock (including igneous rock, limestone and sandstone);
    - iv) Building stone;
    - v) Coal;
    - vi) Brick clay and Fireclay;

- Metaliferous minerals have not been included within the MSA. Although of historical importance there is no evidence of current economic interest. The MSA will be reviewed in the light of any changes to economic circumstances. However the mineral resource linework used to compile this MSA is not suitable for delineation of the extent or distribution of metaliferous minerals in the Shropshire area.
- Shropshire contains buried deep coal deposits which are potentially capable of yielding methane through coal bed methanogenesis. However, coalbed methane has not been included in the MSA because the technology is not yet established in the UK, the MSA relates primarily to surface mineral resources and no potential wellhead locations have been identified in Shropshire. It would be inappropriate to incorporate all buried coalfield which depths at which methane is potentially recoverable. The MPA's will review the scope and justification for identifying coalbed methane areas in the context of future reviews of the MSA.

3.2 CONSULTATIONS

"MSAs can be defined objectively using the best available geological and mineral resource information…including that made available by 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 SCC. This was compared with BGS's 'BRITPITS' database of active and non-active pits.
- Notification of the project was provided to these mineral operators by letter, including an invitation to comment and discuss the criteria for the delineation of MSAs (Appendix 1), A set of relevant proposed mineral safeguarding maps were included to aid this process (Maps 1-6)
- Where possible, consultation appointments were arranged between BGS staff and industry in order to gain local information which 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. Feedback from Industry was limited, but where feedback was provided it suggested that the consultation maps were correct in the areas in which they felt able to comment (often around active sites). Less than 20% of those that were asked to consider the consultation maps responded.

In addition to consultations with the minerals industry ongoing dialogue took place with SCC and T&W throughout the project, taking account of the Mineral Planning Authorities detailed local knowledge of mineral workings. This dialogue also took account of the findings of a comprehensive GIS based survey of historic mineral workings in Shropshire and Telford & Wrekin, undertaken by SCC.

3.3 DETERMINATION OF PROXIMAL DEVELOPMENT BUFFERS

"…It should be kept in mind that, in addition to proposed development within an 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 Shropshire is described as follows:

Starting from the basis of the examples provided in the case study section of 'A guide to mineral safeguarding in England' (McEvoy et al., 2007) BGS held discussions with industry and SSC. SSC requested that the buffer widths shown in Table1 were applied to account for potential sterilization by future proximal development:

Table 1: MSA buffer widths.

Category	Resource Type	Buffer
Sand & Gravel	Superficial	250m
	Unconsolidated Bedrock	250m
Crushed Rock	Sandstone	400m
	Limestone	400m
	Igneous & metamorphic	400m
Coal	Coal (Lower and Middle Measures)	400m
	Coal (except Lower & Middle Measures)	250m
Brick Clay & Fireclay	Brick Clay	250m
	Fireclay	250m
Building Stone	All types	150m

- Justification of buffers requested by SCC.
    - A buffer of 250m was applied for sand and gravel and coal and clay to account for potential environmental disturbance associated with mineral working.
    - A buffer of 400m was applied for crushed rock. This balances the MPA's knowledge of the effects of quarry blasting with the need to maintain useable areas for mineral safeguarding purposes.
    - A lesser buffer of 150m was applied for building stone to reflect the typically intermittent and less intensive way in which building stone is worked in Shropshire.

Note: Some mineral resource areas have already been sterilised by existing built development. In these areas, standoffs of 250m have been provided to the boundaries of the mineral resource areas, to provide appropriate protection to the communities living and working in these areas. In these circumstances the window of opportunity for mineral working has been lost, with the possible exception of short-term extraction in advance of committed new development.

3.4 INCLUSION AND EXCLUSION OF LITHOLOGICAL UNITS WITHIN THE MSA

The lithological units that were covered by the resources on the County Mineral Resource Map (CMRM) were identified and used as a basis for discussion. After consultation the following deviations from the units covered by the CMRM were proposed, with the final decision being made by the clients. MSA maps were produced based on the linework present in the CMRM with the following alterations.

- Deviations from the CMRM requested by BGS
    - Replace the Coal resource linework with the Coal Map of Britain (CMB). After further detailed analysis by the BGS geologist the tertiary elements of CMB data were reduced in extent. Beds of coal are known from parts of the Warwickshire Group. Although thin beds of coal may be present within the Etruria and Salop formations, coals have only been mapped within the Halesowen Formation, and this unit is considered the zone of 'sporadic coals of various thicknesses separated by thick interseam lithologies'; the Etruria and Salop formations have therefore been excluded. The MSA includes all of the Halesowen Formation with the following exclusions:
        - Areas of Halesowen Formation outside the 'Tertiary Resource' as defined by BGS (2006) have been excluded.
        - Mapped beds of sandstone have been excluded.
        - Mapped beds of limestone have been excluded.
        - Coalbrookdale coalfield only: strata above the lowermost mapped sandstone from the base have been excluded. [included: strata up to and including the horizon of the Little Sulphur Coal].
        - Wyre Forest Coalfield only: strata above the second mapped sandstone from the base have been excluded. [included: strata up to and including the horizon of the Brock Hall Coal].
    - Replace Fireclay resource linework with the Pennine Lower Coal Measures Formation (Mudstone lithologies) in the Telford area and with the boundary of the primary coal linework from CMB in the Oswestry area.
    - Replace resource linework in the Welshpool area with DiGMapGB-50 data, as it has been resurveyed and is more accurate that the CMRM in this area. The result is the removal of river sands and gravels from this area, the addition of glacial sands and gravels, and additional igneous units.
- Deviations from the CMRM requested by SSC
    - Removal of recent Alluvium as a resource from the Sand and Gravel MSA as there is no evidence it is an economic mineral resource in Shropshire and Telford & Wrekin.
    - Inclusion of part of the Alveley Member (south of Bridgnorth) in the Brick Clay MSA to reflect the presence of an active clay pit.
    - Inclusion of the Upper Ludlow Shales in the Building Stone MSA to reflect the presence of an active quarry and widespread historic building stone workings in this formation.
    - Inclusion of part of the Halesowen Formation (formerly the Highley and Coalport Beds) in the Brick Clay MSA to reflect knowledge of the mineral resource and widespread evidence of historical brick workings for the Shropshire area only.

- Removal of part of the Halesowen Formation (formerly the Coed-yr-Allt Beds) from the Brick Clay MSA as there is limited evidence of historical clay working.
- Inclusion of the Etruria Formation (Ruabon Marls) of the Oswestry area in the Brick Clay MSA to reflect evidence of historical clay working and the presence of extensive workings in this formation in the Coalbrookdale Coalfield.
- Extension of the area of the Building Stone MSA to include all drift-free Triassic Sandstone scarps, to reflect extensive evidence of historical sandstone working and the presence of active quarries at Grinshill and Myddle.

3.5 PRODUCTION OF MSA DATASET

The final dataset was clipped to the county boundary and maps produced for the following five categories

- **Sand and Gravel** (Map 7)
- **Crushed Rock** (Map 8)
- **Coal** (Map 9)
- **Brick and Fireclay** (Map 10)
- **Building Stone** (Map 11).

Each mineral resource was buffered to avoid sterilisation by proximal development, both within this MPA and also to highlight where proximal development in neighbouring MPA may sterilise resources within this MPA. Maps showing the MSA for each resource were produced (Map 12 - 16). These are displayed together on the final map (Map 17). Individual digital ESRI shapefiles for each MSA were provided to SCC and T&W.

4 Overview of the economic mineral resources in Shropshire and Telford & Wrekin

4.1 SUMMARY OF THE GEOLOGY AND CURRENT MINERAL RESOURCES

This section provides a brief summary of the geological mineral resources in Shropshire from an economic perspective. It is intended to provide background to Sections 5 to 11. These sections discuss individual mineral resources in more detail including the decisions made about mineral safeguarding.

The geology of Shropshire and Telford & Wrekin is exceedingly diverse, with a preserved geological history dating back over 700 Million Years, and rocks and deposits from 10 out of the 12 geological periods occurring within the county.

A geological sketch map (Figure 1) shows the generalized geological succession in Shropshire, and resources derived from the rocks. The bedrock in Shropshire and Telford & Wrekin generally becomes younger towards the north and east; there is a patchy cover of much younger Quaternary deposits, which generally become thicker and more pervasive in the north. A comprehensive account of the geology of the county is given in Toghill (2006). The bedrock can be split into three broad domains. South and west Shropshire is underlain by a complex assortment of mainly Lower Palaeozoic rocks, giving rise to a well-featured topography, including the Shropshire Hills AONB. North and east Shropshire, including Telford & Wrekin is

underlain predominantly by Permian and Triassic strata, giving rise to a gently undulating plateau, a southern extension of the Cheshire Plain. The outcrop of the economically important Carboniferous rocks is split, with main areas present at Oswestry, Shrewsbury and Telford to Bridgnorth, with smaller outcrops at the Clee Hills, and to the south of Market Drayton. Beds of coal occurring within the upper part of the Carboniferous strata have given rise to a number of coalfields, the most important being the Coalbrookdale Coalfield, which has been worked for coal since Roman times. Other coalfields in the county are the Oswestry, Shrewsbury, Leebotwood and Wyre Forest/Clee Hills coalfields.

The mineral resources of Shropshire occur in igneous, sedimentary and metamorphic rocks, which vary widely in terms of age and composition, in addition to unconsolidated superficial ('drift') deposits. Geological units within the sub region have been historically worked for a wide variety of economic uses including roadstones, building stones, furnace flux, coal, non ferrous and ferrous metalliferous minerals (including lead, zinc, barites and copper), lime, aggregate, fireclay, brick and ceramic clays, tiles and peat.

A major extractive industry is based around **sand and gravel**, which has been worked from both glacial and post-glacial deposits, and some of the sedimentary bedrock conglomerates from the Triassic Sherwood Sandstone Group.

Igneous, metamorphic and some of the older sedimentary rocks (including Cambrian Quartzite and Silurian and Carboniferous Limestone) have been worked for **crushed rock aggregates**. These are used primarily as a roadstone, and occur in the southern and western parts of Shropshire and within Telford & Wrekin.

The sub region has a long history of **coal** extraction from the Carboniferous Coal Measures and Warwickshire groups. Historically the industry was based on deep mining, but presently the only economic extraction method for coal in Shropshire and Telford & Wrekin is by opencast techniques.

Brick clay and fireclay resources are present in sedimentary rocks, principally the Lower Coal Measures, and the Etruria and Salop formations, in the Telford and Bridgnorth areas. The clays are used to manufacture bricks, tiles and specialist engineering bricks.

Building stones of both national and local importance have been extracted from bedrock from all geological periods present in the county. Sandstones from the upper part of the Sherwood Sandstone Group (including 'Grinshill' stone) is actively worked, and is used in buildings nationally as a source of 'white' sandstone. Building stones from other parts of the geological sequence are typically of historic or local use. The profile of this industry is being enhanced through recent national guidance that requires the matching of replacement stone for restorative work, as advised by English Heritage.

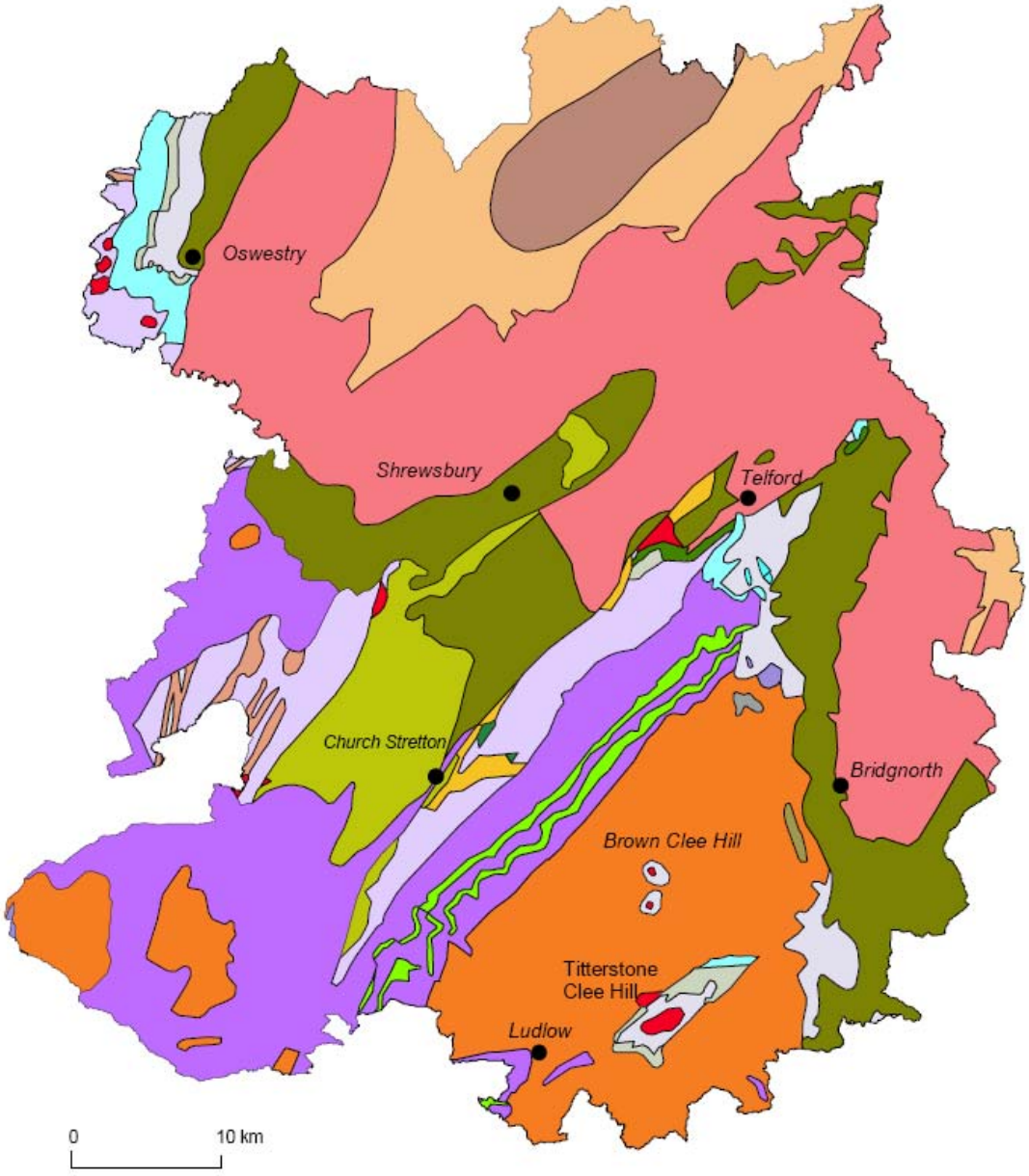

Figure 1. Simplified geological map of Shropshire, based on 1:625 000 Geological Survey Map, South Sheet (Solid) and 1:250 000 Mid-Wales and Marches Solid Geology. Key relating mineral commodities to geology is shown on the facing page.

Figure 1 (continued). Key to map on facing page. Blue indicates mineral commodities no longer produced or never worked.

4.2 HISTORICAL MINERALS WORKINGS IN SHROPSHIRE

Many of the mineral safeguarding decisions that have been made during this project have been based on the research that SSC have undertaken in relation to historical mineral workings, therefore an overview of the findings of their research is outlined in this section. The great diversity of Shropshire's geology has led to a wide range of mineral resources being worked historically. South-west Shropshire was a major producer of Lead and Barites (barium ore) in the 19th Century. The last workings closed at Snailbeach Mine near Minsterley in the 1950s. Working of copper also occurred in South West Shropshire and around Clive in North Shropshire and Llanymynech in the north-west of the county.

All the county's coalfields have been extensively mined in the past. The last coal mining ended at St Martins near Oswestry and Highley near Bridgnorth in the late 1960s. The only current

opencast coal working occurs at Caughley Quarry south of Broseley as an incidental by-product of fireclay extraction.

The county was the focus for an important lime industry in the 19th century, working the Silurian Limestones of Wenlock and Aymestry Edge, the Carboniferous Limestone around Oswestry and Titterstone Clee Hill and the Devonian Bishop's Frome Limestone Member (formerly known as the 'Psammosteus Limestone') of the Clee Hills. The 18th and 19th Centuries also saw widespread brick clay working, particularly in the Upper Carboniferous. Many of the county's towns previously had their own local brickworks, some of which also produced tiles. The higher quality fireclays of the Coalbrookdale Coalfield were also used to manufacture pottery and clay tobacco pipes which were exported widely.

The extensive distribution of sand and gravel within bedrock and superficial deposits led to widespread sand and gravel working, particularly in the north and east of the county. Crushed rock working also became increasingly significant from the late 19th Century onwards, to service the local road building and construction industries. A far wider range of materials was worked for crushed rock and sand and gravel than is currently the case, emphasising the geological diversity of the county.

The exceptional diversity of Shropshire's building stones lends character to the county's historic buildings and local distinctiveness to the areas in which they were worked. The County Council's survey of historic stone quarries has identified over 2000 such quarries throughout Shropshire, with a particular concentration in the south and west of the county. At least twenty important types of stone were used in the county and distinct zones of building stone use can be recognised. Prominent amongst these are the widespread red Triassic sandstones of north and east Shropshire, the nationally renowned cream coloured Triassic sandstone found more locally around Grinshill, the grey-green silty limestones of Corvedale, the deep red Devonian sandstones quarried around the Clee Hills and the flaggy Silurian sandstones of the Clun Forest area which were also used locally for roofing stone. Now only a handful remains, at Grinshill, Myddle and in Corvedale. However, English Heritage has promoted a renewed recognition of the importance of building stone nationally. The Shropshire Geological Society is undertaking an English Heritage funded study of the use of Shropshire building stone and the County Council's GIS survey of historic quarries will also assist in furthering this objective.

From the early 20th Century onwards the pattern has been towards the consolidation of aggregate quarries into fewer and larger workings operating in a more restricted range of geological horizons and extending progressively into adjacent areas. This reflects the increasing economies of scale of the minerals industry and increasingly stringent specifications applied to mineral resources. Whilst the current MSA study reflects the best understanding of what is currently considered economic by the industry it should be recognised that in the past a much wider range of mineral resources was worked in Shropshire than is currently the case. The minerals industry is subject to constantly changing technologies and market conditions. Shropshire's MSA will need to be reviewed periodically in order to reflect these changes.

4.3 HISTORICAL MINERALS WORKINGS IN TELFORD AND WREKIN

Telford is centred on the Coalbrookdale Coalfield, which gave birth to the industrial revolution. The geology of the Borough is complex, being heavily faulted, but containing a wealth of commercially viable minerals. A range of minerals have been worked by quarrying, opencasting and underground mining methods since Roman times. These include: coal, fireclay, pyrites,,oil, coal gasification, brick clay, limestone, sand and gravel, sandstone, igneous rocks, brine, fullers earth, minestone and ironstone. Currently only igneous rocks (Leaton quarry) and brick clay (Hadley quarry) are quarried in the Borough.

Table 2 The Historic Economic Geology of Telford & Wrekin.

QUATERNARY	
Holocene	River Terrace Deposits. These gravel deposits were worked in the 20th Century for aggregate in the Alscott/Longdon on Turn area, north west of Wellington and adjacent to the River Tern. The last workings at Isombridge finished in 1987.
Pleistocene	River Terrace Deposits. Localised sands and gravel deposits have been locally worked for aggregates. Output is currently confined to Buildwas quarry.
PERMIAN / UPPER CARBONIFEROUS	
Warwickshire Group	
Salop Formation (Enville Member)	Sandstones have historically been locally quarried for building stone.
Aveley Member (Keele Member)	Sandstones and calcareous mudstones (marls) have historically been worked as building stone, occasionally to make bricks and to improve the lime content of the soils. Localised clays were quarried to provide a clay liner for the adjacent landfill site at Redhill in 1999.
Etruria Formation (Hadley Beds)	Brickclay. Red mudstones and siltstones have been extensively worked for their clays by the brick, tile and ceramics industry. They were most important in the southern coalfield at Blists Hill mine and on the banks of the River Severn, south east of Ironbridge. The clays have been less widely worked north of Ironbridge. The red tile clays are not developed in the northern coalfield where quarrying has concentrated on red brickclays in the Hadley, Ketley and Donnington Wood areas. Fireclay. Calaminker fireclays are recorded in many shaft sections of the southern coalfield (Brown, 1975). A seam is recorded as having been worked at Blists Hill in the 1940s. Coal. The Thin Sulphur Coal, a poor quality, thin sulphurous coal is shown as having been worked in a shaft section of Wallace Mine, near Broseley.
Halesowen Formation (Coalport Beds)	Spirorbis Limestone. Several important seams of the freshwater limestone occur but they are best developed east of Broseley where they have been worked. Main Sulphur Coal. A thin and pyritous coal has been widely worked south of the Severn and was occasionally worked north of the Severn, e.g. Lightmoor and Madeley areas. Chance Pennystone Ironstone. This nodular ironstone was fairly widely worked in the Donnington Wood and Hadley areas of the northern coalfield.
MIDDLE COAL MEASURES	Hydraulic Fireclay. This horizon is only recorded in the Snedshill and St Georges area of the northern coalfield. Fungous Coal and Fireclay. A good quality coal widely distributed in the Donnington Wood area. The underlying fireclay was largely worked, particularly in the St Georges and Donnington Wood areas. It has not been preserved in the southern coalfield. Ragged Robins Ironstone. This black nodular ironstone is developed in the Ketley, Donnington Wood and Hadley areas. Blackstone Ironstone. An important brownish grey ironstone, usually as small nodules, that was developed north of Malinslee and is recorded in mine plans for the Wombridge and Wrockwardine Wood areas indicate early mining. It yielded 1,500 tons per acre and was valuable in making the best cold blast iron. Deep or Stone Coal. Variable quality coal. Recorded in the Lodgewood and Ketley area of the northern coalfield. Blackstone/Foot Coal. A thin coal and poor quality northern coalfield coal that was not generally worked. Gur Coal. Thin and poor quality coal. Unrecorded shallow workings at Snedshill. Brick Measures Ironstone. This ironstone consists of two or three tabular layers which fractured in brick like masses. Occasionally worked in the northern coalfield. Not an important ironstone. Ballstone Ironstone. Good quality, nodular ironstone. Widely worked in the northernmost areas of the northern coalfield and occasionally in the Ketley and Ketley Bank areas. Evidence of early mining. Dun Earth Ironstone. A locally developed ironstone that was worked in Ketley in the 19th Century. Top Coal and Fireclay. Very good quality coal, widely worked in both coalfields. Extensive workings in Donnington Wood, Lillyhurst and Madeley areas. Used more recently as a domestic and power station coal. Evidence of early mining. A fireclay is recorded as being worked at Madeley.

	Double Coal. Good quality, thick coal and fireclay. Widely worked. Evidence of early working. Yellowstone Ironstone. This average quality nodular ironstone was worked north of Dawley, often with the underlying Yard coal or alone in the northern coalfield owing to the latter's poor quality. Mine plans are incomplete and it is likely to have been worked where it was developed. It yielded 1,200 tons per acre and was more expensive to work than other ironstones. It was used for hot and coal blast iron. Yard Coal. The very constant thickness gave this coal its name. It was widely worked except in the north due to deteriorating seam quality. Incomplete mine plans indicate early working. It was less popular than the Clod coal for coking. Blue Flat Ironstone. This good quality ironstone is developed at and to the north of Malinslee. Its name is derived from its brownish grey nodules contained in a dark bluish mudstone matrix. Near to the base of the horizon the nodules coalesce to form laminars (Dewey, Smyth). It yielded 1,600 tons per acre and produced coal blast iron. White Flat/Sparstone Ironstone. This light coloured, brownish/grey ironstone was widely worked in the Dawley area. It is also recorded as being worked at Ketley. An average quality ironstone that yielded 1,500 tons per acre. Big Flint Sandstone. Locally quarried for building stone, e.g. Lilleshall Hill Obelisk in 1839. Big Flint Coal. A consistently good quality coal, widely worked in the northern coalfield. In the southern coalfield the seam splits into three leaves. The upper leaf is locally worked in the Madeley area and is often referred to as the 'Yard' coal on mine plans. The middle leaf was too thin to work. The lower leaf has been fairly widely worked in the Madeley and Ironbridge areas. Evidence of early working at Ironbridge. Pennystone Ironstone. A good quality very thick nodular ironstone seam, best developed in the north, but widely worked throughout the coalfield, often in two sections, the upper being most prized. Evidence of early workings in the Severn outcrop. Yielded up 3,500 tons per acre. Produced an excellent pig iron. Named after some nodules resembling a penny coin.
LOWER COAL MEASURES	New Mine/Stinking Coal and Fireclay. A sulphurous brittle coal often containing crystallised iron pyrites. Although it occurs throughout the coalfield, it appears only to be worked in the northern. Paradoxically, although considered too sulphurous to work in places, i.e. at parts of Priorslee, in other areas such at Ketley the seam was worked for its pyrites as well as coal. It was widely worked in the northern coalfield due to its relative thickness and last worked underground in 1972/3 at Granville Colliery. It has been used for domestic, malting, mail and forge purposes. The underlying fireclay is recorded as being worked with the coal in the Coalmoor area. Recently, it has been opencasted in south western Telford. Clunch Coal (northern) = Viger Coal (southern) and fireclays. A generally thin and low quality single seam in the northern coalfield that was not widely worked. Localised working in the central and western areas. The seam splits into two leafs in the southern coalfield. The upper (Viger) leaf was not widely worked, although its fireclay was widely worked in the Ironbridge area south of the Severn. The lower (Sill/Two Foot) leaf was only locally worked, although its underlying fireclay was widely worked. Two Foot Coal (northern) = Ganey Coal (southern) and fireclays. Widely worked in northern coalfield but deteriorates in quality to the north. It splits into two leafs in the southern coalfield. The upper (little) leaf was too thin to be worked. The lower leaf (main) has been widely worked in the Ironbridge, Broseley, Benthall and possibly Caughley areas. Incomplete mine records indicate early working. The underlying fireclay was widely worked throughout the coalfield. Some mine plans show early workings. Best Coal and fireclay. This good quality coal is often combined with the underlying Randle coal to form a single seam of one metre. It was often worked in conjunction with both the Randle and Clod coals as a single unit. Widely worked throughout the coalfield, although the combined Best/Randle seam was locally too thin to work in the Ketley and Hadley areas. The incompleteness of mine plans indicate early workings. The underlying fireclay mainly occurs in the south west area forming a parting between the Best and Randle coals. It has been opencasted here recently. Randle Coal and Fireclay. A good quality, widely worked coal where it was more frequently recorded on mine plans where it was jointly worked with the Best coal in the northern coalfield. It was worked as a separate seam in the Madeley area. The underlying fireclay occurs throughout the south western area and throughout the southern coalfield. There are mine plans in the Broseley area and has been opencasted in the south western area. Clod Coal and Fireclay. The best coal for iron smelting and is almost exhausted. It was often the first coal to be worked. Most mine plans relate to later, deeper workings in the concealed coalfield. Rarely, the early miners missed small localised areas south of Broseley which were worked later and are recorded on mine plans. The underlying fireclay was worked throughout the southern coalfield and has been opencasted in the south west area. Little Flint Coal and Fireclay. This is normally the lowest workable coal. It has been fairly widely

	worked in the southern coalfield, and in the central, south western and occasionally north eastern parts of the northern coalfield. The major absence of mine plans indicates early workings. In some opencast sites, this seam is left because it is only seam beneath a thick, hard sandstone. The underlying fireclay has been opencasted in the south western areas. Crawstone Ironstone. The most important ironstone in the southern coalfield but is poorly developed in the northern coalfield. It was formed from iron impregnation of sandstone. The lack of mine plans in the Benthall, Broseley, Caughley and Ironbridge areas reflect early mining as adits are located along this seam outcrop. Some are still accessible today, as already mentioned. Crawstone Coal. This thin coal seam was worked with the overlying ironstone at Hodge Bower mine. Lancashire Ladies Coal. The lowest named coal seam, which was too thin to be worked in the northern coalfield and virtually the whole of the southern coalfield. It is recorded as being worked in the Madeley area. Poor Robins Ironstone. Locally developed in the central and south west of the northern coalfield. It is recorded as being worked at Lightmoor area.
LOWER CARBONIFEROUS	Visean Fluxing Limestones. This is the premier quality of the Dinantian limestones and has been widely worked at both Lilleshall/Church Aston and at the Steeraway/Little Wenlock. The Victorian geologist Prestwich regarded it as the finest limestone as an iron flux in England. Little Wenlock Basalt. This lava outcrops in the Little Wenlock, Doseley and Horsehay areas and has been quarried for aggregate. It has also been recorded underground to the east but apparently not mined. This lava has been cut out by the Lower Coal Measures south east of the Stoneyhill Fault. Tournaisian Limestone Series. This series contains impure limestone strata, sometimes oolitic, that has been widely worked at Lilleshall as a hydraulic limestone that was used as a retarder. The only abandoned limestone mine plan is for Willmoor mine, which indicates mainly early working. This strata is absent at Little Wenlock.
LOWER PALAEOZOIC **Silurian** Wenlock Series **Ordovician** Tremadoc Stage **Cambrian** Comley Series	Wenlock Limestone. The miners were particularly keen to work the large, up to 5km thick and 20m long, hemi-spherical to lenticular masses of almost pure calcareous carbonate, locally known as 'ballstones'. These are scattered vertically within the limestone strata, predominantly in the upper horizons of the formation. At the base of Lincoln Hill mine is a thin seam of Walkers Earth. Wenlock Shales. Within the Coalbrookdale Formation thin bentonitic mudstones and siltstones occur that has been locally mined near Coalbrookdale for Walkers Earth, a low quality Fullers Earth Clay. Sheinton Shale Formation. Very fine grained, laminated, fissile, grey mudstones have been locally worked where they have been baked by thermal metamorphism 23 metres either side of a camptonite intrusion at Maddocks Hill Quarry, near the Wrekin. Wrekin ('Arenite') Quartzite. This is a hard arenitic sandstone that has been quarried in the 20th Century for roadstone at the Ercall Quarries.
PRE CAMBRIAN	Uriconian Volcanic Series. The volcanic rhyolites, tuffs and basalts of the Uriconian hills that outcrop along the Wrekin/Boundary faults have been worked for aggregates. Only one quarry at Leaton Hill, near Wellington, is in current production.
INTRUSIONS	Camptonite Sill. This was locally quarried at Maddocks Hill quarry, near the Wrekin for roadstone in the 20th Century. It forms an unusual occurrence of a vertical sill. Ercall Granphyre. Locally quarried at the Ercall for roadstone.
This summary is based on research carried out by Telford &Wrekin Council.	

4.4 MINERAL EXTRACTION IN SHROPSHIRE: REGIONAL AND NATIONAL SUPPLY

Each year around 4 million tonnes of aggregate is extracted in Shropshire, Telford & Wrekin. About three-quarters of this is crushed rock used principally for road building. The remainder comprises sand and gravel. The county also produces lesser quantities of brick clay, fireclay, opencast coal and building stone. As Mineral Planning Authorities Shropshire and Telford & Wrekin must ensure that sufficient supplies of these minerals are maintained to industry, whilst also ensuring that Shropshire's environment is protected in accordance with the Council's policies.

The current minerals policy document for Shropshire is the Shropshire Telford and Wrekin Minerals Local Plan 1996-2006. This was jointly prepared by Shropshire County Council and Telford & Wrekin Council and contains detailed policies governing mineral development in the plan area. The Minerals Local Plan must ensure that sufficient mineral reserves exist in each year of the plan to produce the county's agreed annual output or 'apportionment', and to provide sufficient reserves at the end of the plan period (the post plan landbank).

The annual apportionment is determined by the West Midlands Regional Aggregates Working Party (WMRAWP). This contains representatives from all the Mineral Planning Authorities in the West Midlands Region, including Shropshire and Telford & Wrekin. The WMRAWP analyses details of mineral production and demand throughout the region, in order to forecast future demand and derive the annual apportionment for individual Mineral Planning Authorities (the 'subregional apportionment'). The Department of Environment, Local Government and the Regions (DCLG) then translates these figures into Mineral Planning Guidance (MPG6).

The DCLG has agreed to save many of the policies in the current Minerals Local Plan beyond their original 2006 expiry date. This reflects the changes brought into effect by the Planning and Compulsory Purchase Act 2004 which involve the replacement of ‘old style’ planning policy documents including Structure and Local Plans with ‘new style’ Local Development Frameworks (LDF). Shropshire Telford and Wrekin are working to produce Minerals Policy Documents for incorporation into their respective LDF’s and the current report will form part of the evidence base for these documents. However, the situation is further complicated in Shropshire by the move to unitary status which will occur in April 2009. As such, the minerals policy documents in Shropshire will form part of a new unitary development framework which will be progressed after the new unitary authority comes into effect. Telford & Wrekin has been a unitary authority since 1998.

5 Unconsolidated sand and gravel

This section describes in more detail the unconsolidated sand and gravel mineral resources in Shropshire. It also outlines the reasoning behind inclusion or exclusion of certain areas of the mineral resource for mineral safeguarding.

5.1 GEOLOGICAL DESCRIPTION

The principal uses of sand is as a fine aggregate in concrete, mortar (building sand) and asphalt, with gravel used mainly as a coarse aggregate in concrete. Substantial quantities of sand and gravel may also be used in constructional fill. The sand and gravel resource in Shropshire is divided into two broad categories:

Sand and gravel derived from Quaternary Superficial Deposits

Sand and gravel derived from Triassic bedrock

This division is based on the different origin of the deposits (Table 3), which influences their likely workable extent and yield, composition, particle size and need for processing, and ultimately their relative importance as an aggregate resource.

Table 3. Types of sand and gravel described in this report, based on geological origin.

Unconsolidated sand and gravel resource	Quaternary Superficial Deposits	Associated with modern valley drainage systems	Alluvium
			River Terrace Deposits
			Glaciofluvial Sheet Deposits
		Associated with glacial/glaciofluvial processes (excluding Glaciofluvial Sheet Deposits)	Glaciofluvial Deposits, undifferentiated
			Glaciofluvial ice-contact deposits
			Concealed Glaciofluvial Deposits
	Bedrock	Pebble conglomerates within Kidderminster Formation	
		Pebble conglomerates within Chester Pebble Beds Formation	

5.1.1 Superficial deposits

Deposits of Quaternary sand and gravel are accumulations of rock fragments and mineral grains that have been derived from the weathering and erosion of bedrock by glaciers during the ice ages and modern fluvial activity. As these processes are effective mechanisms for sorting the deposit, both in terms of particle size and composition, the accumulations of sand and gravel are typically composed of the more durable fraction of the bedrock substrate. The composition of gravels in Shropshire reflects the varied bedrock, with quartz, quartzite and limestone being found alongside more exotic lithologies such as chert and volcanic rock fragments.

The Quaternary sand and gravel resource is split into two types, based on the genetic origin of the deposit: that which is associated with modern valley drainage systems, and that which is associated with glacial and glaciofluvial processes. The former includes Alluvium, River Terrace Deposits and Glaciofluvial Sheet Deposits, with the latter including glacial sand and gravel either present at surface or identified beneath in excess of 1 m of other Superficial Deposits. This separation of the superficial resource reflects, to some extent, the likely particle size which is generally finer in glacial deposits.

Alluvium typically comprises unconsolidated silt and clay, with units of sand, gravel and organic lenses. Deposits of sand and gravel can often be present within the alluvial sequence as channel lag deposits. However, research undertaken by SSC suggests that there is very limited evidence for historical working of recent alluvial deposits. Hence, SCC has requested that alluvium is excluded from the sand and gravel MSA.

River Terrace Deposits are well-developed on the flanks of some of the larger valleys, and represent one of the principal sand and gravel resource in the county. Some gravel-dominated deposits with a terrace like form are thought to be glaciofluvial in origin (**Glaciofluvial Sheet Deposits**); these have been included in the river sand and gravel MSA where they are part of a modern valley drainage system. River Terrace Deposits may sometimes be present as sub-alluvial deposits beneath modern Alluvium. However, this relationship has generally not been recognised by SSC in Shropshire and as a consequence, areas of recent Alluvium have been excluded from the sand and gravel MSA'.

Sand and gravel deposits associated with major modern rivers are typically 4-8 m thick, being thinner elsewhere. The deposits can vary due to depositional conditions, and are influenced by factors such as valley shape and stream confluences.

River gravels vary in composition, reflecting to some extent the geology of the catchment area including the characteristics of any covering of superficial deposits. In the north and east, gravels are likely to be dominated by quartzite pebbles derived from the Sherwood Sandstone Group. Further to the south and west, the underlying bedrock will influence the pebble content, which may be rich in limestone, igneous and metamorphic clasts.

Glaciofluvial deposits occur extensively in north, east and central Shropshire and represent currently the most important sand and gravel resource in the county. Sand and gravel is present either at or near the surface in a patchy spread. These deposits include sand and gravel deposited in contact with an ice sheet (either deposited by meltwaters within, below or in front of the ice sheet), or as glacial outwash plains (sandar) that are deposits with a high sand and gravel content that have a subdued topography; these are in excess of 25 m thick in the Prees and Wem areas. In some districts the deposits of sand and gravel have a pronounced topography, and form hummocks and ridges ('Kame Terraces') thought to have been deposited in contact with a retreating ice sheet ('Ice-Contact Glaciofluvial deposits'). Undifferentiated Glaciofluvial deposits are typically intimately associated with till (boulder clay), and may be interbedded within extensive bodies of till. Glaciofluvial deposits may be concealed by other glacial deposits, some of which have been identified by BGS Industrial Minerals Assessment reports of the 1970-80s and are shown within the Superficial Sand and Gravel mineral safeguarding area. Units of sand and gravel may infill buried channels cut by glacial action into the underlying bedrock or older glacial deposits. Buried channels can be in excess of 20 km long, and over 36 m deep, but can thin rapidly either side of the central channel. In general, due to the apparent chaotic nature of their formation, the geographic distribution of this type of sand and gravel resource is less easy to predict than the deposits associated with modern valley drainage systems.

5.1.2 Unconsolidated bedrock sand and gravel

Shropshire is one of the few counties in England that has important resources of gravel derived from the Permo-Triassic bedrock. This resource has been exploited in the past, and is worked presently near Market Drayton. Two other bedrock sand and gravel sites near Bridgnorth and Newport currently have resolutions to grant planning permission. This resource, which is a potential source of concrete aggregate, comprises poorly-cemented conglomerates (dominantly pebbles with sand). Units of conglomerate are sporadic and of variable thickness within the bedrock sequence and, where conglomerates are absent or thin, the host rock unit is of limited value as an aggregate resource. Consultation with Industry indicates that the formations become finer grained and are generally more strongly cemented in the south of the MPS, therefore the northern outcrop is likely to yield higher quality material.

Bedrock units that have been identified as a gravel resource are restricted to the **Kidderminster Formation** in the east of the county, and the **Chester Pebble Beds Formation** in the Knockin area. Both of these units, which are stratigraphically equivalent, are from the lower part of the Permo-Triassic Sherwood Sandstone Group (formerly termed 'Bunter Sandstone/Pebble Beds'), and are only identified as a resource where they are free from mapped Superficial Deposits. Unconsolidated sand and gravel has also been worked historically from other bedrock sources, including sandstones of Upper Carboniferous age in eastern Shropshire. However, these are not currently considered to be an economic mineral resource and have not been included within the unconsolidated bedrock sand and gravel MSA.

6 Crushed rock aggregate

6.1 GEOLOGICAL DESCRIPTION

The crushed rock aggregate resource in Shropshire is largely confined to Palaeozoic sandstones, some of the Silurian and Carboniferous limestone units, and igneous and metamorphic rocks of varying ages.

6.1.1 Sandstones yielding crushed rock aggregate

The **Bayston-Oakswood Formation** of the Wentnor Group comprises a sequence of coarse-grained purple sandstones and grits with subordinate purple mudstones, siltstones and at least three beds of pebbly sandstone. The Formation, which is Longmyndian (Neoproterozoic) in age, averages 1800 m in thickness. This unit is presently worked at Haughmond Hill, north-east of Shrewsbury, and at Bayston Hill to the south-west of Shrewsbury.

The Cambrian **Wrekin Quartzite Formation** is a structureless, white, cream or pale blue quartzite which may be pebbly in the lower part. The Wrekin Quartzite is up to 50 m thick, and was formerly quarried for crushed rock at the Wrekin.

The **Stiperstones Quartzite Formation**, which is Ordovician in age, is a well-cemented white or pale grey siliceous sandstone which is pebbly in part, and is interbedded with subordinate beds of grey mudstone. It has been formerly quarried for crushed rock in the Pontesbury area, and ranges in thickness from 150 m to 280 m. (152, 165)

Beds of blue-grey mudstone and sandstone comprise the **Mytton Flags Formation**, which overlies the Stiperstones Quartzite. This is quarried for crushed rock at Callow Quarry near Minsterley (recently dormant). The sandstones have also been used historically as a local building stone.

Sandstone units from the Millstone Grit Group (**Cefn-y-Fedw Sandstone Formation** to the west of Oswestry and the **Cornbrook Sandstone Formation** in the Clee Hills area) have been formerly worked, principally for building stone. There may also be a potential for crushed rock use, although there is no evidence of current economic interest from the minerals industry and hence, these strata have been excluded from the crushed rock safeguarding area as currently defined. The Cefn-y-Fedw Sandstone is up to 585 m thick, with the Cornbrook Sandstone significantly thinner at 55-215 m. The sandstones are typically medium- to coarse-grained, rarely pebbly, and well-bedded.

6.1.2 Limestones yielding crushed rock aggregate

Silurian limestones are a major crushed rock aggregate resource, and are present between Telford, Bishop's Castle and Ludlow. Limestones of Silurian age include the **Edgton Limestone Member** of the Alston Mudstone Formation, the **Much Wenlock Limestone** and the **Aymestry Limestone** formations. The Much Wenlock Limestone is up to 30 m thick, and predominantly well-bedded, grey and muddy, interbedded in the lower part with mudstones. The limestone has been extensively worked as a crushed rock aggregate and for agricultural use. The Aymestry Limestone was also extensively worked historically for crushed rock, lime and building stone to the north and east of Church Stretton although more recent workings have concentrated on the Wenlock Limestone. Ordovician limestones including the **Alternata Limestone** and the **Acton Scott** formation have a far more localised outcrop and, as such, are not significant as potential crushed rock resources.

A limestone resource of Lower Carboniferous age includes the **Minera** and **Cefn Mawr Limestone** formations (both part of the Clwyd Limestone Group), which are present to the west

of Oswestry. These pale grey, shelly limestones, which are up to 300 m thick, are characteristically interbedded with mudstone and sandstone. The quality of the lower parts of the limestone is affected by varying degrees of dolomitisation and iron staining; the deposit is irregularly dolomitised in the southern part of the outcrop. This resource is exploited as a crushed rock aggregate and for agricultural use at Llynclys south of Oswestry.

Other smaller areas of Carboniferous limestone include the **Oreton Limestone Formation** (part of the Pembroke Limestone Group), which is up to 46 m thick and located in the south-eastern part of the county; and the **Peak Limestone Group**, which is up to 80 m thick and includes limestones at Lilleshall and Telford. The sequence at Lilleshall is particularly variable in lithology, being interbedded with significant units of sandstone, mudstone and basalt. As these limestone units are significantly thinner than the limestones of the Clwyd Limestone Group, and have a small outcrop and are lithologically variable, they are considered a minor resource.

6.1.3 Igneous and metamorphic rocks yielding crushed rock aggregate

The igneous and metamorphic crushed rock resource includes rocks of varying ages and lithologies, from some of the oldest in the UK, to those associated with younger Caledonian and Varsican mountain building events (Table 4). Igneous rocks are classified as either intrusive (formed from magma or molten rock that solidified below the Earth's surface) or extrusive (formed from lava and volcanic ash erupted onto the earth's surface). In general, intrusive rocks tend to be of more consistent quality for aggregate production.

Table 4. The igneous and metamorphic units which have been included within the crushed rock aggregate minerals safeguarding area.

Name of igneous rock	Component lithologies
CEFN GWYN TUFF	TUFF
ERCALL GRANOPHYRE	GRANOPHYRIC GRANITE
HAGLEY VOLCANIC FORMATION	VOLCANICLASTIC ROCKS (BOTH PYROCLASTIC & REWORKED VOLCANIC ROCKS)
HELMETH GRIT MEMBER	TUFFACEOUS-SANDSTONE
HOPE SHALE FORMATION	VOLCANICLASTIC-SANDSTONE
HYSSINGTON VOLCANIC MEMBER	VOLCANICLASTIC ROCKS (BOTH PYROCLASTIC & REWORKED VOLCANIC ROCKS); VOLCANICLASTIC-SANDSTONE; TUFF, FELSITE and TUFFITE
LITTLE WENLOCK BASALT MEMBER	BASALT
PRIMROSE HILL METAMORPHIC COMPLEX	GNEISS; SCHIST
RUSHTON SCHIST	SCHIST
STAPELEY VOLCANIC MEMBER	TUFF AND SANDSTONE; TUFF, MAFIC and TUFFITE; VOLCANICLASTIC-SANDSTONE
URICONIAN GROUP	BASALT; RHYOLITE; TUFF; DACITE; ANDESITE; TUFF AND LAVA;
UNNAMED IGNEOUS INTRUSION, ORDOVICIAN	MICROGABBRO; ANDESITE
UNNAMED IGNEOUS INTRUSION, ORDOVICIAN TO SILURIAN	BRECCIATED-PORPHYRITIC FELSITE; PORPHYRITIC FELSITE
UNNAMED IGNEOUS INTRUSION, WESTPHALIAN	MICROGABBRO
UNNAMED SILL, WESTPHALIAN	MICROGABBRO
UNNAMED IGNEOUS INTRUSION OF UNKNOWN AGE	MICROGABBRO

These rocks outcrop mainly in the southern, central and western parts of the county. Dolerites intruded into Carboniferous Coal Measures rocks are worked for crushed rock at Clee Hill Quarry east of Ludlow. Dormant quarries with planning permission to work Ordovician igneous rock are located at More near Bishop's Castle and Llanyblodwel south of Oswestry.

7 Coal

7.1 GEOLOGICAL DESCRIPTION

Due to the current economic situation, commercial exploitation of coal is weighted towards opencast extraction and not deep mining. Coal is present as beds within the Coal Measures (which, in Shropshire, are split into the Pennine Lower and Middle Coal Measures formations) and Warwickshire groups. The main exposed coalfields in the county are shown in table 5.

Table 5. Details of the main coalfields within Shropshire.

Coalfield	**Activity**
Coalbrookdale/Broseley	Currently worked; opencast (incidental to fireclay extraction)
Clee Hills	Recently worked; opencast at Clee Hill Quarry Historical opencast and deep mining
Severn Valley & Wyre Forest	Formerly worked deep mining at Highley and Alveley (to 1970s) and at Wyre Forest.
Denbighshire (Oswestry)	Formerly worked; deep mining
Leebotwood	Historically worked, deep mining
Shrewsbury	Historically worked, deep mining

There are three coal resource safeguarding areas. The Pennine Lower and Middle Coal Measures are grouped together, and contain the thickest, good quality coals. The Halesowen Formation of the Warwickshire Group typically contains thinner, more widely spaced coals of poorer quality. The coal resources in the Coal Measures and Warwickshire groups may be suitable for either extraction by deep or opencast methods. A third coal resource safeguarding area is shallow coal with less than 50 m of overburden.

7.1.1 Pennine Lower and Middle Coal Measures Formations

These are present in all the coalfields mentioned above. These strata are the main target for opencast coal extraction as they contain zones of relatively closely spaced, thick coals. 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 Coalbrookdale Coalfield is the most important in Shropshire, both in terms of size and thickness of coals. Deep mining, which peaked in the mid 19th Centaury, ceased in 1979. Opencast mining on a large, co-ordinated scale, began during the middle part of the 20th Centaury, and continues to the present day. Opencast mining has operated in tandem with land reclamation associated with the development of Telford New Town, begun in the 1960s. Opencast resources are today largely depleted, with only a few remaining potential sites. Current opencast activity is restricted to the southern part of the coalfield, near Broseley, where coal is recovered with fireclay. The main workable coals are restricted to the upper part of the Lower Coal Measures, above the Little Flint Coal, and the lower part of the Middle Coal Measures, below the Fungous (Marquis) Coal (Figure 2), with the interval up to the Big Flint coal being the main opencast resource. In total, 16 coals have been opencast in the coalfield; these are typically less than 1.2 m thick, and seam splits are common in certain seams, which can complicate estimation of the resource.

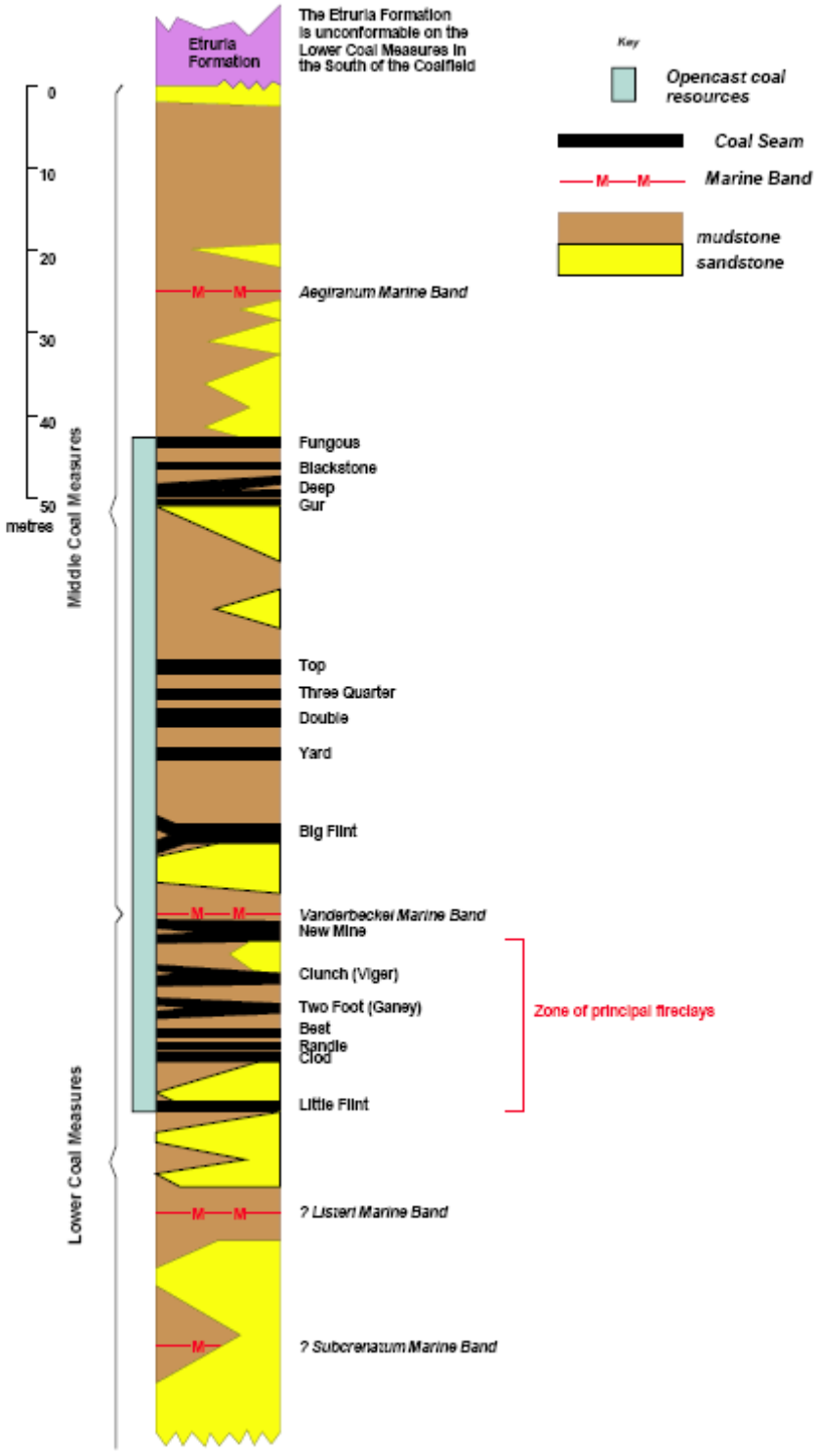

Figure 2: Generalized vertical section of the Lower and Middle Coal Measures of the Coalbrookdale Coalfield.

The Clee Hills Coalfield was worked between 1988 and 1992 for coal. The coalfield is intruded by a dolerite sill, and coal was removed as overburden in an exercise to work the dolerite as aggregate (Crump and Donnelly, 1994).

The Oswestry Coalfield is largely covered by a variable spread of Superficial Deposits. Coals have been won by deep mining in the past, although the quality of the coals is believed to be low,

and consequently the resource potential is probably low. The coalfield has not been exploited by opencast activities.

Coal Measures in the Wyre Forest Coalfield were worked by deep mining methods up to 1969. There has been no opencast interest in this coalfield since deep mining ceased.

7.1.2 Halesowen Formation

Coals from the lower part of the Warwickshire Group have been worked in the Coalbrookdale and Shrewsbury coalfields, from the **Halesowen Formation**. Three coals have been worked in the Shrewsbury Coalfield, with a combined thickness of 2 m in approximately 70 m of strata. The ratio of coal to overburden suggests that the opencast potential for coals within this unit is low.

The Halesowen Formation has an extensive outcrop and contains numerous, typically thin coals, including the Main Sulphur and Little Sulphur coals. It is likely that the ratio of coal to overburden is poor, and that the overburden is likely to comprise a large proportion of hard sandstone, and that, as with the Shrewsbury Coalfield, the opencast potential for this unit is low.

7.1.3 Buried coal resource overlain by up to 50 m of overburden

A **buried coal resource overlain by up to 50 m of overburden** has been included in the coal safeguarding area. This includes the concealed down-dip part of the exposed Coal Measures and Warwickshire groups. For this study, overburden is defined as bedrock, and does not include Superficial Deposits, which over parts of the Coalbrookdale Coalfield are up to 17 m thick. These areas have a theoretical opencast potential, which is dependant on the thickness and type of overburden, and the ratio of coal to overburden.

7.1.4 Deeper coal deposits underlie significant areas of north and east Shropshire. These may have potential for future deep mining or coal-bed methane recovery as technologies and market conditions evolve. However, it is not considered appropriate or practicable to incorporate these deeper coal deposits in the current mineral safeguarding area.

8 Brick clay and Fireclay

8.1 GEOLOGICAL DESCRIPTION

The safeguard areas relating to clay resources in the Shropshire area are split between Brick Clay (‘common clay and shale’) and Fireclay. Brick Clays from the **Warwickshire Group** (Etruria and Halesowen formations- see Figure 2; previous nomenclature is given in Table 6) are used predominantly in the manufacture of structural clay products, including facing and engineering bricks, but also as pavers, clay tiles and vitrified clay pipes. Fireclays typically occur as beds of seatearth (fossil soils) beneath coal seams and the term ‘fireclay’ is restricted to describe seatearths of economic importance. The fireclay resource is restricted in Shropshire to the Carboniferous **Coal Measures and Warwickshire groups**. Fireclays are used for refactory purposes, and increasingly in the production of buff-coloured facing bricks and pavers.

8.1.1 Brick Clay

Modern brick manufacturing processes require raw materials with predictable and consistent firing properties, which can be achieved if needed by blending different clays. The principal brick clay resource in Shropshire comes from mudstones overlying the productive Coal Measures including the Etruria Formation (formerly known in Shropshire as the ‘Hadley, Kinlet

and Ruabon marls') and the overlying Halesowen Formation (formerly known in Shropshire as the Coalport, Highley, Newcastle, Keele and Coed-Yr-Allt 'formations').

A lower unit of brick clay in the Warwickshire Group, comprising over 90 m of red and purple mudstones and siltstones, interbedded by lenticular sandstones (called 'espleys') has been exploited in the Telford area. This interval was known by a variety of informal and local names in different coalfields (Table 6). Following a rationalization of the stratigraphy of the late Carboniferous red-beds (Powell et al., 2000), these equivalent units were formally termed the **Etruria Formation** and assigned to the Warwickshire Group. The Etruria Formation is worked in the Coalbrookdale Coalfields. The relative proportions of clay minerals within the Etruria Formation, and low levels of impurities (which can cause black coring in bricks, or high emissions levels) makes the mudstone particularly suitable in the production of high quality facing and engineering bricks, pavers, and roofing and floor tiles.

The **Halesowen Formation** is a sequence of mudstone and sandstone, with subordinate beds of coal and limestone. The formation is 120-150 m thick in the Coalbrookdale Coalfield, with individual sandstones reaching 40 m. Mudstones from the Halesowen Formation (formerly known in Shropshire as the Coalport, Highley, Newcastle, Keele and Coed-Yr-Allt 'formations') have been historically used as a brick clay in Telford and the Severn Valley. The Salop Formation conformably overlies the Halesowen Formation, and represents a return to red-bed sedimentation. The lower part of the Salop Formation is termed the **Alveley Member** (formerly the upper part of the 'Keele Formation/Beds'), and is worked for brick clay to the south of Bridgnorth. The Alveley Member is up to 158 m thick and comprises calcareous mudstones with locally developed beds of sandstone and limestone.

Table 6. Current and former nomenclature of the Warwickshire Group (Upper Carboniferous).

	Current nomenclature	**Previous nomenclature**
Warwickshire Group	**Clent Formation**	Not present in Shropshire
	Salop Formation:	Radwood Formation (North Staffordshire)
	Enville Member	Enville Formation (Shropshire; South Staffordshire)
	Alveley Member	Parts of the Keele Formation/Beds (South Staffordshire)
		Parts of the Erbistock Group (Shropshire)
	Halesowen Formation	Highley Formation (Wyre Forest Coalfield)
		Coalport Formation (Coalbrookdale Coalfield)
		Coed-yr-Allt Formation (Shrewsbury and Denbigh coalfields)
		Newcastle Formation (North Staffordshire)
		Parts of the Newcastle and Keele formations (Shropshire; South Staffordshire)
		Parts of the Erbistock Group (Shropshire)
	Etruria Formation	Kinlet Formation (Wyre Forest Coalfield)
		Hadley Formation (Coalbrookdale Coalfield)
		Ruabon Marl (Shrewsbury and Denbigh coalfields)
		Old Hill Marl (South Staffordshire)

8.1.2 Fireclay

Fireclays are beds of non-marine sedimentary clays that usually underlie a coal seam. Beds of fireclay are typically thin (less than 1.5 m) and widely spaced, making surface working one of the few viable sources of the clay. As they are associated with coal beds, fireclays are usually worked by opencast methods as a by-product of coal extraction. The zone of principal fireclay resource within Shropshire is from the upper 20 m of the **Lower Coal Measures Formation**, specifically between the Little Flint and New Mine coals in the Coalbrookdale Coalfield (Figure 2). The Lower Coal Measures are present at surface in the western part of the Coalbrookdale Coalfield, from Lawley to Little Wenlock and Ironbridge, north of the River Severn. Production in this coalfield has historically been dependant on the level of opencast coal activity, but with the decline in opencasting the only current source is Caughley Quarry in the Broseley area, where high quality fireclay, brick clay and ancilliary coal is currently extracted by opencast methods. Fireclays are laterally variable in thickness and quality, and contain 23-33% Al_2O_3 (uncalcined), and become more siliceous towards the east. Individual fireclays horizons are named after the overlying coal seams. The principal fireclays are the Clod, Randle, Ganey (Two Foot), Clunch and New Mine (Upper Clunch) in ascending stratigraphic order. Although the fireclay resource is largely coincident with the opencast coal resource for the Lower Coal Measures, extensive areas have already been worked out.

A small area of Lower and Middle Coal Measures strata is present in the Oswestry Coalfield. Due to extensive cover by Superficial Deposits, detail on the strata is insufficient to enable the boundary between the two formations to be mapped out with any certainty, although it is possible that there is a fireclay resource in this coalfield. The combined thickness of the Lower and Middle Coal Measures is in excess of 200 m, although only a very limited amount of this would be expected to yield fireclays of any importance.

8.1.3 Other clays

Other widespread sources of brickclay have also been worked historically in Shropshire, including Lower Palaeozoic, Permotriassic and Devonian Musdtones and glacial and alluvial clays. Ordovician clays are worked to the west of Shropshire, at Buttington near Welshpool and similar low calcium clays occur within the county. Fluvioglacial clays at the base of a sand and gravel deposit at Bromfield Quarry near Ludlow have been used for small-scale brick making trials at the Acton Scott Historic Working Farm near Craven Arms. It is possible that some of these clays may be the subject of more substantial economic interest in the future. However, at present, there is insufficient evidence to justify the inclusion of non-Carboniferous clays in Shropshire's Brickclay safeguarding area.

9 Building stone

9.1 GEOLOGICAL DESCRIPTION

The wide range of building stones found in Shropshire is a result of the county's extremely diverse geology. Building stone has been extensively used historically, particularly in the south and west of the county, and the characteristics of the individual stone types adds character and distinctiveness to the county's historic buildings. Rocks from all geological periods present in the county have been utilised historically as building stones. However, only a few of these are quarried now or have been worked recently, mainly to provide specialist sources of stone for small-scale building and conservation schemes. Of these, five rock units remain of sufficient importance to warrant inclusion in the mineral safeguard areas.

The Ordovician **Hoar Edge Grit Formation** comprises up to 120 m of brown coarse-grained, locally calcareous sandstone that is pebbly in the lower part. The Formation (also known as the

'Harnage Stone') is present between Clungunford and Cressage, and the more calcareous lower part has been used throughout its outcrop as a general building and roofing and walling stone.

Fine-grained purple and brown mottled sandstones within the **Chatwall Flags,** and the overlying **Chatwall Sandstone** (also known as Soudley and Horderley Sandstone) have yielded high quality building stones, used locally in churches, farms and cottages. The Chatwall Flags, which are 23 – 91 m thick, and the Chatwall Sandstone, which are up to 152 m thick are present between Aston on Clun and Acton Burnell.

Dark grey flaggy sandstones are common in the upper part of the Ordovician **Cheney Longville Formation**. These beds are micaceous and fine-grained, and split into tabular slabs, making them suitable for use as a roofing stone. The flags are present between Aston on Clun and Cressage, and attain a full thickness in the region of 240 m.

Very fine-grained calcareous sandstones, siltstones and limestones of the Silurian **Upper Ludlow Shales Group** have been worked extensively in the past for building stone in the Corvedale area between Craven Arms and Much Wenlock and are currently worked at Diddlebury. The best quality stone is found in the more calcareous strata near the junction with the underlying Aymestry Limestone Formation. At stratigraphically higher levels, the increased mud content can result in the stone weathering badly. The main crop of the Group in Shropshire is between Shelderton and Broseley, with smaller areas of outcrop at All Stretton and Neen Sollars.

'White', cream and red-coloured sandstones of Triassic age have been quarried on a large scale in the Grinshill, Clive and Myddle area. These sandstones are from the **Helsby Sandstone Formation** (upper Sherwood Sandstone Group), with the 'white' and cream sandstone locally known as '**Grinshill Stone**' and the red sandstone locally known as '**Myddle Sandstone**'. The Helsby Sandstone and the equivalent Bromsgrove Sandstone has an extensive crop in Shropshire and historically has been quarried extensively throughout its outcrop. However, the highest quality, most homogeneous and thickly bedded sandstones (freestones) are best developed in the area around Grinshill where they form sharp escarpments. Quarries are currently operational at Myddle (red sandstone) and Grinshill (white/cream sandstone), and supply high quality ornamental building stone for regional and national use.

Other important historical sources of stone include the flagstones of the Upper Ludlow, Cefn Einion formation around Clun, the dark red Devonian (Ditton) Sandstones around the Clee Hills, the Mid Carboniferous Cefn-Y-Fedw sandstones around Oswestry and the Upper Carboniferous (Salop Formation) sandstones of the Severn Valley, which at Stanley south of Highley were used historically to supply stone for Worcester Cathedral. There is currently insufficient evidence to justify the inclusion of these other stone types in the building stone safeguarding area but this situation will be kept under review by the Mineral Planning Authorities .

A comprehensive account of the building stones of Shropshire can be found in Scard (1990).

10 Conclusions

This study has provided SCC and T&W with a clearly defined and delineated set of MSAs. BGS has provided advice and followed the recommendations and guidance, of ‘A guide to mineral safeguarding in England’ (McEvoy et al., 2007) in support of MPS1, where possible. The final decisions have been made by SSC with the aim of creating a practical MSA that will be used in the implementation of policy within the forthcoming Core Strategy.

Paper maps and Adobe PDF documents were provided to SCC showing the mineral resources and MSA within the Mineral Planning Authority. The digital data was supplied in the form of ESRI shapefiles for use in a Geographical Information Systems. SCC licensed the BGS mineral resource linework for the county for this project, supplied under licence to SCC.

A wide range of minerals have been worked historically in Shropshire. This study identifies those mineral resources which are considered most likely to be the subject of economic interest on the basis of current market information. The Mineral Planning Authorities will need to review the mineral safeguarding areas periodically to ensure that they continue to accurately reflect our understanding of mineral resources and safeguarding as technologies and markets evolve.

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Appendix 1 Consultation letter to stakeholders

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Shropshire County Council

Mineral Safeguarding Areas

Dear

Shropshire County Council and Telford and Wrekin Council have 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 the Appendix to this letter along with a list of related documents.

Consultation process and timescales

Consultation with industry (either directly with operators and/ or trade bodies as appropriate) and other stakeholders will be by letter, email, telephone and, where agreeable, onsite meetings. It is hoped that onsite meetings will take place mainly in late February and early March 2008.

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 draft 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.

The Draft Maps

The maps showing the mineral resources are as follows:

- Superficial sand and gravel
- Bedrock sand and gravel
- Coal
- Other Resources (Igneous, Limestone, Clay, etc)
- Bedrock and Superficial Geology (all formations)

I appreciate not all of these maps will be of interest to you, please disregard those that are not. Please note there are a number of discontinuities on the maps.

- On the Bedrock and Superficial geology map (All Formations) the south-west corner has not been mapped to the same scale as the rest of the map.
- The legend on the Bedrock and Superficial geology map is alphabetical not stratigraphical.
- Resource linework is more detailed in some areas because additional studies have been undertaken, therefore the resource boundary may end abruptly.
- The area in the north-west region does not extend beyond the Shropshire boundary into the buffer zone; however this will be included in the final maps.

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/included from the final map.

Please feel free to annotate the maps and return to me at the above address, or highlight areas of concern that you may wish to discuss further.

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

Yours sincerely

Rhonda Newsham

Project Leader, British Geological Survey

0115 9363461
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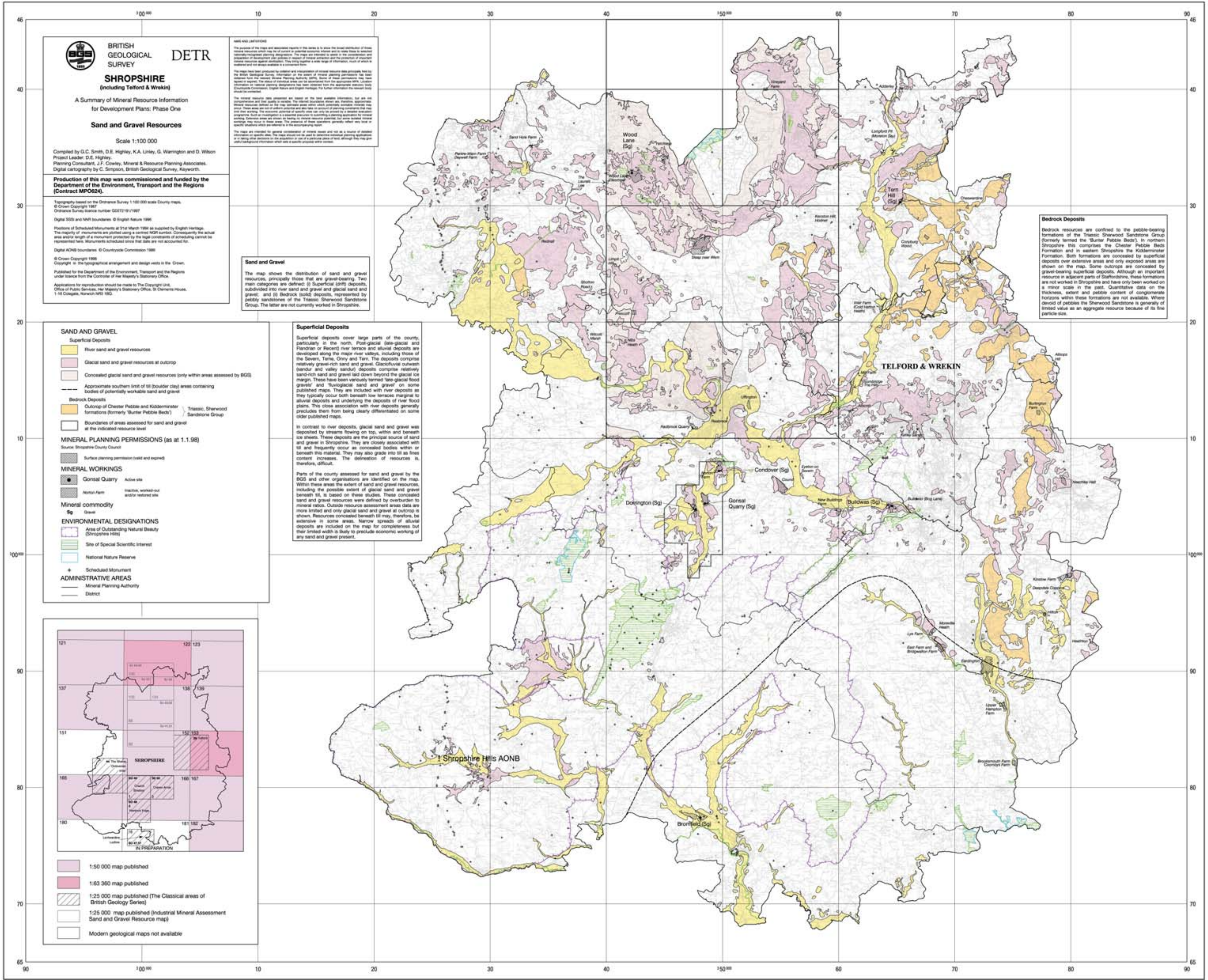
Map 1 Published BGS 'County Minerals Resource Map' for Shropshire (Sand and Gravel)



Map 2 BGS 'County Minerals Resource Map' for Shropshire (Other Resources)

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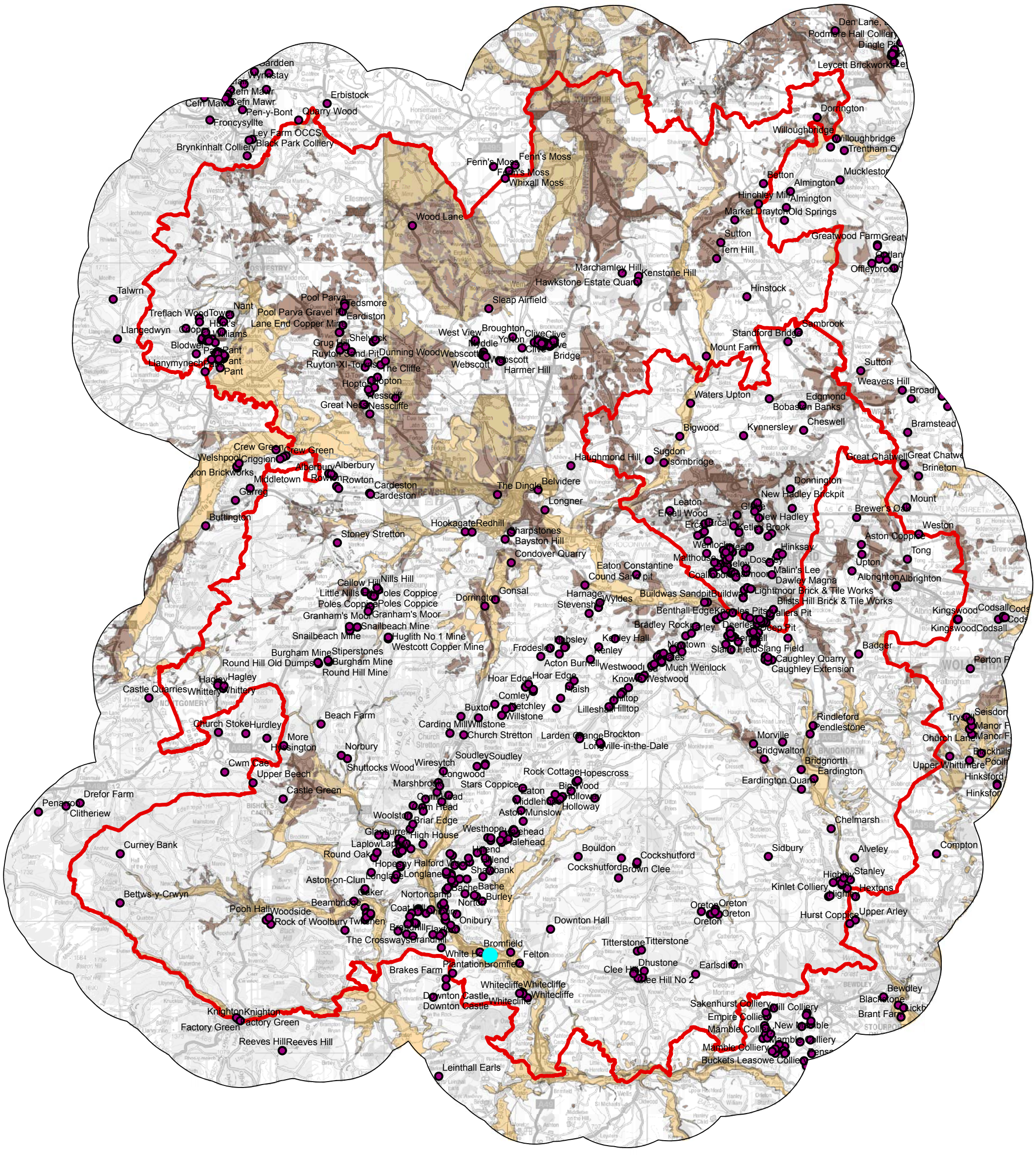
Map 3 Shropshire Mineral Safeguarding Consultation
Superficial Sand and Gravel



- Concealed glacial sand & gravel (only within areas assessed by BGS)
- Concealed river sand & gravel (only within areas assessed by BGS)
- Glacial sand and gravel
- River sand and gravel
- MPA Boundary (SCC & T&W)
- Active and Disused Workings

0 5 10 15 Km

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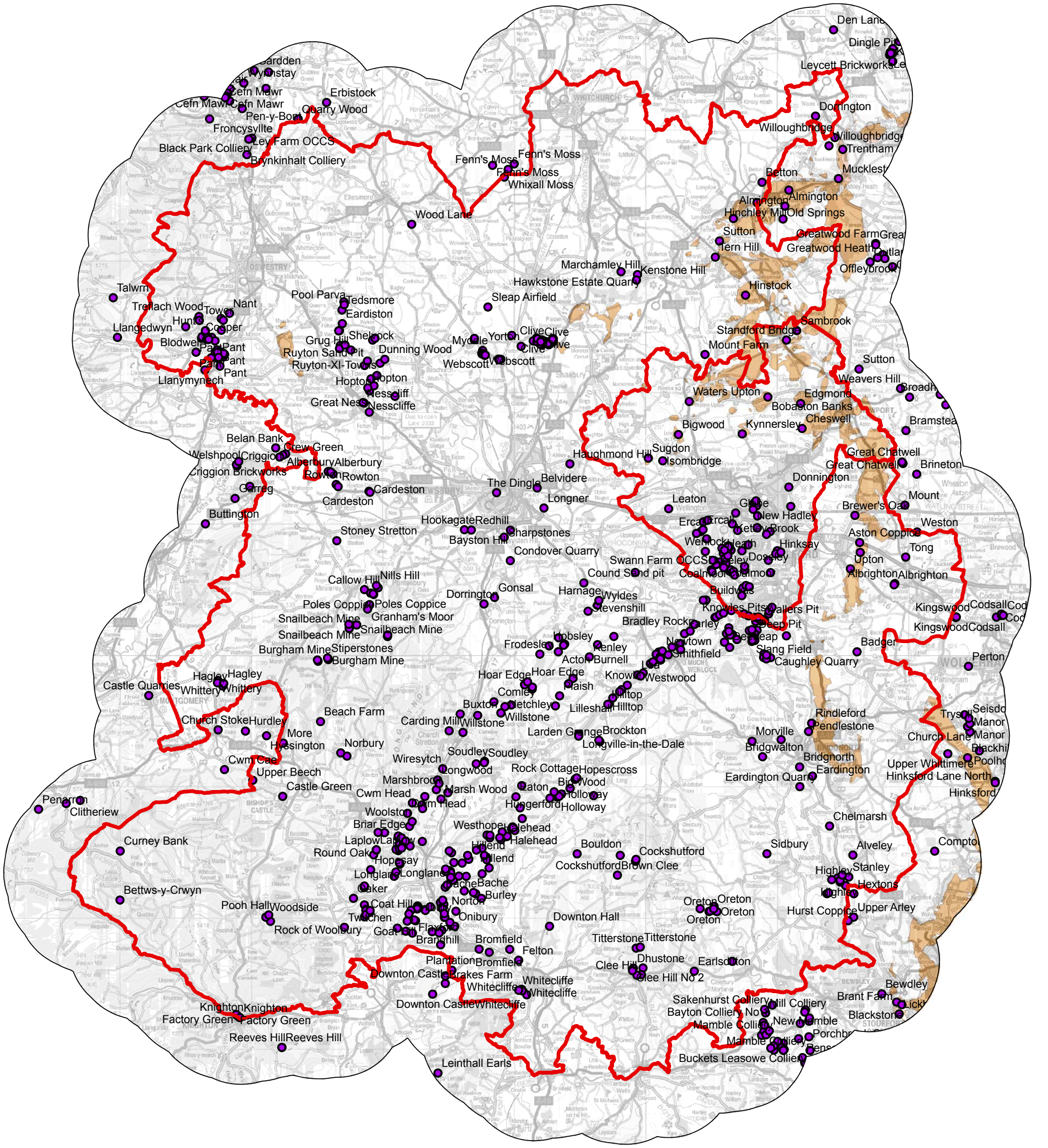
Map 3a Shropshire Mineral Safeguarding Consultation
Bedrock Sand and Gravel



Bedrock sand and gravel
Concealed bedrock sand and gravel
MPA Boundary (SCC & T&W)
Active and Disused Workings

Map 4 Shropshire Mineral Safeguarding Consultation
Coal

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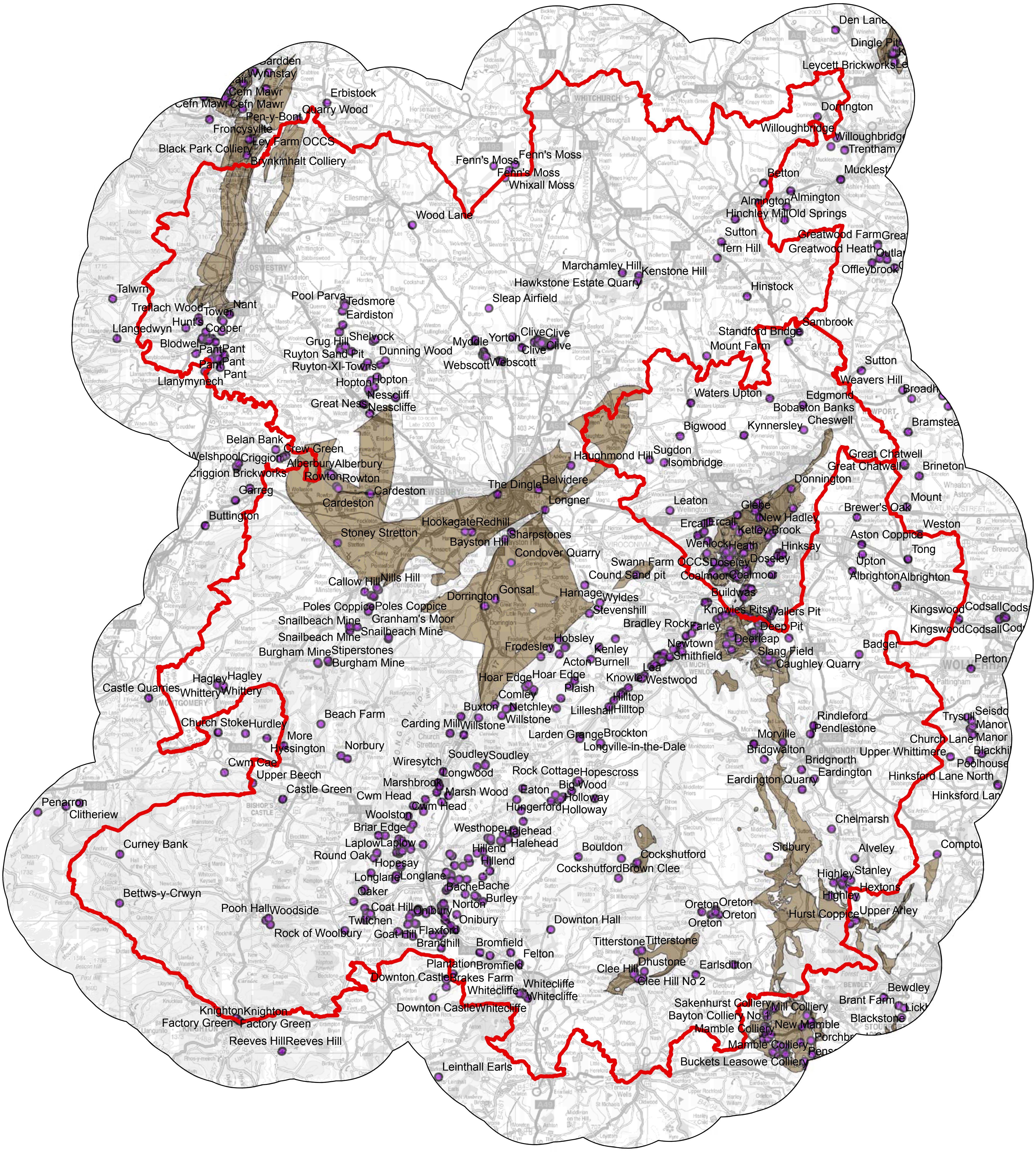

0 5 10 15 Km

- Coal
- MPA Boundary (SCC & T&W)
- Active and Disused Workings

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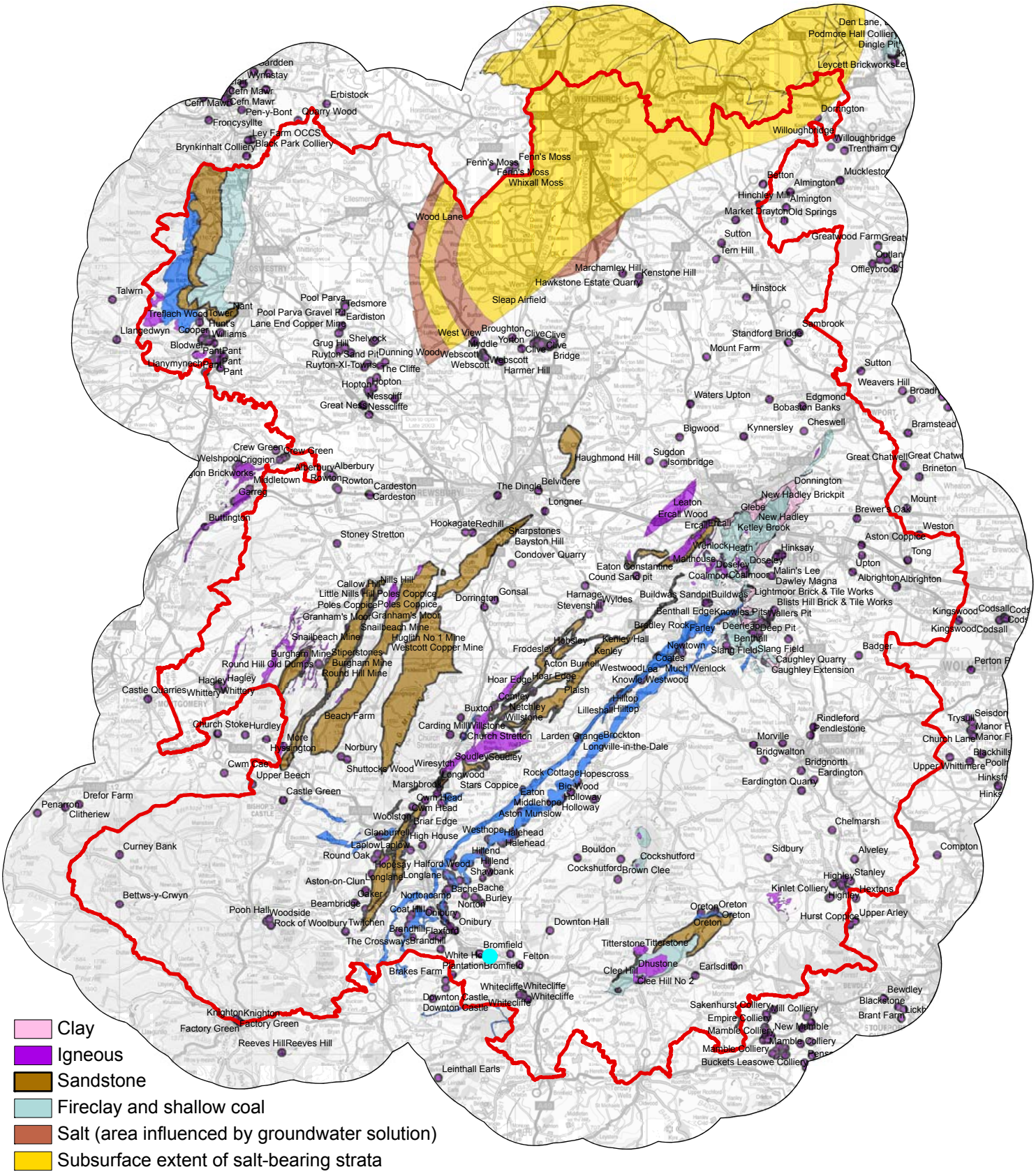
Map 5 Shropshire Mineral Safeguarding Consultation Other Mineral Resources



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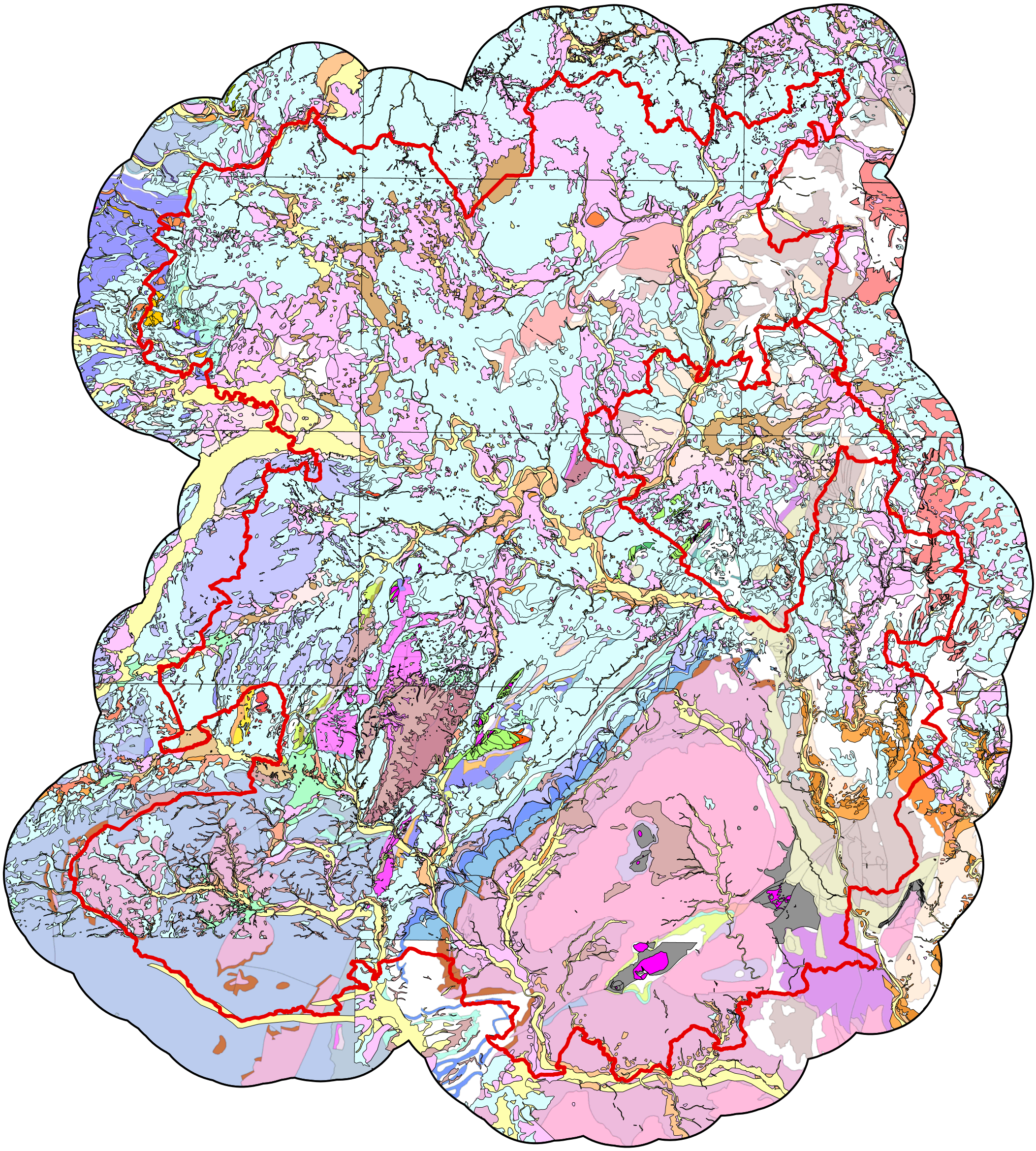
Map 6 Shropshire Mineral Safeguarding Consultation Geology Map (For Reference Only)



MPA Boundary (SCC & T&W)

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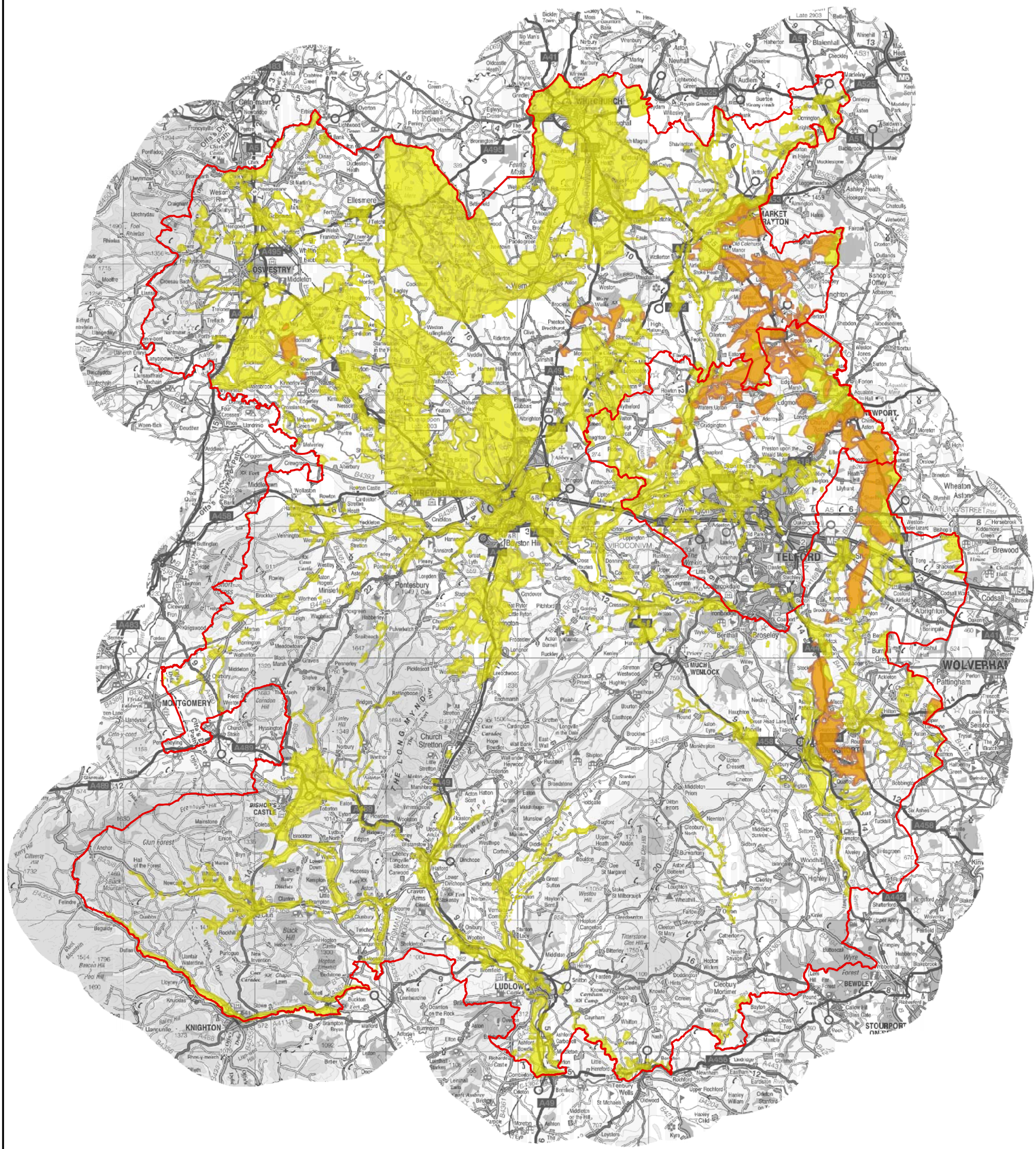
Map 7 Shropshire - Sand and Gravel



MPA Boundary (SCC & T&W)

Unconsolidated Superficial Sand & Gravel

Unconsolidated bedrock Sand & Gravel

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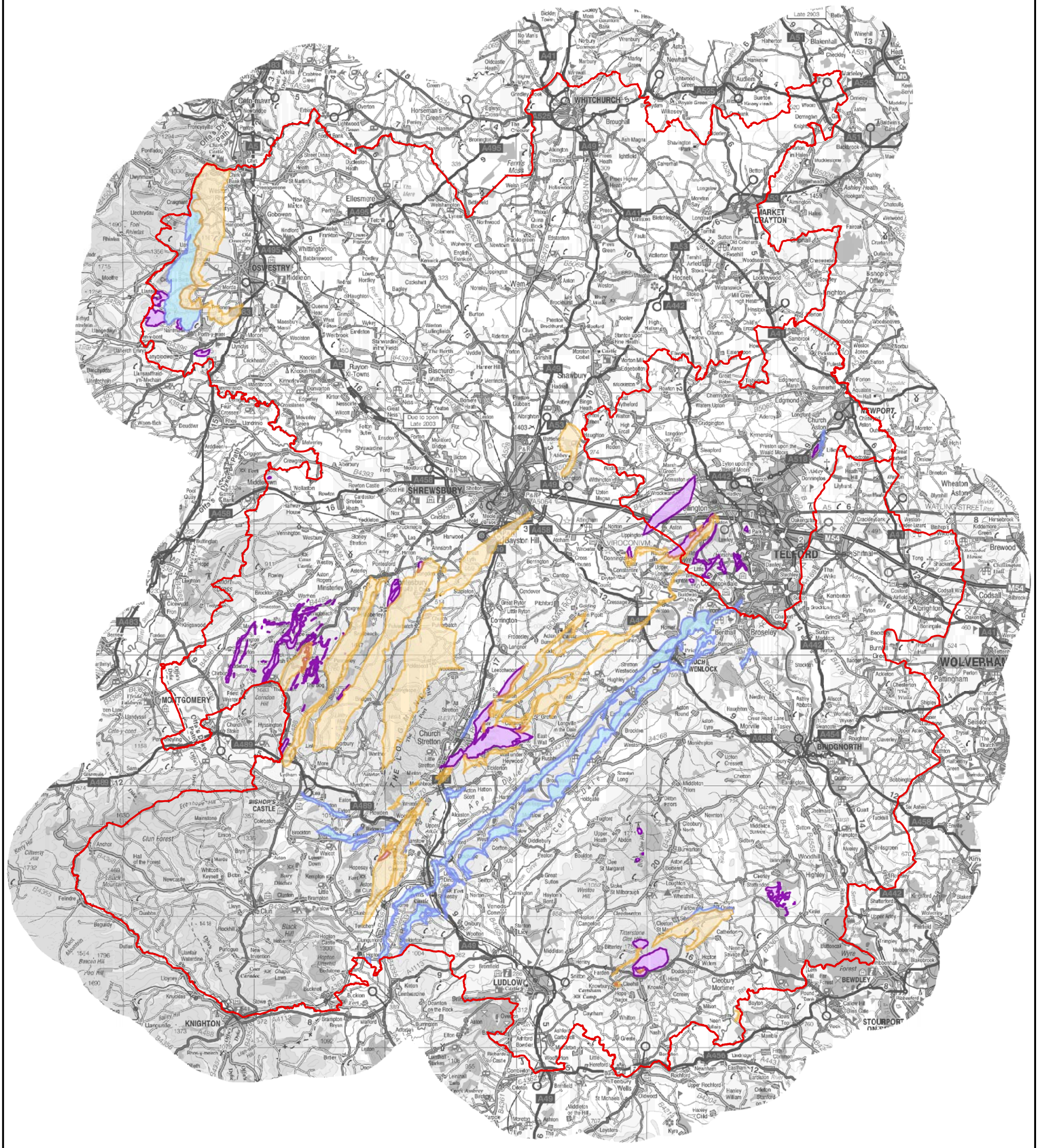
Map 8 Shropshire - Crushed Rock



MPA Boundary (SCC & T&W)

sandstone

limestone

igneous

0 5 10 15 Km

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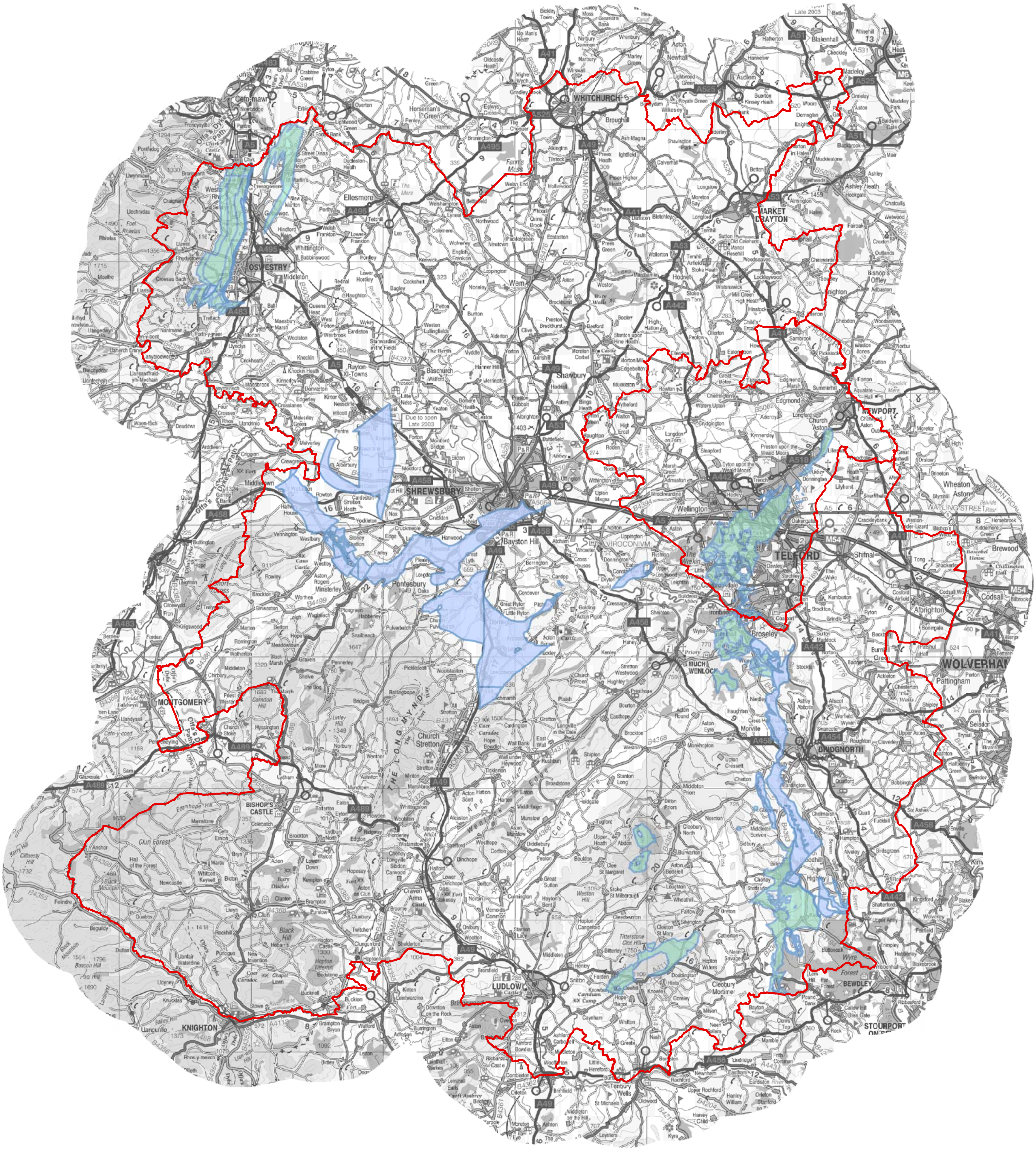
Map 9 Shropshire - Coal



0 5 10 15 Km

MPA Boundary (SCC & T&W)

Coal (Lower & Middle Measures)

Coal (Except Lower & Middle Measures)

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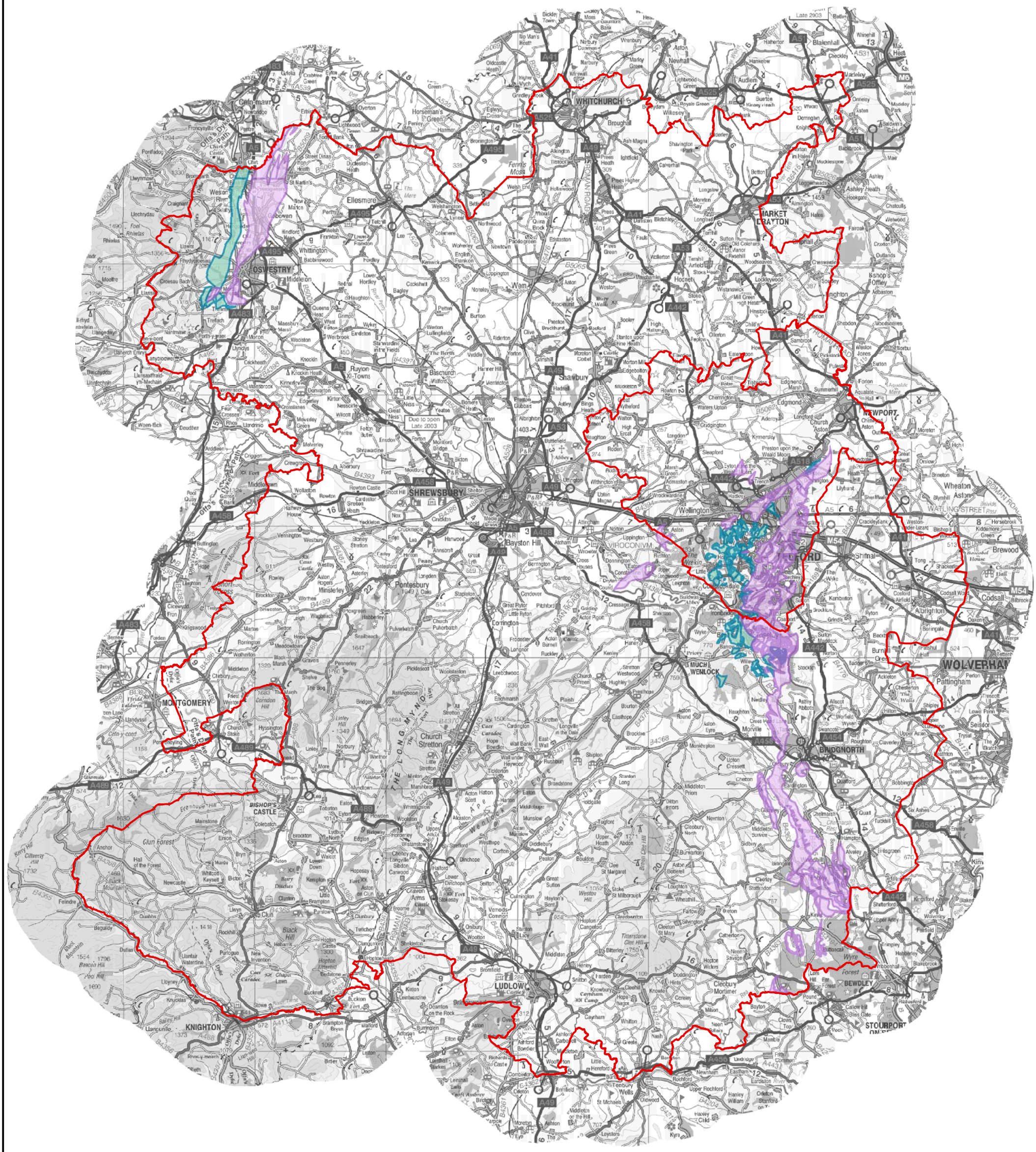
Map 10 Shropshire - Brick Clay & Fireclay



MPA Boundary (SCC & T&W)

Brickclay

Fireclay

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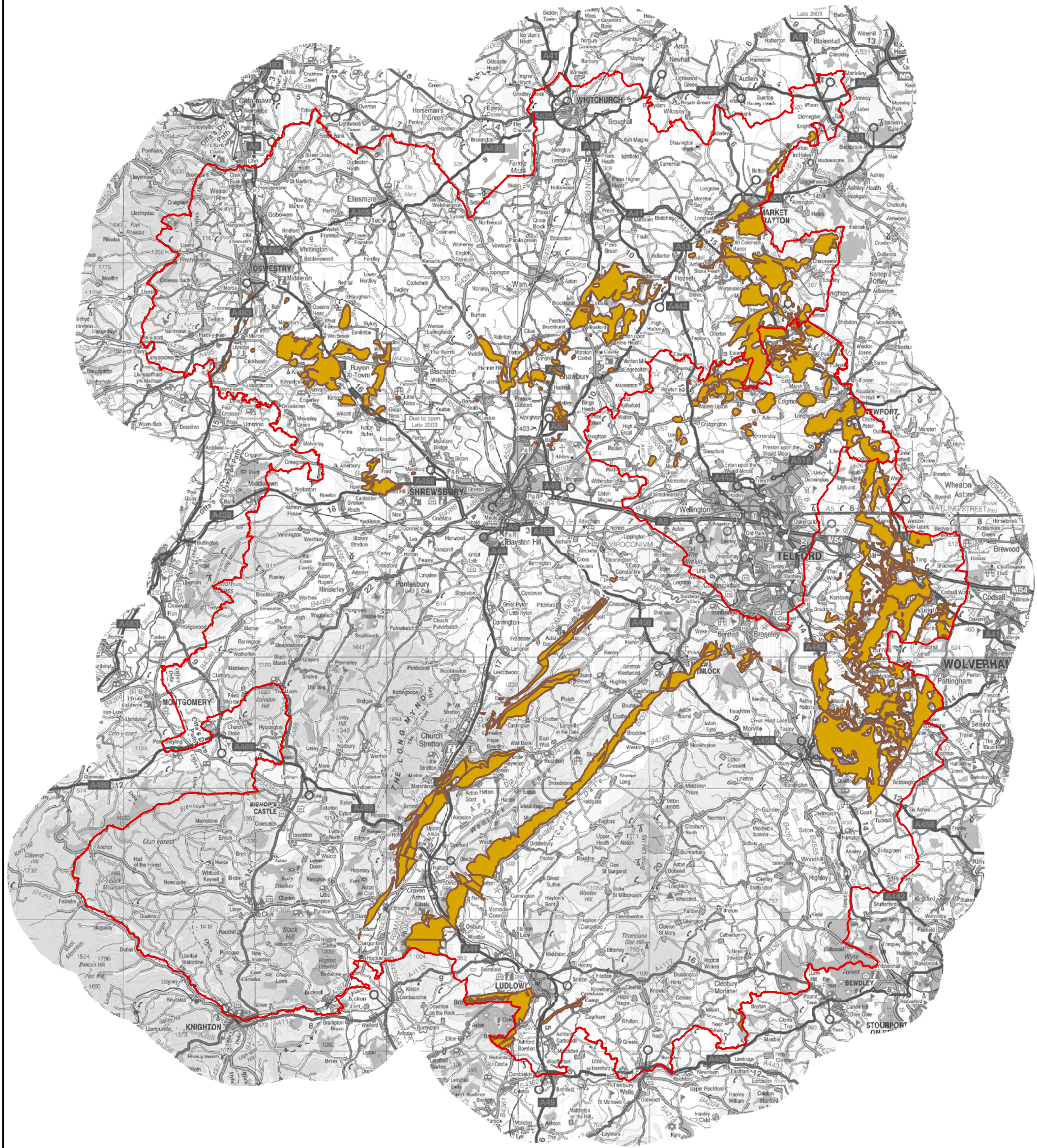
Map 11 Shropshire - Building Stone



MPA Boundary (SCC & T&W)

Building Stone

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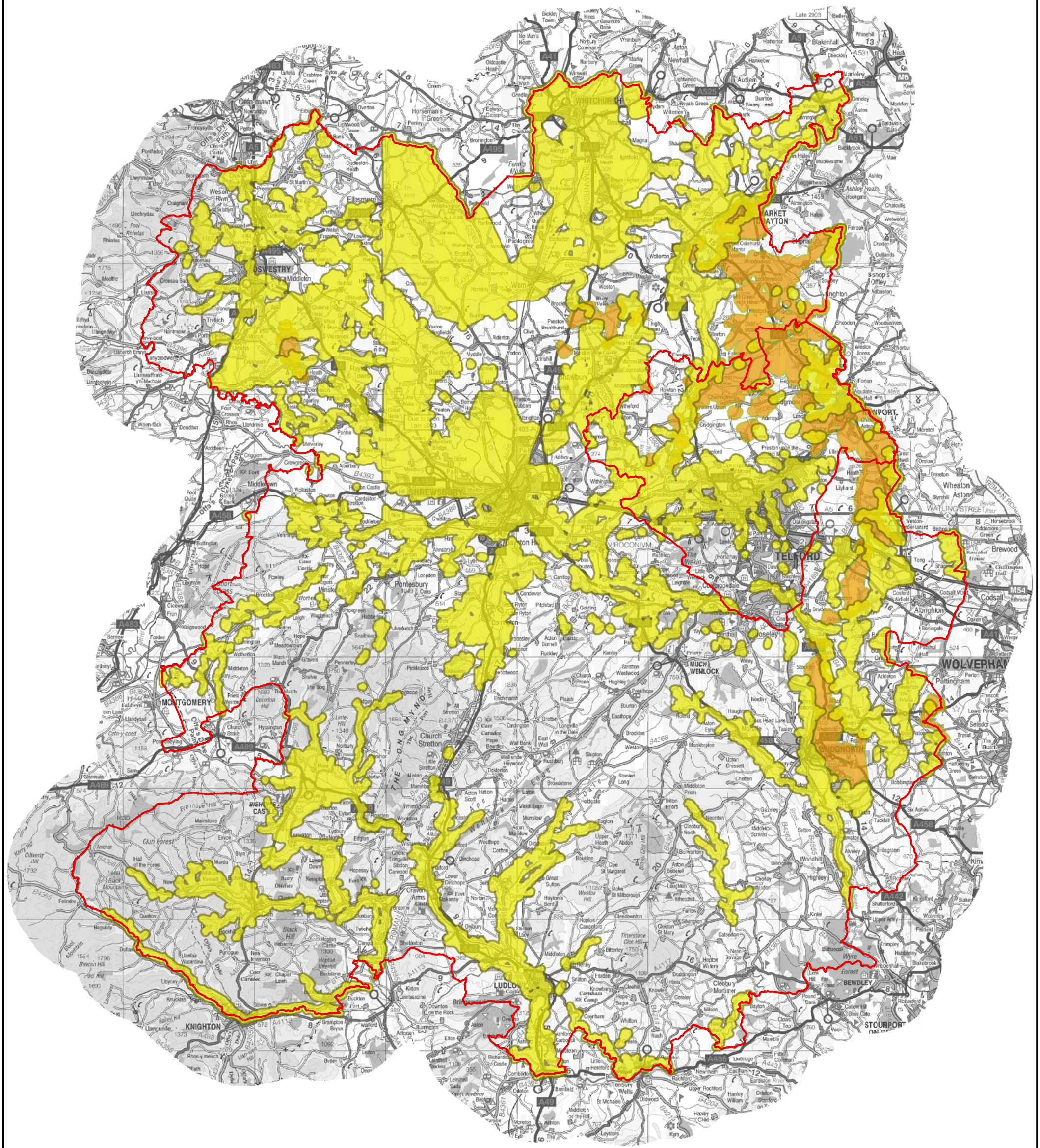
Map 12 Shropshire - Sand and Gravel MSA



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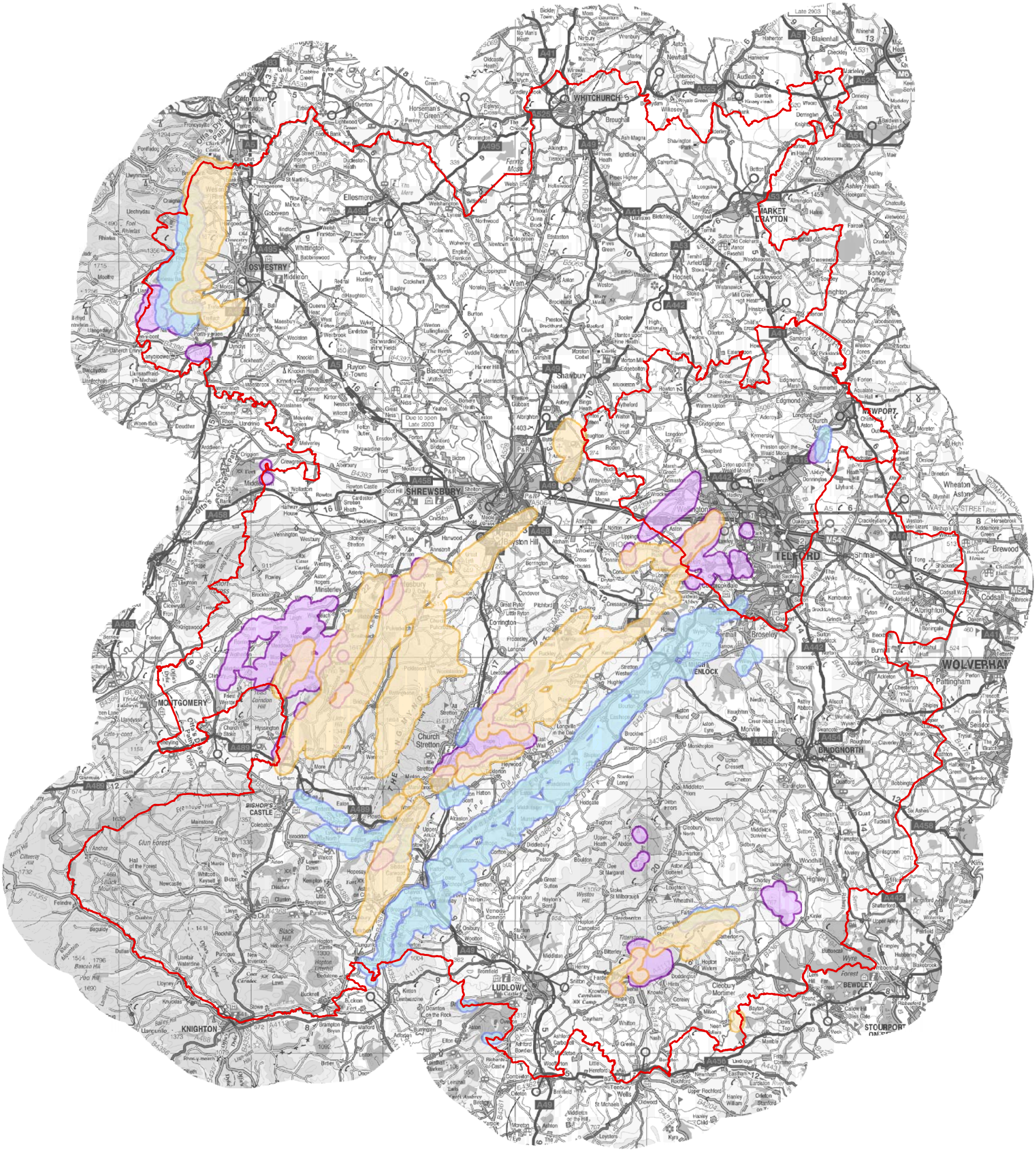
Map 13 Shropshire - Crushed Rock MSA



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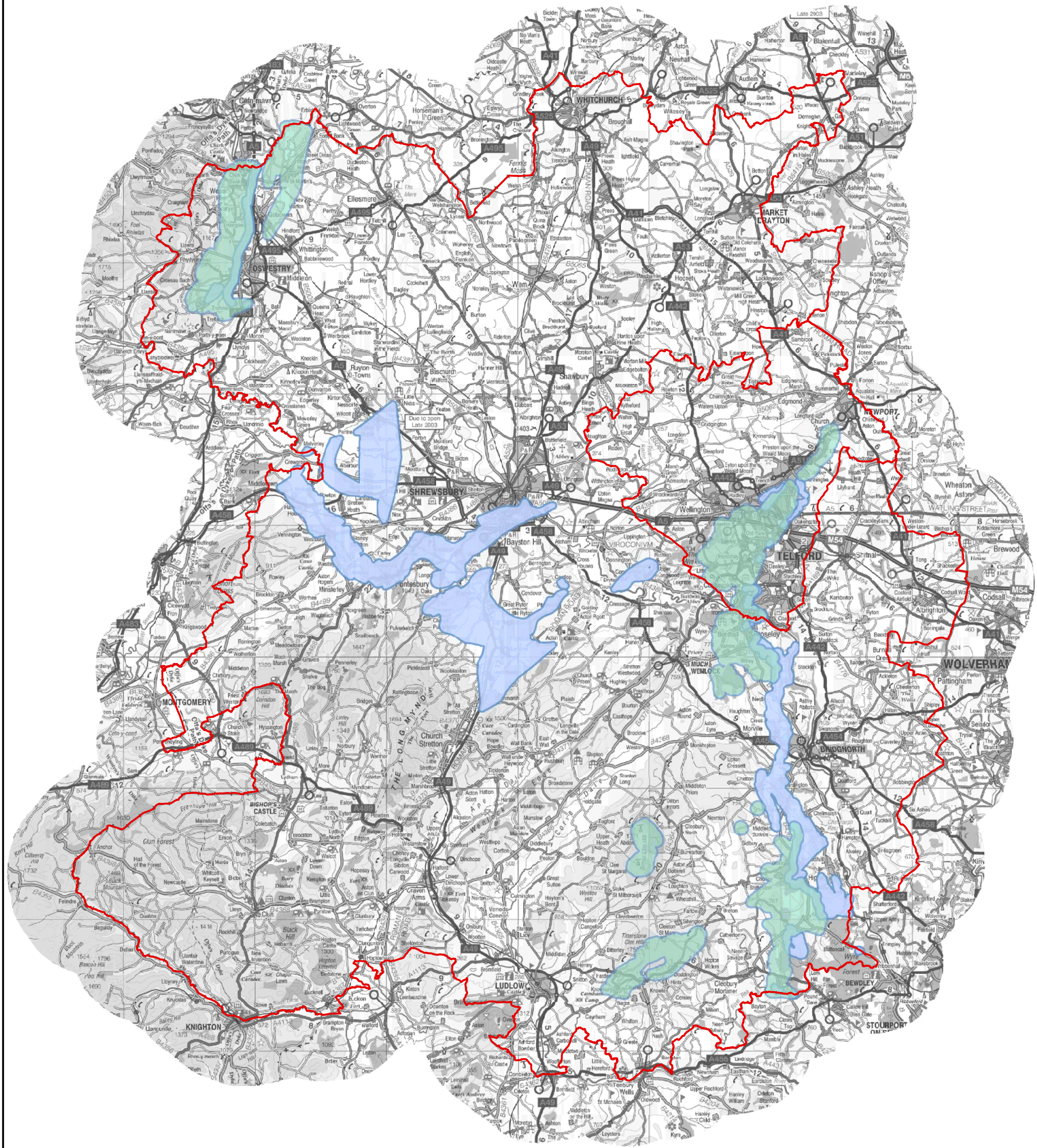
Map 14 Shropshire - Coal MSA



MPA Boundary (SCC & T&W)

Coal (Except Lower & Middle Measures)

Coal (Lower & Middle Measures)

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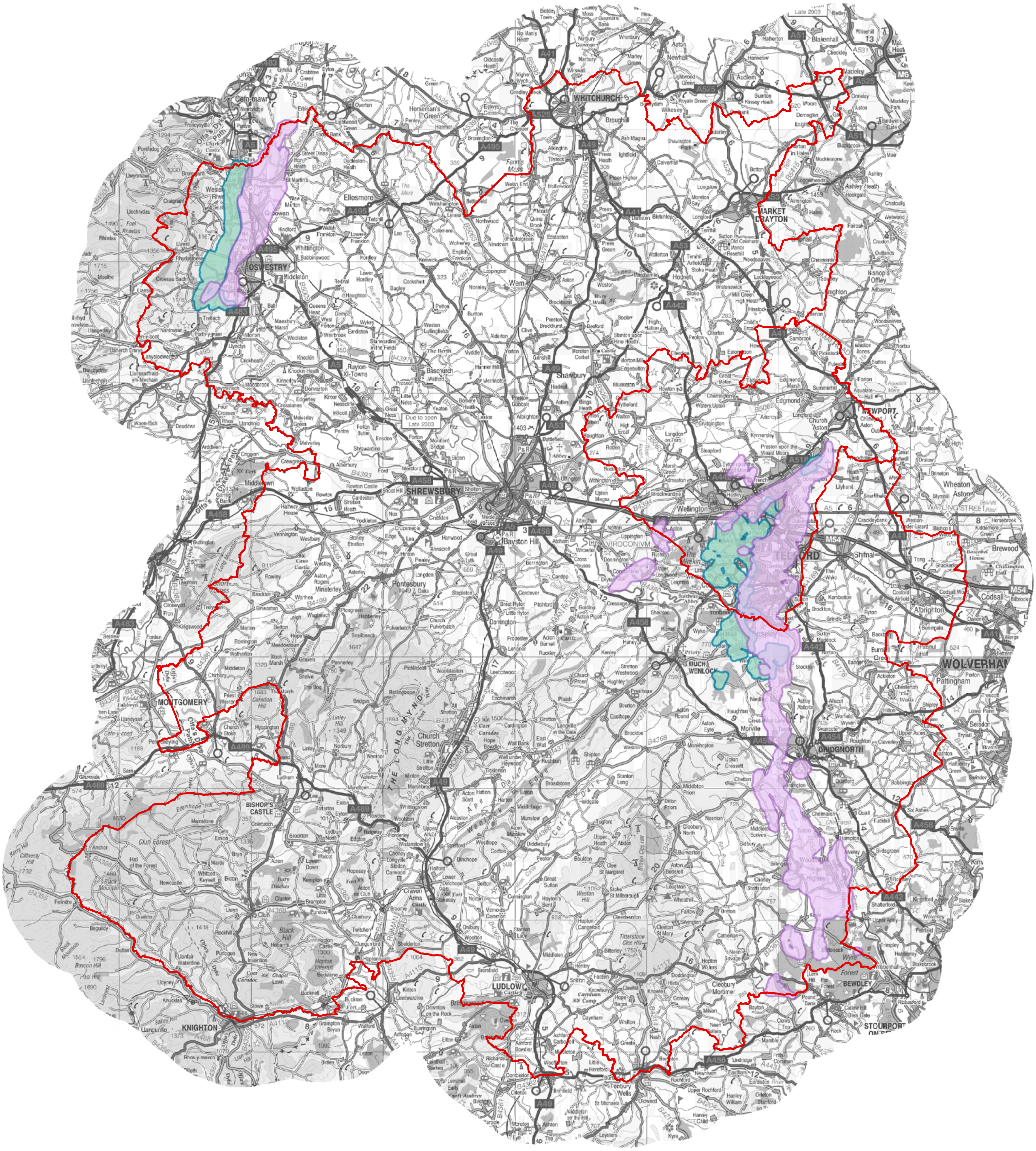
Map 15 Shropshire - Brick Clay & Fireclay MSA



0 5 10 15 Km

MPA Boundary (SCC & T&W)

Brick Clay MSA

Fireclay MSA

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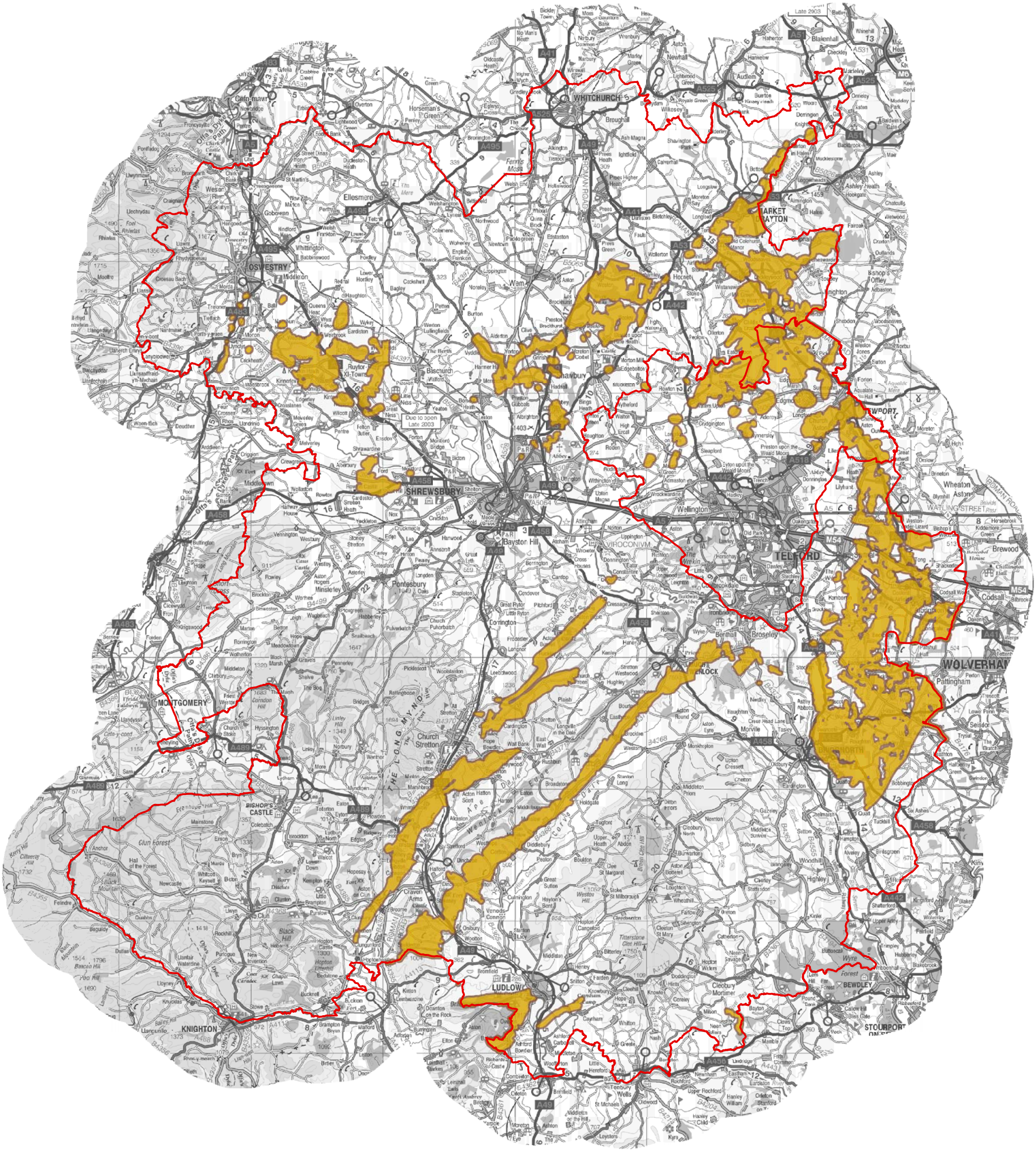
Map 16 Shropshire - Building Stone MSA



MPA Boundary (SCC & T&W)

Building Stone MSA

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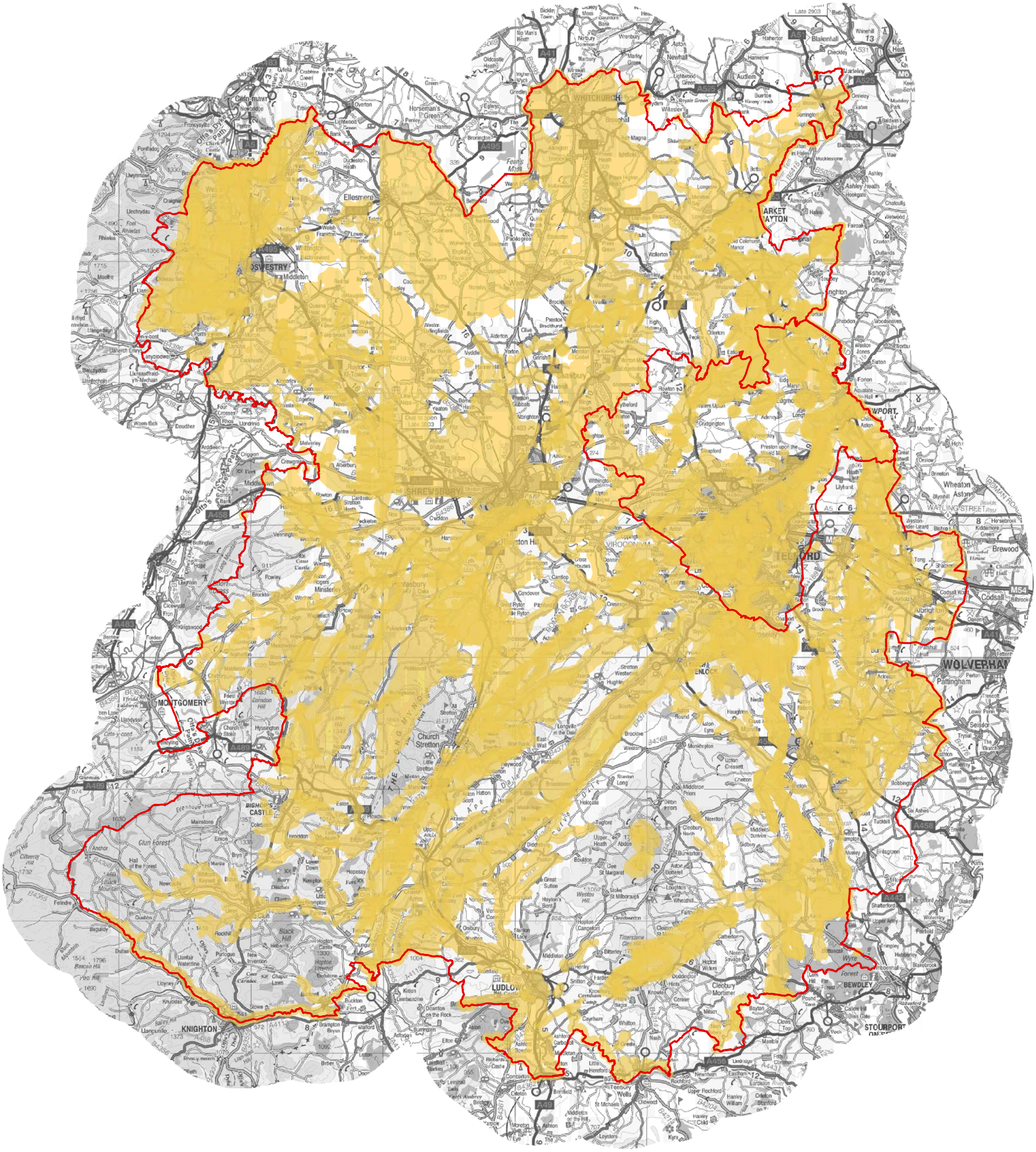
Map 17 Shropshire - Mineral Safeguarding Areas



MPA Boundary (SCC & T&W)