Your Dales Rocks
Draft Local Geodiversity Action Plan

North Yorkshire Geodiversity Partnership

NIDDERDALE Area of Outstanding Natural Beauty

YORKSHIRE DALES National Park Authority

ENGLISH NATURE

NYGP

North Yorkshire County Council

Harrogate BOROUGH COUNCIL

ENGLISH NATURE The Countryside Agency Landscape Access Recreation
DEFRA'S AGGREGATES LEVY SUSTAINABILITY FUND GRANT SCHEME

BGS 1835 British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Tarmac

Hanson

The 'Your Dales Rocks Project' – A Draft Local Geodiversity Action Plan (2006-2011) for the Yorkshire Dales and the Craven Lowlands

The Yorkshire Dales and Craven Lowlands have a diverse landscape that reflects the underlying geology and its history. The auditing and protection of this geodiversity is important to help preserve the landscape and the underlying geology. It is also important to help integrate the needs of the local population, education, recreation and science with quarrying and the National need for aggregate. This draft Action Plan sets out a framework of actions for auditing, recording and monitoring the geodiversity of the Dales and Craven lowlands. As its title indicates, it is a draft and subject to change as comments are made and incorporated. The implementation of the Action Plan is also dependent on funding becoming available. For this draft, the North Yorkshire Geodiversity Partnership is particularly thankful for the support of the Aggregates Levy Sustainability Fund from the Department for the Environment, Food and Rural Affairs, administered by English Nature, and the Landscape, Access and Recreation side of the Countryside Agency. It is also very grateful to the organisations of the authors and steering group listed below (and whose logos appear on the front cover) that have invested staff time and money to make this draft Action Plan a reality. Over time, the plan will evolve and Adrian Kidd, the project officer (address below) welcomes suggestions and comments, which will help to formulate the final version of the Geodiversity Action Plan. This plan and future updates will be placed on the North Yorkshire Geodiversity Partnership web site http://www.nygp.org.uk and on the 'Your Dales Rocks' website http://www.yourdalesrocks.org.uk

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Introduction

North Yorkshire is the largest county in England. It has a rich landscape, which includes two national parks (the North York Moors and the Yorkshire Dales) and three Areas of Outstanding Natural Beauty (the Forest of Bowland (part), the Howardian Hills and Nidderdale). Unlike many other counties, which have produced county level Biodiversity Action Plans, those in North Yorkshire have been at either district level or have covered a specific area as for example *'Nature in the Dales'*, the Biodiversity Action Plan for the Yorkshire Dales National Park. Local Geodiversity Action Plans (LGAPs) are being prepared following a similar pattern with the North East Yorkshire Geology Trust producing LGAPs for the Scarborough and Ryedale Districts (including the North York Moors National Park and the Howardian Hills Area of Outstanding Natural Beauty), and the North Yorkshire Geodiversity Partnership preparing LGAPs for the remainder of the County.

The Boundary of the 'Your Dales Rocks Project'

The area covered by the 'Your Dales Rocks Project' includes two closely interrelated geological zones the Askrigg Block in the north (which underlies much of the Yorkshire Dales National Park) and the Craven Basin in the south. It includes all the Yorkshire Dales National Park, all of Nidderdale AONB and the northern part of the Forest of Bowland AONB. In addition, it includes the remaining parts of Craven District that lie between the national park and North Yorkshire County Council boundaries (Figures 1 and 2).

Figure 1. Local Geodiversity Action Plan area with the Yorkshire Dales National Park and adjacent Areas of Outstanding Natural Beauty (AONB).

The Project area covers parts of the following local authority areas (Figure 2):

- North Yorkshire County Council
  - Craven District Council
  - Harrogate Borough Council
  - Richmondshire District Council
- Cumbria County Council
  - South Lakeland District Council

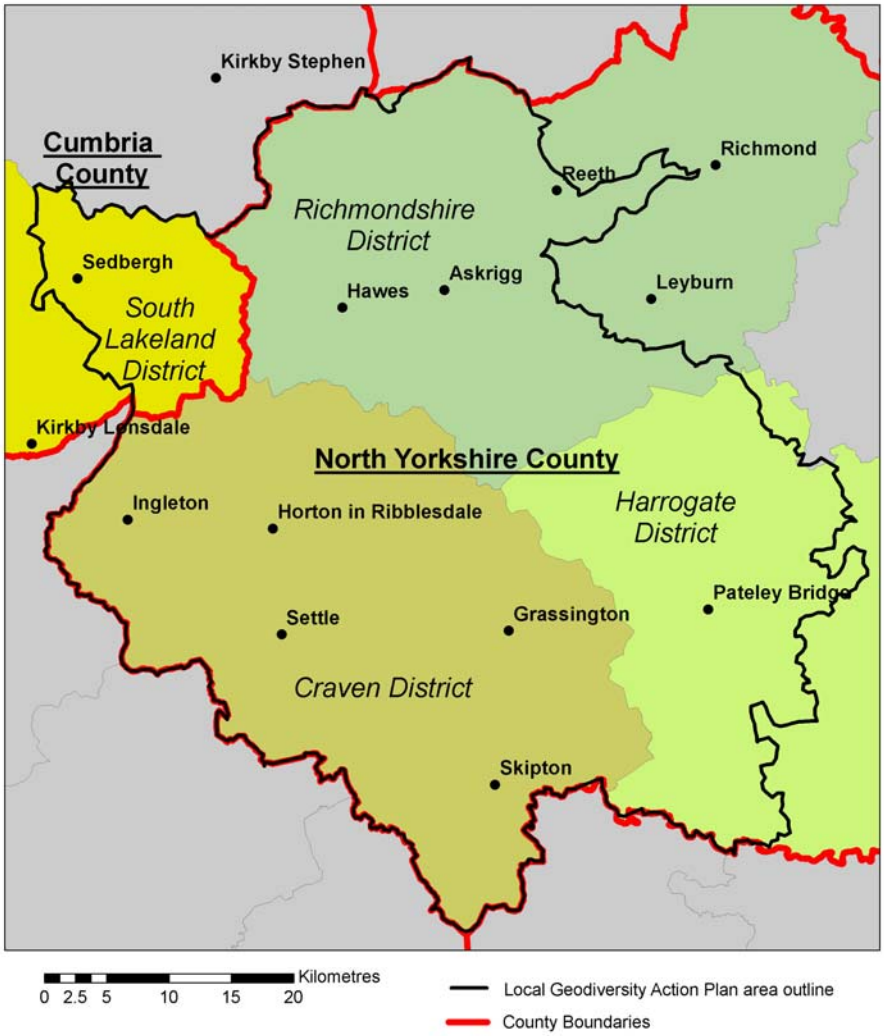

Figure 2. Map of the Local Geodiversity Action Plan area, county and district local authorities

Geodiversity - learning from the rocks

In addition to what is naturally exposed, old quarries and mines can show us important things about the rocks. These are useful for teaching, scientific understanding, recreation, and the preservation of our geological heritage. The whole range of natural and man-made "rock-related" components is the geodiversity of the area. Geodiversity has been defined as: *'the link between people, landscapes and their culture: it is the variety of geological environments, phenomena and processes that make those landscapes, rocks, minerals, fossils and soils which provide the framework for life on Earth'* (Stanley 2001) and as: '*the natural range of geological, geomorphological and soil features, assemblages, systems and processes*' (Pemberton 2002).

Geodiversity is the foundation of our environment that should be cherished and protected.

Geodiversity issues

It is a widely held, but erroneous, popular view that geological features are 'permanent' and are not in need of the level of conservation afforded to biodiversity. In 1996 as part of the Natural Areas Project, English Nature identified a range of threats to the Project areas geodiversity which include:

- the loss of limestone pavement
- damage to the underground cave systems through both internal and external activities
- the loss of quarry exposures through landfill
- degradation of sites due to vegetation growth and natural processes

The purpose of a Local Geodiversity Action Plan (LGAP)

English Nature's website states that:

'*…the common aim of LGAPs is the **conservation and enhancement of geodiversity**. LGAPs are being developed to provide a framework for the **delivery** of geoconservation, in part, developed from the model of Biodiversity Action Plans and have adopted the process of setting clear aims and objectives, with measurable targets, for local geoconservation in order to provide:*

- *a structured approach to local geoconservation*
- *wider awareness of geological sites and geoconservation*
- *increased protection for existing and newly identified sites, and*
- *a framework for grant applications.*

Local Geodiversity Action Plans (LGAPs) set out actions to conserve and enhance the geodiversity of a particular area. In general they aim to:

- *identify, conserve and enhance the best sites that represent the geological history of an area in a scientific, educational, recreational and cultural setting*
- *promote geological sites and make geoconservation relevant to people*
- *provide a local geodiversity audit (an audit of sites and skills)*
- *influence local planning policy'.*

The 'Your Dales Rocks Project' is one of a series of Local Geodiversity Action Plans (LGAPs) covering the country. English Nature Research Report No. 601(Burek and Potter, 2004), *Local Geodiversity Action Plans - sharing good practice* provides a summary of a workshop held, in December 2003, by English Nature. It examines the common features of six recently completed LGAPs (Cheshire Region, County Durham, Leicestershire and Rutland, North Pennines AONB, Staffordshire, Tees Valley and Warwickshire). The report and a leaflet summarizing the workshop are available to download from English Nature at www.english-nature.org.uk).

At present there is no national geodiversity strategy similar to that set out in the 1994 *UK Biodiversity Action Plan* (DEFRA 1994) and in *'Working with the grain of nature – a biodiversity strategy for England'* (DEFRA 2003). Jonathan Larwood of English Nature and Cynthia Burek, Chair of NEWRIGS, have recently stated the need for a National GAP (Larwood, 2006: Burek, 2006)

Any action plan related to an area's geodiversity has to include references not only to surface and sub-surface geology but to the impact of the exploitation of geological features such as mineral deposits, the contribution the area has made to the development of the study of the science of geology, the existence of rock, mineral, fossil, literature and map collections and the link between the geology and landscape.

The North Yorkshire Geodiversity Partnership

The North Yorkshire Geodiversity Partnership (NYGP) is made up of representatives from local authorities, the minerals industry, geological and ecological organisations. Towards the end of 2004 informal approaches were made to a variety of potential partners considered to have an interest in earth science conservation in North Yorkshire. Following those initial approaches, in March 2005, the British Geological Survey, English Nature, Hanson Aggregates, Harrogate Borough Council, Nidderdale Area of Outstanding Natural Beauty, North Yorkshire County Council, Tarmac, and the Yorkshire Dales National Park Authority agreed to form the Steering Group of the NYGP. The NYGP is also the steering group for a RIGS Group affiliated to UKRIGS. To avoid potential overlap, discussions were held with Mike Windle, the Director of the North East Yorkshire Geology Trust to establish the boundaries of the Partnership's area. The 'Your Dales Rocks Project' only covers the western section of the Partnership's area. The production of an LGAP for the remaining area, the Vale of York, is one of the future aims of the Partnership.

Designated areas and geodiversity conservation in the project area

The majority of the Project area is so important in terms of its landscape, archaeology, biodiversity and geodiversity that it has statutory protection (i.e. it is protected by law). The two main types of landscape-scale designation are:

National Parks - The Yorkshire Dales National Park is one of nine national parks in England. It was designated in 1954 with the twin aims of conserving and enhancing its natural beauty, wildlife and cultural heritage, and promoting opportunities for the understanding and enjoyment of its special qualities by the public (Figure 1).

Areas of Outstanding Natural Beauty (AONB) – The whole of the Nidderdale AONB (designated in 1994) is within the project area. The area also includes the northern part of the Forest of Bowland AONB, which was designated in 1964 (Figure 1).

Specific types of geodiversity site have been identified using the Earth Science Conservation Classification (ESCC) developed in 1990 and revised in 2004 (English Nature Research Report 561, Humphries and Potter, 2004). **Exposure** sites are defined wherever surface rocks are exposed as in quarry faces and river sections. **Integrity** sites include sites that have features, such as fossils or minerals, (that are valuable for their rarity) or geomorphological features, such as drumlins, screes and karst, which are important elements of the landscape.

Since 1977, over 3000 **Geological Conservation Review (GCR)** sites, throughout the UK, have been identified by the Joint Nature Conservation Committee (JNCC). They represent the most important national and in some cases international geological sites, and the majority have been designated as geological Sites of Special Scientific Interest. Geological Conservation Review sites are divided into 100 different types or blocks and the project area includes sites representative of 12 blocks:
Caledonian Structures of the Lake District
Caradoc-Ashgill (Ordovician)
Caves
Dinantian of Northern England
Fluvial Geomorphology
Karst
Mineralogy of the Pennines
Namurian of England and Wales
Pleistocene Vertebrata
Pre-Cambrian of England and Wales
Quaternary of the Pennines
Wenlock (Silurian).

Sites of Special Scientific Interest (SSSI) are the only geological sites protected by law (statutory sites). The term applies to areas of land that have been notified under the provisions of the Wildlife and Countryside Act 1981, as being of '*special interest by reason of any of its flora, fauna, geological or physiographical features'*. They are administered by the relevant national nature conservation agency (English Nature in England). No operation likely to damage the special interest of the site is permitted without the consent of the appropriate national nature conservation agency.

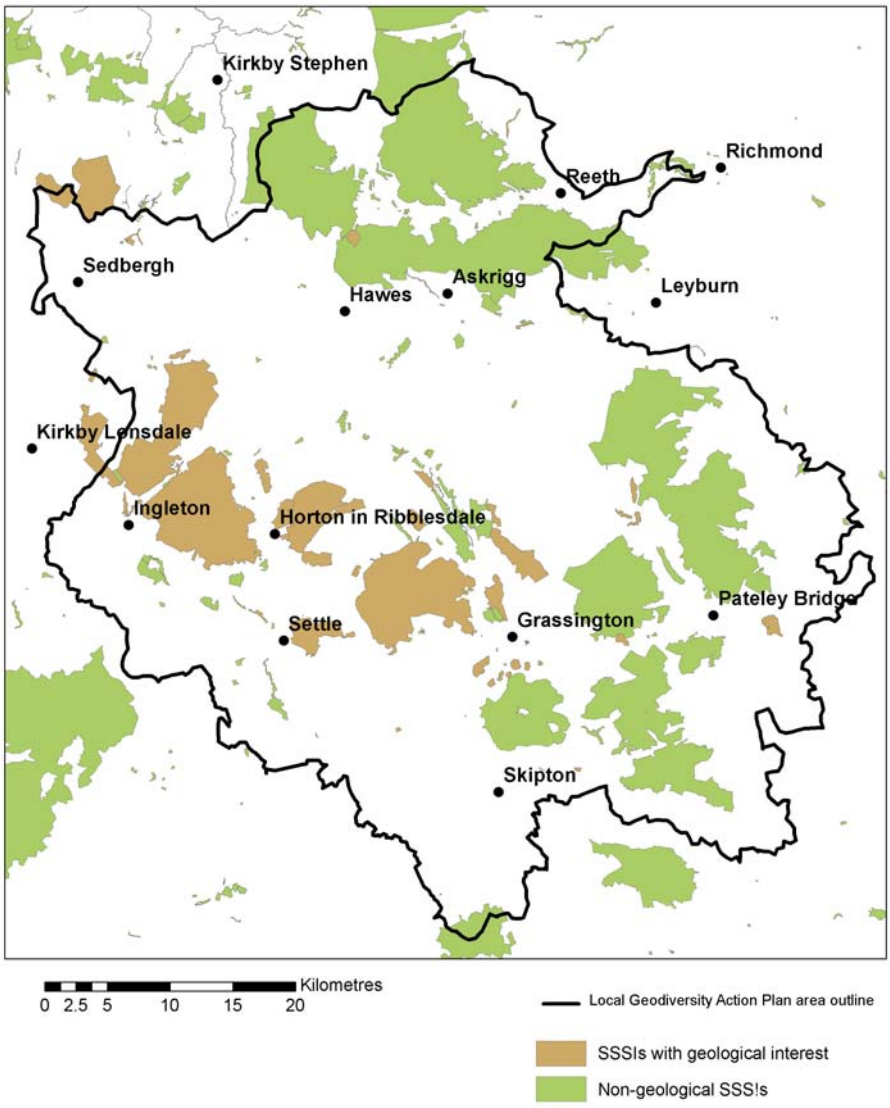

Figure 3. Sites of Special Scientific Interest (SSSI) within the 'Your Dales Rocks Project' area. Note that those labelled as geological also include biological SSSI's.

Regionally Important Geological and Geomorphological Sites (RIGS)

In many parts of the country local groups of professional and amateur geologists, together with other conservation groups such as the Wildlife Trusts, have formed RIGS groups to identify and where appropriate designate Regionally Important Geological and Geomorphological Sites (RIGS). These are similar to Sites of Importance for Nature Conservation (SINC) in that they are non-statutory but may receive a measure of protection by being notified to local authorities and included in the relevant local development framework documents. As well as their value for geology and geomorphology, RIGS are also identified by reference to criteria relating to their access, safety, cultural, heritage, economic, education and geodiversity value. The North Yorkshire Geodiversity Partnership is also the steering group for a RIGS group.

Currently, there are 12 RIGS within the Project Area. These were designated by the Cumbria RIGS Group and are all located within the Cumbrian section of the Yorkshire Dales National Park.

Many geodiversity features also occur within sites designated primarily for their biodiversity:

- **National Nature Reserves (NNR)** - some SSSIs are also designated as National Nature Reserves because of the national status of their habitats, for example Ingleborough NNR.
- **Local Nature Reserves (LNR)** – are a statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949 by principal local authorities.
- **Sites of Importance for Nature Conservation (SINC)** are similar to RIGS but used to identify high quality wildlife sites that are not given statutory protection as Sites of Special Scientific Interest. No SINCs have been designated for their geodiversity but many do contain significant geodiversity features.
- **Special Areas of Conservation (SAC)** are sites containing specific habitats which have been given special protection under the European Union's Habitats Directive
- **Special Protection Areas (SPA)** are protected by the European Union's Birds Directive.

Various conservation organisations are also involved in the management of geodiversity sites. The **National Trust** owns and manages a range of sites including Brimham Rocks and the land around Malham Tarn. The **Yorkshire Wildlife Trust** has several reserves in the area with geodiversity features, for example South House Pavement, Ingleborough.

Natural Areas and the 'Your Dales Rocks Project'

English Nature's Natural Areas Project defines areas where the links between the geology, landscape and biodiversity are similar enough to produce a distinctive unit. The 'Your Dales Rocks Project' area is mostly covered by the Yorkshire Dales Natural Area, but it also includes parts of six other Natural Areas: the Cumbrian Fells and Dales, the Forest of Bowland, the Lancashire Plain and Valleys, the Pennine Dales Fringe, the Southern Magnesian Limestone and the Southern Pennines (Figure 4).

In 1996, English Nature published Research Report 158 *'Earth heritage conservation in England: a Natural Areas perspective'* in which the key geological features, issues and objectives for each natural area were identified. The Yorkshire Dales, and Cumbrian Fells and Dales Natural Areas were both described as having ***outstanding*** (the highest possible category) geodiversity The Report went on to say that in such areas Earth Heritage objectives should be of a ***very high priority***.

The following key geological features, issues and objectives were identified by the Report for the seven natural areas within the Project Area:

Key geological features:

1. The upland exposures of deformed and fossilferous Early Palaeozoic (Ordovician and Silurian) sequences
2. The exposures of Carboniferous and Permian rocks and their stratigraphical relationship
3. Important fossil localities in Carboniferous Limestone reef-knolls
4. The karst landforms including dolines, potholes, scars and areas of limestone pavement (about half of Britain's limestone pavements and associated features are found in the area)
5. The underground cave systems and their associated surface and subsurface streams
6. Pleistocene stratigraphy
7. Glacial erosional and depositional landforms and scenery
8. Periglacial landforms including tors, edges and weathering regoliths
9. The development of river systems in the upland areas
10. The geological influence on the landscape character, and soils of the Project Area.

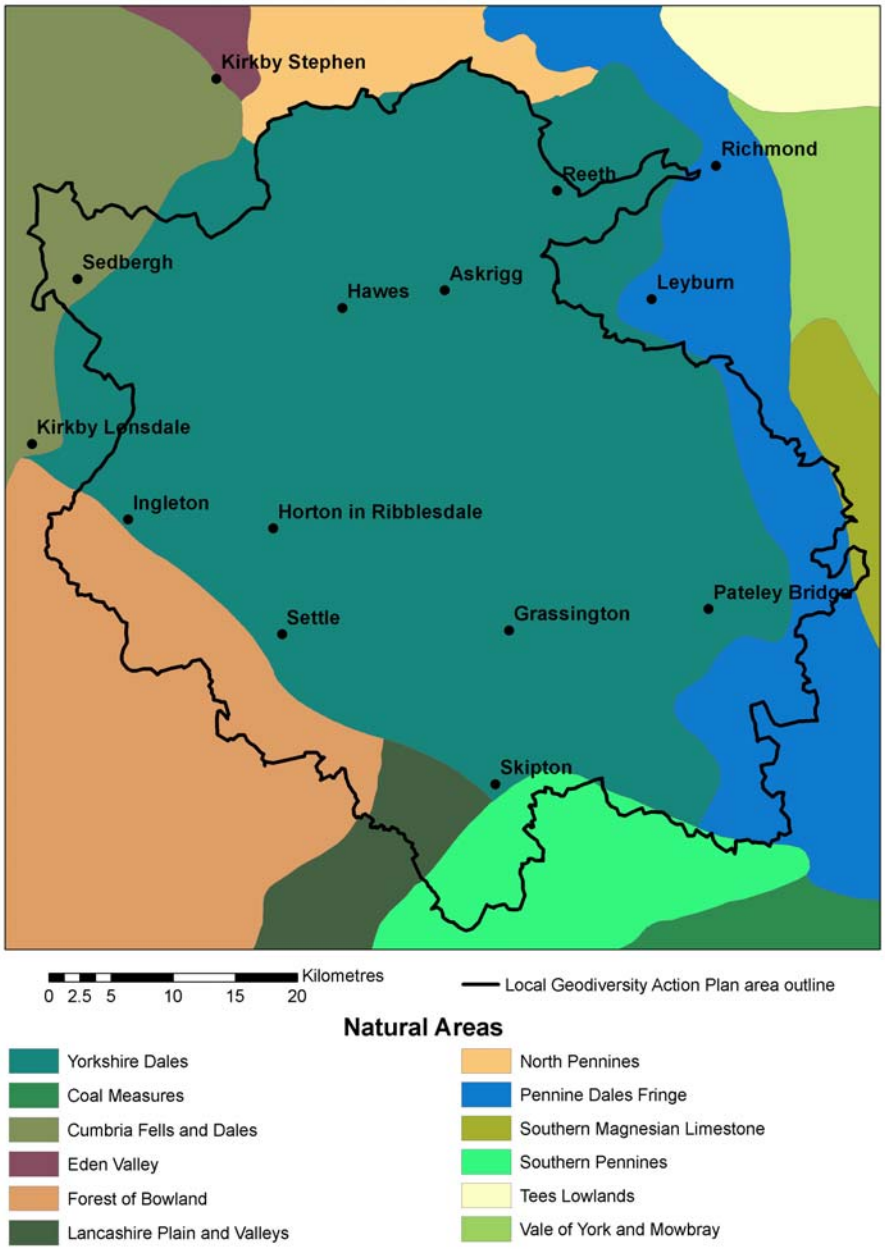

Figure 4. Natural Areas defined by English Nature and the Countryside Commission (described in Appendix 5).

Key geological management issues:

1. Maintaining and enhancing the exposures of Early Palaeozoic (Ordovician and Silurian), Carboniferous and Permian rocks in the Natural Area
2. Maintaining the operation of natural fluvial processes in the Natural Area
3. Protecting and enhancing the areas of limestone pavement within the Natural Area
4. Reducing the potential for damage to the underground cave systems through both internal and external activities
5. The lack of a RIGS group in the Yorkshire Dales Natural Area
6. The need, where practicable, to safeguard and maintain exposures in quarries and cuttings
7. The potential conflict between the mineral extraction industry, landfill operations and geological conservation
8. The need to promote the heritage value of mineral sites

Key geological objectives:

1. To protect areas of limestone pavement through Limestone Pavement Orders, and through encouraging initiatives aimed at joint geological / biological management of these areas
2. To encourage local caving organisations to take responsibility for cave conservation by undertaking cave conservation plans for cave systems
3. To encourage initiatives aimed at the promotion and interpretation of the geological and landscape character of the Project Area
4. To restore natural fluvial processes (including catchments and floodplains) in the Natural Areas
5. To maintain and where appropriate restore or improve valued exposures of Early Palaeozoic (Ordovician and Silurian), Carboniferous and Permian rocks in the Natural Areas
6. The maintenance of important geomorphological sites such as drumlins

The geological features, issues and objectives identified in the report form a very important framework to this plan. Further details of the geological features of the areas, along with the management issues and objectives, are shown in Appendix 5.

The Aggregates Industry and the 'Your Dales Rocks Project'

Quarrying has a long and distinguished history in the area commencing in pre-Roman times with small-scale extraction for building, walling and lime products. Extraction rates have continued to rise ever since as uses for stone have increased. Initially, this increase in demand was for building stone and lime for use in mortar, metal working and agriculture. Extraction continued to increase through the Middle Ages and in to the industrial revolution driven by society's demand for industrially produced goods and constructional materials including aggregates. The aggregates are sand, gravel, and crushed rock, which are vital to the construction industry. The project area is the key area in North Yorkshire for their production. In 2003, the nine active quarries in the project area produced approximately 6 million (75%) of the 8 million tonnes of aggregate quarried in the County. Hanson plc, Lafarge and Tarmac Ltd operate the nine quarries. All of the aggregate produced is crushed rock, either from greywacke or limestone.

Seven of the quarries are located in the southern part of the Yorkshire Dales National Park, one in the Nidderdale Area of Outstanding Natural Beauty, and one in Craven District outside of the National Park. Quarrying in such landscape sensitive areas is seen by some groups as highly controversial; however, since pre-Roman times quarries and mineral extraction have formed an integral part of the area's landscape and are important to both the national and local economies. As such this issue requires a careful balance to be reached.

QUARRY	GRID REF	AUTHORITY	COMPANY	AGGREGATE
Arcow	3803 4704	YDNP	Tarmac	greywacke
Coldstones	4125 4642	Harrogate / Nidderdale AONB	Hanson	Carboniferous Limestone
Dry Rigg	3804 4694	YDNP	Lafarge	greywacke
Giggleswick	3810 4650	YDNP	Hanson	Carboniferous Limestone
Horton	3800 4721	YDNP	Hanson	Carboniferous Limestone
Ingleton	3705 4742	YDNP	Hanson	greywacke
Skipton Rock	4014 4532	Craven	Tarmac	Carboniferous Limestone
Swinden	3983 4615	YDNP	Tarmac	Carboniferous Limestone
Threshfield	3977 4645	YDNP	Tarmac	Carboniferous Limestone

Table 1. Active aggregate quarries in the 'Your Dales Rocks Project' area.

Over the centuries quarrying and mineral extraction have helped our understanding of geology. It is recognized that quarries past present and present play a vital role in the geodiversity of the county providing some of the most important, and several unique, sites at which certain rock units and features may be seen.

In the project area, six of the geological SSSIs, including Greenhow Quarry and Hambleton Quarry, are former aggregate quarries. They provide evidence of how mineral working can increase geodiversity by exposing previously unseen rock and geological structures.

Another example of how quarries contribute to geodiversity is Arcow Quarry that extracts Silurian greywacke from within the Ingleborough SSSI. It offers an excellent opportunity to observe the structural deformation and processes that have helped shape the UK. It shows the nature of the unconformable contact between the Silurian greywacke and Carboniferous Limestone. The Silurian turbidite sediments here are superbly exposed and it is the type locality for the Arcow Formation. It is also a significant and important resource for the training of geotechnical students/engineers with respect to rock mechanics and failure mechanisms.

Coldstones Quarry is situated within a folded and fractured Carboniferous Limestonee dome. It is covered by sandstones and shales, and intersected by mineralization that is thought to originate on Grassington Moor. The nearby North Craven fault is believed to have had an affect on the area. Quarrying for lime and mining started at about the same time. As a result of the mining, the area has been drained and this has enabled the current quarrying at depth to take place with limited dewatering.

Horton Quarry originally started by working the Ingleton Group strata, but later developed to work the overlying Carboniferous Limestonee, which was initially burnt for lime. Exposures of both rock types currently exist and over time the unconformable contact between the two and also with the Silurian Austwick Formation (which is not exposed at present) will be exposed. A draft GAP has been prepared for Horton Quarry.

Quarrying in the Ingleton area originally started in the fine-grained beds for use as slates. It is now concentrated in the massive greywacke sequence (originally locally known as 'Ingleton Granite'). The quarry exposes the core of a steeply dipping syncline cut by a lamprophyre dyke.

Swinden Quarry is an active quarry (operated by Tarmac Ltd) and a designated SSSI that forms part of the Cracoe reef complex Geological Conservation Review (GCR) site. It has exposed a unique cross-section through one of the Craven Basin's reef knolls permitting the recording and research of this interesting palaeo-environment.

Geodiversity and the project area's Biodiversity Action Plans (BAP)

The rock type of an area is one of the major abiotic factors which determines biodiversity, through its weathering to form soil and its control on the movement of water. Specific habitats with their distinctive plant communities can be related to variations on the surface geology. In the Carboniferous Limestone areas in the south of the Yorkshire Dales National Park, calcium-rich rendzina soils are associated with calcareous grassland habitats. Upland ash woodland occurs on these calcareous soils and in areas such as Scar Close, Ingleborough, limestone pavements have developed unique plant communities. On the more acidic soils, developed on the sandstones of the Millstone Grit Group, upland heath occurs dominated by heather, with bell heather on the drier slopes and cross-leaved heath where conditions are wetter. On the higher plateaux, conditions are wet enough to allow the formation of blanket bog.

Many of the habitats in the area are Priority habitats in the UK Biodiversity Action Plan (UK BAP) and specific habitat action plans have been prepared for them in *'Nature in the Dales – A Biodiversity Action Plan for the Yorkshire Dales National Park* ' (2000) and where appropriate in the Local BAPs published or in preparation - Harrogate District BAP, Richmondshire BAP and Craven BAP (outside of the YDNP), developed in partnerships led by North Yorkshire County Council and the district councils. Table 2 below illustrates the range of UK Priority and Local Habitats, which occur in the Project area, and Table 3 links the major habitats to the underlying geology.

Key habitat	UK BAP	Nature in the Dales	Harrogate District BAP	Richmond-shire BAP	Craven BAP
Ancient and/or species-rich hedgerows	√	√	√	√	√
Blanket bog	√	√	√	√	√
Caves and natural rock exposures	√	√			
Cereal field margins (and arable)	√	√	√	√	√
Eutrophic standing waters	√	√	√	√	√
Fens	√	√	√	√	√
Floodplain grazing marsh	√		√	√	√
Gardens			√	√	√
Limestone pavements	√	√			
Lowland calcareous grassland	√	√	√	√	√
Lowland meadows	√		√	√	√
Lowland raised bog	√	√			√
Lowland wood pasture and parkland	√	√	√	√	√
Mesotrophic lakes	√		√	√	
Moorland edge			√	√	
Other standing waters	√	√	√		
Other woodland		√			
Purple moor grass and rush pasture.	√	√			
Reedbeds	√		√	√	
Rivers and streams		√	√	√	√
Rock outcrops, scars, scree and spoil		√			
Scrub		√	√	√	√
Species-rich road and rail verges		√	√	√	√
Upland calcareous grassland	√	√	√	√	√
Upland hay meadows	√	√		√	√
Upland heathland	√	√	√	√	√
Upland mixed ashwoods	√	√		√	√
Upland oakwood	√	√	√	√	√
Wet acidic grassland	√	√			√
Wet woodland	√	√	√	√	√

Table 2. Habitat representation in BAPs.

Underlying geology	Key habitat	UK BAP	Nature in the Dales	Harro-gate District BAP	Richmon-dshire BAP	Craven BAP
Carbon-iferous Limestone	Caves and natural rock exposures	√	√			
	Fens	√	√	√	√	√
	Limestone pavements	√	√			
	Limestone quarries		√			
	Lowland calcareous grassland	√	√	√	√	√
	Mines		√			
	Mine spoil		√			
	Rock outcrops, scars, scree and spoil		√			
	Upland calcareous grassland	√	√	√	√	√
	Upland mixed ashwoods	√	√		√	√
Millstone Grit	Blanket bog	√	√	√	√	√
	Fens	√	√	√	√	√
	Gritstone and shale quarries		√			
	Lowland raised bog	√	√			√
	Mines		√			
	Mine spoil		√			
	Rock outcrops, scars, scree and spoil		√			
	Upland heathland	√	√	√	√	√
	Upland oakwood	√	√	√	√	√
	Wet acidic grassland	√	√			√
Alluvial and glacial deposits	Ancient and/or species-rich hedgerows	√	√	√	√	√
	Cereal field margins (and arable)	√	√	√	√	√
	Fens	√	√	√	√	√
	Floodplain grazing marsh	√		√	√	√
	Lowland wood pasture and parkland	√	√	√	√	√
	Reedbeds	√		√	√	
	Species-rich road and rail verges		√	√	√	√
	Upland hay meadows	√	√		√	√
	Wet woodland	√	√	√	√	√

Table 3. Key underlying geology and related habitat types.

For more information go to: www.ukbap.org.uk, and www.yorkshiredales.org.uk .

Geodiversity Action Plan and other Management Plans

As the project covers a large area, it involves numerous local authorities all of which are in the process of preparing local development framework documents (LDF) for their areas. It is the intention of this Action Plan to raise their level of awareness of geodiversity issues and to have geodiversity policies and RIGS included in their plans.

Relevant existing management plans include:

- *The Forest of Bowland Area of Outstanding Natural Beauty Management Plan 2004 – 2009,* Forest of Bowland AONB 2004
- *The Nidderdale Area of Outstanding Natural Beauty Management Plan 2004 – 2009*, Nidderdale AONB 2004
- *North Yorkshire County Council Minerals Local Plan*, NYCC 1997
- *Yorkshire Dales National Park Authority Minerals and Waste Local Plan 1998*, NDNPA 1997 (in process of revision as part of the Local Development Framework)
- *Yorkshire Dales National Park Management Plan, 2006-2010*, YDNPA 2006
- *Nature in the Dales: A Biodiversity Action Plan for the Yorkshire Dales National Park*, YDNPA 2000

Geodiversity and the archaeology and historic landscape of the project area

Since the retreat of the last Ice Age, the geology and geological resources of the area have been used by the people who have settled there. The landscapes we are so proud of today result from the interaction of this exploitation, the geology, climate and time. The earliest known evidence of human activity in the area has been found in a cave in the Yorkshire Dales National Park and is dated to 12,300 BC. Later Bronze and Iron Age farmers cleared forests and woodland to utilise the developing soils and create their distinctive field patterns but in the process also added to soil impoverishment and erosion on the moorlands. Settlements were cleverly sited to utilise the natural environment – valley bottom settlements such as Buckden, Kettlewell and Starbotton developed on alluvial fans to avoid flooding. In the post-medieval period the ready availability of good building stone, particularly sandstone, led to the development of a distinctive vernacular architecture, accentuated by the use of sandstone flags as the dominant roofing material. Boundary walls are more varied. They generally use either stone from field clearance or from small quarry pits and provide strong visual clues to the local geology.

The mineral resources of the area have been used for at least two thousand years. Lead mining dates back to the Romans and lead mining landscapes, particularly the dramatic 'hushes', abandoned mines and spoil heaps, have their own character and sometimes contain clues to mineral deposits deep underground. Coal mining too has left its mark. Today we have large quarries producing crushed limestone, but hundreds of ruined lime kilns and small limestone quarries provide evidence of widespread use in the past.

Many archaeological sites in the area are recognised as being nationally important and have been protected by being designated as Scheduled Ancient Monuments. A large number of them are also important for their geodiversity. This is particularly true of sites such as Moulds Side in Arkengarthdale, which includes the very impressive Stodart and Hungry Hushes, Dam Rigg Lead Mine and numerous other adits and levels. The complex of lead mine workings on Grassington Moor are also important. Furthermore, lead mining sites commonly have important lead-tolerant plant communities on lead spoil; this biodiversity includes plants such as *Minuartia verna* - the spring sandwort.

For more information go to: www.outofoblivion.org.uk

The geology of the area

A geological overview

The Yorkshire Dales National Park, Nidderdale Area of Outstanding Natural Beauty and Craven Lowlands, have a unique character. Much of it results directly from the rocks, the effects of the ice ages and the way man has influenced the land since the ice melted. Millions of years of Earth history have culminated with the landscape we know today. The rocks tell a story of the evolution of the areas from deep oceans, through tropical seas, swamps and tropical forests. The most recent times have culminated with the ice-ages and erosion to form the present day landscape. A vertical geological section through all the rocks of the area shows four main geological sequences separated by unconformities that illustrate intervals of earth movements, mountain building and considerable erosion.

The Ordovician Ingleton Group, nearly 500 Million years old, is the oldest sequence hereabouts forming the ancient roots of the area. The succeeding strata, representing some 30 million years of Earth history are inferred to be hidden beneath younger rocks. This basement sequence was folded and eroded before it was overlain by the Silurian rocks that represent a deep ocean basin. These were deposited over a time interval that spanned 446-423 million years ago. The late Silurian and Devonian saw a major mountain building interval, which folded the Ordovician and Silurian rocks. They were then subjected to extreme erosion that wore them down almost to sea level (peneplanation). Ancient continental drift powered the ocean development and the mountain building, it also moved continents, so that by the start of the Carboniferous Period some 354 million years ago the area lay in tropical latitudes. Shallow sea water lapped over the worn-down Silurian and Ordovician rocks and limestones with fringing reefs developed. Later the sea was swamped with fluvial deltaic outwash and the area became a swamp that was periodically flooded. More mountain building and another break in the sequence occurred before the Permian tropical seas developed to the west and east of the Pennines, the Magnesian limestone sequence was deposited, but very little of it is present in the Dales area.

After the Permian rocks, the Dales were probably buried beneath much younger rocks, but these have all been eroded away. The land has been eroded by the ice-ages that occurred less than half a million years ago right up to around 12,000 years ago.

Ancient Roots – Ingleton Group and Windermere Supergroup

The ancient roots of the Dales are seen in the quarries and waterfalls of the River Doe upstream from Ingleton. The sequence of rocks seen here is the Ingleton Group, by far the oldest rocks seen in the area (Aitkenhead et al., 2002; Soper & Dunning 2005). They have not yielded many fossils, but microfossils from them indicate that they are most likely early Ordovician (late Tremadoc to Arenig) in age dating from around 485 to 475 million years before present. The rocks are dominantly massive sand-grade greywackes with conglomerate beds and interbedded sequences of siltstone and mudstone. Deposition from turbidity currents on a deep ocean slope is the inferred mode of origin and submarine slumping has been suggested for much of the complex folding. The sedimentary sequence is thick and may have been thickened by slump folding; in addition, the rocks are tectonically folded. The rocks are quarried at the so-called “Ingleton Granite Quarry”, but they are definitely not granites. The ancient foundations of the area are only seen in two places and it is not known how much of the sequence is present, or how much has been eroded away before the deposition of the overlying Windermere Supergroup. However, the tectonic structure of the Ingleton Group is more complex than the Silurian sequence and the rocks may have suffered some pre-Silurian tectonism, or the folding may just be associated with submarine slumping and subsequent uplift. Whatever the cause, there is a significant sedimentological break in the sequence and the Late Ordovician rocks rest unconformably on the Ingletonian.

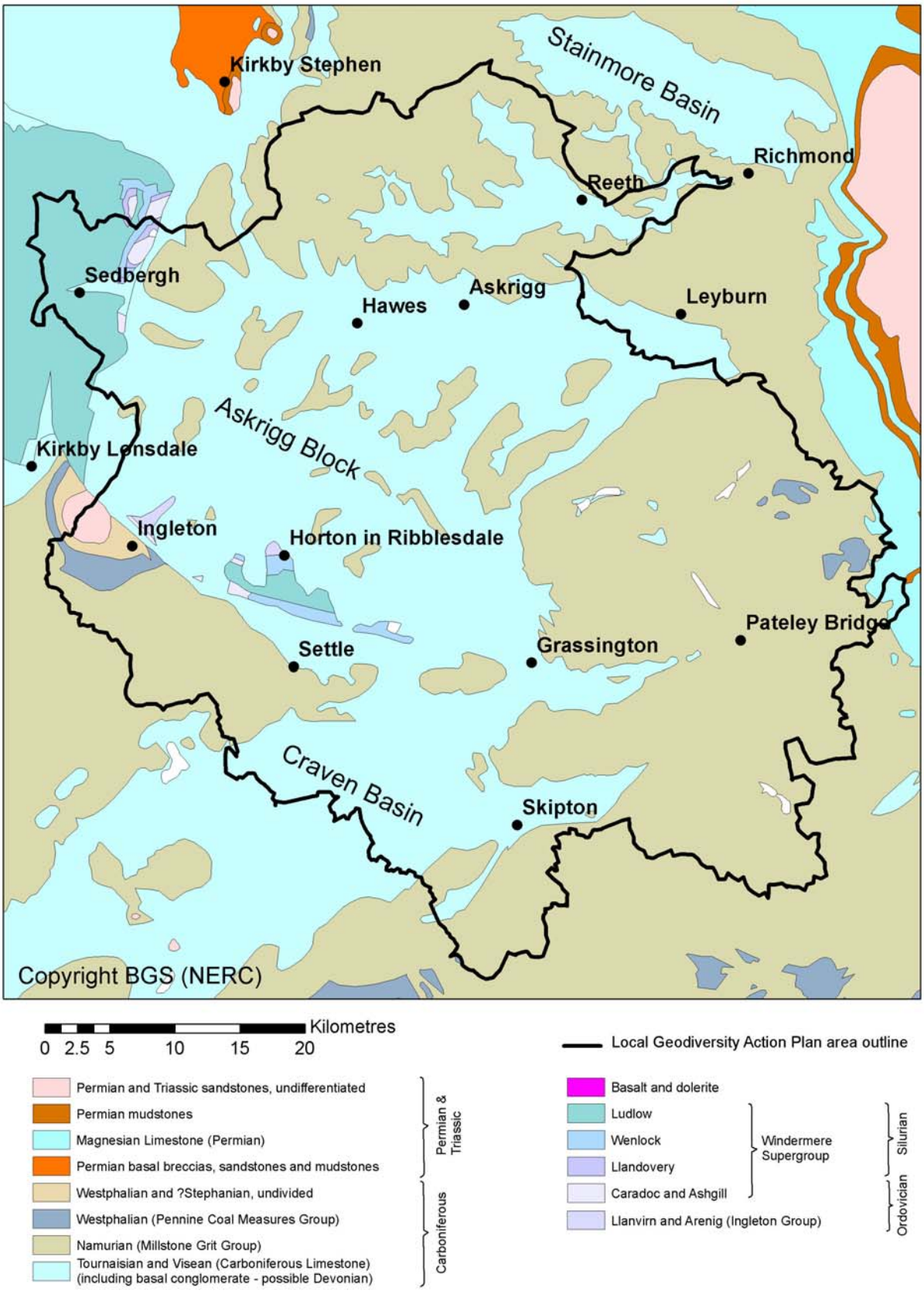

Figure 5. Geological map of the area based on the British Geological Survey 1:625,000 scale map, © BGS (NERC)

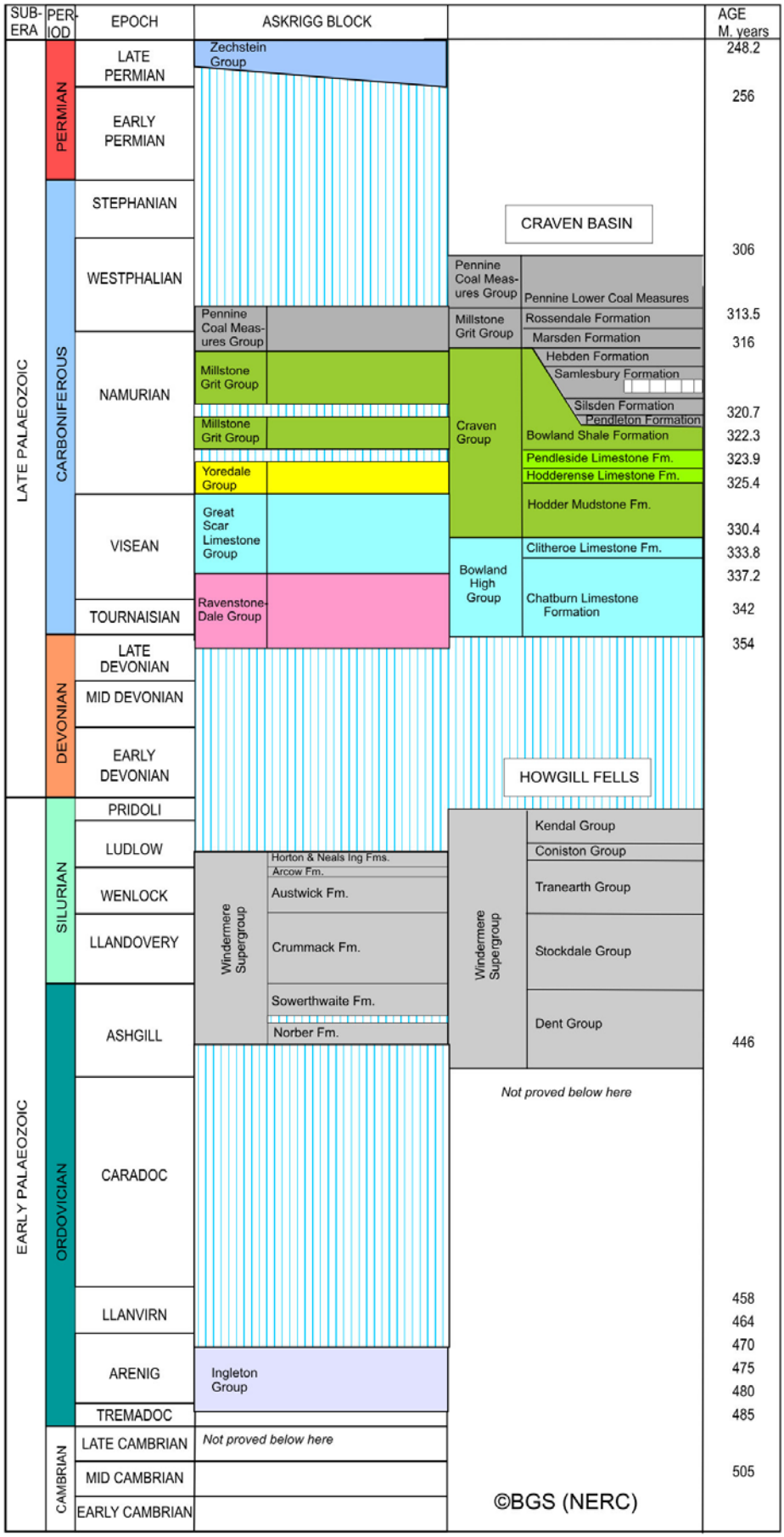

Figure 6. Stratigraphical sequence of the rocks of the Yorkshire Dales and Craven Basin Copyright BGS (NERC)

The Late Ordovician and Silurian sequence is present in the Craven inliers and exposed near Ingleton, in Crummack Dale, Ribblesdale and around Malham Tarn. The Silurian sequence is also exposed to the north-west in the Howgill Fells; the rocks here are collectively called the Windermere Supergroup (Aitkenhead, et.al., 2002; Rickards & Woodcock, 2005). At the base they include breccias and limestones, but above these the sequence is mainly grey mudstones, siltstones and sandstones that have yielded graptolites which indicate their age. Like the Ingleton Group that preceded them, the majority of this sequence was deposited as muddy and sandy submarine turbidity flows into a deep ocean basin. By a combination of depositional burial, later tectonism and metamorphism, the mudstones and siltstones have been altered into slates. The Windermere Supergroup sequence is locally up to about 1700m thick in the Craven inliers with around 3000m of strata present in the Howgill Fells (Rickards & Woodcock, 2005).

Earth movements and unconformities

The end of the Silurian saw a dramatic change in the local environment. The sea shallowed and was eventually uplifted into land. Over an interval of about 80 million years, the rocks were folded by the mid-Devonian (Acadian) tectonic deformation, intruded with granites, uplifted and eroded. This tectonic deformation altered and metamorphosed the rocks forming a recrystallisation fabric (or cleavage) turning the mudstones and siltstones into slates. By the end of the Devonian, much of the uplifted rock had been weathered, eroded and worn down again to a level that could be transgressed by the tropical Carboniferous sea that flooded the area.

Blocks and basins

Basement structures that helped to control the Ordovician and Silurian sedimentation, and subsequent tectonism, took on an important role during the Carboniferous. This is especially true for the Craven faults, which divided what was to become the Craven Basin in the south from the Askrigg Block and Stainmore Basin in the north. The Askrigg Block was effectively more buoyant, being cored by the Wensleydale Granite. As a result, it subsided slowly and tilted northwards. It was covered by a thin generally shallow water sequence of limestones that thicken northwards into the Stainmore Basin. In contrast, the Craven Basin subsided more quickly, becoming a deep water basin that was the receptacle area for a deep water mudstone sequence with subordinate limestones. This fundamental split in the geology is reflected in the current geomorphology of the region with the Craven Lowlands to the south and the limestone highlands to the north.

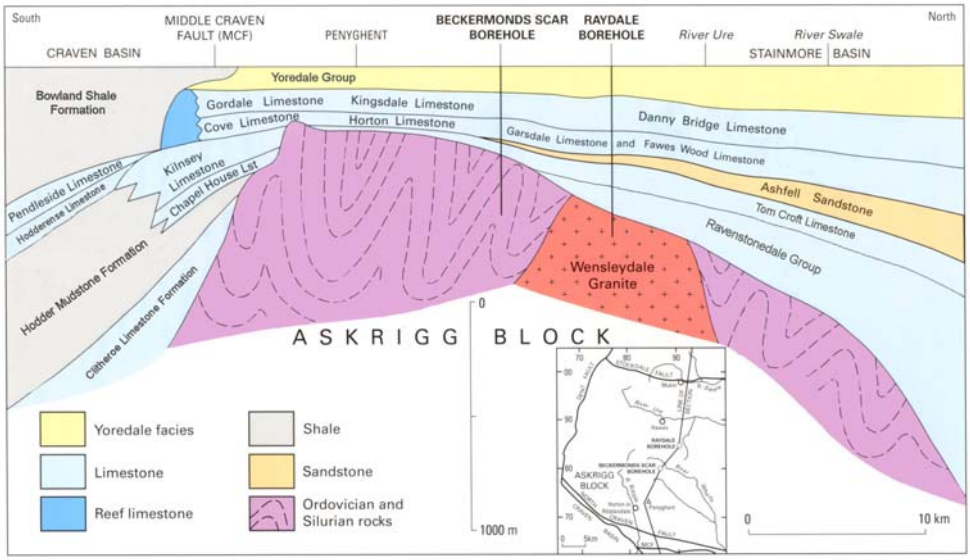

Figure 7. Cross-section through Craven Basin in the south, the Askrigg Block and northwards to the Stainmore Basin, © BGS (NERC) (after Aitkenhead et al., 2002 with additional information on new terminology from Colin Waters).

Tropical seas – Carboniferous Limestones and deep water mudstones

In the early Carboniferous, the tropical seas that flooded the area swept across the eroded Ordovician and Silurian rocks reworking them into patchy basal conglomerates. These rest with a marked angular unconformity on the underlying sequence. They are of variable age and only exposed on the southern flank of the Askrigg Block (Aitkenhead et al., 2002). The thin conglomerate here includes clasts of the underlying bedrock cemented by a limestone matrix. The near horizontal beds deposited onto the eroded, steeply dipping older rocks produce a spectacular unconformity.

Figure 8. Unconformity between the folded Silurian strata and the overlying Carboniferous Limestone sequence, Horton in Ribblesdale.

Early Carboniferous shallow water limestones developed in the Craven Basin while the Askrigg Block was still being eroded. By the time the Askrigg Block became the focus for limestone deposition, the Craven Basin was a deep-water basin receiving debris from the block and surrounding areas carried into the deeper water by turbidity currents. The Craven faults, and their associated active fault scarp, which bound the south of the Askrigg Block, became the site of a coral reef similar to those barrier reefs developing today. To the north of this reef a shallow limestone sea developed with mud-mounds (also called patch or knoll reefs). To the south the Craven Basin received a mixture of mudstone which was interbedded with limestone debris derived from the reef and shelf behind it. In the Craven Basin this sequence comprises more than 2500m of mudstone and limestone passing up into mudstone and sandstone. On the Askrigg Block, the sequence is much thinner (around 1200m), mainly of limestone passing up into a mixed cyclic limestone, mudstone and sandstone sequence called the Yoredale Facies. Because the block tilted northwards during sedimentation, this sequence thickens northwards into the Stainmore Basin. The cyclic Yoredale Facies gives rise to the distinctive landscape of alternating limestone and sandstone scarps and gently dipping hill tops. Each cycle or cyclothem represents a sea flooding event, followed by shallowing and fluvial sandstone and mudstone deposition with associated seatearths (fossilised soils) and sporadic thin coal seams. The limestone-rich sequences of the district were deposited from around 350 to 327 million years ago when they were followed by the more fluviatile Millstone Grit Group sequence.

Swampy deltas – Millstone Grit and Coal Measures

About 327 million years ago marks the start of the Namurian age and a change to a dominantly estuarine sandstone and mudstone sequence with sporadic marine inundations. As time progressed, the influence of river delta systems became greater and thick

sandstones and mudstones were laid down. The blocks and basins that were already established continued to have a marked influence on the sedimentation and the thicknesses of the sequences preserved. The Craven Faults marked the edge of the basin, with a total Namurian sequence about 500m thick on the Askrigg Block thickening rapidly to over 2000m in the Craven Basin. In the Craven Basin, much of the sequence is buried at depth and the low ground comprises mainly mudstones with limestone and sandstone beds deposited from turbidity currents. The fluviatile rocks are best seen to the south-east of the area, especially in Nidderdale. Here there are numerous escarpments with sandstone outcrops along their edges and tops. Weathered exposures such as Brimham Rocks show massive sandstone sequences, with abundant cross-bedding on various scales up to many metres. These exposures explain the fluvio-deltaic environment in which much of the sandstone was deposited. Periodically these delta areas were inundated by the sea and marine mudstones with goniatite or other marine fossil beds were deposited. The youngest of these rocks is around 311 million years old.

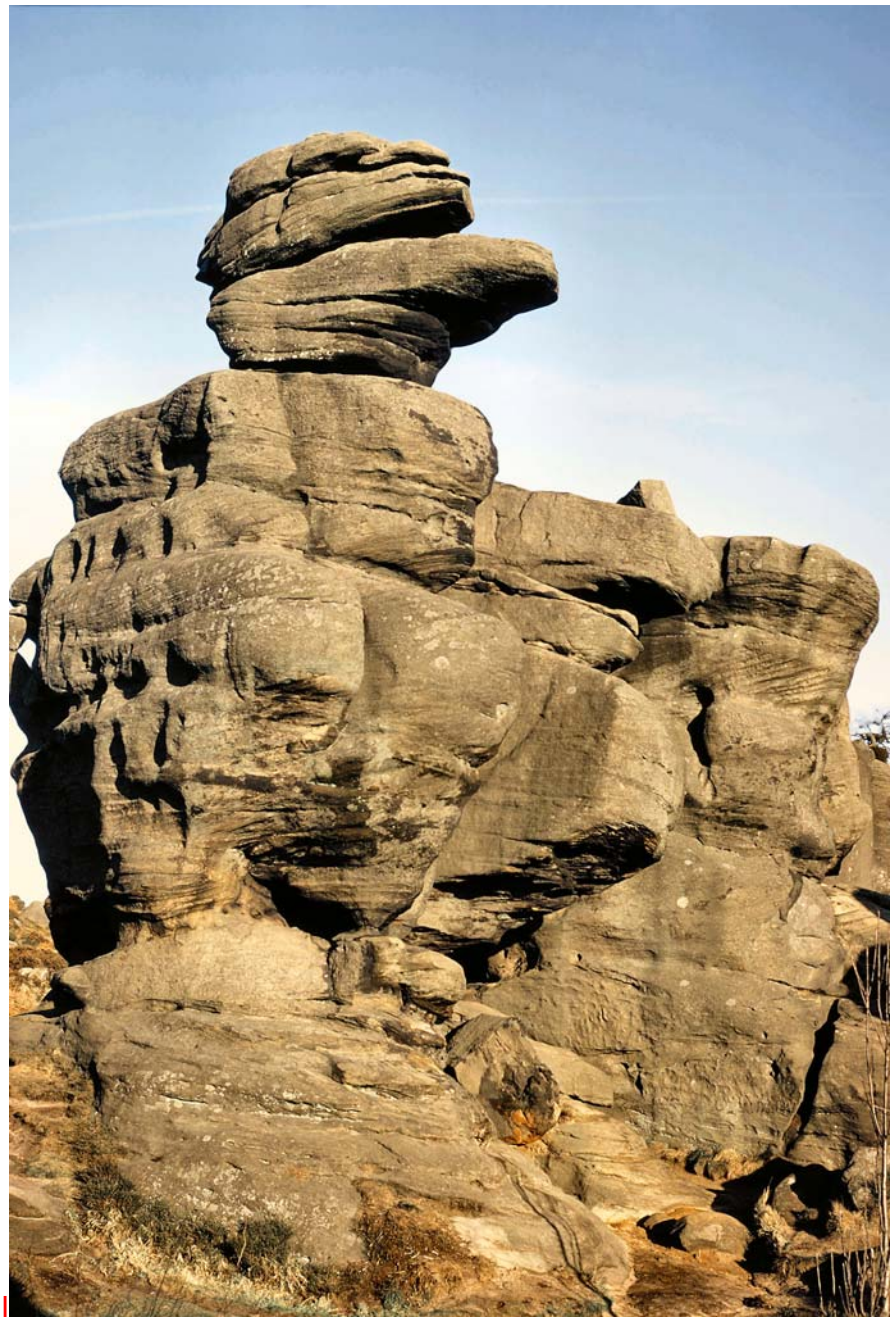

Figure 9. Brimham Rocks, weathered fluviatile Brimham Grit, © BGS (NERC).

Deserts and shallow seas – Permian Zechstein Group

Permian rocks form a tiny portion of the action plan area. They are restricted to the far east of the district where dolomites of the Cadeby Formation are present. These are late Permian in age, from about 252 to 251 million years old, and represent deposits formed at the margin of an enclosed marine sea that periodically became hypersaline and evaporitic.

Folds, faults and mineral veins

Towards the end of the Carboniferous the whole area was subjected to uplift, folding and faulting. The rigid Askrigg Block remained fairly intact, but the rocks in the Craven Basin were squeezed against the rigid block to the north. Partial basin inversion occurred and basement faulting was reactivated so that numerous folds such as the Skipton Anticline were developed. At around the same time, mineralization, possibly reactivated from the underlying granite, took advantage of fracturing and fluid flow to form mineral veins in suitable host rocks such as the limestones on the Askrigg Block. Mineralization was possibly also associated with fluid flow from the Permian evaporitic basins to the east and west of the district. The results of the mineralization are classic lead-zinc veins that follow fractures and faults for many kilometres through the limestone country.

Ice ages – Anglian and Devensian ice

Taking a giant leap forward in time, between 478,000 and 423,000 years ago, the whole area was buried in ice. Massive erosion occurred and much of the landscape was shaped. This sculpting continued during another, more recent, ice age which lasted from around 30,000 to 12,000 years ago. It is this ice-age (called the Devensian Ice-Age) that was responsible for the character of much of the landscape that we see today. The ice moulded the gravelly clays of the valley bottoms into trains of rounded hills called drumlins and these form a very distinctive landscape in the low ground. The ice transported both local rocks and some from far away. When it melted, it left behind rocks called erratics perched on different underlying rocks. These include the famous sandstone erratics that rest on the Carboniferous Limestone at Norber.

Figure 10. Erratic of sandstone near Norber, left by the last ice-age on the surface of Carboniferous Limestone which has dissolved leaving the erratic on small pedestals of limestone. © BGS (NERC).

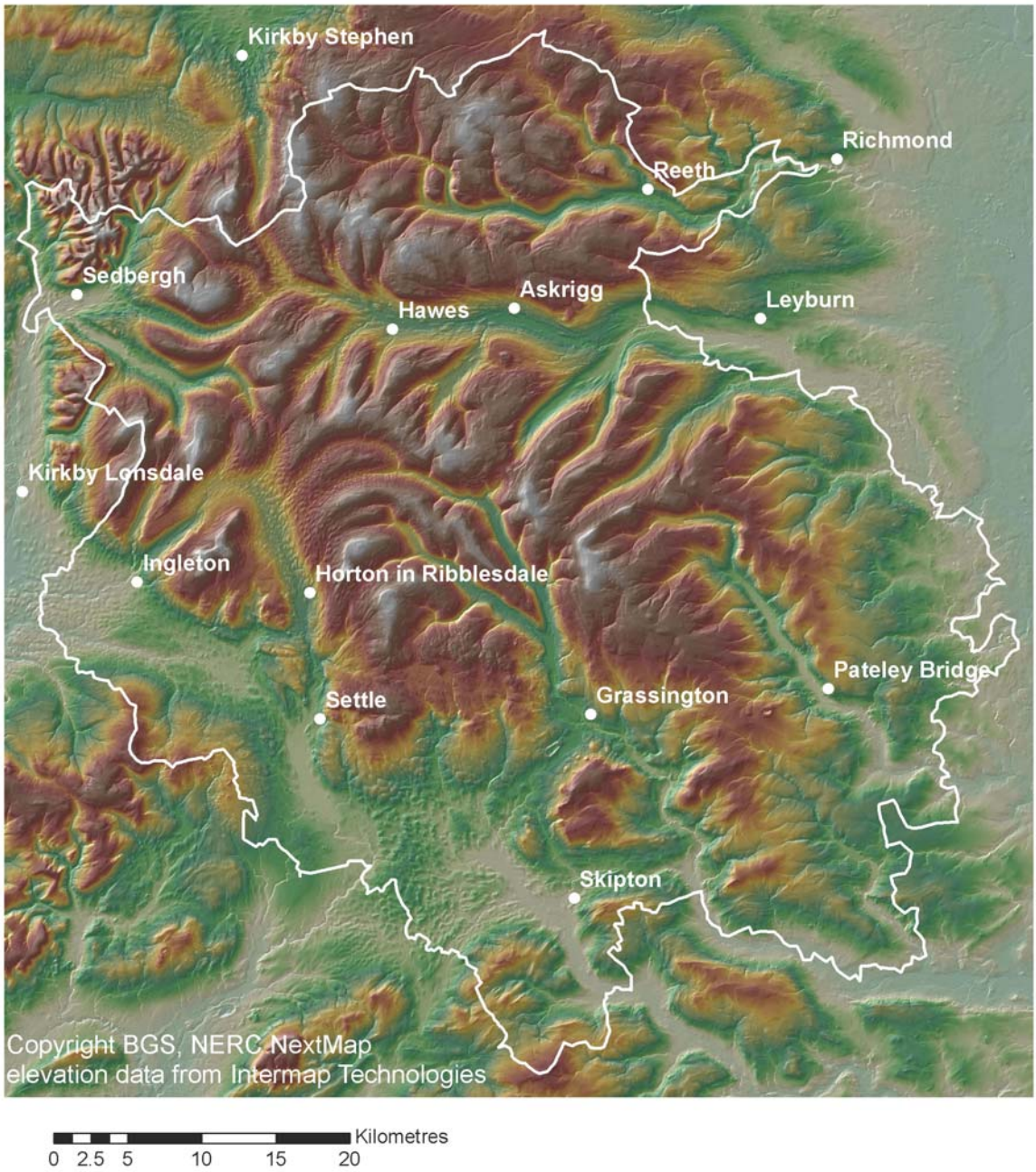

Figure 11. Shaded relief map of the Yorkshire Dales and Craven Basin derived from NextMap digital terrain data from Intermap Technologies, © BGS (NERC). Note the drumlin fields shown on the image.

Caves and limestone pavements

For a considerable period of time, before and during the last and previous ice-ages, the ground has been subject to slightly acidic rainfall. This has allowed the underlying limestone to be dissolved by slightly acidic rain water, forming caves and limestone pavements. Water flow and the joints and layers in the rock combined to control their development. Stalactites and stalagmites have been produced in the caves, and at the surface the wonderfully weathered joints in the rock form grikes, which separate the blocks or clints; this produces a special habitat that results from the interaction between geological and biological processes.

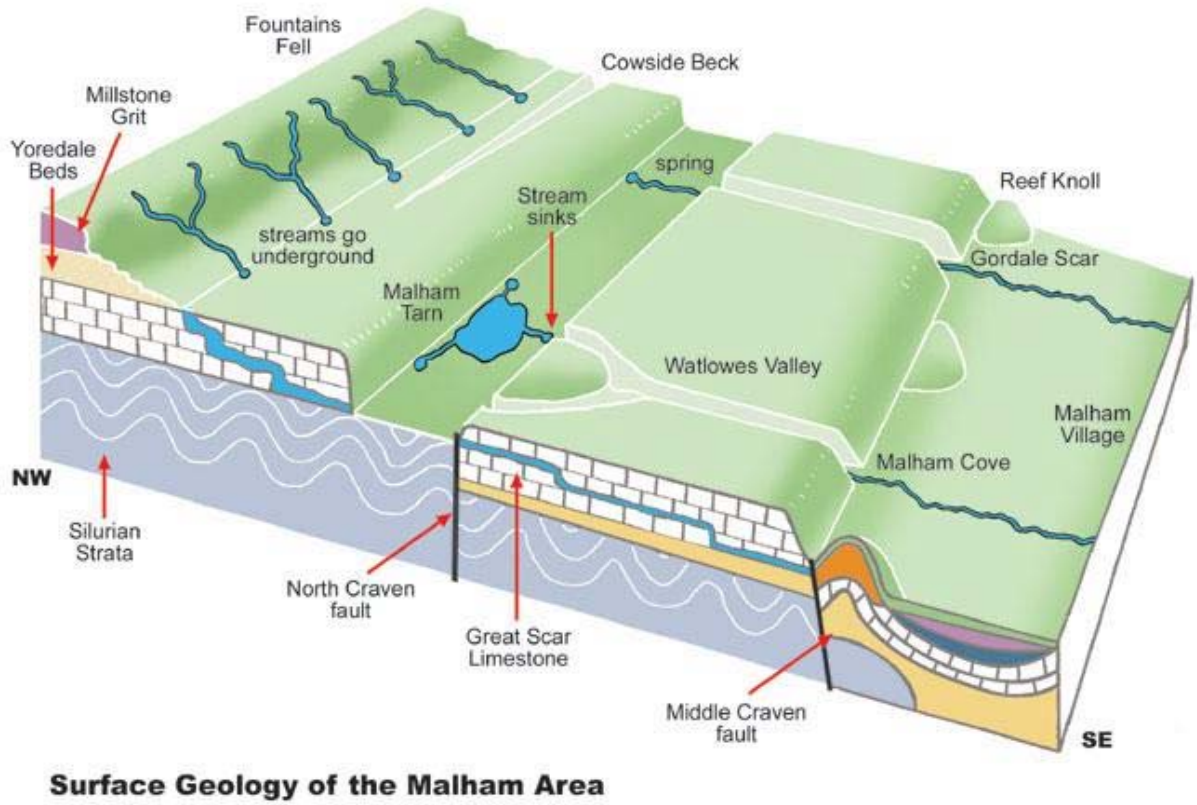

Figure 12. 3D model of the Malham area showing the interaction between bedrock geology, landscape and cave drainage (karst). © Yorkshire Dales National Park Authority.

Mining the minerals

The Dales have a rich and varied heritage of mineral extraction with parts of the area being relatively industrial with quarries for building and roofing stone, lime kilns, lead and coal mines. Throughout the district there are the relics of mining: open holes (stopes, shafts and adits) penetrate the hillsides, marking the underground courses of many of the mineral veins, some of which run for many kilometres. Their remains are part of the countryside heritage that we appreciate today. The old exploration technique of “hushing” has also left its mark, as water-eroded scars running down hillsides from where the miners dammed and diverted water to wash off the overlying soils and loose material. In addition to the mining, mineral processing and smelting have added spoil heaps and old buildings to the landscape. The sparsely wooded landscape can also be partly attributed to the processing of minerals. Peat and wood were the principal fuels for lime burning and metal smelting before the late 1700’s when coal burning began to be widely used.

Our need for quarries

The area is economically very important, providing us with crushed rock aggregate from modern quarries. This is used extensively to build and maintain roads, housing, hospitals, factories, schools and other important infrastructure. The limestone in particular is ideal as an all purpose concrete aggregate and large-scale quarrying takes place mainly in the south of the district where there are suitable transport connections and nearby conurbations. The area is also a key supplier within the UK for greywacke crushed rock with high skid resistance properties for use in surfacing the north of England’s high speed road network. We all benefit from the use of the natural resources and great efforts are made to fit our modern needs in with our use of the countryside.

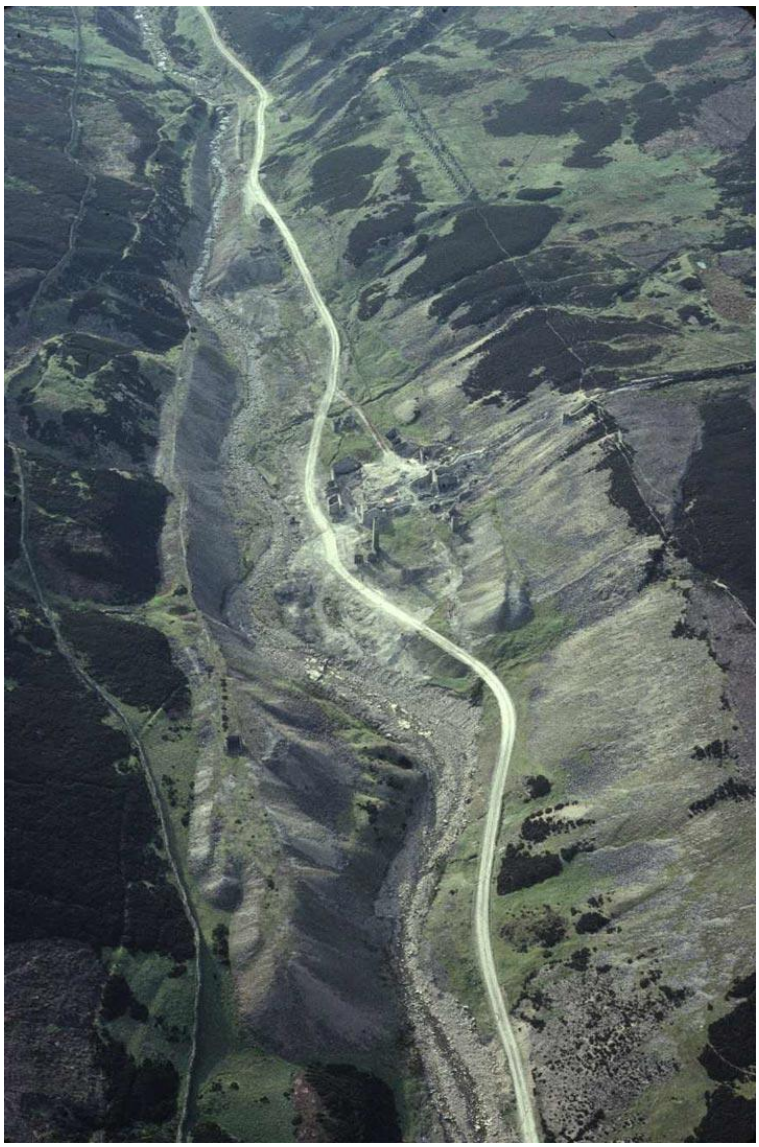

Figure 13. Lead mining and processing remains in Old Gang Gill, Swaledale © R.White, Yorkshire Dales National Park Authority.

The 'Your Dales Rocks Project' Draft Action Plan

Aims, principles and objectives

The 'Your Dales Rocks Project' has the following **aims**:

- To record, conserve, and where practicable, enhance geodiversity within the project area
- To increase public awareness of, and involvement in, conserving geodiversity
- To contribute to the conservation of geodiversity on a national and international scale
- To create, maintain and support the North Yorkshire Geodiversity Partnership RIGS Group, and to work with other relevant RIGS organisations.

The aims are based on the following **principles**:

- Conservation practice should be based on sound knowledge
- The conservation of geodiversity should be an integral part of government programmes, policy and action
- The conservation of geodiversity requires the care and involvement of individuals and communities
- Wise use should be ensured for all non-renewable geological resources and consideration should be given to their sustainability.

Phase 1 - Partnership and Involvement

1. To maintain the level of partnership involvement.

2. To seek greater collaborative working between the Partnership, local communities, local authorities, conservation agencies and quarry operators.

3. To prepare the Draft Local Geodiversity Action Plan and advertise it and the partnership activities.

Phase 2 - Site Evaluation and Geo-audit

1. To audit the local geological and geomorphological resources, including the identification and recording of:

- all SSSIs, RIGS, potential RIGS and Dales Geological Sites (DGS) (important non-statutory rock, mineral, palaeontological and geomorphological sites)
- active quarries, disused quarries, mine workings, and spoil heaps
- significant geological features in the built and transport environments
- the major geomorphological features including karst (limestone pavements and cave systems)
- important soil types.

2. To create and maintain a GIS compatible database of all features and sites.

Phase 3 - Education and Site Use

1. To increase public awareness, understanding and appreciation of the geodiversity of the area.

2. To encourage opportunities for education, lifelong learning, and research related to local geodiversity.

Phase 4 - Conservation and Management

1. To suggest targets and actions for local geological conservation.

2. To encourage the inclusion of local geological conservation targets within any other plans or strategies that impact upon the local geological resource.

3. If approved by the relevant local authorities, to investigate the possibility of part of the area becoming a GeoPark with the potential for geotourism.

Phase 5 - Monitoring and Review

1. To establish a framework to monitor and review the implementation of the Geodiversity Action Plan.

Implementation

The Draft Local Geodiversity Action Plan will be implemented by the members of the NYGP Steering Group. At appropriate stages in the Plan advisory partners (listed below) will be consulted to obtain their expert opinion. Local volunteers (particularly the Dales Volunteers of the Yorkshire Dales National Park and the Friends of Nidderdale AONB) will be encouraged to become involved in educational and geoconservation projects. Action will be taken to obtain funding to achieve the geodiversity audit, education and conservation targets and to promote the Project.

The Draft Local Geodiversity Action Plan has been divided into five sections, which approximate to the various phases of the implementation of the Plan:

1. Partnership and Involvement
2. Site Evaluation and Geo-audit
3. Education and Site Use
4. Conservation and Management
5. Monitoring and Review

The various actions in the Plan have been prioritised using a three point scale: Priority 1 represents the highest priority, the action due to be completed within two years, Priority 2 within 4 years, and Priority 3 within 5 years. Duration refers to the period of time each action will take. Short-term actions should be completed within one year, ongoing actions will continue throughout the life of the Plan.

Funding for the 'Your Dales Rocks Project'

The first phase of the Project has been supported by Defra's Aggregates Levy Sustainability Fund (ALSF) through its Partnership Grants Scheme administered by English Nature and the LAR (Landscape, Access, Recreation) side of the Countryside Agency. Future funding sources are uncertain.

References

Aitkenhead, N., Barclay, W., Brandon, A., Chadwick, R.A., Chisholm, J.I., Cooper, A.H. and Johnson, E.W., 2002. *British Regional Geology: the Pennines and adjacent areas* (fourth edition). (British Geological Survey, Nottingham). 206pp.

Burek, C., 2006. Do we need a National GAP? *Earth Heritage* **25** p.10

Burek, C. and Potter, J., 2004. Local Geodiversity Action Plans: Sharing good practice, *English Nature Research Report* Number **601**. 38pp. http://www.english-nature.org.uk/pubs/publication/PDF/601.pdf

DEFRA, 1994. *Biodiversity: The UK Action Plan*

DEFRA, 2003. *Working with the grain of nature: A biodiversity strategy for England* http://www.defra.gov.uk/wildlife-countryside/biodiversity/biostrat/index.htm

Humphries, R.N. and Donnelly, L., 2004. Geological conservation benefits for biodiversity. English Nature Research Report Number **561**. 47pp. http://www.english-nature.org.uk/pubs/publication/PDF/561.pdf

King, A., Glasser, N., Larwood, J., Littlewood, A., Moat, T. and Page, K., 1996. Earth heritage conservation in England: A Natural Areas perspective *English Nature Research Reports* **158** http://www.english-nature.org.uk/pubs/publication/PDF/158_1.pdf (web address for part 1of 18 sections)

Larwood, J., 2006. LGAPs: where are we now? *Earth Heritage* **25**, **p.**9.

Pemberton, M., 2002. in Prosser, C., Terminology: speaking the same language *Earth Heritage* **18** 24-25

Rickards, R.B. and Woodcock, N.H., 2005. Stratigraphical revision of the Windermere Supergroup (Late Ordovician-Silurian) in the southern Howgill Fells, NW England. *Proceedings of the Yorkshire Geological Society.* **55**. pp. 263-285.

Stanley, M., 2001. Editorial in *Geodiversity Update* **1** p.1

Soper, N.J. and Dunning, F.W., 2005. Structure and sequence of the Ingleton Group, basement to the central Pennines of northern England. *Proceedings of the Yorkshire Geological Society.* **55**. pp.241-261.

YDNPA, 2000 *Nature in the Dales: A Biodiversity Action Plan for the Yorkshire Dales National Park* http://www.yorkshiredales.org.uk/nature_in_the_dales

Acknowlegements

The North Yorkshire Geodiversity Partnership is particularly thankful for financial support through the Aggregates Levy Sustainability Fund from the Department for the Environment, Food and Rural Affairs (DEFRA) administered by English Nature and the Landscape, Access and Recreation side of the Countryside Agency. The partnership thanks English Nature for the use of its offices at Leyburn for the partnership meetings. It is also very grateful to all the organisations of the authors and steering group listed at the front of the report (and whose logos appear on the front cover) that have invested staff time and money to make this draft Action Plan a reality. The partnership particularly thanks the following for their constructive

comments about the Draft LGAP: Dr Jonathan Larwood and Dr Ian Williamson of English Nature; Dr John Powell, Poul Strange and Keith Ambrose of the British Geological Survey.

Advisory Partners, Circulation and Consultation

Initially, for comments and suggestions, this Draft Local Geodiversity Action Plan is being circulated to the organisations listed below:

British Cave Research Association
Council of Northern Caving Clubs
Country Land and Business Association
Countryside Agency
Craven and Pendle Geological Society
Craven Museum
Craven District Council
Cumberland Geological Society
Cumbria County Council
Cumbria RIGS
Department of Earth Sciences (Leeds University)
Earby Museum
Environment Agency
Field Studies Council – Malham
Forest of Bowland AONB
Lafarge Aggregates Ltd
Limestone Pavement Action Group
Limestone Research Group
National Trust
North East Yorkshire Geology Trust
North Yorkshire County Council
Northern Mine Research Society
PLACE Education and Research Centre
Richmondshire District Council
Rural Development Service
South Lakeland District Council
The National Trust
UK RIGS
University of Huddersfield
University of Leeds
Westmorland Geological Society
Yorkshire Dales Millennium Trust
Yorkshire Dales National Park Authority – Minerals and Waste
Yorkshire Geological Society
Yorkshire Water PLC
Yorkshire Wildlife Trust

In addition to these organisations, the North Yorkshire Geodiversity Partnership would like to receive comments from any other groups or individuals. Comments should be sent to:

Adrian Kidd, Project Officer - North Yorkshire Geodiversity Partnership, Yorkshire Dales National Park Authority, Grassington, SKIPTON, BD23 5LB
geodiversity@yorkshiredales.org.uk

Appendix 1. Your Dales Rocks: A Geodiversity Action Plan for the Yorkshire Dales and Craven Lowlands

A. Partnership and Involvement
B. Site Evaluation and Geo-audit
C. Conservation and Management
D. Education and Site Use
E. Monitoring and Review

Priorities: 1 – high; 2 – medium; 3 – low; see Appendix 2 for priority listings of actions.

A Partnership and Involvement					
Objective	Target	Action	Key Partners	Timescale	Priority
A1. To maintain the level of partnership involvement.	To encourage the involvement of the existing partners	Keep the partners fully informed of all developments	NYGP	Ongoing	1
A2. To seek greater collaborative working between the Partnership, local communities, local authorities, conservation agencies and quarry operators.	To invite and encourage associate partners, local communities, local authorities, conservation agencies and quarry operators to join the partnership for specific projects	Keep advisory partners informed and to invite their input as appropriate	NYGP	Ongoing	1
	To widen the partner representation of the RIGS group	Contact local geological groups and individuals	NYGP Craven and Pendle Geological Society, Yorkshire Geological Society	Ongoing	1
	To establish appropriate links with other RIGS groups	Contact Cumbria RIGS	NYGP Cumbria RIGS	Ongoing	1
	To establish appropriate links with other conservation groups	Contact other conservation groups	NYGP Yorkshire Wildlife Trust	Ongoing	2

B Site Evaluation and Geo-audit					
Objective	Target	Action	Key Partners	Timescale	Priority
B1. To audit the local geological and geomorpho-logical resources.	To identify possible sources of funding for the geo-audit	Contact UKRIGS to identify sources of funding	NYGP UKRIGS	Ongoing	1
		Contact the BGS to obtain estimate of cost of geo-audit	NYGP BGS	Short Term	1
	To obtain details of all geological SSSIs	Contact English Nature to obtain details of geological SSSIs	NYGP English Nature	Short Term	1
	To obtain details of all GCR sites	Contact the JNCC to obtain details of GCRs	NYGP JNCC	Short Term	1
	To obtain details of all existing RIGS	Contact Cumbria RIGS to obtain details	NYGP Cumbria RIGS	Short Term	1
	To identify potential RIGS and Dales Geological Sites (DGS)	Contact local geological groups and individuals to identify possible sites	NYGP BGS FSC Craven and Pendle Geological Society, Yorkshire Geological Society	Short Term	1
		Contact BGS to identify sites as part of the geo-audit	NYGP BGS	Short Term	1
	To obtain details of all active quarries	Contact local quarry operators for details	NYGP Hanson Lafarge Tarmac	Short Term	1
	To identify records of all disused quarries, mine workings, and spoil heaps	Contact the Northern Mines Research Society, Yorkshire Dales NPA Archaeology Section, BGS and County Archivist to identify existing records	NYGP NMRS YDNPA BGS	Short Term	1
	To identify records of significant geological features in the built and transport environments	Contact archaeology sections of YDNPA and NYCC to identify possible records	NYGP YDNPA NYCC	Ongoing	2
	To identify the major geomorphological features including karst (limestone pavements and cave systems)	Contact YDNPA and Limestone Pavement Action Group to obtain details of limestone pavements database	NYGP YDNPA LPAG	Short Term	1

B1. To audit the local geological and geomorpho-logical resources ***continued:***		Contact British Cave Research Association and Council of Northern Caving Clubs to obtain details of cave databases	NYGP BCRA CNCC	Short Term	1
	To identify unrepresented or poorly represented geological and geomorphological features	Relate existing SSSI, GCR and RIGS to stratigraphical column	NYGP BGS	Ongoing	1
	To identify important soil types	Contact Soil Survey of England and Wales to obtain details	NYGP SSEW	Short Term	2
	To identify important museum specimen and map collections	Contact local museums	NYGP York Museum Nidderdale Museum Craven Museum Bradford University BGS	Short Term	2
	To record existing geodiversity publications aimed at the general public	Identify existing publications	NYGP YDNPA Nidderdale AONB BGS National Trust Museums Libraries	Short Term	1
B2. To create and maintain a GIS compatible database of all features and sites.	To record data using the UKRIGS GeoConservation Database	Obtain a copy of the GeoConservation Database from UKRIGS	NYGP UKRIGS	Ongoing	1

C Conservation and Management					
Objective	Target	Action	Key Partners	Timescale	Priority
C1. To suggest targets and actions for local geological conservation.	To use the UKRIGS criteria to identify potential additional RIGS or DGS sites	Contact UKRIGS to obtain criteria	NYGP UKRIGS BGS	Short Term	1
	To identify RIGS and Dales Geological Sites (DGS) of value for primary and secondary education	Apply UKRIGS criteria to identify DGS	NYGP BGS	Short Term	1
	To develop a procedure for the designation of RIGS and DGS	Contact Cumbria RIGS and UKRIGS to identify existing procedures	NYGP Cumbria RIGS UKRIGS	Short Term	1
		Obtain funding to contract the BGS to identify possible RIGS and DGS as part of geo-audit	NYGP BGS	Short Term	1
	Engage the interest of the local community by involving them in historical and field research to identify sites of geological interest - thus encouraging them to take part in conservation	Contact local groups e.g Dales Volunteers and Friends of Nidderdale to identify potential volunteers	NYGP Dales Volunteers Friends of Nidderdale Yorkshire Dales Society	Ongoing	1
	To establish an appropriate working relationship with local land owners	Contact Country Land and Business Association	NYGP CLBA	Ongoing	2
	To encourage the protection of the areas of limestone pavement, limestone rock outcrops, cliffs and scree in the area	Promote the enforcement of existing Limestone Pavement Order Legislation	English Nature YDNPA Limestone Pavement Action Group	Ongoing	1
		Work with relevant parties to avoid applications for new permissions (or extensions to existing ones) which will result in the loss or damage of limestone pavement	English Nature YDNPA Limestone Pavement Action Group	Ongoing	1
	To monitor the condition of all geological SSSIs, RIGS and DGS	Contact Cumbria RIGS and English Nature to identify existing guidelines, methods and timescales	NYGP Cumbria RIGS English Nature	Ongoing	3

C1. To suggest targets and actions for local geological conservation - ***continued:***	To encourage all users to understand and respect the geodiversity and biodiversity value of cave systems	Liaise with user groups to establish voluntary codes of practice and management guidelines for caves of high geodiversity and biodiversity value	Council of Northern Caving Clubs British Cave Research Association YDNPA English Nature	Ongoing	2
	To encourage the use of local stone in building	Contact local planning authorities	YDNPA Harrogate BC Richmondshire DC Craven DC	Ongoing	3
	To seek to safeguard sources of local stone to support the conservation of traditional buildings and features such as dry stone walls	Contact local Minerals and Waste Planning Officers	YDNPA NYCC	Ongoing	3
	To foster the retention of traditional building and dry stone walling skills	Contact local conservation groups (Dales Volunteers)	NYGP YDNPA Dry Stone Walling Association	Ongoing	3
	To identify suitable projects for practical conservation work	Contact local conservation groups (Dales Volunteers)	NYGP Dales Volunteers Friends of Nidderdale	Ongoing	3
C2. To encourage the inclusion of local geological conservation targets within any other plans or strategies that impact upon local geodiversity	To review existing local authority policy documents to establish the level of inclusion of geodiversity policies	Obtain copies of policy documents and meet with local authority representatives	NYGP NYCC YDNPA Craven DC Harrogate BC Richmondshire DC	Ongoing	2
		There should be a presumption, wherever possible, of maintaining geological features exposed in road construction or road widening operations. Exposed geological features should not automatically be concealed beneath topsoil and planting.	NYGP NYCC	Ongoing	3
		To work towards a system where geological records are made of exposures revealed during road improvement or similar construction works.	NYGP NYCC BGS UKRIGS	Ongoing	3

C2. To encourage the inclusion of local geological conservation targets within any other plans or strategies that impact upon local geodiversity – ***continued:***		Quarry operators should be encouraged to record and conserve important geological features alongside commercial activity and to encourage enhancement of those features where appropriate.	NYGP Hanson Lafarge Tarmac	Ongoing	3
		As part of the LDF process produce geodiversity factsheets for circulation to local planning authorities	NYGP NYCC YDNPA Craven DC Harrogate BC Richmondshire DC	Medium	2
	To develop a partnership approach between LGAP and LBAP production	Liaise with Biodiversity Officers	NYGP NYCC YDNPA Craven DC Harrogate BC Richmondshire DC	Medium	3
C3 If approved by the relevant local authorities to investigate the possibility of part of the area becoming a GeoPark with the potential for geotourism.	If approved by the relevant local authorities to investigate the possibility of part of the area becoming a GeoPark with the potential for geotourism	Contact the European GeoPark Network	NYGP European GeoPark Network	Short Term	3

D Education and Site Use					
Objective	Target	Action	Key Partners	Timescale	Priority
D1.To increase public awareness, understanding & appreciation of the geodiversity of the area.	To promote the area's geodiversity in publications, plans and strategies	Identify existing relevant publications	NYGP YDNPA Nidderdale AONB BGS National Trust Libraries Museums	Short Term	1
		Produce a promotional information leaflet	NYGP BGS	Short Term	1
		Produce a biannual newsletter for circulation within the steering group	NYGP	Ongoing	2
		Produce a series of geological interpretative leaflets	NYGP NYCC YDNPA Nidderdale AONB BGS	Ongoing	2
	To produce an interpretative geological/land-scape map	Obtain funding for the production of the map	NYGP BGS English Nature	Short Term	1
	To encourage, where possible, the inclusion of geodiversity in programmes of guided walks and other interpretative events	Contact those local organisations which organise guided walks and interpretative events	NYGP YDNPA Nidderdale AONB National Trust	Ongoing	1
		Develop a programme of talks related to geodiversity	NYGP	Ongoing	1
	To raise awareness of geodiversity among identified groups	Contact various groups: General public Education sector Conservation organisations Local authorities Business	NYGP	Ongoing	1
	To obtain funding for the creation and maintenance of a LGAP web site	Identify possible sources of funding	NYGP YDNPA Nidderdale AONB BGS	Ongoing	1
D2 To encourage opportunities for education and research related to local geodiversity.	To promote the study of the area's geodiversity	Produce educational resource materials for use by schools and colleges	NYGP NYCC YDNPA Nidderdale AONB BGS FSC	Ongoing	2
	To identify the key geodiversity sites which are suitable for general and educational information and interpretation	Select appropriate sites for information and interpretation	NYGP YDNPA Nidderdale AONB EN FSC	Short Term	1

D2 To encourage opportunities for education and research related to local geodiversity - ***continued:***		Produce interpretative resource materials for selected sites	NYGP NYCC YDNPA Nidderdale AONB BGS FSC	Ongoing	2
		Produce an educational register of key sites (Dales Geological Sites)	NYGP BGS FSC	Short Term	1
		Produce educational resource materials for selected sites for use by schools and colleges	NYGP NYCC YDNPA Nidderdale AONB BGS FSC	Ongoing	2
	To further opportunities for education and conservation within working quarries	Work with the aggregates industry to encourage them to consider controlled access for the interpretation and protection of geological features within their quarries	NYGP Hanson Lafarge Tarmac	Ongoing	2
	To promote opportunities for school field visits	Identify sites suitable for fieldwork at each Key Stage	NYGP NYCC	Ongoing	1
	To document current research on the area's geodiversity	Contact BGS, local universities and geological societies	NYGP BGS Leeds University YGS CPGS	Ongoing	3
	To encourage research within the area	Contact BGS and local universities	NYGP BGS Leeds University	Ongoing	3

E Monitoring and Review					
Objective	Target	Action	Key Partners	Timescale	Priority
E1 To establish a framework to monitor and review the implementation of the Geodiversity Action Plan.	To establish a framework to monitor and review the implementation of the Geodiversity Action Plan	Annually, review the implementation of the GAP	NYGP	Ongoing	1
		Review the GAP following the geo-audit	NYGP	Ongoing	1
		Review procedures every five years	NYGP	Ongoing	1

Appendix 2. Priority 1 Actions: to be achieved where possible within two years.

A Partnership and Involvement	• Keep the partners fully informed of all developments • Keep consultee partners informed and invite their input as appropriate • Contact local geological groups and individuals • Contact Cumbria RIGS
B Site Evaluation and Geo-audit	• Contact UKRIGS to identify sources of funding • Contact the BGS to obtain estimate of cost of geo-audit • Contact English Nature to obtain details of geological SSSIs • Contact the JNCC to obtain details of GCRs • Contact Cumbria RIGS to obtain RIGS details • Contact local geological groups and individuals to identify possible sites • Contact BGS to identify sites as part of the geo-audit • Contact local quarry operators for details • Contact the Northern Mines Research Society, Yorkshire Dales NPA Archaeology Section and BGS to identify existing records • Contact YDNPA and Limestone Pavement Action Group to obtain details of limestone pavements database • Contact British Cave Research Association and Council of Northern Caving Clubs to obtain details of cave databases • Relate existing SSSI, GCR and RIGS to stratigraphical column • Identify existing geodiversity publication • Obtain a copy of the GeoConservation Database from UKRIGS
C Conservation and Management	• Contact UKRIGS to obtain RIGS identification criteria • Apply UKRIGS criteria to identify DGS • Contact Cumbria RIGS and UKRIGS to identify existing RIGS procedures • Obtain funding to contract the BGS to identify possible RIGS and DGS as part of geo-audit • Contact local groups e.g Dales Volunteers and Friends of Nidderdale to identify potential volunteers • Promote the enforcement of existing Limestone Pavement Order Legislation • Work with relevant parties to avoid applications for new permissions (or extensions to existing ones) which will result in the loss or damage of limestone pavement.
D Education and Site Use	• Identify existing relevant geodiversity publications • Produce a promotional information leaflet • Obtain funding for the production of an interpretative geological map • Contact those local organisations which organise guide walks and interpretative events • Develop a programme of talks related to geodiversity • Contact various groups to promote awareness of geodiversity: General public, Education sector, Conservation organisations, Local authorities and Business • Identify possible sources of funding • Select appropriate sites for information and interpretation • Produce an educational register of key sites (Dales Geological Sites) • Identify sites suitable for fieldwork at each Key Stage
E Monitoring and Review	• Annually, review the implementation of the GAP • Review the GAP following the geo-audit • Monitor conservation and education policies and actions

Appendix 3. Priority 2 Actions: to be achieved where possible within three to four years.

A Partnership and Involvement	• Keep the partners fully informed of all developments • Review partnership involvement • Keep consultee partners informed and invite their input as appropriate • Contact other conservation groups
B Site Evaluation and Geo-audit	• Contact archaeology sections of YDNPA and NYCC to identify possible records of significant geological features in the built and transport environments • Contact Soil Survey of England and Wales to obtain details of important soil types • Monitor progress in identification of RIGS and DGS • Review RIGS and DGS criteria
C Conservation and Management	• Contact Country Land and Business Association to establish an appropriate working relationship with local land owners • Liaise with cave user groups to establish voluntary codes of practice and management guidelines for caves of high geodiversity and biodiversity value • Obtain copies of policy documents and meet with local authority representatives • As part of the LDF process produce geodiversity fact sheets for circulation to local planning authorities
D Education and Site Use	• Produce a biannual newsletter for circulation within the steering group • Produce a series of geological interpretative leaflets • Produce educational resource materials for use by schools and colleges • Produce interpretative resource materials for selected sites • Produce educational resource materials for selected sites for use by schools and colleges • Work with the aggregates industry to encourage them to consider controlled access to, interpretation and protection of geological features within their quarries.
E Monitoring and Review	• Annually, review the implementation of the GAP • Review the GAP following the geo-audit

Appendix 4. Priority 3 Actions: To be achieved where possible within five years.

A Partnership and Involvement	• Keep the partners fully informed of all developments • Keep consultee partners informed and invite their input as appropriate
B Site Evaluation and Geo-audit	
C Conservation and Management	• Contact Cumbria RIGS and English Nature to identify existing guidelines, methods and timescales for monitoring sites • Contact local planning authorities to encourage the use of local stone in building • Contact local Minerals and Waste Planning Officers to seek to safeguard sources of local stone to support the conservation of traditional buildings and features such as drystone walls • Contact local conservation groups (e.g. Friends of Nidderdale) to foster the retention of traditional building and dry stone walling skills • Contact local museums to identify important museum specimen and map collections • Contact local conservation groups (e.g. Dales Volunteers) to identify suitable projects for practical conservation work • There should be a presumption, wherever possible, of maintaining geological features exposed in road construction or road widening operations. Exposed geological features should not automatically be concealed beneath topsoil and planting. • To work towards a system where geological records are made of exposures revealed during road improvement or similar construction works. • Quarry operators should be encouraged to record and conserve important geological features alongside commercial activity and to encourage enhancement of those features where appropriate. • Liaise with Biodiversity Officers to develop a partnership approach between LGAP and LBAP production • To contact the European GeoPark Network to investigate the possibility (if approved by the relevant local authorities) of part of the area becoming a GeoPark, with the potential for geotourism.
D Education and Site Use	• Contact BGS, local universities and geological societies to document current research on the area's geodiversity • Contact BGS, local universities and geological societies to encourage geodiversity research within the area
E Monitoring and Review	• Annually review the implementation of the GAP • Review the GAP following the geo-audit • Review procedures every five years

Appendix 5. The geological features, issues and objectives of the Natural Areas within the project area.

Cumbrian Fells and Dales	Forest of Bowland	Lancashire Plain and Valleys	Pennine Dales Fringe
Key geological features	*Key geological features*	*Key geological features*	*Key geological features*
• The upland exposures of deformed and fossiliferous Lower Palaeozoic sequences • The exposures of igneous rocks such as the Borrowdale Volcanic Group • Glacial erosional and depositional landforms and scenery • Cave and karst features including limestone pavement	• The exposures of Dinantian and Namurian rocks • The Global Stratotype Section and Point for the Pendleian Stage • The development of river systems in this upland area	• The exposures of Carboniferous rocks and their stratigraphical relationship • Sites of international importance for Carboniferous palaeontology • Important fossil localities in Carboniferous Limestone reef knolls • Glacial deposits and glacial landforms	• The geological SSSIs of Brimham Rocks, Great Almscliff Crag, Greenhow Quarry and Upper Nidderdale
Key geological management issues	*Key geological management issues*	*Key geological management issues*	*Key geological management issues*
• Maintain and enhance existing geological exposures and fluvial systems • Agree conservation sections in working quarries • Promote the heritage value of mineral sites • The conservation of sensitive cave and karst sites	• The need to safeguard and maintain exposures in man-made quarries and cuttings • The potential conflict between the mineral extraction industry, landfill and conservation • Promoting the geological heritage of this scenic upland area	• Maintaining and enhancing the exposures of Carboniferous rocks in the Natural Area, by limiting site degradation due to landfill and vegetation growth • The poor condition of many internationally important sites	• Quarrying and post-quarrying restoration
Key geological objectives	*Key geological objectives*	*Key geological objectives*	*Key geological objectives*
• The maintenance and enhancement of the geological resource through a) targeted site clearance, b) agreeing conservation faces in working quarries and c) protecting cave and karst features, • The promotion of the geological resource of the Lake District using opportunities for site interpretation, • Encourage links with Lake District scenic appeal, tourism and mining heritage.	• To maintain and where possible enhance the existing geological exposures by agreeing management plans with owners and occupiers • Negotiate the long-term conservation of exposures with mineral extraction companies at key geological sites • Encourage the creation and recording of both temporary and permanent exposures in the area as part of road schemes and other developments • Encourage responsible fossil collecting at vulnerable sites	• Promote and enhance the geological resource in the Natural Area using appropriate site management clearances • Maintain the natural processes in both rivers and coastal zone within the Natural Area • Ensure access is maintained to sites of international importance	• The maintenance of important geomorphological sites such as moraines

Southern Magnesian Limestone	Southern Pennines	Yorkshire Dales
Key geological features	*Key geological features*	*Key geological features*
• Permian Magnesian Limestone of the Yorkshire Province • Pleistocene stratigraphy • Pleistocene vertebrates • Early settlement by palaeolithic man	• The exposures of Namurian rocks and their goniatite fossils • Periglacial landforms including tors, edges and weathering regoliths • The geological control on the character and soils of the Natural Area	• The exposures of Carboniferous rocks and their stratigraphical relationship • The karst landforms including dolines, potholes, scars and areas of limestone pavement (about half of Britain's limestone pavements and associated features are found in the area) • The underground cave systems and their associated surface and subsurface streams • The geological influence on the character of the Dales landscape and National Park
Key geological management issues	*Key geological management issues*	*Key geological management issues*
• Maintain and enhance existing geological exposures • Agree conservation sections in working quarries • Assess new sites (temporary or permanent) • Promote the educational value of the geological resource	• The need to safeguard and maintain exposures in man-made quarries and cuttings • The potential conflict between the mineral extraction industry, landfill and conservation • Promoting the geological heritage of this scenic upland area • The deterioration of existing sites due to vegetation growth and natural degradation	• Maintaining and enhancing the exposures of Carboniferous rocks in the Natural Area • Maintaining the operation of natural fluvial processes in the Natural Area • Protecting and enhancing the areas of limestone pavement within the Natural Area • Reducing the potential for damage to the underground cave systems through both internal and external activities • The lack of a RIGS group in the area
Key geological objectives	*Key geological objectives*	*Key geological objectives*
• The maintenance and enhancement of the geological resource through a) enhancement of existing exposures, site clearance in disused quarries, b) development of local conservation strategies that include geology and c) continued assessment of the educational/research value of new sites e.g. quarries and cuttings (temporary or permanent). • The promotion of the geological resource through the a) assessment and promotion of site educational value, b) on-site interpretation e.g. sign boarding, trail guides and leaflets and c) the promotion of initiatives that link geology, local habitats, scenery and the industrial development of the Natural Area	• To maintain and where possible enhance the existing geological exposures by agreeing management plans with owners and occupiers, including site clearance opportunities • Negotiate the long-term conservation of exposures with mineral extraction companies at key geological sites • Encourage responsible fossil collecting at vulnerable sites and the creation and recording of both temporary and permanent exposures in the area as part of road schemes and other developments • Encourage site interpretation schemes such as thematic trails	• To protect areas of limestone pavement through Limestone Pavement Orders, and through encouraging initiatives aimed at joint geological / biological management of these areas. • To encourage local caving organisations to take responsibility for cave conservation by undertaking cave conservation plans for cave systems. • To encourage initiatives aimed at the interpretation of the geological and landscape character of the Yorkshire Dales National Park, and this prime recreational area. • To restore natural fluvial processes (including catchments and floodplains) in the Natural Area • To maintain and where appropriate restore or improve valued exposures of Carboniferous rocks in the Natural Area • To maintain important geomorphological features e.g.drumlins.