

West Yorkshire Geodiversity Action Plan A Consultative Document



W YORKSHIRE
GEOLOGY TRUST

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Calderdale view from Heptonstall quarry



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Introduction

What is Geodiversity?

Geodiversity is a concept which links together geology, which is the study of rocks, minerals, fossils and earth systems, with the landscapes that we see and the processes which produce them. Geodiversity leads to biodiversity. Through weathering, climatic processes and rock types create a variety of soils, which in turn allow natural plant and animal ecosystems to develop. Geodiversity influences agriculture, settlement and industrial development and the way we use our local areas for recreation. Geodiversity defines landscapes which give communities a sense of place and a cultural identity.



Digley Reservoir above Holmfirth

What is the purpose of the Geodiversity Action Plan?

The aim of the West Yorkshire Geology Trust (WYGT) Geodiversity Action Plan (WY GAP) is to safeguard, manage and promote geodiversity in the county. The action plan is intended to facilitate a large and complex process which involves cooperation with many groups and organisations and it will be the basis for future geoconservation work in West Yorkshire. The objectives identify the key issues and provide the framework for the Trust's activities. The actions put forward in the WY GAP are related to the objectives and suggest the activities which will enable the group to meet the aim. It is a consultative document and the ideas suggest some possibilities for future projects, but are included largely to stimulate discussion. Geodiversity Action Plans have been developed in many other regions in the UK in the last few years and a national GAP is also being planned. It is recognised that they are a source of information and guidance for a wide range of planning, management, conservation

and interpretation interests and form a useful basis for discussion. The WY GAP has been funded by the Aggregates Levy Sustainability Fund (ALSF) from the Department of the Environment, Farming and Rural Affairs (DEFRA), administered by Natural England.

West Yorkshire's Geodiversity

The county's landscapes include the distinctive Pennine uplands characterised by plateau and valley scenery, produced by Millstone Grit rocks, as well as urbanised undulating lowlands, largely underlain by less resistant clays. In the east of the county are yellow limestones which have a distinctive upland landscape of their own. In the high Pennines naturally weathered scars and cliffs are common. West Yorkshire has many old quarries and delves, from which sandstone or limestone was extracted for building walls, farms, cottages and mills. Shale underlies about half of West Yorkshire but is generally covered by vegetation, so the best exposures of shales are in cloughs and valleys. In the last several hundred thousand years the landscape has been influenced by glacial processes as ice sheets have advanced and retreated. West Yorkshire has many sites where visitors can see West Yorkshire's rocks, even though much of lowland West Yorkshire is urbanised or covered with vegetation. They compose the geodiversity which we seek to share and protect.

View from Pule Hill to Green Owlers, Marsden



Introduction	01
Contents	02
The Geology of West Yorkshire	03
How to share and protect our Geodiversity	04
Regionally important Geological/Geomorphological sites	05
Map to show the location of RIGS	06
Summary table of RIGS	07
Sharing and protecting Geodiversity sites	08
Planning policy and Geodiversity	09
Geodiversity and Industrial Heritage	10
What Geological stories are we telling?	12
Geology is fun! Who needs to learn more?	14
How can we interpret Geodiversity?	15
Publicity and communication	17
Education and Geology	18
Geological Records	19
Skills audit	20
Participation in the West Yorkshire Geodiversity Action Plan	21
Sustainability of the West Yorkshire Geology Trust	22
Monitoring the progress of the Geodiversity Action Plan	23
Bibliography	24
Acknowledgements	Inside back cover

The Geology of West Yorkshire

Millstone Grit

This term is used for a series of sandstones, siltstones and shales (mudstones) which date from the Namurian epoch of the Upper Carboniferous period and are about 320 million years old. The area that is now northern England lay in a subsiding basin between high mountain ranges. Rivers carried sediments which compressed under pressure of overlying rocks to give a rock sequence which is about 1700m thick. Deltas of sand built out over deeper waters in which clay and mud was deposited. Sea-level fluctuated because of global temperature changes, so alternating beds of mudstones and sandstones are found. River and delta sediments contain plant fossils, whereas mudstones contain marine fossils, particularly molluscs such as goniatites (like the WYGT logo) and shells.

Coal Measures

After the Millstone Grit rocks were deposited the seas became shallower and deltas built out from the coastlines. Sands and muds brought down by rivers were deposited in huge channels, much like the present Amazon Basin. The continent was close to the equator, so the land surface was covered with luxuriant vegetation, such as tree ferns and other

spore-bearing plants. In stagnant lakes and marshes, plant material decomposed without oxygen, so that carbon was retained in the muds. Carbon was locked into coal seams during later burial by sediments. Tree branch and root fossils are very common in river sandstones, whereas marine shell fossils are found in mudstones which were deposited in shallow seas, as sea-levels continued to fluctuate.

Permian Rocks

The Permian period followed the Carboniferous period about 290 million years ago. Plate tectonic uplift of southern Europe formed large mountains, so that northern England lay above sea-level in a hot, arid climate. Wind erosion produced blown sand so the first Permian rocks are dune-bedded desert sands called the Yellow Sands Formation, found in a few places in the east of the county. In Late Permian times the land was flooded by a shallow, salty sea called the Zechstein Sea, which dried out regularly because of high evaporation and sea-level fluctuations, leaving precipitated carbonates and other salts behind. The carbonates have been altered to yellow dolomitic limestones during later burial, interbedded with reddish mudstones. Fossils are rare, because not many forms of life could survive in such saline waters.



How to share and protect our Geodiversity

Aim

To provide a framework to safeguard, manage and promote the geodiversity of West Yorkshire

Share and Protect

This geodiversity action plan seeks to identify and protect the geodiversity of West Yorkshire and to share it more widely throughout the county. Knowing more about our geodiversity leads to greater understanding of how natural and industrial landscapes have developed. From this knowledge and understanding comes wisdom about how to manage our resources, as part of the ecosystems on our planet.

Geodiversity sites

In order to share and protect our geodiversity it is necessary to identify the most valuable sites. Nationally important sites have been identified and managed by Natural England, whereas Regionally Important Geological/geomorphological Sites (RIGS) are designated by local groups, usually called RIGS groups or Geology Trusts. Local geodiversity groups are organised in a similar way to the county wildlife trusts, which protect and manage biodiversity sites.

Surveying the Permian Cadeby Formation limestones in Hetchell Woods quarry, Leeds

Sites of Special Scientific Importance

Nationally important geological and geomorphological sites are protected as Sites of Special Scientific Importance (SSSIs). They were selected through the Geological Conservation Review between 1977 and 1990 to provide a scientific record of important sites which would represent our national geology and landforms. SSSIs are managed by Natural England, as befits sites of national importance. There are 13 geological SSSIs in West Yorkshire as shown in the box. These sites are sufficiently important to need protection from development and other threats. More details about each can be obtained from the Natural England website: www.englishnature.org.uk/special/ssi/citation_search.asp.

SSSIs in West Yorkshire

Crimsworth Dean
 Elland Bypass Cutting
 Great Dib Wood
 Hetchell Wood
 Honley Station Cutting
 Micklefield Quarry
 Nostell Brickyard Quarry
 Park Clough
 Rake Dike
 South Elmsall Quarry
 South Pennine Moors
 Standedge Road Cutting
 Yeadon Brickworks and Railway Cutting

Regionally Important Geological/Geomorphological Sites (RIGS)

Regionally Important Geological / Geomorphological Sites (RIGS)

RIGS are sites with features which are of regional and local interest. Some of them have an over-riding scientific importance, but many are accessible sites which can be used for education and interpretation for the general public. 69 sites in West Yorkshire were identified during 1995/2000 and many of them have been subsequently reviewed. The criteria under which they were designated conform to similar criteria used in other regions and are shown in the box below which gives the headings used in the site designation sheets. The RIGS are located on the map on page 6 and brief information about each is given on page 7. The WYGT website (www.wyorksgeologytrust.org) gives a short version of the designation sheet for each RIGS and more details are obtainable from WYGT. The designation sheets provide information which can be used to support any issues which might arise. 20 RIGS have been surveyed in detail in 2007/2008 with a view to active management in the future. Full details will be made available to owners and managers and other interested groups.

Weathering of the main face of the East Carlton Grit at Hetchell Crags, Leeds

Objective 1

To identify and monitor the RIGS in West Yorkshire.

Actions to make sure we identify and protect RIGS

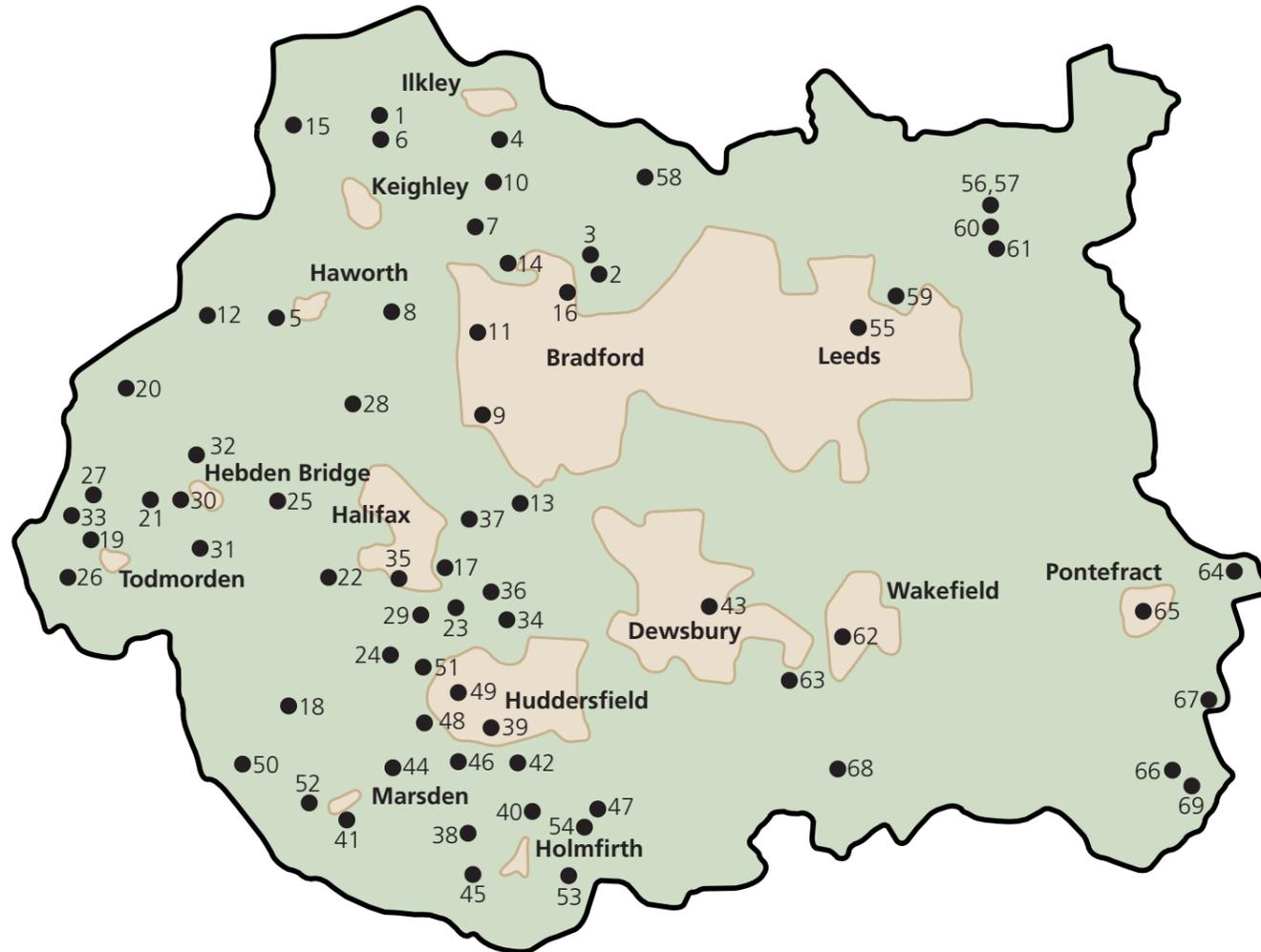
- Review the RIGS that have not been visited recently and check for threats to their value and use.
- Assess the existing sites to see if they are sufficiently representative of the geodiversity in the county and identify any gaps.
- Use recent geological literature and BGS maps to identify further sites.
- Continue to welcome suggestions from local geologists, specialists and other interest groups, about other sites which should be considered as RIGS.

RIGS Designation Headings

Location details
 Date of most recent survey
 Description of site
 Historical associations
 Educational value
 Aesthetic characteristics
 Access and safety
 Potential for interpretation and management
 Ownership and permission
 Scientific importance
 Scientific references



Map of RIGS



Summary table of RIGS

Bradford RIGS		Grid ref.		
1	Addingham Edge Millstone Quarry	SE 074 472	HA	
2	Baildon Bank and Baildon Green Quarries	SE 145 388	E A	
3	Baildon Moor	SE 142 401	HA	
4	Cow and Calf Rocks, Ilkley	SE 131 467	E A	
5	Dimples Quarry, Haworth	SE 025 369	E A	
6	Doubler Stones, Addingham Moorside	SE 073 465	A	
7	Eldwick Crag and Quarry	SE 124 423	A	
8	Goitstock Waterfall, Cullingworth	SE 077 367	A	
9	Horton Bank Country Park, Bradford	SE 126 308	E A	
10	Lanshaw Delves, Ilkley	SE126 455	HA	
11	Noon Nick, Shipley	SE 118 360	A	
12	Ponden Clough, Haworth	SE 987 367		
13	Royds Hall Beck, Wyke	SE 143 272	E HA	
14	Shipley Glen	SE 130 391	E HA	
15	Throstle Nest, Silsden	SE 038 468		
16	Wrose Hill, Shipley	SE 156 371	HA	
Calderdale RIGS				
17	Beacon Hill and Godley Cutting, Halifax	SE 103 252	HA	
18	Derby Delph Quarry, Booth Wood Reservoir	SD 892 260	E A	
19	Cliviger Gorge	SD 934 326	HA	
20	Cludders Rocks, Widdop	SD 983 274	A	
21	Colden Clough, Hebden Bridge	SE 017 162	A	
22	Dixon Scar, Sowerby Bridge	SE 052 238	E A	
23	Elland bypass road cutting (north)	SE 080 201		
24	Eaves Top Quarries, Stainland	SE 102 215	E A	
25	Foster Clough Delves, Mytholmroyd	SE 022 271	A	
26	Gorpley Clough, Todmorden	SD 914 233	E HA	
27	Great Brides Stones, Todmorden	SD 932 268	E A	
28	Ogden Clough, Ogden Water	SE 095 216	E A	
29	Greetland Quarry	SD 985 278	E A	
30	Hell Hole Quarry, Heptonstall	SD 960 220	E A	
31	Langfield Edge and Stoodley Pike	SD 993 314	A	
32	Lumb Falls, Hebden Bridge	SE 054 318	E A	
33	Paul and Coal Cloughs, Cliviger	SD 907 272		
34	Round Hill, Rastick	SE 137 207	A	
35	Scarr Wood, Halifax	SE 083 234	HA	
36	Strangstry Wood, Elland	SE 127 217		
37	Wood Head Quarries, Hipperholme	SE 118 259	E	
Kirklees RIGS				
38	Bannister Edge, Meltham	SE 067 093	H	
39	Beaumont Park, Huddersfield	SE 128 147	E HA	
40	Brockholes and Round Wood, Brockholes	SE 1510	A	
41	Butterley Cutting, Marsden	SE 049 106	E A	
42	Castle Hill, Huddersfield	SE 152 140	E HA	
43	Caulms Wood Quarry, Dewsbury	SE 250 223	E A	
44	Clough Head Quarry, Slaithwaite	SE 082 157	A	
45	Digley Quarries, Holmbridge	SE 111 073	E A	
46	Folly Dolly Falls, Meltham	SE 107 113	E H	
47	Hartley Bank Quarry, Thunderbridge	SE 189 115	E A	
48	Johnson Wellfield Quarries, Crosland Hill	SE 1114	E A	
49	Longwood Edge Quarry, Huddersfield	SE 101 177	E	
50	March Haigh and Buckstones	SE 018 136	E A	
51	Old Lindley Moor, Huddersfield	SE 098 187	E A	
52	Pule Hill Quarry, Marsden	SE 032 108	E HA	
53	Scar Hole Quarry, Jackson Bridge	SE 175 074	E A	
54	Upper and Lower Stone Woods, Stocks Moor	SE 1810		
Leeds RIGS				
55	Gledhow Valley, Leeds	SE 319 363	A	
56	Hetchell Craggs, Scarcroft	SE 377 424	E A	
57	Hetchell Wood Quarries, Scarcroft	SE 378 423	E	
58	Otley Chevin and Caley Craggs	SE 1944	E HA	
59	Roundhay Park Gorge, Leeds	SE 333 391	E A	
60	Scarcroft Hill Railway Cutting	SE 375 414	E	
61	Thorner Quarry	SE 381 407		
Wakefield RIGS				
62	Dewsbury Road Recreation Ground	SE 314 204	E A	
63	Horbury Quarry	SE 288 183	E A	
64	Knottingley Canal Sides	SE 499 241	E HA	
65	Mill Hill Road, Pontefract	SE 454 215	E A	
66	Upton Recreation Ground	SE 475 138	E A	
67	Wentbridge Road Cutting	SE 487 178	E A	
68	Woolley Edge Quarry	SE 308 137	E A	
69	Wrangbrook and Upton Cuttings	SE 496 137	E HA	

Key
 Shaded RIGS have been surveyed in detail as part of the 2007/2008 project.
 E – Educational Value
 H – Historic Value
 A – Access means that the site can be seen from a road, track or public footpath. It does not imply that the site can be approached, nor that it is suitable for large groups or for disabled users.

Sharing and Protecting Geodiversity Sites

Sharing Geodiversity

A key objective of the West Yorkshire Geology Trust is that knowledge and information about geodiversity is shared with others

Objective 2

To raise public awareness and promote understanding of West Yorkshire's geodiversity

Actions for sharing the Geodiversity of RIGS

- Make copies of designation sheets available to owners and managers of RIGS.
- Assess which sites could be used for educational interpretation.
- Assess high priority RIGS for the drawing up of site management plans after discussion with owners and managers.
- Take guided walks to visit RIGS under the aegis of local geological or community groups or as part of local authority walks programmes.
- Cooperate with Natural England on work in SSSIs.

Overgrown face at Woolley Edge, Wakefield



Rubbish tipped at Woolley Edge quarry, Wakefield

Threats to rock exposures and landscapes

Development, especially road cuttings or removal of subsoil on steep slopes for building, can create new rock exposures which may be temporary or permanent. However, development in existing sites can obliterate good exposures, particularly of special rocks and features, such as coal seams and fossil bands. Most of West Yorkshire's landforms, such as upland plateaux and benches, are created from resistant sandstones, but there are features formed by unconsolidated sediments which can be easily destroyed by development. Geomorphological features made from glacial, periglacial and river deposits give excellent evidence about processes which have occurred in the county in the last few hundred thousand years during a period of considerable climate change. Many of these features are in lowland areas on river flood plains and are therefore very vulnerable to development.

Threats to RIGS

Rubbish and unauthorised tipping
Graffiti
Damage to sites because of over-enthusiastic use of hammers
Formation of debris slopes obscuring rock faces, due to natural weathering or casual tipping
Vegetation growth which reduces access and obscures rock faces
Building developments, particularly in disused quarries
Use of disused quarries for landfill

Objective 3

To identify threats to geological features or landscapes of local or national importance.

Planning Policy and Geodiversity

Objective 4

To continue to ensure that geodiversity is identified and included as an integral part of planning strategies and policies.

Planning policies

Geodiversity needs to be considered at every stage of planning, not only to prevent damage to important sites but also to promote enhancement of geodiversity. New exposures can be uncovered, quarry faces can be made safe and access to sites improved to promote education and general interest. Many sites, particularly disused quarries, have wildlife interest so that biodiversity and geodiversity values can be considered together.

Planning Policy Statement 9 on Biodiversity and Geological Conservation (August 2005) sets out key objectives to conserve, enhance and restore the diversity of England's wildlife and geology. It is suggested that regional planning bodies should liaise with environmental bodies such as local RIGS groups and Geology Trusts on geodiversity issues. Local authorities should integrate biodiversity and geodiversity when preparing local development documents.

Actions

- Ensure that RIGS are included on the Local Development Framework proposals map for each local authority.
- Liaise with planning authorities to make sure that they receive current geodiversity information which can inform planning policies and decisions.
- Cooperate with planning authorities to safeguard designated sites by developing a role in the existing planning process, including reviewing relevant planning applications for their impact on geodiversity.
- Identify existing or disused quarries and collaborate with local authority mineral planners and quarry owners and managers to plan for safe exposures to be available for study, education and enjoyment as part of the quarry restoration plan.



Lanshaw Delves RIGS is probably a glacial moraine, containing a mixture of rock types carried by ice sheets during the last glacial advance. The ridge has been quarried for hundreds of years for limestone blocks which were processed for use as agricultural fertiliser. Now the site needs protection.

Geodiversity and Industrial Heritage

Objective 5

To link the geodiversity of West Yorkshire to its industrial heritage

Geological resources and our Industrial Heritage

The exploitation of the limestones, sandstones, shales and coal seams has created the industrial landscape that is so characteristic of this county. Each rock type has made an important contribution to the economy of the county so that geology is fundamentally linked to the industrial heritage of West Yorkshire.



Bradshaw quarry track, Digley, Holmfirth

West Yorkshire's rock and mineral resources

- Yellow limestones – building stones, road aggregate and agricultural lime for fertilising fields
- Millstone Grit sandstones – building stones, flags, roofing slates and aggregates as well as for making millstones and grindstones
- Shales – many contain clays which are suitable for making bricks and pipes and many include ironstone nodules which were used in early iron works
- Coal – the fuel which powered the industrial mills and factories
- Gravel and sands - aggregates
- Pure, soft water – held in the sandstone aquifers and used in the textile and chemical industries

Brick made at Upton, Wakefield, from Coal Measure shales



Digley Reservoir, Holmfirth

Actions

- To cooperate with local history and archaeological societies in the interpretation of West Yorkshire's industrial heritage.
- To develop walks and talks for communities close to mines and quarries to link the extraction industry in West Yorkshire with local geology

Project Idea

Upton Beacon, Wakefield, has an outcrop of yellow limestone which has been quarried for building stone and aggregate. The hill is surrounded by Coal Measure rocks which include coal seams, exploited by Upton Colliery until its closure in 1964. The disused railway cutting nearby has excellent exposures of yellow limestones which can be used for geological interpretation. The site has been designated recently as a Local Nature Reserve. The industrial heritage of Upton is fascinating, so it is hoped that WYGT can cooperate with the local community and Wakefield Countryside Services to interpret the geodiversity through guided walks and events.

Halifax from Beacon Hill



Quarrying and Mining and our Industrial Heritage

Sandstone and Limestone quarrying

Millstone Grit gets its name from one particular use of this versatile sandstone. Most of West Yorkshire's sandstones are excellent building stones, usually marketed under the misnomer of York Stone. York Stone is produced by the quarrying industry in many parts of West Yorkshire. There are between 30 – 40 quarries at present, some of which are very small but others employ over a hundred staff. They contribute to the economy of the county as well as maintaining an important historical skill.

Yellow limestones have been quarried in many places in the eastern part of the county, both for building stone and for agricultural lime.

The many place names that include the words 'delph' or 'delves' or 'quarry' testify to the importance of the quarrying industry in the past.

Present buildings often incorporate materials from other parts of Britain and the rest of the world and these can be used with education groups to widen their experience of geological rock types.

Objective 6

To link the built environment of West Yorkshire to local materials and to value imported building stones which have been used in West Yorkshire, especially in town centres, cemeteries and churchyards.



Hepworth churchyard

Project ideas

To produce building stone trails or leaflets for town centres, such as Keighley, Bradford, Wakefield and Halifax and important cemeteries.
To take guided walks around town centres



Coal mine entrance to adit, Gorpsey Clough

Coal Mining

Coal seams, varying in thickness from 30cm to 300cm, are found in Coal Measure shales underlying the central and eastern part of West Yorkshire and have provided the energy for industry for centuries. The earliest mines were shallow pits (bell pits) or horizontal tunnels (adits). Coal seams towards the east of the county lie deeper under the ground surface so were exploited by deep shaft mining which developed as technology improved. Landscapes and buildings are evidence that coal mining was common everywhere in the Coal Measures area in the east of the county.



Coal Pit Lane, Lower Cumberworth, Kirkstall

Project idea

Keep a record of place names with connections to West Yorkshire's geodiversity, particularly the quarrying and mining heritage.

What geological stories are we telling?

Carboniferous Environments

The area which is now West Yorkshire was situated close to the equator 315 million years ago during the Carboniferous period. Rivers flowing from mountains to the north, west and east brought sand and mud into a shallow sea, full of animal life. Above sea-level, tropical forests flourished and the luxuriant plant life decomposed to give coal in thick seams, squeezed between sandstone and shale rocks.

Can you imagine West Yorkshire looking like the Amazon Basin?



Amazon Basin

Fossils in our rocks

Seas during Carboniferous times were rich in fish, sharks, shells and coiled molluscs called goniatites. Their teeth and shells were sometimes fossilised in the clays on the seabed and can sometimes be found in the shales in the West Yorkshire area. Because fossils are fragile, collecting them is not easy, but they have been vital for correlating and interpreting Carboniferous rock environments.

Skaftafelljökull glacier in Iceland



The tropical forest trees have left good fossil evidence, particularly in sandstones. Branches, roots and sometimes entire tree trunks have been found in quarries and their distinctive markings are often seen in walling stone. Lister Park, Bradford, has an example of a complete root system and the lower part of a tree trunk.

Can you imagine vicious sharks with jaws like this swimming in the seas of West Yorkshire?



Brockholes shark

Carboniferous Glaciation and Climate Change

Part of the huge continent of Gondwanaland lay across the south pole during the Carboniferous period. It had large ice-sheets which changed in size as global temperatures fluctuated. Sea-levels rose as ice-sheets melted and fell again in cold times. These changes are recorded in Carboniferous rocks, so provide vital evidence to show how present climate change might affect the world.

Geology in West Yorkshire can provide valuable research into present Global Climate Change.

What geological stories are we telling?

Permian Continents and Seas

The yellow limestones in the east of Leeds and Wakefield date from the Permian period and are about 290 million years old. The area that is now Britain lay to the north of the equator in a hot, arid climate. The yellow limestones were precipitated in shallow saline seas which were frequently dried up by the heat.

Can you imagine Leeds and Wakefield looking like this?

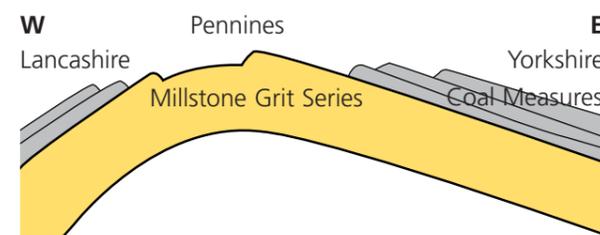


Desert salt lakes and debris fans, Death Valley California

West Yorkshire's Landscapes

The Pennines are formed because earth movements at the end of the Carboniferous period lifted the crust into a huge north-south trending upfold. Resistant sandstones form the plateaux of the high Pennines in Calderdale, Bradford and Kirklees, while recent river erosion has cut into the less resistant shales to give cloughs. The oldest rocks dip gently to the east under Leeds and Wakefield and are covered by more recent shales and coal seams, which give an undulating landscape.

The plate tectonics of Europe have given us the Pennine Hills: erosion of different rock types has produced our varied landscapes



Cross section of the Pennine upfold



Walsden valley, south of Todmorden

Industrial Landscapes and Geology

Our industrial heritage is based on the practical skills of the people who made cloth in hill farms and cottages. This industry was later concentrated in textile mills as water power and steam power was harnessed. Ironstone was needed to make iron for machinery, coal was used for heating and steam generation, water was needed in dyeing and finishing the cloth and building stone was used for constructing mills, factories and housing. Human skills and ingenuity, combined with available raw materials, provided employment and wealth for many in the county.

Our Industrial Heritage was based on the Geological resources of West Yorkshire



Wildspur Mills, Jackson Bridge

Geology is fun! Who wants to learn more?

Children

For many children their first experience of geology is the excitement of dinosaurs and they learn about them from books, posters, television programmes, films and activities. For many of them this avid learning experience generates an understanding of science and learning in the future. But they also respond to the beauty and interest of rocks, minerals and fossils and love to draw and collect them. Roadshows in museums and countryside centres draw large numbers of enthusiastic youngsters and their parents.



Children enjoying studying minerals at Cliffe Castle, Keighley

Adults

Adults rarely have the opportunity to study geology systematically. For many adults an interest in geology develops from their awareness of the landscape and how it is formed, or from an interest in local industries and buildings. Guided walks and leaflets are an effective way of raising the awareness of adults interested in a different aspect of familiar landscapes.

Activities in the classroom at Cliffe Castle Museum, Keighley



Climbers at Hell Hole quarry, Heptonstall

Project idea

Gritstone and climbers

Many sandstone crags and quarries in West Yorkshire's RIGS are used informally or formally by climbers. Talking to climbing groups about how they value gritstone would be interesting and valuable.

Example of good practice

The West Yorkshire Geology Trust, at the request of Kirklees Countryside Unit, published a leaflet on Castle Hill, Huddersfield. It uses two guided walks on footpaths around the hill to illustrate the relationship between the geology and landscapes of the Huddersfield area. The leaflet won the 2006 ENI Geological Challenge Award.

How can we interpret Geodiversity?

Guided walks

Guided walks are enjoyable ways of attracting adults and children into town centres or the countryside to benefit from the stimulation of different ideas in a new area.

For many adults and children, being told what to look for is an effective and interesting way to learn. Features in the landscape which do not usually attract attention can be pointed out and stories told about their history and development. The interaction between leader and participants, who often know a great deal about other aspects of landscapes and history, generates enthusiasm.

Using a leaflet can be valuable to guide walkers around an interesting area on safe footpaths, so that they can look at landscapes and identify geological features, while also enjoying exercise. Leaflets must have an accurate map and information on how to follow the route on the ground, in addition to providing geodiversity details. Leaflets can be read and enjoyed at home while planning a walk or after it has been completed.



Wakefield building stones walk with Wakefield Naturalists Society

Where to take guided walks

Guided walks for families and adult groups can be provided in many places throughout West Yorkshire. Some of the RIGS have good access by public transport and many have parking within walking distance. Town centres and cemeteries provide excellent opportunities for studying local and imported rocks and many people feel more comfortable in urban areas. Some of our towns also have guide books to the history of urban buildings so knowledge of geological materials links nicely with the history of the town.

Project idea

Baildon, Bradford

Baildon Moor has a long archaeological and industrial history, because of the ironstones, coal seams and sandstones found in the Coal Measure rocks of which the hill is made. Nearby, Shipley Glen and quarries at Baildon have been designated as RIGS because of their good exposures of Rough Rock, a sandstone which is excellent for building.

Bracken Hall Countryside Centre is very close to Shipley Glen and already has an excellent geological exhibit on the local area. There are opportunities for geological events at the centre and guided walks over Baildon Moor, including Shipley Glen and Baildon quarries. Cooperation with archaeology and local history groups to produce a leaflet linking the geodiversity and industrial heritage would be an exciting project.



A walk along Upton Cutting, Wakefield, with Wakefield Countryside Services

Project idea

These RIGS are suitable for guided walks:

- Digley Quarries, Holmfirth
- Dimples Quarry, Haworth
- Gorpley Clough, Todmorden
- Hetchell Crags, Leeds
- Heptonstall Quarry (Hell Hole)
- Horton Bank Reservoir, Bradford
- Judy Woods, Bradford
- Ogden Water, Halifax
- Pule Hill, Marsden
- Upton Local Nature Reserve, Wakefield

Ideas for interpreting Geodiversity

Interpretation boards

Interpretation boards are most effective when they are positioned at viewpoints where the attention of passers-by is caught. Many views include dramatic landscapes, so interpretation of the underlying geology and geographical processes is appropriate. Links can be made to wider aspects as landscapes include human and industrial features too. Most people only pause for a few minutes, so interpretation boards need to be brief and well presented.



Interpretation board at Johnson Wellfield Quarry, Crosland Hill, Huddersfield

Talks to groups

Talks to local geology and natural history groups about geodiversity generate excellent feedback from those who know their local area well. Digital presentations with local photographs are very well received.

Project idea

Make a digital presentation on West Yorkshire's geodiversity that can be shown as an illustrated talk to local groups and organisations.

Roadshows

Roadshows are mainly aimed at children and provide activities designed to excite them about rocks, minerals and fossils. Many are already very knowledgeable and enjoy learning more, while others are wide-eyed when they see samples of interesting geological materials and hear the stories behind their shapes, colours and origin. Some children like practical activities and learn from making or drawing an object based on rocks, minerals or fossils. A roadshow is also an opportunity for parents to learn more about geodiversity so that they can give their children a better experience when out for walks or visits. West Yorkshire has a wealth of countryside centres and museums, staffed by education officers who welcome ideas for events with a geological theme.

Where to hold Roadshows

Activities for children are best provided in existing countryside centres and museums in the five metropolitan districts in West Yorkshire. They have excellent educational facilities, with experienced and knowledgeable education officers.

Examples of centres for education and enjoyment

Bracken Hall Countryside Centre, Shipley Glen, Bradford
Cliffe Castle Museum, Keighley
National Coal Mining Museum, Wakefield
Oakwell Hall Country Park, Kirklees
Ogden Water Countryside Centre, Halifax
Tolson Memorial Museum, Huddersfield
Waterton Countryside Discovery Centre, Angler's Country Park, Wakefield

Publicity and communication

Publicity

Publicity for our activities will be provided by us through the newsletter and the website and also by the events organisers, such as the countryside units in local authorities, countryside centres and museums. Publicity from the press and local radio is invaluable.

Objective 7

To raise the profile of geodiversity in West Yorkshire.

Actions

- Provide roadshows in conjunction with Countryside Centres and Museums.
- Provide guided walks to geological sites.
- Give talks on geology and geodiversity in conjunction with countryside and community organisations.
- Provide information for interpretation boards at appropriate sites.
- Provide displays on the work of the Geology Trust at appropriate events.
- Liaise with tourist information offices to publicise our events and guided walks.
- Liaise with the press and local radio to publicise our events and publications.
- Provide and circulate posters to publicise events.
- Use local newspapers throughout West Yorkshire for publicity.
- Up date the website regularly with news of roadshows, guided walks and talks.
- Use the WYGT newsletter to publicise activities and elicit ideas from active members.
- Publish the WYGT newsletter on the website.

Project idea

Leaflets which the Trust could produce

Leaflets for building stones guides to town centres
Guided walk leaflets to include RIGS and local landscapes



Wall at Stones, Todmorden

Example of good practice

Johnson Wellfield Quarry, Crosland Hill, Huddersfield has provided office space for the West Yorkshire Geology Trust. Several years ago an interpretation board, which included material from local geologists and the company, was sited overlooking one of the quarries. The Trust will use local footpaths, which overlook the quarries, to take guided walks explaining the geological and economic importance of the stone, its extraction methods and the way in which the site is restored

Project idea

Publish a promotional information leaflet about West Yorkshire Geology Trust.

Wind erosion on sandstones of different strengths has produced the Doubler Stones, Rombalds Moor



Education and Geology

Geology in schools

Primary schools sometimes have science or geology clubs for which the Trust could lead a session on an interesting topic on fossils, evolution, minerals, rocks or local geology.

A leaflet for use in primary and secondary schools telling the West Yorkshire geological stories could be circulated widely. This would enable any schools with a particular interest in their local area or any other topic to make contact with WYGT.



In the classroom at Cliffe Castle Museum

Rock trails for individual schools would enable building materials to provide a starting point for talking about sandstones, bricks, slates, tarmac and concrete and the industrial processes which produce them. The trust could liaise with Education Department Science Advisors in each local authority, with a view to providing background geological knowledge for science staff who teach earth sciences as part of Key Stage 3 and 4 Science.

Project ideas

Write a leaflet for schools telling the West Yorkshire geological stories.
Produce a template for a schools rocks and buildings trail, which could be adapted for any school.

Environmental education

Many environmental education officers in local authorities, museums and countryside centres are trained in biodiversity and conservation. Many will have some geological knowledge but may not be familiar with West Yorkshire's geology. Interest has been expressed in the provision of some training in geology which could be used to enliven a guided walk or a children's event at a museum or educational centre. Field identification of the basic rocks, structures and fossils is important so any course



Evening class student at a sandstone quarry near Holmfirth

should be practical and should focus on the features found at an accessible RIGS location.

Ideas for a training course

- Describe the geology of the local area in which the participants work
- Identification of sandstones, shales and coal seams and common fossils found in them
- Knowledge about the processes by which West Yorkshire's sedimentary rocks were formed
- What the Carboniferous and Permian environments were like
- The relationship between climatic and sea-level changes in the Carboniferous period and how it relates to the issues of present climate change

Lifelong Learning

Adult classes in earth science in West Yorkshire are run at present in association with local colleges, the Worker's Education Association and the University of the Third Age. It would be valuable to keep a record with details of these adult courses, in order to respond to enquiries.

Evening class group at Lobb Mill, Todmorden



Geological Records

Accurate and current knowledge

Any information or advice on geodiversity needs to be based on good geological knowledge. There is a place for both professional and amateur geologists in the promotion of geodiversity in West Yorkshire, as befits a science in which many major geological ideas have come from field scientists from all backgrounds who have a detailed knowledge and experience of rocks they have seen. Interpretation for the general public needs to be based on good information, but presented without jargon. Interest and excitement about geological ideas can be conveyed by both amateurs and professionals who understand their audience.

Links between geologists in West Yorkshire

Links between researchers and amateur geologists in West Yorkshire occur through local geological societies, professional societies, university departments and national research establishments. Conferences, talks, publications and guided walks are accessible to all and there are some enthusiastic geologists in the county.

Some geologists are employed in local authorities, while some schools have geology staff. Many individuals in unrelated jobs have geological training from universities or from evening classes and enjoy using their expertise as a hobby and outside interest.

Action

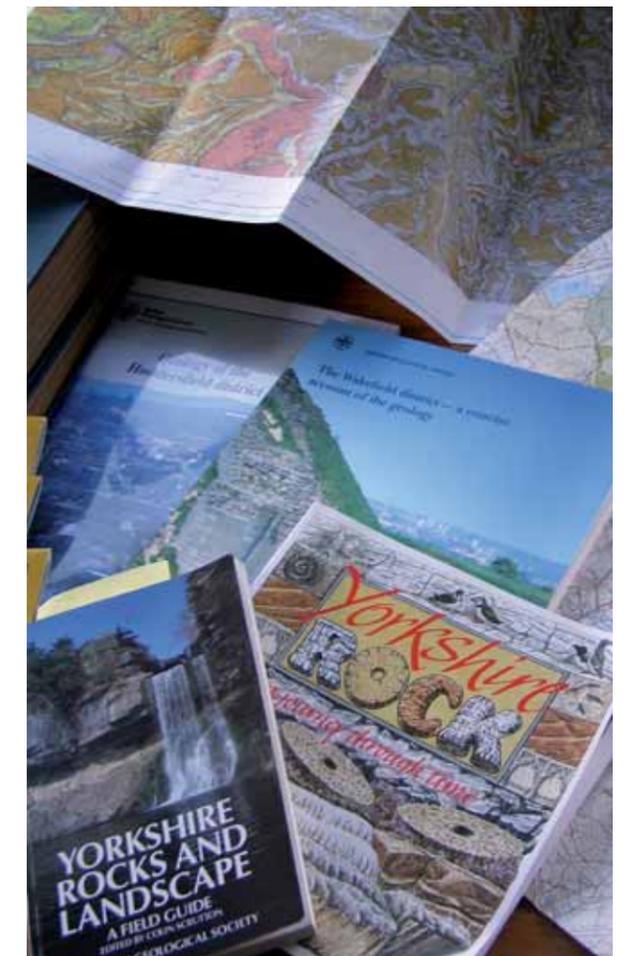
- Seek out and talk to groups and individuals to find out who is promoting geodiversity in the county already, so that we can work with them to share resources and knowledge.

Geological Records in West Yorkshire

The archive departments in local history and reference libraries hold books and maps of historical value on geological and industrial heritage. Other local authority departments, such as countryside units, sometimes hold book and map collections which can be used for reference. Cliffe Castle Museum, Keighley, has a huge collection of geological resources, including specimens, research material, books and maps. Other museums have specimens and reference material, some of which are of national importance in the history of geological research in the UK.

Actions

- Reference books and scientific papers on West Yorkshire geology are being obtained from various sources for the West Yorkshire Geological Records Office at Crosland Hill, Huddersfield and this process will continue.
- RIGS information is held digitally but needs to be developed as a Geographic Information Systems (GIS) compatible data base so that it can be used by planners and integrated with biodiversity records.
- Contact reference libraries and archive libraries in each local authority to see what resources are held.
- Contact West Yorkshire museums to find out what geological resources they hold: maps, collections of rocks, minerals and fossils, books and scientific papers.



Skills audit

Objective 8

To build appropriate knowledge, skills and resources from present and future members and partners to use as a foundation and basis for geodiversity and conservation work to be undertaken in the future.

What skills do we need?

- Scientific knowledge from university research departments, the British Geological Survey and experienced individuals
- Expertise in using and continuing to develop the website as an essential means of communication
- Knowledge of how to raise funding to continue our activities
- Knowledge on how to provide RIGS information so that it is easily accessible through a GIS compatible data base.
- Practical help and information on how to manage geodiversity sites so that rocks and structures can be visible and accessed safely
- Educators who would be prepared to lead walks and give talks to interested groups, in the different districts of West Yorkshire
- Educators for school groups at different levels
- Specialised knowledge on biodiversity for geological sites
- Knowledge on the industrial heritage related to geology, particularly on present and past quarrying and mining techniques
- Other skills which may become relevant as the work of the trust continues

Action

- Keep records, within the limits of data protection legislation, of those who could contribute their knowledge and skills for the promotion of geodiversity in West Yorkshire.



Studying the quarry restoration map, Wellfield Quarry, Crosland Hill, Huddersfield

Geologists visiting Wellfields Quarry, Crosland Hill, Huddersfield



Wider participation in the West Yorkshire Geodiversity Action Plan

Participation in the West Yorkshire Geodiversity Action Plan

Geology touches many aspects of life in West Yorkshire so there are many groups who could have an interest in working towards the common aim of promoting geodiversity in West Yorkshire

Objective 9

To develop greater collaboration between organisations and groups concerned with the value of geodiversity resources.



Walk with the Friends of Beaumont Park, Huddersfield



Surveying in Judy Woods, Bradford, with the Friends of Judy Woods Group

Consultation

While the aims and objectives of the West Yorkshire Geology Trust are distinctive, many of the actions shown in the boxes in this action plan have been suggested by groups and organisations who share our interest in the environment. The Trust would like to continue the working partnerships that have been developed and foster new relationships with other groups.

This document is intended for discussion and consultation with organisations which are able to make connections between their projects and the trust's objectives. West Yorkshire has five local authorities, as well as organisations which are based on the county or larger regions. There are also many special interest groups which focus on a smaller area. Links with such a variety of groups and organisations could be based on the five local authority areas, Bradford, Calderdale, Kirklees, Leeds and Wakefield, in which there is likely to be a common interest.

Working with others

Here are some of the organisations and groups with whom we hope to be able to have valuable contact in the future. We have already talked with many of them and exchanged useful ideas and information.

- Adjacent county RIGS groups and Geology Trusts
- British Trust for Nature Conservation
- Climbing groups
- Community groups
- Dry Stone Walling Association (West Yorkshire branch)
- Evening classes
- Huddersfield Geology Group
- Leeds Geological Association
- Libraries, especially reference and local history sections
- Local Authority planning departments, countryside services, archaeology departments and mineral planners
- Local history groups
- National Trust
- Natural England
- Natural history groups
- Peak District National Park
- Pennine Prospects
- Quarrying companies
- Teachers in schools at all levels
- University archaeology and earth science departments
- West Yorkshire museums
- Yorkshire Geological Society
- Yorkshire Water
- Yorkshire Wildlife Trust

Action

- Hold regular partnership meetings in West Yorkshire to consult other groups about the progress of this action plan and other issues.

Sustainability of the West Yorkshire Geology Trust

Priorities

As an organisation we expect to continue with monitoring and assessing any threats to RIGS, as our priority. We will also continue to improve our holding of geological records and record resources elsewhere in the county. The Trust will also continue to keep a record of groups and organisations with skills and knowledge which would be useful for us. The sustainability of the Geology Trust needs to be considered so that we can continue to pursue the Trust's aims.

Communication within WYGT and outside agencies throughout West Yorkshire will be maintained by using appropriate means, such as the website, the membership newsletter and partnership meetings. Other activities will be influenced by the expectations that other groups and organisations have of the Trust and by its success in finding funding to carry out the printing of leaflets, the management of sites, production of interpretation boards and so on.

Funding

The development and publication of this consultative action plan and updating the surveys of the RIGS in the county has been funded by the Aggregates Levy Sustainability Fund (ALSF) from the Department of the Environment, Farming and Rural Affairs (DEFRA), administered by Natural England.

Funding for publishing the Castle Hill leaflet was obtained by the West Yorkshire RIGS Group (before it was renamed as WYGT) through Awards for All and it is expected that funds for future projects will be found in a similar way.

For these and other projects the input of time and expenses of members of the West Yorkshire Geology Trust and its executive committee has been entirely voluntary and grateful thanks are due to them for the huge commitment that they have undertaken for the work of the Trust.



Executive meeting at the WYGT office

Objective 10

To establish a sustainable organisation with effective links to other bodies and groups in order to ensure that geodiversity conservation can be maintained and that public awareness of geology and landscape in West Yorkshire can be promoted.

Action

- It is essential to secure funding in order to carry out the actions which will enable the Trust to share and protect West Yorkshire's geodiversity

Monitoring the progress of the Action Plan

The work of the West Yorkshire Geology Trust will change and develop. The Trust needs to work closely with other groups and organisations in order to provide the information and materials that they would like, so that we can achieve our aim of promoting geodiversity in West Yorkshire. The nature of the action plan is therefore likely to evolve as more organisations are involved in its development. The actions included here are not prescriptive but it is hoped that it will be possible to respond to ideas and suggestions from other organisations. Regular reviews will be held to assess how the actions outlined in this document have progressed and whether new priorities have emerged.

Time scale for actions

Some of the actions mentioned in this document are already being implemented, as a result of recent surveying of RIGS and discussions held with other groups and organisations. Other actions are implicit

How to monitor the progress of the Action plan

Quantitatively assessing the success of an action plan, which has been formulated with less consultation than would have been ideal, will not be easy. However, there are some quantitative and qualitative measures that can be used. It is to be hoped that in due course it will be possible to analyse any feedback we get from groups, organisations and individuals in a more structured way.

Actions

- Keep records of WYGT membership.
- Measure the level of participation in activities and events.
- Assess progress on projects undertaken.
- Assess the process of getting RIGS established in Local Development Frameworks.
- Assess the degree to which geodiversity is embedded in local authority planning policies.
- Assess the success of partnership meetings.



in the organisation of the Trust, which is expected to keep records of membership, resources and finance. The project ideas in the boxes have been included to stimulate discussion inside and outside the Trust over the next few years and activities which arise will extend the time scale.

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West Yorkshire Geodiversity Action Plan

A Consultative Document