Access and safety at geological sites

A manual for landowners, quarry operators and the geological visitor

Peter W. Scott, Clive Nicholas, Helen Turner, David Roche and Robin Shail

DAVID ROCHE
Geo Consulting

GeoValue: valuing geodiversity for the community

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English Nature	Jonathan Larwood
Health and Safety Executive	Helen Turner
MIRO	Abbie Richards
Cornwall RIGS Group	Peter Ealey
Somerset Geology Group	Hugh Prudden
University of Plymouth	Jim Griffiths

Many quarry operators and major landowners in England provided information on their policies and procedures for visitors to enter their properties to observe and study the geology.

The second component of GeoValue has developed and tested the Geodiversity Profile. This is an independent procedure for describing and valuing geodiversity at geological sites. It is particularly designed for use in quarries. The procedure is described in a companion publication:

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Extended Summary

This manual provides information about land ownership, the law and rights of access by the visitor to geological sites in England. Safety and responsibilities for safety at geological sites are addressed in general and specifically for visits to active and other quarries. The current practice of landowners and quarry operators in allowing access for geological visits is reviewed. Suggestions are made so that the quarry operator can improve the access to view the geology in active quarries without compromising safety or the quarrying activity. This extended summary should be read in conjunction with the Tables.

Geological sites and visitors (see Tables 1 and 2)

Geological sites include natural rock exposures, such as crags and cliffs, active, abandoned and historic quarries, and other man-made excavations. Geological sites are the major resource for observing, studying and interpreting the structure, composition, relationships and uses of the rocks, minerals, fossils and soils, which make up the fabric of our country. People wish to visit geological sites for one or more of several reasons: geology forms part of their school, college or university education; it is a component of their life-long learning; it is part of a research project; or, it is a recreational or professional activity. Geological visitors to active quarries have a special requirement beyond that which may be offered to the general visitor.

The quarrying industry is keen to encourage visits to their operations as it promotes good community relations. In lowland England away from the coast, active, abandoned and historic quarries form the major resource for observing geology as natural rock exposures are generally lacking. The variety of geological features, sometimes known as geodiversity, in active quarries are special. They gives a positive scientific gain, as much cannot be seen elsewhere, or are not of the same high quality.

Land ownership and access (Table 3)

Unless a geological site is on a public right of way or in an area where legal or voluntary access has been granted, permission from the landowner is required. When permission is granted, the visitor has to adhere to any conditions under which any visit is allowed, such as timing and safe behaviour. Where there is a right of way, legal or voluntary arrangement, or the land designated within the Countryside and Rights of Way (CROW) Act, 2000, the access is available usually only on foot and for the purpose of recreational activities. Published paper maps and an internet site show access land under CROW. Some geological activities are not recreational. In most of lowland England, there are only isolated areas with open access. There is no right of access to active quarries. Persons entering land where there is no right of access or permission has not been gained are trespassers. A landowner can ask a trespasser to leave without giving reason.

Landowners' (occupiers') liability

The Occupiers' Liability Acts, 1957 and 1984, set out the duty of care required for visitors who are invited or trespass onto their land. Occupiers (landowners or sometimes tenants) must take reasonable care that visitors will be reasonably safe in undertaking their activities. The duty is more than that to avoid negligent acts, it extends to negligent omissions as well. Risks willingly accepted by the visitor on behalf of themselves or others are excluded. The CROW Act, 2000, does not place any greater responsibility on the occupier to ensure the safety of those entering their land.

Safety at geological sites (Tables 4 and 5)

All geological sites present hazards of varying degrees and further hazardous situations can develop during a visit. Falling rock is a particular hazard and it should not be assumed that any rock face in an active, inactive, abandoned or historic quarry, or forming a natural cliff, is safe. Vehicle movements present a major hazard at active quarries.

Managing risk (Tables 5 and 6)

The risks from hazards at a geological site may need to be addressed by the visitor as well as the occupier. It is good practice for the visitor to make an assessment of likely hazards prior to a visit and ensure that precautions are put in place to minimise them. It is impossible to quantify risk absolutely, although one way is to use a measure of potential for injury against severity of injury (Table 6). When there is high risk it may not be possible to achieve all the objectives of a visit, or

it has to be abandoned. Active or other quarry or cliff faces are important places for examining geological features. The risk cannot be eliminated entirely, even in faces where there have been no obvious recent falls.

Responsibilities for safety

Visitors to geological sites have at least some legal responsibility for their own safety and that of others with them. A leader particularly has responsibility for a group. The hierarchy of responsibility may rest with the landowner / quarry operator and then the individual / group leader or vice-versa. At active quarries the primary responsibility rests with the operator. Visitors may require training and / or supervision to increase their awareness of hazards when visiting geological sites.

Applying the Quarries Regulations 1999, to geological visits (Table 7)

These regulations and Approved Code of Practice are intended to protect the health and safety of people working in an active quarry and others who may be affected. Although not designed for geological visitors several parts of the Regulations are applied to visits. Important points are:

- The operator has responsibility to ensure safety of all visitors, who must accept the operator's arrangements for safety.
- Visitors cannot expect to have unlimited or unrestricted access to observe the geology.
- A health and safety document should be available to all visitors.
- A competent person has to be at the quarry at all times when visitors are there.
- A geological visitor usually is not considered a competent person and therefore has to be accompanied at all times in the quarry.
- The operator has to ensure that the visitor has knowledge of the health and safety requirements and understands them. A briefing is given at the start of a visit.
- The operator may have identified parts of the quarry which are hazardous and no-one may visit.
- Pedestrian access may be restricted or not allowed.
- Pedestrians and vehicles should be separated.
- A barrier to discourage trespass is placed around the perimeter of the quarry.
- In some situations it may be appropriate for the operator to issue a 'permit to work' for a geological visitor who has received comprehensive induction and safety training.
- The visitor must not hinder the operator's compliance with the requirements of the regulations.

In order to meet the safety requirements, a visitor to an active quarry is required to wear personal protective clothing at all times including a hard hat, safety boots with ankle support, high visibility vest or jacket, and sometimes, gloves and eye protection.

Current practices of landowners for granting access (Table 3)

Different practices exist with different landowners. Individuals, private or public companies generally lack formal policies and procedures, each request being considered individually and access to the geological visitor may or may not be granted. Public bodies and charities have a presumption for granting access on request if the land is not already open. They may require the visitor to have insurance against injury and liability. Establishment bodies treat each request on its merits, although there is a general presumption to grant access, as long as there are no liability implications. Formal written agreements with landowners would appear to be appropriate for visits where groups are involved.

Current practices of quarry operators for geological visits

Quarrying companies policies generally welcome visitors. All of the major extractive industry companies and most other quarry operators allow visits to their sites to examine the geology.

The geological visitors' need for access goes beyond that provided to the general visitor. There is no evidence of there having been any accidents to geological visitors at active quarries. The geological visitor is sometimes regarded as too focussed on their subject to take an adequate account of the need for safety. Some educational groups have a poor reputation for discipline.

There is considerable variation in practice. Visitors are usually accompanied by a competent person, often the quarry manager. Specific policies to accommodate the special needs of the geological visitor appear to be lacking, as are specific induction procedures. Visitor's vehicles are rarely allowed in the quarry, and walking sometimes is not permitted or severely restricted.

Quarry staff have limited resources to devote to the geological visitor, who may require a lot of time for supervision. Hazards are mainly those involving vehicle movements, collapse of unstable faces and tripping / stumbling. If a visit is made when no mobile plant are operating it is recognised that at least one major hazard is removed, and pedestrian access may be possible. Some operators accept that some geological visitors have sufficient experience and knowledge to be competent and can undertake a visit safely without being accompanied. The Contractors Safety Passport Scheme indicates commitment but is not very relevant to the geological visitor.

Providing facilities for the geological visitor at active quarries

Facilities that the quarry operator might like to consider providing for the geological visitor are:

- External or internal viewing areas.
- Refuges at suitable locations where interesting geological features are to be found.
- Accept geological visitors when there are no mobile plant movements, allowing pedestrian movement and hence a better observation of the geology.
- Provide special pedestrian routes within the quarry.
- Provide faces well away from mobile plant movements which can be safely accessed directly.
- Develop an internal or external boulder park containing a collection of rocks from the quarry.
- Provide a rock collection or fossil hunting zone.
- Provide sample boxes containing the rocks etc found in the quarry, plus examples of quarry products.
- Provide a geological literature resource of information relating to the quarry.

Each of these present advantages or disadvantages to either the operator and/or the visitor. Grants may be available to the operator to aid the development of some of these facilities.

Summary of conclusions and recommendations

- Obtaining permission for access from the landowner (or occupier) is recommended in all situations where it is not certain that a right of access or open access exists. Many landowners have a policy for granting access if a request is made. Permission should always be sought if material is to be collected.
- Legal and practical responsibilities for safety at geological sites would appear to rest with the landowner and the visitor. Except for visits to active quarries, it would be prudent for the individual visitor or group leader to assume they have full responsibility for safety, and not expect the landowner to consider themselves liable.
- The individual or group leader is advised to make a thorough assessment of hazards prior to a visit and to put in place precautions to minimise risk. This risk assessment should be discussed and agreed with the landowner, or before visiting active quarries, with the manager.
- Risks cannot be eliminated entirely and ultimately the visitor has to decide about accepting a risk or perhaps not fulfilling the requirements of the visit.
- Owners of abandoned or historic quarries should consider erecting boards explaining the access arrangements.
- The access requirements of geological visitors at active quarries are greater than that of other visitors. Visitors who go to active quarries should acquaint themselves with the Quarries Regulations 1999.
- The most suitable time for a geological visit to an active quarry is at week-ends or other times when there are minimal or no vehicle movements.
- Quarry operators should consider designing an information sheet on safety and procedures specifically for the geological visitor.
- Operators of active quarries where many requests for geological visits are received might consider developing facilities so that the objectives of a visit can be fully achieved.
- Published guidelines on safety and 'Codes of Practice' for geological fieldwork are generally more than 10 years out of date. They do not reflect current thinking and attitudes to risk and, particularly, regulations on safety in quarries. They require comprehensive revision and updating. This would be best undertaken by a professional body.
- A Certificate of Competence scheme could be developed for geological visits to quarries, and in particular for group leaders. The system could be developed and administered by an appropriate training organisation to set an agreed industry standard, which would then be accepted by many employers. This could enable less resource to be given by the operator in supervising a visit, although site induction and compliance with safety management systems would still be required.

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1. Introduction

Geology is a profession for some, a hobby for many others and often both. There are over 5,000 students of geology or related subjects in our universities at any one time, along with others undertaking school or college level studies. Geology is a popular subject in continuing education. Local or national geological societies attract members of the community who have a geological interest. Fieldwork, which includes site visits, is a major activity for learning about geology. It provides the fundamental information for Earth science, including recognition of the rocks, their composition and structures, their relationships, minerals, fossils and the landscape. Fieldwork is dependent on there being access to rock exposures and other geological sites so that the geology can be seen and studied. Access should be legal and safe. Risks should be minimised through careful preparation before a visit is made.

There are innumerable sites in the United Kingdom where features of geological interest can be seen. They include coastal cliffs, inland crags, river banks, and man-made excavations such as quarries and road cuttings. Although there are a large number of active quarries, far more exist in an abandoned or dormant state and in variable conditions of decay. In lowland parts of inland England, quarries are the major places for examining geological features in the bedrock. Some sites have statutory protection for the geological features they display. These are Sites of Special Scientific Interest (SSSIs) of which there are approximately 1215 in England alone. Many of these are at active or former quarries. There are many other sites recognised as having geological significance at a local level. Again, many are in quarries. These are designated Regionally Important Geological and Geomorphological Sites (RIGS) or County Geology Sites. The vast majority of geological sites, however, have no designation, yet also show features of geological interest and diversity, and may attract the geological visitor.

All land in the United Kingdom is owned by some individual, group or body. Most geological sites, including quarries and others, are on land where an automatic right of access, along with a right to collect and take away geological samples, cannot be assumed. There is no right of access to observe the geology in working quarries. Disused and abandoned quarries are mostly on private land where there is no right of access. There is no automatic right of access to SSSIs or RIGS / County Geology Sites.

Increasingly in recent years, the quarrying industry has taken the view that visits to active quarries should be encouraged so that the public may get to know how and from where the minerals which are essential to their way of life are made available. The geological community have long realised that active quarries are valuable educationally and scientifically in revealing many geological features that may be new or otherwise would not be seen or recorded. This is also now widely recognised by the quarrying industry in a Memorandum of Understanding between English Nature and the Quarry Products Association (2005) and the development of company geodiversity action plans (Thompson *et al*., 2006).

It is very important to ensure that visits to quarries are correctly managed so that risks to health and safety are minimised, and that the legal requirements, including those given in the Quarries Regulations 1999, are followed. These regulations are not intended to provide obstacles to visits taking place. The Health and Safety Executive acknowledge the educational value of visits to any commercial or industrial operation.

This manual provides information about land ownership in England and the law relating to access to geological sites. It is especially relevant to active quarries and other disused, abandoned or historic quarry sites, where

safety is also an important factor. It reviews the current practices of landowners and quarry operators for allowing access. Safety is addressed in general and specifically with respect to visiting quarries. The manual is intended to provide the geological visitor with the information needed in planning fieldwork, as well as give the landowner and quarry operator, an understanding of the requirements of the geological visitor so that the objectives of a visit can be achieved. Weaknesses in the law relating to access and responsibilities are recognised. Recommendations are made so that the awareness of safety issues by the geological visitor is improved, especially at active quarry sites, and for landowners and quarry operators to consider so that risks are minimised, yet the visitor gains maximum benefit by achieving the objectives of a visit.

The manual has been compiled from a desk study and fieldwork by the authors, supported by discussions with a legal expert and others, on land ownership in England, the law relating to access to land, occupiers liability, health and safety legislation, quarries regulations and codes of practice. A cross-section of different types of landowners has given information on their views, policies and procedures for allowing access to their properties by geological visitors. Similarly, a large number of quarry operators, and managers in quarrying companies have been personally contacted for their views so that an understanding of current practices for allowing access to active quarries by geological visitors can be obtained.

(***Please note:***

1. *This manual provides a guide to the legal issues relevant to access to geological sites. It does not constitute formal legal advice. If required, such advice should be sought from a qualified member of the legal profession who specialises in property and injury or tort.*

2. *The information here applies to England only. In general it applies to Wales. Scottish Law is different and different laws and access provisions may exist.)*

2. Acknowledgements

This manual is one of two books from a research project entitled GeoValue: Valuing Geodiversity for the Community, funded by The Mineral Industry Research Organisation through the MIST initiative (Mineral Industry Sustainable Technology Fund) (Project Number MA/5/2/001). The other is the Geodiversity Profile Handbook (Scott *et al*., 2007). The partners for GeoValue are David Roche Geo Consulting, Camborne School of Mines (University of Exeter, Cornwall Campus), Cornwall Wildlife Trust, British Geological Survey, English Nature (now Natural England) and the Health and Safety Executive. Many quarrying companies, and other geological site landowners provided information about policies and procedures for gaining access to their land. Their help is gratefully acknowledged.

Cligga Head greisen quarry, near Perranporth, Cornwall. Historic quarry much visited by student groups. It is owned by the local Parish Council who allow open access.

3. Types of geological sites

Geological sites can be divided into two types, natural and man-made (Table 1). Landscape and active geomorphological processes usually cover a much larger area than a rock exposure and may or may not include exposed rock. They are included here as access to private land may be required.

There are innumerable geological sites in quarries, and in a major part of inland England, quarries are almost the only sites where rocks are exposed. Quarries vary in status considerably. There are over 2,000 active quarries in the UK, where on-going extraction of rocks is taking place on a daily or regular basis. Some quarries can be regarded as inactive or not-working, extraction being irregular or infrequent, yet permission to extract remains extant. Others can be regarded as dormant, closed, abandoned or historic. In the latter, there may be little evidence of existence of the quarry other than a small exposure of rock within an area of disturbed ground. The different terms used to describe quarry status are defined in the Appendix.

Buildings constructed using natural stone are sometimes included as geological sites as the stone may illustrate features of geological interest. They are excluded from the present discussion.

Table 1. *Types of geological sites*

1. Natural:

a. Exposed rock in:
- Inland cliffs, crags and pavements
- Landslides
- Loose boulders and scree
- River banks, lake sides and estuaries
- Coastal cliffs, foreshore and inter-tidal areas

b. Landscape

c. Active geomorphological processes

2. Man-made:

a. Exposed rock in:
- Active and inactive quarries
- Dormant, closed and abandoned quarries (without conservation)
- Conserved faces in abandoned, closed or historic quarries
- Road cuttings
- Railway cuttings (active and abandoned)

b. Exposed rock in temporary excavations

Rock is defined in the geological sense, and includes weathered and unlithified earth materials, such as clay, sand and gravel.

A young student group viewing a blast at an active quarry. Such visits encourage an interest in quarrying as well as geology. Whatley Quarry, Somerset. (Photo: Clive Nicholas)

***Table 2**. Visitors to geological sites*

Visitors to geological sites	
Visitors	**Requirement, need or interest**
1. Individuals	
a. College or University students	Research project as part of an undergraduate or higher degree.
b. Academic geology, geography or other staff from universities, colleges or museums.	Research, as part of their academic duties.
c. Geoscientists from public bodies (e.g. British Geological Survey; English Nature)	Research project forming part of their duties, but not part of any monitoring or regulatory requirement.
d. Geoscientists from industry and geological consultants	Research into geological formations relevant to their industry (e.g. oil, gas, coal, other minerals or rocks, hydrogeology, hydrology, engineering geology)
e. Amateur geologists	Research and/or a general interest in geology
f. Geologists from conservation bodies	Recording, documenting and maintaining a database of geodiversity. Consideration of sites for geoconservation purposes.
2. Groups	
a. Primary and pre-GCSE school children and students	Learning about, touching and feeling rocks, and any minerals and fossils. Gaining an understanding of Earth's natural materials and their uses.
b. GCSE, A Level, college and university geology and other geoscience students	Receiving an introduction to, or advanced studies in geology. Training in geological observations, measurement and interpretation.
c. Special interest research groups	Discussion of a geological problem of mutual research interest, the site having the critical characteristics. Sometimes to gather high quality data.
d. Group from an amateur, mostly local, geological society	Observation and discussion of the geological features and their interpretation, perhaps with data recording as part of a group study.
e. Group from a professional or learned geological society, (Sometimes follows on from a conference)	Observation of the geological features, discussions of their significance and their interpretation. Forms a component of continuing professional development.
f. Companies and consultants providing professional training / continuing professional development	Observation of the geological features, discussions of their significance and their interpretation for comparison with similar geological settings elsewhere (e.g. where data may be only available in borehole cores).
g. Geological conservation groups	Observation and discussion of the geological features and their interpretation, perhaps with data recording as part of an ongoing group study of a site.
h. General interest groups or societies	Observation of the rocks and other geological features along with an interpretation. The visit may be mainly a social or cultural event.

4. Visitors to geological sites

Those who have an interest in going to geological sites include individuals and groups (Table 2). Research, which is usually the main reason for a visit by an individual, may include studying and recording geological features, other data collection and sometimes physical collection of rocks, minerals or fossils. Invariably, direct access to a quarry face or other rock exposure is needed.

There are some individuals, such as those from monitoring and regulatory bodies (e.g. Environment Agency, Health and Safety Executive), who have legal rights to gain access to geological sites. They are excluded from the list (Table 2). Their visits usually are not directly related to observing the geology, although they may make geological observations as part of their work. In addition, there are individuals and groups who visit sites to collect rocks, minerals or fossils for commercial purposes. Their activities are also outside the definition of visitors for the present purposes.

Visits by groups usually, but not always, have a leader who has responsibility for the behaviour and activities of a visiting group. The individual who has the role as leader may be clearly defined (e.g. the person is an employee of an educational organisation or company making the visit and is leading a group of students or colleagues). With some groups there may be no obvious leader, and no-one with a clear responsibility for the actions of the group. In this situation, the group effectively is made up of a number of individuals making the same visit at the same time.

5. Geological visitor activities

The activities desired by visitors to geological sites vary considerably as different individuals and groups have differing objectives and reasons for making a visit (see above). Generally, the purpose is to observe, record and gain an understanding of the rocks and any minerals or fossils and/or landscape or active processes at the site. Visitors either make their own observations and interpret the geological relationships, significance, aesthetics, natural history, uses and/or origin of the rocks, etc., or are given this information by a group leader. With groups, discussion of the interpretation of the geological features (*sensu lato*) whilst at the site may form an important part of a visit. The activities and interpretation will vary according to the composition and level of understanding of a group.

At its simplest, a visitor has a need to observe geological features from a distance, but usually this is not sufficient to meet with the desired objectives of most visits. Closer inspections are usually necessary to observe internal structures within rock units, and to determine any

Sea cliffs at Filey Brigg, North Yorkshire of Jurassic limestones and sandstones with thick overlying Quaternary till. The embayments in the till are caused by rockfalls and mass slumping. Such cliffs are hazardous locations for geological visits. The base of the cliff is not accessible at high tide.

Bedruthan Steps, North Cornwall. Cliffs of Devonian metasediments. Access to the beach is by a permissive right of way. Rockfalls present a significant hazard to the geological visitor, especially after wet weather. There is a possibility of being cut-off by the incoming tide.

relationship between adjacent rocks, so that a better understanding of the geology can be achieved. More detailed observations require a very close, 'hands-on' inspection of the rock surface to examine minerals, fossils, grains or crystals, either with the naked eye or using a hand lens. Examination of a fresh surface after breaking off a piece of rock with a hammer may be needed to make a full observation of the rock and any contained minerals or fossils.

Some visitors, especially advanced student groups (GCSE, A level and university students), researchers, and others fulfilling their professional or academic duties, have a need to make measurements in varying detail of the rocks at close quarters. This activity can involve the use of a compass-clinometer to determine the orientation of any structures, sketching and/or photographing the detailed internal features, and measurements of the sequence and relative thickness of exposed strata. Occasionally, more specialised equipment is needed for data collection (e.g. for geophysics, specialised sampling or surveying).

Visitors sometimes have a need to collect rocks, minerals or fossils for later study or research. Other visitors, especially children and general interest groups, often like to collect pieces of rock, minerals or fossils as a memento of their visit, or to make a geological collection. This provides a further encouragement for the visitor to learn more about geology and earth resources, and it increases awareness of geodiversity and its importance for understanding Earth history. At an active quarry, collecting normally does not remove irreplaceable material or have any direct environmental impact.

Hammering and excavating to remove and collect rocks, minerals and fossils at natural exposures and other sites with important features often lead to degradation of the site. Nowadays, hammering is discouraged and a voluntary code of not hammering at geological sites is generally accepted in the UK (see Geologists' Association, undated; Geological Society, Code for Geological Fieldwork). Normally, leaders do not allow hammering by student groups and others, unless there is a specific requirement to collect material for research and if necessary, permission has been obtained from the landowner. Sites in classic geology areas of the UK, such as south-west England and parts of Scotland and Wales are visited regularly by student groups and others from other countries. Their practice often differs and hammering is allowed or even encouraged in their country. It is usually difficult to advise them of the code unless they visit a parallel organisation in the UK or are encountered at a site.

UK based and international mineral and fossil collectors sometimes make large excavations destroying geological features in the search for their material. Such individuals

should not be considered as geological visitors. Generally, they operate outside any code, and often without permission for access from any landowner. Their motive often is commercial gain.

6. Land ownership and rights of access

6. 1. Ownership

In England all land is under some form of ownership, referred to as 'occupiers' in law (see Appendix). There are several different types of landowners (Table 3).

Aristocrats (e.g. Dukes, Earls, Countesses) have the major part of land under individual ownership. Access to geological sites without seeking prior permission cannot be assumed even on land that is owned by public bodies or charities.

Table 3. *Types of land ownership in England*

1. Individual or individuals
2. Private or public company (e.g. a farming company, quarry company)
3. Public body (e.g. Ministry of Defence; Forestry Commission; local authority; Natural England (formerly English Nature))
4. Establishment body (e.g. Church Commissioners; Crown Estate; Duchy of Lancaster; Duchy of Cornwall; the 'older' universities)
5. Charity (e.g. National Trust; Wildlife Trusts)

6. 2. Access

Unless a geological site is on a public right of way or in an area where legal or voluntary access has been granted, permission from the landowner is required if a visit is to be made without trespassing. When permission is granted, the visitor has to adhere to any conditions under which any visit is allowed, such as timing and safe behaviour. Where there is a right of way, legal or voluntary access, it is likely that the access is available only on foot and for the purpose of recreational activities. Many visits to geological sites could be said to be recreational. A large number are educational. Visits for the purpose of collecting material may not be recreational.

6. 2. 1. Public rights of way

England has about 190,000 km (118,000 miles) of rights of way. These include footpaths, bridleways and byways open to all traffic, as well as roads. They are all highways that allow a public right of passage. Anyone may use a right of way, and may do so at any time. The width of the public right of way may vary considerably, and there is no right to deviate from the route. Highway authorities

Geological sites on public footpaths and bridleways can be visited without gaining the permission of the landowner.

The coastline provides important geological sites, yet access is not necessarily open. The landowner of this beach has granted access to the public for specific purposes. This does not include the geological visitor, who should seek permission. The lifebuoy contained in the red box fulfils the landowner's duty of care for the permitted activities.

(national park, county council, (sometimes) district council, metropolitan borough or unitary authority) must record the legal existence and location of rights of way on a definitive map, and ensure that paths are open for public use. Many of these maps are available on local authorities' web sites. Landowners (e.g. farmers) must ensure that paths are not blocked by crops or other vegetation or otherwise obstructed, that the route is identifiable and the surface is restored soon after any cultivation or other activity. The permanence of a public right of way is guided by the principle 'once a highway always a highway'. It remains a highway until there is a legal event to close, divert or extinguish it as a public right of way.

6. 2. 2. *Rights of access*

A number of legal provisions allow an effective freedom for access to some land. This enables visits to natural rock exposures, disused and abandoned quarries and other geological sites on this land, but not working quarries, without trespass and without any need to seek further permission. These rights, however, do not extend to undertaking activities beyond observational, such as collecting samples. A freedom of access to large areas of land has been enabled recently by the Countryside and Rights of Way Act, 2000 (CROW) (see below). Whether it is safe or not to visit a site is a separate issue. Responsibilities for safety lie with the individual, any group leader and landowner (see Section 10, below).

Before the CROW Act, a number of different provisions already gave an effective freedom to roam over certain areas of land. These include the following:

Du Jure (by law or right). Some parliamentary Acts give a right of access (i.e. to walk) over certain areas of land such as commons and specific places including parts of Dartmoor, the New Forest, the Malverns, Helvellyn and Haweswater in the Lake District, and the Elan Valley.

Voluntary access. Some owners are required by law to allow access to their land. Others have been given a financial incentive, or allowing access is part of their policy or status. There is voluntary access to much of the land owned by the Forestry Commission, water companies and the National Trust. Land covered by schemes such as Countryside Stewardship and Countryside Access Scheme has limited access, landowners receiving a cash payment for managing the land for conservation. Some landowners have been given exemption from Inheritance Tax for allowing limited access to their land. There are some voluntary access agreements with local or National Park Authorities (for example part of the Peak District and Forest of Bowland).

Altruistic access. A few landowners grant public access over their land. This includes some public bodies, charities or conservation organisations, and some

local and national park authorities. Few private individuals grant the public access over their land.

De facto access. Access is assumed on some land because there has always been an apparent right to roam, although landowners could prevent it at any time. Bodmin Moor in Cornwall is an example, and the same applies to many of Britain's beaches.

It is difficult to know if any area of land has access available under the above provisions, as maps showing locations and areas are difficult to find or may not even exist, other than with the landowner and/or government / local authority / land registry.

Before the CROW Act all so called 'Common Land' did not have automatic open access, it being owned by an individual or often a local authority. The term 'common' refers to a right of individuals or the community to graze or do other traditional activities on the land but not necessarily to roam.

Virtually the whole of the coastline (cliffs, beaches and inter-tidal areas) provides important geological sites with rock exposures and/or active processes. The majority of the coastline is owned by a relatively small number of organisations, including the Crown Estate, Duchy of Cornwall, Duchy of Lancaster, National Trust and Ministry of Defence. In general, these organisations allow good public access to the coast, but not based on clear legal rights. There are areas of coastline in private ownership that are inaccessible to the public or where rights of access are uncertain.

6. 2. 3. Countryside and Rights of Way Act, 2000 (CROW Act)

As a consequence of the CROW Act, the public are allowed to walk freely on open country, generally described as mountain, moor, heath or down, and registered common land. The land included in the act is shown on new official maps. Landowners and long-term tenants will be able to dedicate other land for public access if they wish to. The land with the new rights is called 'access land'. The maps showing open access are available for England at (http://www.countrysideaccess.gov.uk/things_to_do/open_access/open_access_maps). Published paper maps also show access land but do not take account of excluded land or temporary restrictions (see below). Large areas of the Lake District, Peak District and Pennines and North Yorks Moors have open access. In most of lowland England, however, there are only isolated areas included. The right of access is only on foot for open-air recreation, which includes climbing. Apart from collecting samples, which is specifically excluded in the rights, many activities of a geological nature by individuals and groups would appear to be allowable on the access land under the act. Access by riding a horse, bicycle or driving a vehicle is not permitted under the rights.

There is a large list of excepted land, even if it is within 'access land' shown on maps. 'Excepted land' includes:

- Buildings and the land immediately attached to them (e.g. courtyards).
- Land within 20 metres of a house or a building containing livestock.
- Parks and gardens.
- Land under structures such as electricity substations, wind turbines or telephone masts.
- Quarries and other active mineral workings.
- Railways and tramways.
- Golf courses and race courses.
- Aerodromes.
- Land being developed in one of the ways above.
- Arable land ploughed for the growing of crops within the past year.
- Temporary livestock pens.
- Racehorse training gallops.
- Land under Military Byelaws (e.g. Ministry of Defence training areas).

Existing access rights, access arrangements and public rights of way are not affected by the excepted land provisions.

The exception for active quarries and other mineral workings does not extend to abandoned and other former quarries, which are generally accessible under the CROW legislation. Land-owners can apply for a public safety direction (i.e. prevent access) if there is something on the land, such as dangerous abandoned mineral workings, that puts the public at risk. Individuals and group leaders need to assess whether it is safe to enter sites in abandoned quarries where a right to roam exists.

Farmers and landowners have the right to close their land sometimes, usually for reasons of nature conservation, land management or public safety. If access land is temporarily closed, it will have a 'restriction' placed on it so there is no public access. This is shown on the internet-published map and details about the restriction are listed. Looking at the maps requires the input of date

information by the person accessing the maps, so that temporary access restrictions can be seen prior to a visit. Landowners can apply for up to 28 days under discretionary powers to close their land.

Vast areas of land are not included within the CROW Act, particularly farmed, urban, industrial, derelict, coastal and other amenity land. Access to sites on this land without trespassing, therefore, is dependent on gaining the permission from the landowner.

6. 2. 4. Trespass

Persons entering land where there is no right of access and permission has not been obtained are trespassers. Also, by straying outside an area to which access is allowed, exceeding a time limit for access, or using the land in an unauthorised way, a permitted visitor is trespassing. Ignorance of the facts is no defence under trespassing laws.

A landowner ('occupier' in law), or his/her representative, can ask a trespasser to leave the land, and does not have to give a reason. Reasonable force may be used to remove trespassers, who are required to leave as quickly as possible, by the shortest route. Trespassing is not a criminal offence, except on railway land and sometimes on military training land, unless property is damaged. Trespassers can be sued in civil law. This rarely happens as the trespassing usually is not sufficiently serious for it to be worth doing.

The land does not have to be fenced, and people often go onto private property, such as heathland where the owner does not appear to mind. Technically, this is trespassing. It is not normally possible to be a trespasser whilst legitimately on a right of way. Using the right of way, however, for a reason other than as a means of getting from one place to another could be considered trespassing, although this is unlikely to be a reason for preventing access to a geological site on a right of way. Trespassing could apply if activities other than observational were to be taking place (e.g. use of equipment or sample collection).

The remedies to a landowner from a trespasser are damages, which will be nominal if there is minimal damage to the land, or an injunction to prevent further trespass, which is at the discretion of the court. If the landowner is deprived of lawful possession then further actions for recovery can be made. Any hammering of a site, especially if indiscriminate or excessive, could be considered to be causing damage even though material may not be taken away.

In summary, a legal visit to geological sites where there is no right of access requires the permission of the landowner or his/her representative. This applies to the majority of land in England where there is no right to roam, and where there is no other form of public right of way or grant of permission for public access. Further permission for the removal of material should be sought if samples or other geological items are to be taken (see Theft, below).

6. 2. 5. Theft

Removal of material, including rocks, minerals, fossils and soil, from land without the permission of the landowner is theft (i.e. a crime is committed). The intention must be to deprive permanently the landowner of the item. It is separate issue from trespassing. Although it is unlikely that the taking of a sample of a common rock would result in a prosecution for theft, there are many geological sites where the contents have some value (e.g. some waste from a former building stone quarry; high quality mineral specimens or fossils), are rare or unique and their removal would deprive the landowner of an asset.

7. Occupiers' liability

The occupier of land is the owner or tenant and there is a duty of care required for visitors who are invited or permitted to enter land. The Occupiers' Liability Act, 1957, sets out the duty of care. Occupiers must take reasonable care that visitors will be reasonably safe doing whatever it is that they have been invited or permitted to do. The duty of care is more than a duty to avoid negligent acts, but extends to negligent omissions as well. A further Occupiers' Liability Act 1984, sets out the duty of care for trespassers.

The 1957 Act states that the occupier has the same 'common duty of care' towards all type of visitors arising from the state of the land or things done or not done on it. It is a 'duty of care' in all circumstance to see that the visitor will be reasonably safe in using the land for the authorised purpose. The duty applies while the person's use is authorised, but not if they have no authority to do or be there. Children are expected to be less careful than adults and therefore a greater duty of care is needed, but workmen are expected to be aware of any special risks associated with their trade. The latter could apply to professional geologists visiting a site.

There are some exceptions, especially risks willingly accepted by the visitor on behalf of themselves or to

people (e.g. children) in their care. Risks excluded by the occupier by notice do not lead to liability, although this does not exclude or restrict an occupier from liability arising through negligence. Risks arising on public rights of way and on land subject to an access agreement or order made under the National Parks and Access to the Countryside Act 1949 or on land subject to access rights under the Dartmoor Commons Act 1985 also are excepted.

The occupier also has a duty of care to trespassers under the Occupiers' Liability Act 1984. The occupier owes a duty towards a trespasser in relation to any danger arising from the state of the land or property or from things done or not done to it. It applies if the occupier is or should be aware of any danger, and knows or should know that people may in practice be exposed to the danger. The occupier can reasonably be expected to have offered the trespasser some protection from danger. The duty is to take such care as is reasonable in all circumstances to see that the person is not injured as a result of that danger. The duty of care required for trespassers appears to be at a lower level than that for visitors who are invited. Where appropriate, the duty may be discharged by giving suitable warnings. As with persons entering land with permission, the duty excludes people who willingly accept the risk and those people using public rights of way. However, a duty of care beyond that required for an adult may be needed if unsupervised children are likely to be trespassers. Quarry operators have a duty under the Quarries Regulations 1999, to erect a suitable barrier around the quarry to discourage trespass.

The CROW Act provides that the occupier cannot be under any greater duty of care as a result of the right to roam than he/she would have otherwise been under the general law (i.e. the Occupiers' Liability Acts of 1957 and 1984). In effect, the lower level of care for trespassers applies. Although not yet tested in the courts it is thought that the access rights under the CROW Act should not place an undue burden on the occupier, and secondly that the maintenance of the character of the countryside and features of historic or traditional interest is important. Presumably, the character and features might otherwise be affected if works were undertaken in order to fulfil a duty of care. The extent of the injured party in complying with the code of conduct for persons exercising the right to roam most likely would need to be considered in any claim. The Countryside Agency publication NCAF4/1 Occupiers Liability gives a good review of the present status of liability for occupiers (www.countryside.gov.uk/LAR/Recreation/NCAF/NCAF4_1.asp).

A recent case (Tomlinson v. Congleton Borough Council and others, House of Lords, 2003) is relevant to an understanding of the current interpretation of the Occupiers' Liability Acts and the responsibility of landowners in respect of visits to geological sites.

Abandoned quarry within an area designated as open access land under the Countryside and Rights of Way (CROW) Act 2000. The quarry presents hazards of unstable faces next to deep water. Countybridge Quarry, Lizard, Cornwall.

A fuller summary is given at http://www.spr-consilio.com/attort13.htm, and the final House of Lords ruling at http://www.publications.parliament.uk/pa/ld200203/ldjudgmt/jd030731/tomlin-1.htm.

The case relates to injuries received by the Claimant (Tomlinson) when he dived into a lake in a country park owned by the Borough Council seriously injuring himself. The park was in an old sand quarry and there were notices at the entrance and around the lake saying 'Dangerous water, no swimming'. The Claimant sought to recover damages under the Occupiers' Liability Acts of 1957 and 1984. He alleged that there was a breach of duty of care by the Council in failing to ensure that the premises were in a reasonably safe state, because despite knowing that people were swimming in the lake, adequate warning of the risks had not been given or sufficient steps taken to prevent or discourage it. The case was finally decided in the House of Lords. In the judgement, Lord Hoffman, stressed that it would be extremely rare for an occupier of land to be under a duty to prevent people from taking risks that were inherent in the activities that they freely chose to undertake. The duty to protect against obvious risks only existed in cases in which there was no genuine or informed choice, such as employees or children.

For geological sites, particularly rock exposures, the Occupiers' Liability Acts and the Tomlinson v. Congleton Borough Council case are clearly of significance, when visits are made with or without the permission of landowners. The acts and case law would appear to be particularly relevant where the site is in a disused or abandoned quarry. In these the landowner might be expected to be aware of the dangers of rock falls, deep water, soft clay or other hazards induced by the former quarrying activity and to have fulfilled the duty of care with suitable notices, fences or other barriers. In a working quarry the same applies, although the operator should be aware of the dangers, which are largely overcome by adherence to the Quarries Regulations 1999 and other health and safety legislation. An important point is that a greater duty of care applies where permission has been granted to visit the geological site. Thus, one might expect landowners where there is open access to take additional measures to ensure the duty of care. With visits to natural rock exposures there is no clear understanding of liability, but the Tomlinson case and the 'maintenance of the character of the countryside' in interpreting liability under the CROW Act, strongly point to putting the responsibility onto the visitor rather than the occupier or landowner.

An occupier may seek to benefit financially from granting access to a geological site. Should there be payment, the occupier may have to take on additional responsibilities for ensuring the safety of the visitor as required under the Occupiers Liability Act, 1957 and 1984, and the Unfair Contract Terms Act 1977, as a business transaction has taken place. However, business occupiers can validly exclude liability by notice to those invited to visit their land for recreational and educational purposes.

8. Safety at geological sites

Visitors to any geological site may be placing themselves at risk from one or more direct hazards, or a hazardous situation could develop during the visit. Either of these could result in an accident causing injury or death. The hazard and the extent of risk vary considerably from site to site. At many sites, the risk from hazards may be no more than that associated with the uneven ground experienced when walking or rambling in the open countryside. At the other extreme there may be an imminent danger associated with the site or parts of it, and the visit should be abandoned. A summary of common hazards associated with different types of geological sites is given in Table 4.

Vegetation (e.g. nettles; bracken; brambles) and fauna (e.g. snake bites; insect stings) may provide additional hazards to some or all visitors. The density of vegetation alone may be sufficient to create a hazard as it may cover ground that is rough, uneven or unstable. The extent of a hazard may also change as a consequence of weather differences or variation during a visit. For example, rock falls are far more likely during and immediately after rain. Most rocks are more slippery when wet.

All quarries present hazards from falling rocks and as a consequence, regulations are always in place at active quarries controlling or even preventing access to the faces by geological visitors. It should not be assumed that a rock face in an inactive, abandoned or historic quarry is safe. The faces in most of these quarries will not have been made safe prior to abandonment, and in any case, deterioration increasing the hazard from rockfalls may develop with time. Rockfalls from seacliffs are also a hazard, especially after winter storms.

At geological sites which have been actively managed for conservation, the risk from hazards often has been reduced or largely removed, for example, by engineering works to minimise risk from falling rocks or the erection

Table 4. *Common Hazards at geological sites*

Type of site	Hazards
1. Natural rock exposures	
Inland cliffs, crags and pavements	Falling rocks; avalanches and landslides; dislodged loose boulders; steep, unstable, rough or slippery approach slopes and surfaces; loose scree
Landslides, loose bounders and scree	Loose rock, falling rock, mass movement; soft ground; rough and uneven ground
River banks, lake sides and estuaries	Falling rock; soft ground; deep or fast flowing water; sand or mud slides; flash flooding
Coastal cliffs, foreshore and inter-tidal areas	Falling rock; soft mud or quicksand; mud slides; slippery, wet or seaweed covered rocks; rough and uneven ground; incoming tide; abnormal wave surges; deep rock pools
2. Landscape sites	
Inactive sites	Rough or uneven ground, plus others listed above depending on the site
Active geomorphological processes	Sudden increase in intensity of process, plus others listed above depending on the site
3. Man-made rock exposures	
Active quarries	Falling rocks; collapsing faces; uneven ground; soft ground; deep water; water and slurries in tailings and waste lagoons; sharp edges to rocks; unprotected edges at crest of faces; vehicle and other mobile plant movements; blasting; flyrock from in-quarry processing and conveyors; high noise levels; unstable tips and stockpiles
Inactive, abandoned and historic quarries	Falling rocks; collapsing faces; uneven ground; soft ground; sharp edges to rocks; unprotected edges at crest of faces; deep water; sharp and toxic material from fly-tipping
Road cuttings	Falling rocks; landslides; open culverts and ditches; uneven ground; drop at kerb edge; sharp material from fly-tipping; road traffic
Railway cuttings	Falling rocks; uneven ground; trains
Temporary excavations	Falling rock; collapse of excavation; uneven ground

of barriers preventing close access to unstable rock faces. Notices are often placed advising visitors of the hazards. The provision of a safe viewing area in active quarries also partly fulfils a role in enabling some of the geology to be seen from a distance. At most geological sites, however, hazards remain and all visitors need to be aware of them. The risk from hazards is either accepted, as is most likely when visiting natural rock exposures, or it is minimised by the visitor having to agree to the conditions placed on the visit by any leader, landowner or operator of the site.

Sample collection through hammering of rocks creates an additional hazard from flying rock chips and may dislodge larger rocks from the face, or cause mass movement.

9. Managing risk at geological sites

There are always potential hazards when visiting geological sites. Rock exposures, such as cliffs and quarries, provide the best places for examination of geological features, but they are inherently dangerous. All sites that may appear safe can be hazardous under certain conditions of weather. The risk arising from hazards at a geological site may require to be addressed by the visitor as well as the landowner or occupier. Apart from at active quarries, the occupier's actions for minimising risk are likely to be no more than written instructions when granting permission, notices of warning at the site or rarely, fencing off hazardous areas. A summary of precautions to take in mitigating hazards

Table 5. *Precautions for mitigating hazards at geological sites*

Notes:

Not all of these hazards exist for all geological sites. The severity of the hazard and need for taking precautions may vary. There may be other hazards at some sites.

If, after an assessment, the risk of injury is significant (see Table 6) then the hazard is best avoided, rather than a precaution taken. A leader should be aware of the limitations of each member of a group, especially children and older persons, or others with special needs, and additional precautions may be required.

Hazard	Precaution
Rough or steep ground	Boots with ankle support, walking stick, gloves
Slippery rocks	Boots with ankle support, walking stick, gloves
Adverse weather (wind, rain or snow)	Waterproof and warm clothing, hat, boots
Hot sunny weather	Sunscreen, sunglasses, adequate clothing to cover shoulders and neck, hat, carry some water
Falling rock from a cliff or quarry face	Hard helmet (note: this only protects from falls of small pieces of rock). Do not approach a rock face where there is a likelihood of material falling or collapsing
Cliff edges, quarry face crests	Do not approach too closely (within 5 metres)
Loose rock or scree	Do not walk across or do not allow group members to be directly beneath each other
Dust	Safety glasses with side protection
Streams and rivers	Boots; have lifebuoy with rope available; do not cross fast flowing rivers even if not thought to be deep
Sea	Know times of high and low water and whether spring or neap tide; know retreat access route; have lifebuoy with rope available
Mine or other liquid effluent	Avoid. Do not touch or walk through
Fly-tipped material	Avoid. Do not touch or walk over
Soft sand and mud	Avoid. Wear boots; have plank and rope available
Road or quarry traffic	Wear high-visibility jacket or vest. Place sign at roadside in advance of group, along with look-out
Unfamiliar territory	Have map, with GPS, and mobile phone with rescue numbers
Hammering rocks	Safety glasses with side protection, gloves
General precautions	Advise a responsible person of time of return, and instructions for rescue. Do not be late
	Never visit alone in remote areas
	Make group leader or accompanying person aware of any physical disability / medical problems / medication
	Have mobile or satellite phone depending on location
	Have adequate water and food
	Have first aid kit, along with appropriate training
	Have up-to-date tetanus protection
Visits to active quarries: Personal protection equipment is required to be worn at all time in active quarries by law. This always includes sensible clothing, a hard hat, high visibility vest or jacket, and safety boots with ankle support, and may include gloves and safety glasses.	

and other general information on safety is given in Table 5. The majority of hazards likely to be encountered at geological sites in the United Kingdom are listed. Other hazards may exist, in different circumstances, especially in remote upland wilderness areas (e.g. potential for hypothermia).

It is good practice for an individual or group leader to make an assessment of the likely risks associated with a geological site before making a visit. A prior risk assessment may be mandatory for some groups, especially those including children or students making a visit as part of their education. In active quarries, it is a requirement by law that risks are minimised and that procedures are in place to ensure safety of both the workforce and visitors. This includes the wearing of personal protective equipment by everyone visiting active quarries (see Table 5), and visitors must accept any restrictions for access and activity placed on their visit.

A full risk assessment includes all aspects of a visit, from its planning stage, through the visit itself, to making provision in case of accident. It includes methods for mitigation of unacceptable risks. These may exclude certain areas from the visit, or even abandonment if the risk is great. An individual or group leader also needs to assess any further risks mentally as a visit progresses, and put in place further mitigation measures, if required.

It is impossible to quantify risk absolutely, although one way of gauging the likelihood of a hazard causing injury during a visit is to use a measure of potential for injury against severity of injury (Table 6). The assessment recognises that existing control measures to mitigate the risk are in place and states the requirement for remedial action or abandonment if the risk is excessive. There remains some inevitable subjectivity in making the assessment.

A single assessment of risk encompassing all geological visits to all sites is inappropriate as hazards vary in nature and extent at different locations, and according to the requirements of the visit and the participants. Thus, it is recommended that a separate assessment be made by the individual or group leader prior to each visit to a site. Although this may appear tedious when someone has made frequent visits to the same or similar sites, making the assessment before each visit does remind the individual of the need to act in a safe manner. Hazards may also change with time.

Each member of a group should be given copies of the risk assessment prior to a visit and be asked to read and understand it, so that they recognise the hazards, and how they are to be mitigated. A simplified version of the assessment can be explained to children, who should also be made aware that they need to behave sensibly and act in a safe manner. A simple questionnaire can be used to reinforce understanding.

There is always a hazard at quarry or cliff faces from falling rocks, but as these are common sites for examining geological features they require special treatment. The risk of falling rocks cannot be entirely eliminated even when the cliff appears to be stable and/or the quarry face has been standing up without apparent falls for a long time. The geological visitor who wishes to look at detail in the face, either has to accept the risk and approach the face, or stay back and view it from a distance. At an active quarry, the visitor will be informed by the quarry manager or other competent person in charge of the visit as to whether a face may be approached. In many active quarries it is not considered safe to approach the faces. At disused quarries and other sites, one way of assessing the risk is to see if there is fallen debris at the base of the face. If there is none, then the risk in approaching may be acceptable. Posting a look-out to observe the face and provide prior warning of any fall is an additional prudent step. In most cases, the higher and/or steeper the face the increase in risk encountered. Thus, where a face varies in height, it may be safer to make closer observations of rocks where it is lowest. The stability of a rock face may deteriorate during and immediately after wet or freezing weather. Hammering a rock in a face may create vibrations that dislodge material higher up.

If it is essential that access to a rock face is required for the objectives of a visit to be achieved, for example, for the collection of material for research, it may be necessary to commission a remote geotechnical assessment of its stability and/or undertake engineering works to reduce the risk prior to the geological visit.

Measures that land-owners or occupiers of geological sites can take, for example with a disused or historic quarry, is to provide their own risk assessment and conditions when granting a visit, and/or to provide a sign at a suitable location in the quarry. It is good practice to require sight of a risk assessment done by the visitor in considering a request, as this will give confidence that the visitor is aware of the hazards. It is impractical for an occupier to mitigate all areas of potential hazards that the visitor may encounter in visiting natural rock exposures, including cliffs. This would destroy the natural beauty of such features, which in any case may be

Table 6. *A semi-quantitative procedure for making a risk assessment for geological fieldwork or visits*

(Based on the Hazard Identification / Risk Assessment Form used by University of Exeter.)

Risk is a combination of the likelihood a hazard will cause injury and the severity of the injury.

1. Identified hazards (see Tables 4 and 5) and enter on the table below.
2. Enter existing control measures or precautions already in place.
3. Quantify risk for each identified hazard using the following table:

Likelihood of injury	Score A	Severity of injury	Score B
Improbable	*1*	Very minor injury; abrasions / contusions	*1*
Remote	*2*	Minor injuries; cuts / burn	*2*
Possible	*3*	Major injuries; fractures / cuts / burns / damage to internal organs	*3*
Probable	*4*	Severe injury; amputation / eye loss / permanent disability	*4*
Likely	*5*	Death	*5*

4. Quantify the risk by multiplying Score A by Score B, taking account of existing control measures or precautions.
5. If Risk factor is over 5, take remedial action or precautions to improve existing control measures so that risk is below 5 or abandon that aspect of the visit.
6. If Risk factor is 5 or under, the risks are under adequate control, but should be carefully monitored on an ongoing basis during the visit.

For children or others with physical disabilities a threshold Risk Factor of less than 5 for remedial action to be taken may be appropriate.

Location or site					
Identified hazard	**Existing control measures or precautions**	**Score *A***	**Score *B***	**Risk Factor (A x B)**	**Remedial action or further precautions**

protected. Under this situation, individual visitors or group leaders have to make their own assessment of risk, and act on their own judgement.

A landowner or occupier may require the visitor to sign a statement of indemnity, which disclaim any responsibility for safety. The value of this in law is questionable as the relative responsibilities between the landowner / occupier and visitor will depend on the site visited. The benefit is that it reinforces to the visitor the importance of being responsible for safety and the need to act accordingly. However, if the visitor is not accompanied by a representative of the other party, he/she may take the view that having responsibility for ones own safety gives the right to take any risks in pursuit of achieving the objectives of the visit.

9. 1. Codes of practice and assessing competence

There are several published guidelines and codes of practice for geological fieldwork and site visits (e.g. Committee of Vice-Chancellors and Principals, 1995; Committee of Heads of University Geoscience Departments, 1994; Geologists' Association, undated; Association of University and College Lecturers, 1994; Geological Society, Code for Geological Fieldwork). These recommend procedures and contain information on potential hazards, along with further advice including the wearing of suitable protective clothing. They do not address the issue of the competence of the individual or group leader in being able to recognise hazards and ensure safety during a visit.

A 'Certificate of Competence' is adopted by many professional and service organisations whose employees encounter hazardous or risky situations, including when visiting sites controlled by other parties. It is tailored to the particular hazards and risks encountered. The Certificate is issued to individuals following a safety risk assessment considering the hazards and risks of specific work locations and the specific competence, constraints, training and capability of the individual. Such a scheme could be developed specifically for geological visits to quarries. The Certificate of Competence issued to an individual would indicate whether the individual could attend visits alone or under supervision. For group leaders, the Certificate of Competence would state that the individual was competent to lead a group on a geological visit to a quarry.

10. Responsibility for safety during visits to geological sites

Although not always clear in law, individuals making a visit to any geological site are likely to have at least some responsibility for their own safety. This responsibility may be whole, and without any resort to anyone else, or may be shared with a landowner (occupier) or any quarry operator. With visits by groups, the leader also is likely to

A visitor to an active quarry wearing appropriate personal protective equipment. The quarry face is away from the active working area, is stable and direct access presents an acceptable risk to the visitor. The site is extremely important for its geology as it is the best of only three where these strata are exposed. Faringdon Sponge Gravels, Wicklesham Quarry, Oxfordshire.

have a responsibility for ensuring safety of members of the group, although again there is no legal requirement which would apply in all situations and at all geological sites. The leader's responsibility for a group may be through the formal procedures of an organisation, such as an educational establishment, when the visit forms part of a study programme.

The hierarchy of responsibility for a visiting group may rest with the landowner / operator and then the group leader or vice-versa depending on the site. At active quarries the primary responsibility for visitors rests with the operator. This is covered by the Health and Safety at Work Act 1974 (HSWA), the Management of Health and Safety at Work Regulations 1999 (MHSWR), and the Quarries Regulations 1999. In recently inactive quarries the primary responsibility is likely also to remain with the former operator or successor landowner. With quarry sites which have been abandoned, the landowner has a responsibility to ensure his 'duty of care' under the Occupiers' Liability Acts 1957 and 1984 (see above); but this does not include taking the responsibility for minimising or eliminating all possible hazards that the visitor to a geological site might encounter. In this situation, the primary responsibility is likely to exist with a group leader and / or shared by all individuals even after any permission to visit the site, if needed or sought, has been given.

The HSWA sets out responsibilities for safety in the workplace and is applicable to geological sites where work is taking place, such as active quarries. The Quarries Regulations 1999, also apply to active quarries and those where extraction has taken place within the previous 12 months. The MHSWR set out, along with other things, the requirements of the employer to examine the risks associated with the workplace and employee training in health and safety. Although the MHSWR relates to employers and employees, it appears to have some relevance to groups visiting all geological sites, and not only active quarries. HSWA, MSHWR and the Quarries Regulations 1999, are discussed below along with their implications for visitors to geological sites.

10. 1. The Health and Safety at Work Act 1974 (HSWA)

This sets out the responsibilities for safety in the working environment. It applies to employees and also to others who may be in the work place. This will include visitors to geological sites where there is other work taking place, such as active quarries, and can be interpreted as applying where individuals and geological groups are making a visit to any geological site as part of their employment or training.

The Act states that employers have to take reasonably practicable steps to ensure the health, safety and welfare of their employees at work and the health and safety of non-employees, including visitors, who may be affected by their business undertaking. Failure to do so could result in a criminal prosecution in the Magistrates Court or a Crown Court. Failure to ensure safe working practices could also lead to an employee or visitor suing for personal injury or possibly the employer being prosecuted for corporate manslaughter. The level of risk has to be assessed against the cost in time, money or other resources of reducing or eliminating it. The employer's responsibility includes a duty to provide a safe environment and systems of work and trained and supervised staff. This suggests that visitors may also require training and / or supervision to increase their awareness of potential risks when visiting geological sites. Certain groups of visitors may require more care and supervision than others. This will include children and those with little or no prior experience of geological fieldwork, and hence of the potential hazards that may be present.

10. 2. Management of Health and Safety at Work Regulations 1999 (MHSWR)

These regulations set out the responsibilities of employers for the management of health and safety for employees and others affected. It also applies to the self-employed who have a responsibility for themselves and others. The employer is required to make and have effective arrangements for managing the protection of the health and safety of employees and to appoint a competent person to aid compliance. In effect, this means establishing a Health and Safety Policy and implementing effective management arrangements, and appointing a competent Health and Safety Officer.

The regulations require employers to make and keep under review an assessment of the risks to health and safety. Particular account has to be taken of the special needs of young people (i.e. less than 18 years old) due to inexperience and other factors relating to their capability. A hierarchy of principles for preventative and protective measures has to be followed, such as evaluation of risk, avoidance where possible, and combating risks at source, along with the provision of appropriate instructions to employees and others. Where serious and imminent dangers arise, employers have to establish and implement appropriate procedures.

A working quarry with high faces, narrow benches, inadequate protection at the crests of faces and rockfalls. Such a site presents significant hazards for the visitor, and also for the workforce.

Note: the photograph was taken prior to the implementation of the Quarries Regulations 1999. (Photo: Health and Safety Executive).

Employees and others working at the site have to be provided with comprehensive and relevant information on risks to their health and safety and the preventive and protective measures. When a child is employed (i.e. someone below the minimum school leaving age) a parent has to be given the information. The employer is required to provide the employee with appropriate health and safety training and the employee is required to act in accordance with the training and instructions.

MHSWR clearly have a direct relevance to visitors to active quarries, where they apply. For individuals and groups visiting other sites, these regulations could apply, depending on the circumstances of the visit. For example, they would apply at site visits by individuals or groups as part of duties for which they are employed, including continuing professional development activities. The responsibility for health and safety would be the employer(s) of the individual(s), and especially the employer of any group leader.

Universities appear to apply the MHSWR to all their members (staff and students) as a framework for their health and safety in fieldwork policies, risk assessment and instructions. This includes geological site visits. Details are published on many university web sites. Responsibilities for implementation rest either with the Head of Department by delegation or chief executive of the establishment (usually the Vice-Chancellor). Staff and students have to read and agree to follow the university safety policy and instructions.

Most of the published documents on codes of practice for fieldwork (e.g. Committee of Vice-Chancellors and Principals, 1995; Committee of Heads of University Geoscience Departments, 1994; Geologists' Association, undated; Association of University and College Lecturers, 1994) pre-date MHSWR and have not been updated subsequently. Their content varies but they provide advice to university management, leaders of groups, and students about procedures to follow and/or give details of some of the hazards that are encountered at geological sites. They do not explain where the liability for breaches of health and safety rest. One claim (1993) resulting from a serious accident to a university student undertaking independent fieldwork was settled out of court 'on compromise terms without admission of liability' (Committee of Heads of University Geoscience Departments, 1994).

Schools and other public or private educational establishments or study centres should have internal health and safety policies, procedures for risk assessment and instructions for fieldwork and other visits, which includes geological sites. These are likely to be very comprehensive, and place the responsibility clearly onto the leader when the visit includes children.

Sand and gravel quarry, Birch, Colchester, Essex. Although the excavator may move slowly, its arm can swing rapidly through a wide arc. Close access to the area where an excavator is working presents a significant hazard in an active quarry.

MHSWR would not apply where individual or group visits are made entirely as part of a recreational activity, where neither the leader nor individuals are making the visit as part of their employment, and the site is not an active quarry.

10. 3. Quarries Regulations 1999

These Regulations apply to every quarry where material is currently being extracted, or has been extracted within the previous 12 months. The regulations do not apply to quarries which have been inactive for more than 12 months, which will include most closed, dormant, and abandoned quarries, and all historic quarries.

The Quarries Regulations 1999, are superimposed on the general principles of the Health and Safety at Work Act 1974, and the Management of Health and Safety at Work Regulations 1999, which along with other regulations also apply to quarries. The Quarries Regulations and Approved Code of Practice (Health and Safety Commission, 1999) are intended to protect the health and safety of people working at a quarry and others who may be affected by quarrying activities. The Regulations include health and safety management, the duties of employers and employees, risk control, the use of explosives, the safety of excavations and tips and other items such as record keeping. The individual or company ('person' in legal terms) in overall control of the working of the quarry is known as the operator. Although not specifically designed for individuals and groups visiting active quarries to observe or study the geology, several parts of the regulations and approved code of practice are applicable, and are used by most operators as a basis for visits to take place.

The parts of the Quarries Regulations relevant to those visiting geological sites in an active quarry are reviewed in Table 7, along with comments on how they can be interpreted as applying to such visitors. It is assumed that the visit is essentially to examine the geology. However,

Table 7. *Extracts from the Quarries Regulations 1999 (in italics) of relevance to visitors to geological sites in active quarries, with comments on their application*

Readers are advised to refer to the full text of the Regulations, approved code of practice and guidance – see reference list (Health and Safety Commission, 1999).

Part I Interpretation and general

Part I (Regulations 1 to 4) deals with interpretation, definitions, application of the Regulations and other general matters.

Comment. Visitors are not specifically defined or referred to in the Regulations. The phrase 'persons at work at a quarry', who are clearly covered by the Regulations, includes those who are not employed directly by the operator but are working in the quarry as part of their normal employment as a contractor, regulator or similar, directly or indirectly on behalf of the operator. Some visitors will be at work whilst visiting a geological site, such as university lecturers leading student fieldwork, or undertaking research. A student is different in being someone who is visiting the quarry, but is not 'at work', i.e., not present for the purpose of his/her normal employment, and not contributing to the operator's activities.

Application. Regulation 4 (2). *These regulations do not apply to any: (a) quarry at which there has been no extraction…..within the previous 12 month, (b) quarry in relation to which notice of abandonment or ceasing of operations has been given……provided that the quarry is no longer being used for the extraction or preparation for sale of minerals.*

Part II Health and safety management

General duties of the operator. Regulation 6. (1). *It shall be the duty of the operator of every quarry to take the necessary measures to ensure, as far as is reasonably practicable that the quarry and its plant are designed, constructed, equipped, commissioned, operated and maintained in such a way that the persons at work can perform the work assigned to them without endangering their own health and safety or the health and safety of others.*

Comment. The operator has a responsibility to ensure the safety of all visitors, included as 'others' in the regulation. The operator will normally be the company running the quarry, although some aspects of the quarrying activity may be contracted to another company.

General duties of the operator Regulation 6. (2). *The operator shall co-ordinate the implementation of all measures relating to the health and safety of persons at work in the quarry.*

Comment. Although not specifically stated, visitors are likely to be included within the implementation of any measures.

The health and safety document. Regulation 7. (1). *The operator shall ensure that no work is carried out at the quarry unless a document (in these Regulations referred to as the "health and safety document") has been prepared, which - …demonstrates that adequate measures….will be taken to safeguard the health and safety of persons (i) at the quarry and (ii) in the area immediately surrounding the quarry who are directly affected by the activities of the quarry.* (The health and safety document assesses risks, demonstrates the measures taken to ensure health and safety and how they will be coordinated, gives details of the structure, authority and duties of the management, and records all of the rules and arrangements relevant to health and safety of all activities in the quarry. It must contain enough information to demonstrate that the risks have been properly assessed and that adequate measures have been taken to safeguard the health and safety of people at work in the quarry and others who may be affected.)

Comment. Visitors are included as 'persons' at or in the area immediately surrounding the quarry. Visitors cannot expect to have unlimited or unrestricted access to observe the geology in a quarry, and must accept the operator's arrangements for overall management of health and safety on the site.

The health and safety document. Regulation 7. (3). *The operator shall ensure that the health and safety document, including any information recorded therein…… is – (a) kept up to date; and (b) made available to each employer of persons at work at the quarry and to all persons at work at the quarry.*

Comment. The wording is directed towards employees, contractors and similar persons at work in the quarry. Parts of the health and safety document might be expected to be made available to all visitors. The complete document(s) is likely to be complex, lengthy, and much of it not directly relevant. A synopsis containing the relevant information for visitors may be used as part of any health and safety induction procedure for visitors. Where a visitor clearly is acting in their employed capacity, for example a teacher or lecturer conducting a student field trip, suitable pre-visit coordination and communication may include additional parts of the health and safety document relevant to the planned visit.

The health and safety document. Regulation 7. (4). *The operator shall ensure - (a) that the measures identified in the health and safety document are taken; and (b) that any plans included in that document are followed.*

Comment. The operator has to ensure that all those on site follow the requirements of the health and safety document.

Management structure. Regulation 8. (1). *With a view to ensuring the health, safety and welfare of those persons identified …….. it shall be the duty of the operator to - (a) establish a management structure which enables the quarry to be operated in accordance with the health and safety document; (b) make a record of the management structure and the extent of the authority and duties of persons in the said structure; (c) appoint a competent individual to take charge of the operation of the quarry at all times when persons are working in the quarry, ….. (d) ensure that when, for whatever reason, the individual appointed in accordance with paragraph (1)(c) is not readily available, a competent individual is nominated as a substitute to hold the authority and perform the duties of the first named individual; and (e) ensure that a sufficient number of competent persons are appointed to manage the quarry safely.*

Comment. The management structure may state how and by whom visitors may receive permission to gain access to the quarry. Normally visitors will apply to the person appointed by the operator in accordance with 8(1)(c) above. A competent person has to be at the quarry at all times when visitors are there. He/she may be the quarry manager or another suitable competent person.

Management structure Regulation 8. (2). *Without prejudice to the generality of paragraph (1), the management structure shall be established to provide in particular that all persons working at the quarry come under the authority of a competent person in the management structure who shall have a duty to exercise such supervision of those persons as is appropriate to ensure the health and safety of those persons and of all others who may be affected by their activities.*

Comment. This regulation would only apply to those visiting as part of their employment, such as British Geological Survey staff, field trip leaders, etc. The degree of supervision needed will depend upon the experience and competence of the visitor – see Regulation 9, below.

Training and competence. Regulation 9. *The operator shall ensure that no person undertakes any work at the quarry unless - (a) that person is either competent to do that work or he does so under the instruction and supervision of some other person who is competent to give instruction in and to supervise the doing of that work for the purpose of training him; and (b) a sufficient number of persons with the requisite competence to perform the tasks assigned to them are present.*

Comment. Competent is defined in Regulation 2 as " a person with sufficient training, experience, knowledge and other qualities to enable him properly to undertake the duties assigned to him". A few visitors may have sufficient training and experience to be considered competent for the purpose of their visit. Most visitors will not be able to demonstrate that they are sufficiently competent for this purpose, and they must be accompanied, or otherwise directly supervised, by a competent person at all times when in a quarry. Most visitors will not be trained in quarry industry health and safety, or be able to demonstrate that they are trained.

Instructions, rules and schemes. Regulation 10. (1). *It shall be the duty of the operator to - (a) ensure that rules are in place at the quarry with a view to securing - (i) the health and safety of those persons identified……*

Comment. This places responsibility on the operator to ensure the visitors have knowledge of the relevant rules, understands them and the need to comply with them before entering the quarry. A health and safety induction may be given in order to fulfil this responsibility.

Part III. Risk control

Inspection. Regulation 12. (1). *The operator shall (a) prepare and keep up to date a suitable written scheme for the systematic inspection, maintenance and, where appropriate, testing of (i) all parts of the quarry,…….with a view to securing the health and safety of those persons identified … …Regulation 12. (2). Without prejudice to the generality of paragraphs (1)(a) and (b), the said written scheme shall specify that faces above (a) every place of work at the quarry; and (b) every road used by persons at work at the quarry for the purpose of their work or of getting to or from their place of work, are inspected for loose ground or loose rocks before any work at the quarry commences or re-commences.*

Comment. The operator's inspections might identify hazardous parts of the quarry, which might be out-of-bounds to all, including visitors. Some visitors may seek to examine old quarry faces containing interesting geodiversity. These will need to have been examined, and access agreed by a competent person at the quarry. It may be that such areas have safety advantages for other reasons, such as absence of vehicle movements, for example.

Rules controlling risks from vehicles. Regulation 14. *The operator shall make suitable and sufficient rules (known in these Regulations as the "vehicles rules") which shall lay down in writing measures designed to control the risks to persons at the quarry arising from the use of vehicles at the quarry.* Other regulations, including the Workplace (Health, Safety and Welfare) Regulations, 1992, and the Provision and Use of Work Equipment Regulations 1998, also apply to vehicle use. For example, the Workplace (Health, Safety and Welfare) Regulations 1992, Regulation 17, refers to the need for pedestrians to be kept away from vehicles, especially where they have to reverse.

Comment. These rules may prevent visitors driving any vehicle in the quarry. In certain situations the 'vehicles rules' may prevent, or severely limit, pedestrian access or movement within the quarry, thus preventing detailed viewing of the geology at close range.

Barriers. Regulation 16. *The operator shall ensure that, where appropriate, a barrier suitable for the purpose of discouraging trespass is placed around the boundary of the quarry and is properly maintained.*

Comment. Where present, such a boundary barrier would make it clear that entry to the quarry is prohibited without permission. The presence and type of barrier will depend upon the operator's risk assessment and a barrier will not always be present around the whole perimeter.

Part IV. Additional health and safety requirements.

Permits to work. Regulation 18. (1). *The operator shall ensure that a system is in place so as to ensure that any work involving (a) the carrying out of hazardous operations; or (b) usually straightforward operations which may interact with other activities to cause serious hazards, is not carried out unless a permit to carry out that work has been issued.*

Comment. There may be rare circumstances when a single or a few visitors have a need to spend a lot of time in a quarry, for example researchers collecting fossils, or doing a detailed study of a rock formation over several days. In this situation it may be appropriate for a permit to work to be issued after the visitors have undertaken comprehensive induction, including health and safety training. They may then be accepted as competent persons.

Danger areas. Regulation 22. *The operator shall ensure that (a) any danger areas in the quarry are clearly marked; (b) equipment or barriers designed to prevent inadvertent entry by any unauthorised person are installed at any danger area in the quarry in which, because of the nature of the work being carried out there or for any other reason there is (i) risk of a person falling a distance likely to cause personal injury, (ii) risk of a person being struck by a falling object likely to cause personal injury, or (iii) a significant risk to the health and safety of persons; and (c) where any person at work is authorised to enter a danger area, appropriate measures are taken to protect his health and safety.*

Comment. There may be danger areas in the quarry where visitors may not go, for example following a Regulation 12 (2) inspection.

Part VII. Duties of employers and participation and duties of persons at work.

Co-operation. Regulation 39. *Every employer of persons at work at a quarry and every person at work at the quarry shall co-operate with the operator to the extent requisite to enable the operator to comply with the statutory provisions.*

Comment. This applies to visitors who are at work when in a quarry, for example, leaders of educational groups and their students, and university researchers. This regulation places a responsibility on the employers of such visitors and the visitors themselves to comply and not to hinder the operator's compliance with the requirements of the Quarries Regulations. It is logical, therefore, that these visitors and their employers should know the regulations, and how they are applied by the operator.

Duties of persons at work at a quarry. Regulation 42. *Every person at work at a quarry shall (a) to the extent of his responsibility and authority, carry out the duties allocated to him with reasonable care for the health and safety of himself and other persons who may be affected by his acts or omissions; and (b) comply with the rules put in place at the quarry by the operator in accordance with regulation 10.*

Comment. Visitors who are at work have a legal duty here towards their own health and safety and that of any other visitors in their charge, as well as those at work in the quarry. Agreeing to follow all of the operator's rules is likely to be required.

Fluorspar openpit operation, Dirtlow Rake, Castleton, Derbyshire. Visitors collecting samples of fluorite minerals. Although the face is quite low there is a significant hazard from rockfalls. The visitors are not wearing high visibility vests or jackets as there was no legal requirement for this when the photograph was taken in the early 1980s.

The processing plant area of a quarry presents hazards to the geological visitor who usually has to pass through it on the way to the quarry faces. Transport by vehicle through the processing plant or via a designated and separate pedestrian route may be required.

Tailings lagoon, Blackhill Quarry, Devon.
Tailings lagoons and other deep water at active quarries present a hazard for the visitor.
(Photo: Robin Shail).

passage through any part of the quarry might be expected on the way to the geological site, usually one or more quarry faces, and thus many parts of the Regulations and other health and safety legislation apply.

The Quarries Regulations 1999, place considerable responsibilities onto the operator of a quarry when visitors are present. One way of discharging these responsibilities is by applying the regulations to visitors as if they were employees working in the quarry. This avoids any ambiguity in interpretation, and is a policy followed by many operators.

11. Access by geological visitors: current practices of landowners

At many geological sites the visitor must have permission to visit from the landowner, if access is to be gained without trespassing. Permission is not needed for land designated under the CROW Act, although any geological activity, other then observing, is not included within the rights of access. Permission is not normally required to visit most coastal rock exposures even though there may not be a clear right of access in law. Gaining access through land to the coast, however, may require permission, if there is no public right of way. Permission is likely to be required at virtually all disused, abandoned or historic quarries. All working quarries require prior notice so that proper arrangements for supervision of the visit can be made (see Sections 10c, above, and Section 12, below).

As part of the GeoValue project (2005-2006), a large number of landowners have been contacted and asked to provide information on how they deal with requests for geological visitors to gain access. Policies and procedures vary considerably, but similarities exist between different types of landowners (Table 3). The practices of these different owners are reviewed below:

11. 1. Individuals, private or public companies (excluding active quarry sites)

These landowners do not appear to have policies or formal procedures for dealing with requests for visits for geological purposes. They are often unaware that there are features of geological interest on their land until a request for a visit is made. Requests are likely to be treated on an individual basis and practice varies. Access may be granted freely with no conditions attached (as is often the case), allowed with conditions, disallowed without reason, or disallowed stating that the site is unsafe and not suitable for access. With large companies, decisions may be made at the local level or referred to higher authority.

11. 2. Public bodies (e.g. Ministry of Defence, Forestry Commission, Natural England)

As the activities of these organisations are directly or indirectly accountable through the Government to the public, there is a presumption that requests for access to their land should be granted. Sometimes land owned by one of these bodies clearly states on notices at access points that it is open. Generally, access is allowed only on request and conditions are attached to protect both the landowner and the visitor.

These bodies mostly have formal policies and procedures in dealing with requests for access to land which is not normally open. For the purposes of activities, there could be a minimal charge to cover costs or none at all. A permit or licence is granted to an individual visitor or to a group which shows the type of access. By carrying this document at all times when on-site, the visitor is able to provide evidence of having gained permission, if challenged. Conditions may be placed on the extent of the access and the activities that are allowed.

Some areas may be temporarily out-of-bounds because the landowner is undertaking activities in that area at that time which may be hazardous to the visitor, or an area may be permanently out-of-bounds because of hazards. Even if there is open access a permit is always required for sample collection. Hammering, sampling by trenching or other destructive or invasive activities may or may not be permitted, depending on the associated risks to the visitor, especially where there may be buried items such as ordnance, or other contaminated land. There is likely to be a requirement to have adequate insurance to indemnify the landowner in case of damage to the property or injury to the visitor.

11. 3. Establishment bodies (e.g. Church Commissioners, Crown Estates, Duchy of Cornwall)

Much land under this type of ownership is tenanted, and the body may to defer to the tenant for a decision on whether access should be granted. The tenant is the occupier in this situation, and is likely to act in a similar way to an individual landowner and grant or refuse a request, with or without conditions or reasons. These

landowners do not appear to have general policies or procedures for use by themselves or tenants.

Where a request is made to the establishment body and it is considered appropriate for them rather than any tenant to act, the request is likely to be treated on its merits. Details are required about the activities to be undertaken, and a decision is based on this information. There appears to be a general presumption for allowing access as long as it is unlikely to have any legal or liability implications to the landowner.

11. 4. Charities (e.g. National Trust, Wildlife Trusts)

Landowners in this category are invariably involved with conserving and managing our natural heritage for the benefit of everyone. Maintaining biodiversity along with geological conservation may be part of their activities. Their ownership often includes former quarries. Much of their land may be on open access, although some may be tenanted with more restrictions. There is a general presumption by charities for allowing access by geological visitors. A permit specifying the activity to be undertaken may be issued. Hammering or other invasive or destructive activities are not normally allowed. A permit may be issued allowing sample collection by *bona fide* geological researchers for the purpose of their work.

11. 5. Conclusions

A few conclusions can be made as follows:

- As might be expected, different landowners operate different practices for dealing with requests for access to their land by geological visitors.
- Some land is on open access for all visitors, even though it is not designated under the CROW Act. Collecting, however, requires a permit.
- For some land not on open access, it seems that permission to enter normally will be granted by the landowner on request, although the purpose needs to be explained, and there may be restrictions.
- With some landowners, permission to visit a geological site may or may not be given.
- Formal agreements, where both the landowner and visitor are aware of the activities to be undertaken and the associated responsibilities, would appear to be the most appropriate for visits where groups are involved, especially those involving children or students.

12. Access by geological visitors: current practices of quarry operators

All of the major extractive industry companies and many other quarry operators in the UK allow general visits to their quarries as part of their community engagement policy. Some encourage visits as part of community activities. Visits are made by educational groups, other societies or individuals. The main purpose for a visit by most individuals and groups is to observe the quarrying operation. Examining the geological features is a minor part of the whole experience. One large aggregate producer has an educational study centre next to one of its major quarries, and school visits to the quarry are an important part of the activities of the centre.

The purposes of general community visits are:

- For the visitor to understand more about the minerals industry.
- To give the operator an opportunity to explain the contribution the industry makes to society and the local and national economy.
- For the visitor to see examples of good practice, such as restoration, dust suppression etc.
- For the visitor to understand the dangers of unauthorised access to the site.
- To encourage recruitment of good quality younger employees into the industry.

Visits to quarries may be on an *ad hoc* basis, the request coming from individuals or a group, or the operator may have an occasional advertised 'open day' for the local community. The management of all visitors and their activities have to comply with the operator's Health and Safety Document. A short introduction including a safety briefing is usually given at the beginning of a visit, and visitors may be asked to sign a document indicating an understanding of the safety requirements, accept any restrictions, and agree a code of conduct. The document may include a statement about indemnifying the operator against any claim for injury.

Geological visitors are a special category. The geodiversity visible in active quarries is also special (see for example, David Roche Geo Consulting, 2004). It gives a positive scientific gain, as much of the geology often cannot be seen elsewhere, or at least not to the same extent or high quality. Thus, the geological visitors' need for access invariably goes beyond that provided to the general visitor. Requirements are more specific and, in

Abandoned quarry in Jurassic limestone, Kirton in Lindsey, Lincolshire. In order to gain maximum benefit from a visit to a limestone quarry the visitor needs to have close access to see the detail of the rock units and any fossils or minerals, make measurements and drawings or photographs. The hammer provides a scale.

A student geology group in a china clay pit in Cornwall, having the main geological features pointed out to them. Note:
Although all students are wearing hard hats, the photo was taken before the Quarries Regulations 1999 made it a requirement for the wearing of high visibility jackets (Photo: Robin Shail).

this respect, more similar to the visitor who is there as part of their employment. Most quarry operators accommodate geological visitors as best they can, given the need for ensuring safety, and so that there is minimal or no disruption to the normal working of the quarry. However, practice and procedures in allowing access to geological visitors varies considerably.

Quarry operators generally recognise the scientific and educational value of the geology which is continually being revealed in active quarries, and which frequently cannot be seen elsewhere (English Nature, Quarry Products Association and Silica and Moulding Sands Association, 1993)

A large number of active quarries have been visited during the GeoValue Project (2005-2006) and the policies and practices for allowing access by geological visitors has been discussed with quarry managers. Further interviews have been held with geology and other staff of several large extractive industry companies and trade associations. Observations of policy and practices along with comments by operators are given below. Policies and practices for visits involving children or disabled persons, who require special arrangements and supervision, have not been addressed directly. Information on planning and designing sites suitable for visits by the disabled is given in David Jarvis Associates (2005).

12.1. Observations of policy and procedure

A review of observations made by the project team during numerous visits to active quarries is given below:

Policies. Specific policies by operators to accommodate the type of access needed by the geological visitor appear to be lacking. In the main, policies for general visitors or for contractors are adapted for use at the quarry. The general visitor policies of extractive industry companies are similar as are documented procedures for visitor safety.

Variation in procedures. The current procedures for allowing access by geological visitors vary considerably between operators. Also, there are variations between operating sites from within the same company, and between sites where different types of minerals are extracted. Some operators recognise that their quarry has interesting geological features and make some provision for geological visitors to see them to best advantage.

A few operators at some sites treat some geological visitors as equivalent to those entering the site for the purpose of their employment, the visitor being allowed access to undertake specified geological activities without direct supervision. The individual or leader of a small visiting group is recognised as competent and the operator has confidence that the visitor(s) will behave responsibly and not place themselves in danger. Usually, the individual or group leader is well known to the operator. Typically, where access is granted on these terms, the site is relatively small, and/or is likely to be a sand, sand and gravel or clay operation with low faces. There are few mobile plant movements if any, in the area of the quarry face, and/or the visitor is told not to go to areas where there are loading and mobile plant movements. The visitor(s) will 'sign in' and 'sign out' and any induction will be limited to the visitor being reminded of the requirements for safety. Larger, or student groups (e.g. more than 5 persons) may not be allowed access under the same arrangement.

In contrast, at some other sites, particularly large hardrock quarries, individual or group geological visitors are treated in the same way as the general community visitor. The companies' policies and procedures for general visits are applied, although generally some account is taken of the geological visitors' desire to spend time examining the rocks. Neither the individual visitor or group leader are deemed to be competent persons and the visitors are accompanied throughout. An induction on behaviour and safety procedures is given. The visitor is transported and may be required to remain in a vehicle when in the quarry, or only allowed out at specific viewpoints or other locations where hazards are minimal. This can result in the visit being unsatisfactory for the purpose of examining and understanding the geological features in the quarry.

Accidents. There are no reports or data available from quarry operators or their trade associations on accidents involving geological visitors at active quarry sites. This may indicate there have been no accidents, or at least none sufficiently serious to cause concern in the industry. It does not confirm that no accidents have occurred.

Arranging a visit. Prior arrangements for a visit are always required. Practice acceptable to the operator varies from a phone call to make arrangements to a formal letter giving details of the reason for the request. Any visitor arriving at a site without prior arrangements invariably will be turned away.

Risk assessment. The visitor may be asked to provide documentary evidence of having made a risk assessment for the activities to be undertaken during the visit. Leaders of educational groups usually will have completed a risk assessment as part of the preparation for the visit, this being required by their institution. Although geologists employed by a company make risk assessments prior to undertaking their work in the company's quarries, specific risk assessments by companies for geological visitors appear to be lacking.

Responsibility for allowing a visit. Responsibility is ultimately that of the operator. In practice, this is normally represented by the quarry manager or other competent person at the site.

Induction procedures. Specific induction procedures for geological visitors appear to be lacking. A general induction, similar to that in place for new employees or, more likely, for contractors is generally used for geological visitors. It is adapted as appropriate, along with details of site-specific hazards. Visitors are usually required to sign that they have read and understood the documents provided as part of the induction process. One company provides a visitor's safety guide which is sent out prior to the visit.

Indemnity. Several operators use a 'Form of Indemnity' as a procedure for providing some induction for the visitor. The form provides information on the quarry rules and safety requirements. Each visitor may be required to sign the form or a group leader sometimes signs on behalf of the group. An indemnity is frequently regarded as reinforcing the importance of health and safety and emphasising the responsibility of all for the safety of themselves and others.

Visitors' book. It is normal practice that each visitor, or sometimes the group leader alone 'signs in' and 'signs out' with times of arrival and departure at every site.

Frequency of visits. Requests for visits vary considerably between different sites. Those known to have a variety of geological features, which may be scientifically important or even unique, may receive a large number of requests. Some groups (e.g. undergraduate geology classes) make repeat visits annually. Some sites receive few visits, perhaps because there are no geological features of interest or as a consequence of location.

Company geologists. The request for a visit often is made through a geologist employed by the company. He/she arranges the visit and accompanies the individual or leads the group. The responsibility for the visit remains with the operator as represented by the quarry manager or other competent person on site, who usually gives the induction prior to the visit.

Access to rock faces. Access to some or all rock faces is permitted in some quarries. Mainly these are sand and gravel or clay operations and the faces are relatively low (<5m). Access within 5m of faces in most hardrock quarries generally is not permitted, although special arrangements may allow it under certain circumstances and after an assessment of risk has been made. Some companies place rocks from the face at strategic locations for examination by geological groups. This is often satisfactory and can be an advantage if the rocks are selected to show special geological features; but, generally it is not so good as being able to observe and examine the geological features and their relationships in place.

Vehicle movements. Any visitor who is allowed to walk in a quarry is advised to ensure and confirm by waving that he/she has made direct eye contact with the driver of any moving vehicles as soon as they are encountered.

Visitor vehicles. These are rarely allowed into a quarry, even if they are capable of taking rough ground.

Personal Protective Equipment. Hard hats, high-visibility clothing, and at least stout boots, or preferably safety boots are expected to be worn at all times by all geological visitors to quarries. This requirement is rigorously enforced. The visitor, and not the operator, is generally expected to provide them. Eye protection and gloves are sometimes required.

12. 2. Comments from operators

Comments made by operators during visits to active quarries and at meetings with quarrying companies are detailed below:

Company policy. Most operators have a company policy which welcomes visitors by prior arrangement, including those specifically interested in geology. Quarry managers interpret the policy in different ways, some openly welcoming visitors, others less so, claiming that over-riding business priorities prevent much visitor access.

Company resources. Quarry staff are very limited in the time they can devote to visits and geological visitors are particularly demanding on time and type of access. They

require closer supervision than other visitors. Some geological visitors, such as researchers, can take up a lot of time.

Benefit to the quarry manager. Most quarry managers realise that there are benefits to community relations by hosting visits to their quarry. However, it is not normally a specific factor taken into consideration in ongoing performance and development reviews. Hence the manager perceives no extra professional recognition.

Discipline. Geological visitors are the most difficult of visitors to keep together in a quarry. They are often focussed on their subject, they tend to wander, and do not always act responsibly with regards to safety rules. Large undergraduate student groups especially have poor discipline. Visitors who are keen to collect minerals are the least responsible, often ignoring hazards.

Safety incidents. Geological visitors are known to have placed themselves in situations where their safety is at risk, for example by going to and remaining directly below an unstable face, or climbing up a blast pile.

Main hazards for geological visitors. These are common to most sites and are recognised mainly as arising from mobile plant movements, possible collapse of unstable faces, and the visitor tripping / stumbling. Other hazards may exist in parts of some quarries, such as deep water or soft ground.

Educational visits. One operator encourages visits by local schools and pays the costs for a hired coach to transport them to and from school and in the quarry. Although the visit is not entirely related to the geology, the students are taken to a specially prepared vantage point to observe the features. For a relatively modest cost, the operator gains considerable educational and public relations value.

Unaccompanied visitors. Attitudes vary between operators. In some quarries, all geological visitors must be accompanied at all times. This will include some geological visitors who were deemed competent through prior experience of working in quarries. They have been allowed access on an unaccompanied basis in the past. Now, such visitors are required to be accompanied. In other quarries, some geological visitors are allowed access unaccompanied provided they have demonstrated their competence and understanding of the relevant parts of Quarries Regulations 1999, and local requirements.

Walking on site. This is not allowed at many sites, especially large quarries. The visitor is transported to a vantage point to observe the geological features from a distance where it is safe to leave the vehicle. Pedestrian access may be allowed in the parts of the quarry where no mobile plant is operating. In some quarries walking is allowed, although special arrangements may need to be in place (e.g. temporarily stopping mobile plant movements). A 'visitors' route' sometimes is pre-determined by the operator prior to a visit.

Timing of visits. So that the geological visitor can have access on foot which is the preferred way for undertaking geological activities, the timing of the visit may be restricted to week-ends or other 'out-of-hours' times when the is no mobile plant activity. The operator has to provide a member of staff as a competent person to supervise the visit and/or to accompany the visitors. This incurs expense. Some operators prefer geological visitors to come at non-working times.

Payment. Operators do not require payment from geological visitors, although payment to recompense for the time taken to provide supervision may need to be adopted. Those requiring regular access for research purposes might consider building the cost of accompaniment into their budgets. Some operators request that some visitors make a donation to a charity in return for the manager or other person taking time to host the visit outside normal working hours (e.g. Saturday mornings).

Contractors Safety Passport Scheme. All contractors operating within the quarrying industry are now expected to hold a Safety Passport. The passport is recognised by operators as not very relevant to the geological visitor, but could demonstrates that the visitor has made a commitment to behave in a safe manner in a quarry environment.

12. 3. Conclusions

There are several general conclusions that can be made about geological visits to active quarries.

- Quarry operators generally recognise the scientific and educational value of the geodiversity which is continually being revealed in active quarries.
- Whilst most operators welcome geological visitors to their quarries and try to ensure that the objectives of the visit are achieved, there is much variation in practice. This is partly related to the different degree

of hazards presented in different quarries, although much is to do with variation in commercial pressures on the operator (usually the quarry manager), availability of manpower to accompany visitors, and differing interpretations of companies' policies and procedures.

- All operators have a high awareness of the requirements for geological visitors to act in a safe manner and not to place themselves in hazardous situations.
- Some geological visitors do not behave responsibly, either through lack of discipline within a group, or because the individual is wholly focussed on the geology and disregards personal safety.
- There is a need for development of increased awareness of health and safety issues by geological visitors in quarries.
- A risk assessment completed by the visitor should be discussed with the operator as part of the planning for the visit.
- Many operators recognise that adhering strictly to their established policies and procedures for visitors is not wholly appropriate for geological visits. This is unsatisfactory for both the operator and the visitor. There appears to be a need for companies, working along with geological representatives, to develop their policies and procedures for visitors to include the means specifically for those wishing to examine the geology in a quarry.
- Some operators recognise that some visitors are competent and can undertake geological observations unaccompanied as an individual, lead a group, and not place him/her/themselves in a hazardous situation. Although some local induction may be necessary, the operator benefits by not having to provide an accompanying person.
- It could benefit operators by having designated persons to be competent in leading geological visitors. These leaders need not be directly employed by the company, and could, for example be a retired employee, a member of the local RIGS Group or Geology Trust, or a retired university academic or college lecturer who retains an interest in local geology. Although a fee is not likely to be required, payment of expenses to the leader or a donation to a local charity may be appropriate. The competence of the leader will need to be established through experience and/or training. An adaptation of the Contractors Safety Passport Scheme might be appropriate.
- If a geological visit is made when there is no mobile plant operating, then at least one major hazard is removed. The visitor can proceed on-foot, enabling the geology to be best observed, and the visit to be successful. If the visit is led by a competent person, who is familiar with the relevant safety rules and regulations, ensures others behave responsibly and do not place themselves in hazardous positions, then risk is minimised.

13. Providing facilities for the geological visitor at active quarries

Few active quarries have special facilities developed for visitors to observe the quarrying process from a safe distance. Where a facility exists, such as a purpose-built viewing area, these quarries mostly are well established, large, and found in parts of the country where mineral extraction makes an important contribution to the economy of the area, such as limestone from the Mendip Hills and the Peak District.

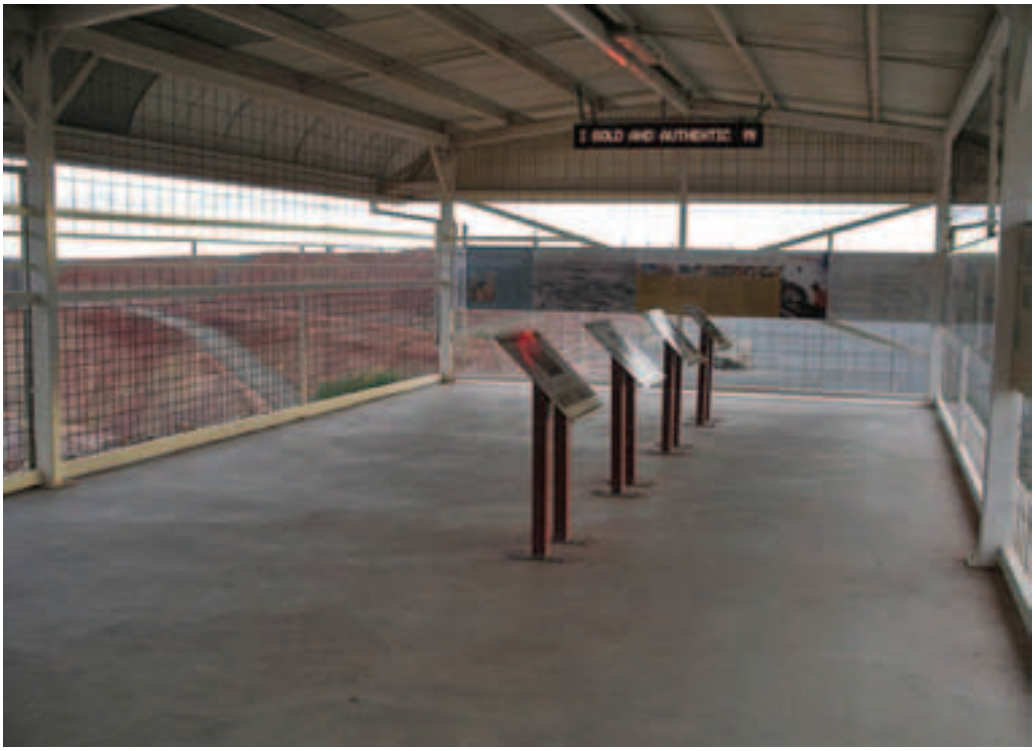
Any visitor facilities generally enable the rock faces to be seen, an appreciation of the scale of the quarry to be gained and the mobile plant to be observed going about their activities of loading and hauling the stone. For many visitors it can be an impressive sight, and the inquisitive mind is satisfied. For the visitor interested in the geology, it may be possible to recognise and observe large scale geological features from a distance. Rarely, an interpretation board may be present explaining the geology along with the statistics of the quarry and its importance, including the uses of the rock. The geological visitor, however, is unable to examine the rock directly, view any structures in detail, or see how features vary throughout the quarry.

There are several ways in which facilities for geological visitors can be developed at active quarry sites. These are detailed below along with their advantages and disadvantages for the visitor and the quarry operator. The provision of some facilities will involve works in the quarry, and thus some capital and ongoing expenditure will be required. Others can be achieved by using human resources and minor works alone, with minimal expenditure. It is recognised that there should be minimal or no disruption to the quarrying process in providing facilities for visitors.

An active aggregate quarry which would present significant hazards to visitors through unstable faces and inadequate edge protection at the crests of faces. The visitors could examine the large blocks of granite in the foreground without significant risk if there were no vehicle movements. The photograph was taken prior to implementation of the Quarries Regulations, 1999.

Dean Quarry, Lizard, Cornwall. Gabbro. Although effectively inside the quarry, this is an external viewing area for visitors who can access it via the South-West Coastal Path, which cuts through the site. The variety of textures in the gabbro, zeolite mineralisation and contact relations with intruding basalt dykes can be seen in large blocks on the quarry floor (to be sold as armour stone) avoiding the need to access the faces directly.

Close up view of gabbro, Dean Quarry, Lizard, Cornwall. Crystal size variation in feldspar and ferromagnesian minerals can be seen in a large block sited away from the quarry faces.



An external viewing platform next to a very large open pit. It has information for the visitor including details of the geology visible in the open pit. Moving illuminated text welcomes visitors and provides up-to-date information, including times of blasting which visitors can observe safely from the platform. There is space for parking, including coaches, and a small exhibition of historic quarrying equipment. Superpit gold mine, Kalgoorlie, Western Australia.

Students wearing correct personal protective equipment at an internal viewing area within a quarry. Some details of the geological features can be seen, but close up viewing is required for a full appreciation of the geodiversity the quarry offers. Moorcroft Quarry, Plymouth, Devon.

13. 1. External viewing area

Typically this is an elevated platform or levelled area placed at a vantage point outside the curtilage of the quarry. It gives a view of the large scale geological features exposed in the quarry faces from a distance. Examples of geological features which could be observed from an external viewing area are different rock types and their boundaries, unconformities, bedding (and large scale cross-bedding), foliations, faults, joint sets and large scale folds. An external viewing area needs to be located such that the large scale geological features can be seen to their best advantage. The most suitable location is near to a public right of way, with appropriate signage, and further signage along the route. Provision of an information board with a labelled drawing or annotated photograph of the geological features along with an explanation aids understanding.

Advantages

The viewing area can be used by anyone wishing to observe the quarrying activities as well as geological visitors. The visitor has access without affecting the quarrying operation, and the quarry personnel are not taken away from their normal duties.

Disadvantages

The quarry operator does not know who has visited the viewing area, and for what purpose (e.g. any photography cannot be controlled). The viewing area and any information board could be vandalised, and repairs may need to be made on a regular basis. The viewing area may provide an easy route for trespassers, especially children, to gain access to the quarry. The viewing area may need to be policed at times of blasting. There is no direct access to observe the details of the rock formations.

13. 2. Internal viewing area

A designated and suitably signed area within the curtilage of the quarry, well away from any areas of quarrying activity and mobile plant. There needs to be sufficient space for vehicles used to transport visitors to be parked. Visitors can alight from the vehicles to observe the large scale geological features from a distance, as with an external viewing area. As the visitor is likely to be nearer to any rock faces compared with an external viewing area, it should be possible to observe the major features more clearly than from an external viewing platform. Smaller scale geological features may be distinguishable (e.g. variations in bed thickness, facies differences in limestones, small fault displacements, joint variations and veins). An internal viewing area is best located at an elevated point within the quarry, selected such that the geological features can be seen clearly. An information board with an explanation and drawing or

photograph aids understanding, although the competent person in charge of the visitor(s) may provide literature giving the details of the geology (see below).

Advantages

The quarry operator knows who is making the visit and its purpose, and can determine the time and duration of the visit. The quarrying operation is unaffected. The viewing area may be suitable for use with other visitors who come to see the quarrying activity. The area will not be vandalised. There is an opportunity to provide a boulder park or sample collection / fossil hunting zone (see below)

Disadvantages

Visitors and their activities have to be regulated according to the company's policy and the Quarries Regulations 1999. A competent person is required to supervise the visit. It may be difficult to locate the viewing area away from the active zone of quarrying, mobile plant routes, and so that the geological features are best seen.

13. 3. Refuges

These are smaller than viewing areas within the curtilage of the quarry. A refuge is a designated and signed area, especially for the purpose of showing visitors particular aspects of the geology. It is closer to a rock face, so that more details of the rock lithologies and structures can be seen, but a safe distance away from any potential rock face collapse. More subtle changes in the rocks can be observed. Space is required for the parking of vehicles. The area is separated and protected from the active quarrying zone and from haul roads by a bund surrounding the refuge. Although it may be along a haul road route, signage is used to stop any quarry plant from accessing the refuge other than by special permission for maintenance.

Advantages

A refuge may be used for other purposes directly related to the quarrying business, such as a safe site for a surveying station, or for the operator's geologists or quarrying engineers to use in viewing the quarry without delaying the extraction and haulage activities. There is an opportunity to place examples of rocks found in the quarry (e.g. vein material containing minerals) within the refuge.

Disadvantages

Visitors and their activities have to be regulated according to the company's policy and the Quarries Regulations 1999. A competent person is required to supervise the visit closely and not allow visitors to

Large trucks, each capable of hauling 240 tonnes of rock. Access by pedestrians to the haulroads in this open pit is extremely dangerous and forbidden as there is a haulage truck passing about every minute during the working day. The photograph was taken at a refuge part way up the haulage ramp. This enables visitors to see the geology. Superpit gold mine, Kalgoorlie, Western Australia.

leave the refuge. The refuge cannot be close to active quarrying even though there may be interesting geological features in that area. There may need to be several refuges to illustrate the detailed geology of the quarry. Refuges will need to be moved as the quarrying activity progresses, and haul roads change.

13. 4. Visiting when mobile plant are not operating

Most quarries close through the weekend. This gives two days where there is minimal or no mobile plant activity. There may be other scheduled times when mobile plant is not operating in all or parts of the quarry. These are advantageous times and/or locations for geological visits.

Advantages

Access on-foot by the geological visitor is less hazardous, as there are few or no mobile plant movements.

Disadvantages

Other hazards, such as unstable faces, remain, and the operator remains responsible for the visitor. There will be a need to provide a competent person at the site and to accompany the visitor(s) for the whole time of the visit. This will be an expense to the operator, or the visitor could be required to pay. Other parts of the site, such as the processing plant, may be active with vehicle movements. Transport in vehicles may be required through active areas as pedestrian access is too hazardous.

13. 5. Pedestrian routes

The designation of separate pedestrian routes enables geological features to be seen to their best advantage. As pedestrians, individuals can record their observations, draw or take photographs, and group members can interact by discussing their individual observations. Changes in the geology laterally and vertically can be recognised more easily than when travelling in a vehicle. A group leader or competent person can explain the features with all members having an equal view of it. Pedestrian access is important for geological visitors to gain the maximum benefit from their visit. It is essential for those undertaking research activities. There is an inherent danger, however, in pedestrians walking unrestricted within parts of a quarry where mobile plant are operating, and where there is danger of rock falls from any faces or unprotected edges.

Where there are frequent requests by individuals and groups to see particular geological features within a

Notice advising pedestrians to keep inside the railings. A pedestrian route within a quarry, from where the geology can be best seen, enables a lot to be gained from a visit. The route needs to have a suitable barrier separating it from moving vehicles.

Pedestrian walkway at the edge of a quarry. It enables the quarry to be viewed from a distance but not the detail of the geology to be seen. Mancetter Quarry complex, Nuneaton, Warwickshire.

quarry, it could be beneficial for an operator to designate and develop a route for pedestrians. It will need to be suitably signed and have fence or bund protection. Where there is much geological variety it may need to extend through several hundred metres of a quarry. It need not begin at the quarry office or quarry entrance car park, the visitors being transported by vehicle to the start of the pedestrian walkway within the quarry, and perhaps met at the other end, or retrace their steps. This could reduce the need for a pedestrian route through a processing plant area, and along much of a haul road distance. The narrower width requirements for pedestrian routes may enable an alternative route to be found avoiding the processing plant area and any haul roads. Information boards could be placed along a pedestrian route.

Advantages

With large groups, the containment of visitors within a pedestrian route may reduce the need for more than one competent person in attendance. The visitor is contained within a specific area and does not affect the normal working of the quarry plant.

Disadvantages

Visitors and their activities have to be regulated according to the company's policy and the Quarries Regulations 1999. A competent person is required to supervise the visit closely so that they do not depart from the pedestrian route. Visitors need to be transported to the pedestrian route. A pedestrian route may need to be moved along with moving of haul roads as the quarry develops. A pedestrian route may need to cross haul roads, necessitating a footbridge, gates or traffic lights.

13. 6. Accessible faces (e.g. those not currently being worked)

Most quarries have faces where active extraction is not taking place, and will not take place for the foreseeable future, or ever. These faces may be at the extremities of the property and well away from any active quarrying zone, haul roads and other mobile plant movements. They may provide good locations for visitors to observe the geological features at closer quarters than would

otherwise be possible, without affecting the quarrying activities.

Suitable sites where this form of access could be appropriate include many sand, gravel, clay, and some limestone quarries, where the faces tend to be low. Direct access to the face for measurements to be made or for sample collection may be achievable in some quarries. In hard rock quarries with larger, unstable faces, some engineering works may be required to stabilise or reduce face heights so that close or direct access can be achieved. Barriers may need to be created to separate pedestrians from moving vehicles.

Advantages
Visitors can gain close access to examine the geology exposed in the rock face. There is an opportunity to select specific material from the rock face to allow close examination or collection (e.g. fossils, or rocks with a specific structure).

Disadvantages
The faces will be maintained as required by the Quarries Regulations 1999, and will need to be inspected prior to any visit. Areas of a quarry away from the active quarrying zone are often required for product stockpiles. These may abut and conceal the quarry face.

13. 7. Internal boulder park

This is a collection of representative types of rocks found in the quarry placed at a designated safe location within the quarry and available for the visitor to examine closely. It is most suitable as a visitor facility for a hard rock quarry. The boulder park can also include other items of geological interest, for example, material from a mineral vein or rock from a particularly fossiliferous horizon. Large boulders will usually contain the main elements of a rock. Combining a boulder park with an internal viewing area, refuge or pedestrian walkway enables the visitor simultaneously to see the major geological structures of the quarry and to examine the rocks in detail.

Advantages
Visitors are able to examine the rocks closely and if smaller pieces are also available, collect samples in a safe environment. There is no disruption to the normal working of the quarry, except that the visitors will require supervision by a competent person so the no-one strays out of the designated boulder park area.

Disadvantages
The relationships between different rock units cannot be examined usually from boulders alone. The precise source of the boulders within the quarry may not be known. The boulders need to be replaced as they degrade through weathering, or cleaned from time to time. Periodic maintenance is also required, a favourable public view of the industry being important.

13. 8. External boulder park

This is a collection of large boulders of representative rocks from one or more quarries placed at a suitable location outside the quarry. This could be at the site of an external viewing platform or away from the quarry, such as a museum, country park, other visitor attraction, or an educational establishment.

Advantages
There is no disruption to the quarrying process and the operator has no responsibility to the visitor. The collection of boulders may become an attraction in their own right.

Disadvantages
There is no interaction between the operator and the visitor, and if sited remotely, the visitor gains little knowledge about the activities of quarrying. The visitor is unable to collect samples, and is not able to place the rocks within the context of the quarry and any larger scale geological features that may be present. The boulders will require renovating or replacing as they degrade through weathering, or cleaning from time to time.

13. 9. Sample collection / fossil hunting zone

Many geological visitors like to collect rocks, minerals or fossils. For some, developing and maintaining a collection is part of their geological activity. For others, rock, mineral and fossil specimens are required for teaching or research. For younger students, collecting something which can be looked at again later is a way of remembering a visit. It encourages an on-going interest in the subject. Many professionals in the minerals industry will admit to their enthusiasm being fired by early encounters with rocks and minerals.

Small heaps of quarried material set aside for geological visitors enables them to collect samples of the rock. Heaps of other material of geological interest, such as

minerals occurring in the quarry, and examples of quarry products and their uses might also be provided. With a clay or shale, a large heap fulfils a similar role, enabling visitors to search for fossils, which are commonly present in these types of strata.

Advantages
The collection / fossil hunting zone can be sited at a location where the requirement for supervision of the visitor by the operator is minimal. For example, a suitable place would be near to a visitors' vehicle parking area.

Disadvantages
A suitable place has to be found and physically separated by fencing or other means from the other parts of the quarry. The heaps have to be tidied and replaced as they are worked through by the visitor. Some geological visitors, especially researchers, may need to collect specific materials from specific locations in the quarry, the context in which the sample is located being important. The collecting zone does not meet these requirements.

13. 10. Sample boxes.

These contain a pre-prepared selection for the visitor of what is found in the quarry, perhaps a small rock sample, or samples, along with other geological ephemera from the quarry (e.g. fossils or minerals). Each item is labelled, along with an explanation, and the company and quarry names are displayed along with other information.

Advantages
The visitor receives a small gift as a memento of the visit. For the operator it promotes good community relations and provides some publicity. The products from the quarry could be publicised.

Disadvantages
The operator needs to spend time, effort and funds in selecting and preparing the samples and designing the sample boxes, which need to be made attractive.

13. 11. Geological literature resource.

Quarries always have been a major resource for obtaining geological information, especially where there are few natural exposures. Therefore, much general and specialised geological literature cites quarries by name, with the specific data on the geological features being published. High resolution geological maps and other publications of the British Geological Survey also contain data from quarries. In recent years, geodiversity audits have been made of some active quarries in some areas of the country. These are a statement of the geological setting and features found in the quarry. Further audits are planned or are in progress by several operating companies as part of their company geodiversity action plans (cGAPS). Other literature is produced by RIGS or County Geology Groups. Some universities and colleges have literature on individual quarries for use by their students when visits are made.

It is useful to the geological visitor for the operator to have copies available of literature which refers to the quarry. This could be in the form of a single copy of each publication or relevant sections kept by the operator, along with a bibliography for giving out to visitors. Visitors can then seek out their own copies of the literature. Providing a bibliography at the time of the visit request would make the visitor aware of any important geological features in the quarry.

Advantages
The operator shows a good awareness of the expectation of the visitor and that he/she is the custodian of the geology found in the quarry. Visitors gains an understanding of the geological significance of the quarry of which they may be unaware.

Disadvantages
The company geologist or an external specialist may be required to seek out the literature and/or provide it to the operator. This involves both time and cost. The literature may require updating as geological knowledge develops.

14. Conclusions

The discussion above has raised many issues relating to access and safety associated with visiting geological sites. Some rights of access are unambiguous, such as to a site on a public highway and on land designated under the CROW Act, although these rights do not extend to collecting rocks, minerals or fossils, or other destructive or invasive activities. Gaining access to many sites is less certain and much concerning the relative responsibilities of the visitor and landowner for safety at many sites are not clear in law. Visiting a geological site is a hazardous activity, and risks need to be minimised.

Some conclusions arising from the current practices of landowners and quarry operators for geological visitors

are given in Sections 11 and 12 above. Further general conclusions are given below:

- The geological visitor is someone who has an interest in observing and interpreting the rocks at and beneath the Earth's surface, their composition, structures and any minerals or fossils they contain, along with the landscape and natural surface processes. Rocks include unconsolidated materials such as sands, clays and soil. Visitors may be interested because geology forms part of their formal education, it is a component of their life-long learning, or it is a recreational or professional activity. Some visitors may want to take samples of rocks, minerals or fossils for research purposes or to develop a collection. Commonly, other investigative activities need to be made.
- The law relating to access rights to land containing geological sites is complex. A right of access may exist, be uncertain or absent, depending on the location of the site, the existence of any legal provision for access or, voluntary arrangement. Permission may need to be granted by the landowner or occupier otherwise the visitor may be trespassing.
- Many landowners, especially those who exist for the public benefit, such as governmental bodies or charities, welcome the geological visitor when proper prior arrangements are made.
- Most quarry operators recognise the benefits in terms of achieving good community relations by allowing geological visitors onto their sites. The practices for allowing access vary considerably between operators.
- Legal and practical responsibilities for safety at a geological site would appear to rest both with the landowner or occupier and the visitor, and who has the greater responsibility can change with different sites and at different times. All visitors have at least some responsibility for ensuring their own safety, and that of others, at all sites.
- At active quarries, the responsibility for safety rests with both the operator and the visitor, although the operator has legal responsibility for ensuring that safety procedures are in place through applying the Quarries Regulations 1999, and its Code of Practice. The visitor is expected to follow the instructions of the operator.

Personal protective equipment for fieldwork includes hard hat, high visibility vest or jacket, and safety boots with steel toecaps and ankle support. These are always required for visits to active quarries. For some visits wellington boots with steel toecaps are a substitute for safety boots, but do not offer the same degree of ankle support. Safety glasses with side protection to protect from dust and rock chips when hammering, and thick or leather gloves to protect from handling sharp rocks or falling are needed for some sites. Safety sunglasses are useful for sunny days or for viewing light coloured rock faces (e.g. chalk).

Small historic quarry in Upper Cretaceous Chalk. Langtoft, East Yorkshire. A well developed monoclinal fold seen in the picture is almost unique in an inland site in the Chalk, providing an important example of geodiversity. Although next to a road, permission from the owner should be obtained prior to visiting.

A notice advising the visitor of falling rocks. Although this notice is within an active quarry site, all landowners might consider placing such notices in abandoned and historic quarries where a similar hazard exists.

- At active quarries, restrictions placed on the geological visitor to ensure safety may result in the objectives of the visit not being met, and the visitor being disappointed or disillusioned.
- Risk assessments and safety briefings given to groups by leaders before a visit appear to be variable in quality. This is particularly the case with visits to active quarries.

15. The way forward

There are several recommendations for the geological visitor, the landowner and the quarry operator to consider.

15. 1. For the geological visitor

- Obtaining permission for access from the landowner or occupier is recommended in all situations where it is not certain that a right of access or open access exists.
- Permission from the landowner or occupier should always be sought, even on open access land, if material is to be collected or any other geological activity apart from observational is to take place. A code for geological fieldwork in the United Kingdom discourages hammering of rocks unless there is a clear need to collect material for serious study.
- Apart from visits to active quarries, it would appear prudent for individual visitors or group leaders to assume they have full responsibility for safety, and not to expect the landowner or occupier to consider themselves in any way liable for injury to anyone entering their property. Group leaders should make certain, therefore, that they have adequate insurance through their employer, relevant body or on their own account, against any potential claim from members of their group or the landowner. Individual visitors should consider whether they need similar insurance to cover themselves against injury or claims. Insurance may be required as a condition for granting access by some landowners.
- The individual visitor and group leaders should acquaint themselves with the Quarries Regulations 1999, and its Code of Practice so that they understand the constraints that are likely to be placed on them when making a visit to an active quarry.
- Leaders of undergraduate student groups visiting active quarries should emphasise the importance of responsible behaviour prior to the visit through explaining the requirements of the Quarries Regulations 1999, the constraints these place on the operator, and their implications for the visit. Anyone under the influence of alcohol or drugs, or their after effects, must not be allowed to participate in the visit.
- Hazards of varying degrees exist at all geological sites. The individual or group leader is advised to make a thorough assessment of hazards prior to a visit and to put in place precautions to minimise risk. This risk assessment should be discussed and agreed with the landowner, or when visiting active quarries, with the manager or the company's appointed competent person. Risk cannot be eliminated entirely, and ultimately the visitor must make a decision about accepting a risk or not succeeding in the task intended.
- All visitors to geological sites should wear appropriate protective clothing to reduce risk of injury. At active quarries this must include a hard hat, high visibility vest or jacket, and safety boots with ankle support, and sometimes eye protection and gloves.
- Published guidelines on safety and 'Codes of Practice' for geological fieldwork are generally more than 10 years out of date. They do not reflect current thinking and attitudes to risk and, particularly, regulations on safety in quarries. They require comprehensive revision and updating. This would be best undertaken by a professional body.

15. 2. For the landowner or occupier (other than a quarry operator)

- Owners of sites, such as abandoned or historic quarries, known to have many geological visitors, should consider erecting boards at the entrance to a site, which state the procedures for gaining access, or explain to the visitor the condition under which access is granted.
- Owners of abandoned or historic quarries, or other man-made sites, which are known to them as being hazardous should erect notices explaining the hazard,

or in extreme cases erect barriers, or undertake engineering work to mitigate the risk. This will reduce the likelihood of their being a claim, or it being successful should there be an accident to a visitor.

- A landowner or operator who charges a fee for allowing access to a geological site, takes on additional responsibilities for ensuring the safety of the visitor.
- Some abandoned and historic quarries are situated on land designated as open access under the Countryside and Rights of Way Act, 2000 (CROW). Some of these sites are likely to attract the geological visitor, who until recently may have been denied access. This presents potential liability issues for the landowner if a visitor suffers injury. It is recommended that a suitable notice or barrier is erected at such sites to warn of danger.

15. 3. For the quarry operator

- Geological visitors are likely to gain most benefit if they are allowed access as a pedestrian during their visit. If considered safe to do so, access to observe the rocks at close quarters *in situ* should be arranged.
- The most suitable time for a geological visit so that the most benefit is gained by the visitor appears to be at a week-end or other times when there are minimal or no mobile plant movements. At these times access is likely to be less restricted and increased pedestrian movement possible.
- Although visitors to working quarries are often given a sheet with safety information, invariably this is not designed for the geological visitor, who may not understand its relevance, or worse, dismiss it and its contents as irrelevant. Quarry operators should consider designing an information sheet specifically for the geological visitor.
- The poor discipline of large undergraduate geology student groups when visiting active quarries could be improved by the operator only accepting small groups for a visit at any one time. A maximum of 15 is considered a suitable number for supervision by a single person.
- Operators of active quarries who receive many requests for visits by geological groups might consider developing facilities for these visitors. Such facilities could include internal viewing areas, refuges, pedestrian routes, a boulder park, sample collecting/

An example of a suitable notice warning visitors of the dangers in an historic quarry, along with fencing to prevent access to the crest of the face. There is access to the quarry via another route. The site is in an urban area. Buckingham sand pit.

fossil hunting zone, or customised sample boxes. Having relevant up-to-date geological literature indicates the operator has knowledge of the significance of the site for the visitor. There may be grants available through sources such a the Aggregates Levy Sustainability Fund (ALSF) for developing visitor facilities.

- A Certificate of Competence scheme could be developed for geological visits to quarries, and in particular for group leaders. This could enable less resource to be given by the operator to supervising the geological visitor or group. The scheme should be tailored to the needs of the geological visitor, rather than the existing procedures, such as generalised visitor or contractor inductions, or the Contractors' Safety Passport.

The Certificate of Competence could be developed and administered by an appropriate training organisation, to set an agreed industry standard which would then be accepted by many employers. However, this would not replace the need for site induction nor for the individual to comply with the site-specific safety management system and arrangements. Alternatively, systems could be developed and administered by individual organisations (quarry operators, university departments etc) for their own personnel, including the self-employed. However, this would lack the status and advantages of an industry-wide standard.

16. References and other sources of information

16. 1. Publications

Association of University and College Lecturers, 1994. Guidelines and code of practice for fieldwork, outdoor and other off-campus activities as part of an academic course. Association of University and College Lecturers, 10pp.

Committee of Heads of University Geoscience Departments, 1994. Safety in geoscience fieldwork. Final report by the CHUGD subcommittee, Geological Society, 18pp.

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Darlow, E. 2002. Health and safety law in quarries. The Institute of Quarrying. Nottingham, 283pp.

David Jarvis Associates, 2005. Planning and designing the restoration of quarries for the benefit of physically and mentally disabled. Final report and handbook, MIST project MA/4/3/004. www.mi-st.org.uk

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English Nature, Quarry Products Association and Silica and Moulding Sands Association, 2003. Geodiversity and the minerals industry – Conserving our geological heritage. Entec UK Ltd., 17pp.

English Nature and Quarry Products Association, 2005. Overarching Memorandum of Understanding. 1p.

Geologists' Association, undated. A Code for Geological Fieldwork. Folded leaflet.

Geological Society, Code for Geological Fieldwork. www.geolsoc.org.uk/template.cfm?name=fieldwork_code

Gray, M. 2004. Geodiversity: valuing and conserving abiotic nature. John Wiley and Sons, Ltd. Chichester, 434pp.

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Health and Safety Commission, 1999. Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice L21. HSE Books, 48pp.

Scott, P.W., Shail, R.K., Roche, D.P. and Nicholas, C. 2007. The Geodiversity Profile Handbook. David Roche Geo Consulting, Exeter, UK. 60pp.

Thompson, A., Poole, J., Carroll, L., Foweraker, M., Harris, K., & Cox, P. 2006. Geodiversity Action Plans for Aggregate Companies: A Guide to Good Practice. Report to the Mineral Industry Research Organisation. Capita Symonds Ltd, East Grinstead.

16. 2. Internet sites

The list includes sites with information on the law relating to land ownership, liability, and safety in quarries:

www.bgs.ac.uk/mineralsuk (British Geological Survey)
www.countryside.gov.uk (Countryside Agency, now part of Natural England)
www.countryside.gov.uk/LAR/Recreation/NCAF/NCAF4_1.asp
www.countrysideaccess.gov.uk
www.defra.gov.uk/rural/publicaccess/default.htm (Department Environment, Food and Rural Affairs)
www.english-nature.org.uk (English Nature, now part of Natural England)
www.forestry.gov.uk/forestry/recreation (The Forestry Commission)
www.geoconservation.com/GCCdocs/fieldworkcode.pdf (A Code for Geological Fieldwork)
www/goodquarry.com
www.hse.gov.uk/quarries (Health and Safety Executive)
www.inlandrevenue.gov.uk/heritage/lbsearch.htm
www.naturalengland.org.uk (The successor of English Nature)
www.naturenet.net/law
www.openaccess.gov.uk
www.opsi.gov.uk/si/si1999/19992024.htm (The Quarries Regulations, 1999)
www.opsi.gov.uk/si/si1999/19993242.htm (The Management of Health and safety at Work Regulations, 1999)
www.quarryed.co.uk
www.quarrysafe.co.uk
www.qpa.org (The Quarry Products Association)
www.ramblers.org.uk (The Ramblers Association)
www.safequarry.com
http://www.swarb.co.uk/acts/1957Occupiers_LiabilityAct.shtml
www.virtualquarry.co.uk
www.vscg.co.uk (Visitor safety in the countryside group)

Appendix: Definition of terms

Abandoned quarry
A quarry where no further extraction is likely to take place and permission to extract does not exist.

Active quarry
A quarry where extraction of mineral is taking place on a daily or very regular basis.

Closed quarry
A quarry where extraction of mineral has ceased and is unlikely to begin again at any time in the future. The quarry may be exhausted and there may or may not be permission to extract.

Dormant quarry
A quarry which is not currently active and there has been no extraction in the recent past. There may or may not be permission to extract.

Geodiversity
The natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landform and processes), and soil features. It includes their assemblages, relationships, properties, interpretations and systems. (Gray, 2004)

Historic quarry
A quarry where extraction took place many years or centuries ago. There is no further permission to extract.

Inactive quarry
A quarry where permission to extract exists, but extraction is not currently taking place. It may or may not become active in the future.

Landowner
The owner of land who is usually also the 'occupier' (q.v.)

Not working (quarry)
A quarry where extraction of mineral has taken place in the recent past but is not currently active. A permission to extract exists and the quarry may become active at any time. Usually applies to a quarry where extraction takes place on an irregular basis.

Occupier
The individual, group of individuals, company or other organisation owning or sometimes tenanting the land on which there is a geological site. The occupier may or may not be the operator of a quarry.

Operator
The company or other organisation that is responsible for the extraction, processing and selling the products from a quarry.

Tort
In civil law, generally, a wrong or injury committed against a person or property. A tort does not include breach of contract.

Photographs Front cover

A group of young students at a safe location away from vehicle movements having the geology and the quarring activity explained to them. They are wearing the appropriate personal protective clothing. Whatley Quarry, Carboniferous Limestone, Somerset. (Photo: Clive Nicholas)

A student geology group undertaking a field visit in Cornwall. (Photo: Robin Shail)

External viewing area with board containing information about the geology, but mainly devoted to the quarrying activity. Dene Quarry, Wirksworth, Derbyshire.

A sign on a public footpath which skirts a large active quarry, warning of danger. The sign and barbed wire fence fulfil the requirements of the Quarries Regulations 1999 in providing a barrier to discourage trespass.

Back cover

Geology student. (Photo: Robin Shail)