## The Geological Heritage of Cavan An audit of County Geological Sites in Cavan

by Matthew Parkes, Robert Meehan, Vincent Gallagher and Sarah Gatley

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## Section 2 – Site Reports

#### IGH 1 Karst Site Name Pollprughlisk West Cuilcagh (Overview) Burren Forest Corratirrim Garvagh Lough

Pollnaowen Shannon Pot White Father's Cave

# IGH 2 Precambrian to Devonian Palaeontology Site Name

Cormeen Quarry Moneycass Glebe

IGH 3 Carboniferous to Pliocene Palaeontology Site name Swanlinbar River IGH 4 Cambrian-Silurian Site name Bruse Hill Quarry Carrickallen Quarry

#### **IGH 5 Precambrian**

**Site name** Not represented in Cavan

#### **IGH 6 Mineralogy**

Site Name Drumcarban

#### IGH 7 Quaternary Site Name

Burren Forest [see IGH1] Blackwater Valley Bruse Hill Cuilcagh Mountain Cuilcagh Meltwater Channels Garvagh Lough [see IGH1] Lough Kinale-Lough Sheelin deltas Mid-Cavan drumlinised ribbed moraines Rockcorry-Cootehill ribbed moraines Scotshouse-Redhills cross-cutting ribbed moraines

## IGH 8 Lower Carboniferous Site Name

Cuilcagh Mountain [see IGH7] West Cuilcagh Legeelan Quarry

#### IGH 9 Upper Carboniferous and Permian Site Name Cuilcagh Mountain [see IGH7]

IGH 10 Devonian Site Name Not represented in Cavan

IGH 11 Igneous intrusions Site Name Crossdoney Granite Quarry

IGH 12 Mesozoic and Cenozoic Site Name Not represented in Cavan IGH 13 Coastal Geomorphology Site Name Not represented in Cavan

IGH 14 Fluvial and lacustrine geomorphology Site Name Tullydermot Falls

IGH 15 Economic Geology Site Name Kill IGH 15 Economic Geology (contd.) *Redhills* 

IGH 16 Hydrogeology Site Name Dromod Spa Well Shannon Pot [see IGH 1 Karst]

### **Report Summary**

County Cavan is recognised both within the county and in the national and international community for its superb geological heritage. The County Council's support for the World's first cross-border Geopark, encompassing the Cuilcagh area and the Marble Arch Caves in County Fermanagh, has been critical in raising the profile of geological heritage in Cavan. The geology of the county is quite diverse and the geological heritage interest extends throughout the county, not just within the Geopark area.

This report documents what are currently understood by the Irish Geological Heritage Programme (IGH) of the Geological Survey of Ireland (GSI) to be the most important geological sites within Cavan. It proposes them as County Geological Sites (CGS), for inclusion within the Cavan County Development Plan (CDP). The audit provides a reliable study of sites to replace a provisional listing based on desk study which was adopted in a previous CDP.

County Geological Sites do not receive statutory protection like Natural Heritage Areas (NHA) but receive an effective protection from their inclusion in the planning system. However, some of the sites described in this report are considered to be of national importance as best representative examples of particular geological formations or features. They have been provisionally notified to the National Parks and Wildlife Service (NPWS) by the GSI for designation as NHAs (Natural Heritage Areas), after due survey and consultation with landowners. However, many of these sites fall within existing pNHAs and SACs where the ecological interest is founded upon the underlying geodiversity. The commission of this audit and adoption of the sites within the County Development Plan ensure that County Cavan follows a now established and effective methodology for ensuring that geological heritage is not overlooked in the general absence of allocated resources for progress at national level. It ensures that Cavan remains at the forefront of geological conservation in Ireland, in parallel with the sustained development of the Marble Arch Caves Global Geopark.

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This report is written in non-technical language (with a glossary for unavoidable geological terminology) as a working document for use by the Heritage Officer and the Planning department of Cavan County Council. It will also be made available *via* the County Council website for the people of Cavan. A chapter of the report includes recommendations on how to best present and promote the geological heritage of Cavan to the people of the county. It will also inform the work of the IGH Programme and be made available through the GSI website.

The preliminary sections, summary geological history and accompanying map, timescale and stratigraphical column particularly may be used as they stand to preface a booklet or as website information in the development of this work, and for information as seen fit by the Heritage Officer. The contents also provide the essential ingredients for a public-oriented book on the geological heritage of Cavan, if funding can be sourced to produce it.

### Cavan in the context of Irish Geological Heritage

This report ensures Cavan remains active at the forefront of geological heritage within Ireland, as it is one of around half of the counties to date to commission such an audit within the scope of the county-based Heritage Plan. It will hopefully encourage the remaining local authorities to follow what is now a tried and trusted methodology. In the absence of significant political and economic resources available at a national level to the relevant bodies for conservation of geological heritage as Natural Heritage Areas (NHA), it represents a significant level of progress in defining and safeguarding Ireland's geological heritage.

It also represents a significant commitment on the part of the Local Authority to fulfil its obligations to incorporate geology into the spectrum of responsibilities under the Heritage Act 1995, the Planning and Development Act 2000, Planning and Development Regulations 2001, and the Wildlife (Amendment) Act, 2000 and the National Heritage Plan (2002). GSI views partnerships with the local authorities, exemplified by this report, as a very important element of its strategy on geological heritage (see Appendix 1).

The Irish Geological Heritage Programme (IGH) in GSI complements other nature conservation efforts of the last decade, by assessing Ireland's geodiversity. Geodiversity is the foundation of the biodiversity addressed under European Directives on habitats and species by the designations of Special Areas of Conservation (SAC) and more recently on a national scale by the introduction of NHAs as the national nature conservation method. As a targeted conservation measure to protect the very best of Irish geology and geomorphology the IGH Programme fills a void which has existed since the abandonment of the Areas of Scientific Interest scheme, listed by An Foras Forbartha in 1981.

The IGH Programme fulfils this by identifying and selecting the most important geological sites nationally for designation as NHAs. It looks at the entire spectrum within Irish geology and geomorphology under 16 different themes:

#### **IGH THEMES**

- 1. Karst
- 2. Precambrian to Devonian Palaeontology
- 3. Carboniferous to Pliocene Palaeontology
- 4. Cambrian-Silurian
- 5. Precambrian
- 6. Mineralogy
- 7. Quaternary
- 8. Lower Carboniferous
- 9. Upper Carboniferous and Permian
- 10. Devonian
- 11. Igneous intrusions
- 12. Mesozoic and Cenozoic
- 13. Coastal geomorphology
- 14. Fluvial and lacustrine geomorphology
- 15. Economic geology
- 16. Hydrogeology

A fundamental approach is that only the minimum number of sites necessary to demonstrate the particular geological theme is selected. This means that the first criterion is to identify the best national representative example of each feature or major sequence, and the second is to identify any unique or exceptional sites. The third criterion, identification of any sites of International importance, is nearly always covered by the other two.

Designation of geological NHAs will be by the GSI's partners in the Programme, the National Parks and Wildlife Service (NPWS). Once designated, any geological NHAs will be subject to normal statutory process within the Cavan Planning Department and other relevant divisions. However, compared to many ecological sites, management issues for geological sites are generally fewer and somewhat different in nature. The subsequent section considers these issues.

From a national perspective, as a result of extensive comparison of similar sites to establish the best among them, there is now a good knowledge of many other sites which are not the chosen best example, but may still be of national importance. Others may be of more local importance or of particular value as educational sites or as a public amenity. All these various important sites are proposed for County Geological Site (CGS) listing in the County Development Plan, along with any clear NHA selections.

Currently, in 2013, a Master List of candidate CGS and NHA sites has been established in GSI with the help of Expert Panels for all the 16 IGH themes. For several themes, the entire process has been largely completed and detailed site reports and boundary surveys have been done along with a Theme Report. Due to various factors, they have not been formally designated yet, although only a very small number of sites (*e.g.* Cormeen Quarry and Moneycass Glebe) are considered to be of national importance and have been put forward as Natural Heritage Areas (NHA). Therefore, inclusion of all sites as County Geological Sites (CGS) in Cavan's planning system will ensure that they are not inadvertently damaged or destroyed through lack of awareness of them outside of the IGH Programme in GSI.

The sites proposed here as County Geological Sites (CGS) have been visited and assessed specifically for this project, and represent our current state of knowledge. It does not exclude other sites being identified later, or directly promoted by the Council itself, or by local communities wishing to draw attention to important sites for amenity or education with an intrinsic geological interest. New excavations, such as major road cuttings or new quarries, can themselves be significant and potential additions to this selection.

It was not possible within the scope of this study to identify landowners except in a few sites, but it is emphasised that listing here is not a statutory designation, and carries no specific implications or responsibilities for landowners. It is primarily a planning tool, designed to record the scientific importance of specific features, and to provide awareness of them in any decision on any proposed development that might affect them. It thus also has an educational role for the wider public in raising awareness of this often undervalued component of our shared natural heritage.

### Geological conservation issues and site management

Since **geodiversity is the often forgotten foundation for much of the biodiversity** which has been identified for conservation through SAC or NHA designation, it is unsurprising that many of the most important geological sites are actually in the same areas as SAC and NHA sites. In these areas, the geological heritage enhances and cements the value of these sites for nature conservation, and requires no additional designation of actual land areas, other than citation of the geological interest.

Broadly speaking, there are two types of site identified by the IGH Programme. The first, and most common, includes small and discrete sites. These may be old quarries, natural exposures on hilly ground, coastal cliff sections, or other natural cuttings into the subsurface, such as Moneycass Glebe or Cormeen. They typically have a feature or features of specific interest such as fossils or minerals or they are a representative section of a particular stratigraphical sequence of rocks. The second type of site is a larger area of geomorphological interest, *i.e.* a landscape that incorporates features that illustrate the processes that formed it. The Quaternary theme and the Karst theme include such sites. In Cavan, the superb ribbed moraines are characteristic of the larger sites encompassed under the IGH 7 Quaternary theme. Large areas of Cavan's landscape are covered by such ribbed moraines or drumlins, which can present a problem for geoheritage as, although unique and impressive, they can be too extensive to consider as 'sites'.

It is also important from a geological conservation perspective that planners understand the landscape importance of geomorphological features which may not in themselves warrant any formal site designation, but which are an integral part of the character of Cavan. A lack of awareness in the past, has led to the loss of important geological sites and local character throughout the country. In Cavan a full Landscape Characterisation Assessment has not yet been completed but the Draft Cavan County Development Plan 2014–2020 has included some basic landscape characterisation and a series of policy objectives to support it. This provides a tool to help future planning decisions maintain the landscape character of the County.

There are large differences in the management requirements for geological sites in comparison to biological sites. Geological features are typically quite robust and generally few restrictions are required in order to protect the scientific interest. In some cases, paradoxically, the geological interest may even be served better by a development exposing more rock. The important thing is that the relevant planning department is aware of the sites and, more generally, that consultation can take place if some development is proposed for a site. In this way, geologists may get the opportunity to learn more about a site or area by recording and sample collection of temporary exposures, or to influence the design so that access to exposures of rock is maintained for the future, or occasionally, to prevent a completely inappropriate development through presentation of a strong scientific case.

In other counties, working quarries may have been listed because they are the best representative sections available of specific rock sequences, in areas where exposure is otherwise poor. No restriction is sought on the legitimate operation of these quarries. However, maintenance of exposure after quarry closure is generally sought in agreement with the operator and planning authority in such a case. At present, no working quarries are

included as County Geological Sites in Cavan, but these issues are briefly explored in a set of Geological Heritage Guidelines for the Extractive Industry, published jointly by the GSI and the Irish Concrete Federation in 2008.

A new quarry may open up a window into the rocks below and reveal significant or particularly interesting features such as pockets of fossils or minerals, or perhaps a karstic depression or cave. Equally a quarry that has finished working may become more relevant as a geological heritage site at that stage in its life. It may need regular maintenance to prevent overgrowth of vegetation obscuring the scientific interest, or may be promoted to the public by means of a viewing platform and information panel.

Nationally, specific sites may require restrictions and a typical case might be at an important fossil locality or a rare mineral locality, where a permit system may be required for genuine research, but the opportunity for general collecting may need to be controlled. However, Cavan's sites are not likely to require such an approach. It should be noted that within the European and Global Geopark Network, there are some self-imposed, self-regulated and quite restrictive rules relating to the collection and sale of geological specimens, which would apply to sites within the Marble Arch Caves Global Geopark area.

#### Waste dumping

An occasional problem throughout the country, including in County Cavan, is the dumping of rubbish in the countryside. The dumping of waste is not only unsightly and messy, but when waste materials are dumped in areas where rock is exposed, such as limestone quarries or karstic depressions, they may leach into the groundwater table as they degrade. This can cause groundwater pollution and can affect nearby drinking water supplies in wells or springs. Groundwater Protection Schemes (DELG 1999) help to combat pollution risks to groundwater by zoning the entire land surface within counties into different levels of groundwater vulnerability. Such a scheme was completed for Cavan County Council by the GSI in 2007, thus ranking the county land surface into vulnerability categories of 'Extreme', 'High', 'Moderate' and 'Low', and helping planners to assess which developments are suitable or not in certain areas of Cavan.

#### New exposures in development

One less obvious area where the Local Authority can play a key role in the promotion and protection of geology is in the case of new roads. Wherever major new carriageways are to be built, or in other major infrastructural work, it should be a policy within the Planning Department that where new rock exposures are created, they be left open and exposed unless geotechnical safety issues arise (such as where bedding dips are prone to rock failure). The grading and grassing over of slopes in cuttings is largely a civil engineering convenience and a mindset which is difficult to change. However, it leads to sterile and uninteresting roads that look the same throughout the country. Leaving rock outcrops exposed where they are intersected along the road, improves the character and interest of the route, by reflecting the geology and landscape of the locality. Sympathetic tree or shrub planting can still be done, but leaving bare rocks, especially where they show interesting features, not only assists the geological profession, but creates new local landmarks to replace those removed in the construction of the roadway. This can also potentially save money on the construction costs.

#### Geoparks

An extremely interesting development in geological heritage, not just in Europe but internationally, has been the rapid recent growth and adoption of the Geopark concept. A Geopark is a territory with a well-defined management structure in place (such as Local Authority support), where the geological heritage is of outstanding significance and is used to develop sustainable tourism opportunities. Initially it was largely a European Geoparks Network (EGN) but since 2004 has expanded worldwide as the Global Geoparks Network (GGN) and is fully assisted by the United Nations Educational, Scientific and Organisation (UNESCO) www.globalgeopark.org Cultural [see and www.europeangeoparks.org]. A fundamental theoretical basis of the Geopark is that it is driven from the bottom up - the communities in the Geopark are the drivers of the project and are the main beneficiaries. The Geopark branding/concept therefore helps promote the geological heritage resource so that the community can benefit from it.

In Ireland there are three members of the Geoparks Network. One is the cross-border Marble Geopark Arch Caves Global in Cavan and Fermanagh [see www.marblearchcaves.net and www.cavancoco.ie/marble-arch-caves-global-geopark]. The following section explores the importance of the Geopark and the relationship with Cavan County Council and partners in more detail, since it has very important implications for geological heritage within the county. The Copper Coast Geopark in Waterford also joined the Network in 2001 [see www.coppercoastgeopark.com]. A recent addition has been the Burren and Cliffs of Moher in County Clare [see www.burrenconnect.ie/geopark]. In addition there are aspirant groups exploring the work and infrastructure required for applications in other areas such as Joyce Country in Mayo and Galway, and the Mourne Mountains, Slieve Gullion and Carlingford area. /? crossborder Mourne-Cooley-Gullion area.

# Marble Arch Caves Global Geopark, Cavan County Council and the promotion of geological heritage in County Cavan

Cavan County Council has a long history of involvement with local communities and the development of tourism through the promotion of geological heritage in particular, and the landscape in general. In this section, this history is briefly summarised and an assessment of the relationship of County Council, Geopark and the community is offered.

#### The 12 Counties Project: 'Landscapes from Stone'

Arising from International Fund for Ireland and EU Special Peace & Reconciliation (SEUPB) funding at the end of the 1990's, GSI in partnership with the Geological Survey of Northern Ireland (GSNI) undertook various projects aimed at developing the scenic landscapes and rocks of the northern 12 counties of the island of Ireland into sustainable tourist attractions. It was decided that the best way to do this and bring geology to the general public would be to develop scenic drives and walks which would link sites of geological interest with established tourist attractions, visitor centres and sites of archaeological and mythological or folklore interest. The idea for "Landscapes from Stone" as a brand for general interest publications arose at this time. The twelve northern counties of the island are: Antrim, Armagh, Cavan, Derry, Donegal, Down, Fermanagh, Leitrim, Louth, Monaghan, Sligo and Tyrone. The European funding secured was supported by contributions from local authorities throughout the region, including County Cavan. A wide range of publications including walking and touring guides were produced under the banner of Landscapes from Stone. This project provided the foundations of much of the cross-border co-operation in geotourism and Geoparks between County Cavan and County Fermanagh which has been the hallmark of subsequent developments.



In the early 2000s a landscape tourism project, called the Breifne Mountains Project was led by the GSI and GSNI, and involved the county councils of Cavan, Fermanagh, Roscommon, Leitrim and Sligo along with Cavan Enterprise Board and the University of Ulster. It centred on the upland region of those counties that was once an ancient kingdom of Breifne. Funding was provided through an EU Peace and Reconciliation Programme [SEUPB]. The project aimed to develop a recognised brand name for this relatively little visited region of the island of Ireland and to promote tourism through highlighting elements of the geological landscape in an accessible way.

In brief, a wide range of printed guides, music and film DVDs, signage and a website were developed, created and installed. Sadly, due to an end to the project funding, and subsequent economic downturn, key continuing elements such as the Breifne tourism website hosted by Cavan County Council have since become inactive (although the GSI continues to host some data). In part, some functions have been superceded by the successful growth of the Marble Arch Caves Global Geopark, the first trans-national

Geopark in the world. Available resources in Cavan County Council for geotourism infrastructure are now directed into the Geopark.



#### Marble Arch Caves Global Geopark

The Marble Arch Caves in County Fermanagh were opened to the public by Fermanagh District Council in 1985. In 1998 an expanded area was designated as the Cuilcagh Mountain Park. In 2001 the Marble Arch Caves were granted membership of the European Geoparks Network, the first in Northern Ireland and one of only 12 in Europe at that time.

In 2004 the Global Geoparks Network was established with a swathe of Chinese Geoparks joining with the European Geoparks Network, and receiving assistance from UNESCO. In 2007, the Marble Arch Caves Geopark was expanded by roughly ten times its original size to incorporate many uplands areas in Fermanagh to the north of the caves. This was followed in 2008 by the proposal, in partnership with Cavan County Council, to expand the Geopark across the border with the Republic of Ireland, which was successful in September 2008.

Since 2008, there has generally been a very successful and significant growth in the Geopark, with a very wide offering of events and activities for everyone from primary school children to mature adults. A high level of community participation and involvement is demonstrated by the range of different communities and partner organisations that can be listed from past annual programmes of events. In Cavan, a Geologist has been employed for most of the time since 2008 to run events, co-ordinate activities and develop educational programmes, primarily through the critical financial and technical support of the Geological Survey of Ireland.

Numerous publications have been produced as part of the Geopark's output. Two in particular are noted here. Kirstin Lemon produced a very valuable guide to sites within the Geopark, called 'Our Outdoor Classroom', aimed at teachers of post primary students, and linking what can be seen and demonstrated, to the school curricula in both Northern Ireland and the Republic of Ireland. For one site in particular, the Burren Forest, a colour workbook type guide entitled 'The Burren Forest - Learning about the landscape' is aimed at a generally younger student group or families. A recently published colour guide to the Geopark is worthy of wider distribution.



The Geopark within Cavan extends from the Cuilcagh area to encompass much of the western part of the county as far east as Cavan town. Programmes of signage, and site infrastructure works have continued and the Geopark is apparently thriving. There is obviously a high degree of 'buy-in' from the local community, as indicated by the sites where permissive access is possible such as Tullydermot Falls, Pollnaowen or Shannon Pot.

The investment of resources has been considerable, and is demonstrated further by the construction (Autumn 2013) of an unmanned visitor centre within the Burren Forest, and the opening up of the park to visitors with interpretation and signage. Of particular note in relation to the West Cuilcagh site and the White Father's Caves within it, has been the commissioning of a Conservation Plan for the caves by Cavan County Council. This site is a popular and accessible caving venue used by individual cavers and by organised outdoor pursuits centre groups. It has been the subject of various problems over recent years, and the Conservation Plan is a most welcome engagement by the County Council. Hopefully implementation of the plan will reduce or eliminate any future difficulties.

Many sites are used in educational activities or are highlighted by Geopark information signs, but many of these are viewpoints where panels show the underlying story of the landscape seen from that point. These have not been treated as County Geological Sites, and are simply good infrastructure for the Geopark visitors. Some sites have been noted which could be delineated with a boundary and a site report (individually or as a highlight within a large site) but have not been. An example is Pollnagossan within the Western Cuilcagh site. This pothole is in an enclosed depression beside the road, and has a Geopark sign identifying it at the roadside. The cave is a difficult pothole requiring particular skills and a site report might be considered as an encouragement to visitors to seek out such a site which is unsuitable and potentially dangerous.

However, in a cautionary note, despite the generally positive impact of the Geopark, it is worth observing that the Geopark concept is not universally understood. As a single example, but not as a scientific sample, one discussion with a landowner, near Garvagh Lough, who was interested and observant about the land around him, established/affirmed that the Geopark idea meant only the Marble Arch Caves to him, and he was unfamiliar with the philosophy and principles behind Geoparks. Even in sight of the Burren Forest and Garvagh Lough, some of the Geopark's communication efforts have not been entirely successful. It is to be hoped that continued work will deepen and broaden the public understanding of the Geopark.

### Proposals and ideas for promotion of geological heritage in Cavan

The inclusion of geological heritage in the County Cavan Heritage Plan 2006-2011 as a component of natural heritage is a most welcome and positive step, for a topic that is often undervalued and poorly known in the wider community. This section examines the existing points in the plan where they can be related to geological heritage and provides specific suggestions as to how these may be implemented, supported or enhanced by the audit of geological heritage sites in the county. Many of the objectives and actions in the Heritage Plan for County Cavan are broad in scope and the audit may contribute to many aspirations relating to communicating and raising awareness of the heritage in Cavan.

#### In more specific terms:

## *Objective 1 Baseline data will be collected on the natural, built and cultural heritage of County Cavan*

**1.2** Following an audit of all information on natural heritage in County Cavan, establish gaps in existing data. Conduct surveys within the county which will address these gaps.

Audit Action: This audit will provide appropriate information and close the gap in existing data on geological heritage, both supplementing and complementing data collated in the Marble Arch Caves Geopark.

## *Objective 2 Heritage baseline data will be disseminated to Statutory, Community & Voluntary Sectors*

**2.6** Information collated on our rich cultural heritage will be made available on the heritage website and will be made accessible to local branch libraries, local schools, the community & voluntary sectors

Audit Action: This action can be partially fulfilled by adding the audit report to the County Council's website section on heritage, as well as to the Geological Survey of Ireland's website. In addition the audit may provide the material for a more 'public friendly' book.

## *Objective 3 A strategic management plan will be developed in order to safeguard the natural, built and cultural heritage of County Cavan*

*3.3* Natural and geomorphologic heritage sites of importance at a county level will be included into all County Development Plans, Town Development Plans and Local Area Plans

Audit Action: This action will be fulfilled in relation to geological heritage when the CGS shapefiles and associated data are included as a layer in the GIS of the Planning Section.

# *Objective 4 The natural, built and cultural heritage of County Cavan will be nurtured and enhanced through the implementation of programmes and initiatives as appropriate*

**4.5** The possibility of utilising our natural, built and cultural heritage in a positive manner to develop sustainable heritage amenities i.e. walking trails, cycling routes, greenways and ecological parks etc will be investigated

Audit Action: Geological heritage data from the audit may contribute to the development of many public amenities to support this action.

### Other audit benefits:

Selected geological and speleological titles will be made available digitally to help build the county's heritage database. These titles will come from the authors' own resources and connections (including from Matthew Parkes, the Speleological Union of Ireland Librarian).

## Specific ideas for projects

#### Leaflets

A project called 'Landscapes from Stone', run jointly between the GSI and the GSNI produced a series of walking and driving guides as leaflets in the year 2000. For Cavan, *Explore Cuilcagh* and *Walk Cuilcagh* remain in print. This is non-technical and broader in scope than just geology.



A range of many different leaflets, guides and posters are available as downloadable documents on the Geopark website, and many of these have been made available as printed editions. It is not appropriate to review them here, but they can be viewed at <u>www.marblearchcaves.net</u>

#### Guides

There are few existing guides to the geology of County Cavan, apart from literature produced within the Marble Arch Caves Global Geopark. There is scope for guides at different levels of detail and accessibility to non-specialists. A wide range of leaflets, booklets, books and other media are all feasible, but the research and production of appropriate text and images is a difficult task to do well without appropriate experience, and adequate time and resources. It is suggested that with only modest editing and reorganisation the content of this report would comprise a good general guide to the geological heritage of County Cavan, in a broadly similar style to those books produced for Sligo, Meath, Fingal, Waterford and Roscommon following audits.

#### Signboards

It is apparent from audit fieldwork that there is a very strong and well developed approach to signage within the Geopark. The expansion of the Geopark means that most of the western half of Cavan is covered. A collection of well sited information boards, all well branded with the necessary Geopark information, but with a wide range of interesting text and images, are found strategically placed at publicly accessible sites, roadside viewpoints with parking places and in key locations.

#### **Museum exhibitions**

As a result of the work to produce this report, the material for a panel based exhibition has been largely compiled. With some extra research covering human dependence on geology and resources, an interesting exhibition can be put together for display in the Cavan Museum, Council offices or County Library branches. The model followed was that used for Carlow and for Dun Laoghaire-Rathdown. Images of these can be seen on the Geological Heritage/Exhibitions section of the GSI website [www.gsi.ie].

#### New media

There are increasing numbers of examples of new methods of promoting Earth Sciences, *via* mobile phone applications and other electronic media. Self-guiding apps on specific sites would be one of these, such as those produced by Ingenious Ireland for Dublin city geology and the recently launched app for tourists in the Burren and Cliffs of Moher Geopark. Plans for such products would require some considerable effort to produce and imaginative planning, with the sites being scattered across the county. A possible channel for this is the superb record of Ice Age Action on the Cavan landscape.



#### Earth Science Ireland Group and magazine [www.earthscienceireland.org]

The group Earth Science Ireland is an all-Ireland group promoting awareness of Earth sciences and supporting educational provision in the subject. A main vehicle for the efforts is the twice a year magazine *Earth Science Ireland* and this is distributed free to thousands of individuals, schools, museums, centres and organisations. The editors would welcome more material from the Republic of Ireland and on Cavan's geological heritage. It is anticipated by the authors of this report that they will contribute a summary article distilled from the audit report.

#### Geoschol website [www.geoschol.com]

Geoschol is an educational project, now essentially represented by a website, which was largely aimed at producing educational materials on geology for primary schools. A four page pdf summarising the geology and some highlights of Cavan is already part of the available material (see Appendix 7). Working links to the Heritage section of Cavan County Council's website, and to other heritage websites, should be established.

#### **Geopark Research Archive**

If the Geopark wanted to do something similar to that produced in the Burren and Cliffs of Moher Geopark, with downloadable (or links to) free access papers, then a lot of groundwork is already provided by the reference lists in this audit. Making available technical references of direct relevance to the Marble Arch Caves Geopark geology and geomorphology will assist many users and researchers into the future. Equally, it could be done as a county-wide Geological Heritage Research Archive.

## A summary of the Geology of Cavan

#### 1) Paragraph summary

Cavan has many rocks that represent the ocean floor of some 400 to 500 million years ago, when Ireland was essentially two halves that were widely separated. The ocean closed by plate tectonic movements over that time, and the rocks were squeezed into stacked slices that now occupy much of central Cavan. The Crossdoney Granite is small but results from the ocean closure and stitching together of all the slices. In the northwest of the county, Carboniferous (specifically Dinantian) age rocks from around 340-320 million years ago are thick limestones, overlain by thick sandstones, such as at Cuilcagh Mountain. The limestones are from tropical seas, with many animals now preserved as fossils, and the sandstones represent a filling of those shallow seas by deltas and rivers. A small portion of Cavan is composed of Permian and Triassic rocks, best seen in Monaghan, but which include gypsum deposits. The overall landscape is most affected by the last Ice Age which left thick deposits of glacial till as drumlins, often combined into mega ridges of ribbed moraine. Disrupted drainage patterns provide a legacy of lakelands interspersed amongst, and rivers winding tortuously within, the ribbed moraines and drumlins.

AGE				IF THIS
(Million	ERA	PERIOD	EVENTS IN CAVAN	TIMESCALE WAS
Years			(non-italics)	А
Ago)				DAY LONG
2.6	Cenozoic	Quaternary	Several ice ages smothering Cavan, followed in the last 10,000 years by the spread of vegetation, growth of bogs and arrival of humans. Deposition of drumlins and ribbed moraines, and moulding of crag-and-tails.	The ice ages would begin 38 seconds before midnight
66		Tertiary	Erosion, especially of limestone. Caves, cavities and underground streams developing in the limestones between Ballyconnel and Belturbet.	The Tertiary period begins at 11.40 pm
145	Mesozoic	Cretaceous	Erosion. No record of rocks of this age in Cavan.	11.15 pm
201		Jurassic	Uplift and erosion. No record of rocks of this age in Cavan.	The age of the dinosaurs, starting at 10.55 pm
252		Triassic	Desert conditions on land. Sandstones and	10.42 pm
298	Dalagazaia	Permian	gypsums deposited east of Kingscourt Town.	10.30 pm
359	Palaeozoic	Carboniferous	Land became submerged, limestones with some shales and sandstones deposited in tropical seas around Lough Sheelin, and throughout the northern half of County Cavan. Limestones remaining today are dominated by muddy limestones. Shale and sandstone dominate northwest of Swanlinbar.	A significant portion of Monaghan's current rocks (limestone and shale) deposited around 10.10 pm
419		Devonian	Caledonian mountain building. Granites intruded into the subsurface around Crossdoney and Bellananagh.	9.52 pm
443		Silurian	Shallow seas, following closure of the lapetus Ocean. Slates, greywacke and shales deposited across the southern third of County Cavan.	Starts at 9.42 pm
485		Ordovician	Slates, siltstones and volcanic rocks form across much of the central portion of County Cavan, northeast and southwest of Cavan Town.	Begins at 9.28 pm
541		Cambrian	<i>Opening of the lapetus Ocean.</i> <i>No record of rocks of this age in Cavan.</i>	Starts at 9.11 pm
2500	Proterozoic	Precambrian	Some of Irelands oldest rocks deposited in Mayo and Sligo.	Beginning 11.00 am
4000			Oldest known rocks on Earth.	Beginning 3.00 am
4600	Archaean		Age of the Earth.	Beginning 1 second after midnight

The Geological Timescale and County Cavan

### 2) Simple summary

The oldest rocks in County Cavan are 417–495 million years old [Ma] mudstones and volcanic rocks. At that time Cavan lay beneath a deep ocean, on the edge of an ancient continent made up of Scotland, north America and the north of Ireland. A huge ocean separated this continent from the rest of Ireland, England, Wales and Europe. Over millions of years, plate tectonic movements closed this ocean and the two ancient continents collided, heating and deforming the ocean sediments to form slates and sandstones. The same rock types can be traced from Longford northeastwards through Cavan, County Down and into the Southern Uplands of Scotland. The ocean floor rocks were pushed up in a series of slivers against the northern side. County Cavan now has these slivers of slate and sandstones stacked up across the southern half of the county. Only where a few graptolite fossils occur in the black slates can we work out the actual age and stratigraphical sequence of the rocks.

As the ocean finally closed around 400 Ma bodies of molten magma moved up through the Earth's crust, cooling slowly to form granite. Just one small area of granite is known from the county, at Crossdoney a little southwest of Cavan town. The northern half of the county is composed of Carboniferous (specifically Dinantian) rocks, firstly limestones deposited in a shallow tropical sea containing abundant animal life. The sea then became shallower and was filled in by sediments that formed in river deltas and later solidified into sandstones and shales. These rocks occur in the uplands around Lough Allen and especially in the Cuilcagh Mountain area. In the area surrounding Cuilcagh Mountain, there is much exposed limestone that has developed karstic features since the last Ice Age, including many caves, potholes and limestone pavements.

In the succeeding Permian and Triassic periods Ireland lay in the northern tropics and the sedimentary rocks from this time are preserved around Kingscourt in Cavan, and also in Monaghan and Meath. They record deposition of sediments in arid deserts and temporary seas that periodically dried, precipitating thick evaporite deposits of gypsum. The subsequent Jurassic, Cretaceous, Tertiary (now officially termed the Paleogene and Neogene) periods have left no geological trace in Cavan, except a few residual weathering deposits. It is inferred that Ireland was mostly a land area, subject to weathering and erosion, which supplied only offshore basins with sediment.

Despite the influence that bedrock geology typically has on landscape, in Cavan the dominant control on formation of the landscape we see today was actually the movement of ice sheets that covered Cavan during the last Ice Age. The ice deposited ribbed moraines, crag-and-tails and drumlins that give the county its characteristic "basket-of-eggs" topography. Ribbed moraines are large 'chains' of drumlins, which are oriented transverse to ice flow. The name "drumlin", used internationally, comes from the Irish 'dromnin' meaning 'low hill'. Drumlins are mounds of debris left behind by melting ice sheets and are typically streamlined in the direction of ice-sheet flow.

The ice sheet flowed generally northwest to southeast across Cavan, a fact illustrated by the orientations of the crag and tails and drumlins, which are aligned northwest to southeast in general. As well as this, erratics of Crossdoney granite have been carried southeastwards by the ice, and are found as far south as Sliene na Calliagh in northwest County Meath.



A simplified geology map of Cavan outlining the main bedrock geological units.

As the ice sheet melted, large lakes formed including Lough Sheelin-Kinale, which were joined as one lake at that time. At the edge of the lake large deltas were formed. Elsewhere in the county, deep meltwater channels were gouged out of the landscape by huge meltwater rivers. These are common on the eastern slopes of Cuilcagh. On the lowlands in the south of the county, the meltwater river of the Blackwater deposited massive volumes of sand and gravel as it flowed through the valley south of Lough Ramor.

Since the Ice Age, during the Holocene, the modern drainage pattern was superimposed on the deglacial channel network, meaning some areas of haphazard drainage among the drumlins and ribbed moraines. At this time peat also formed between the drumlin and ribbed moraine ridges.



Illustrations showing the formation of ribbed moraines (left) and drumlins (right) under a moving ice sheet.

#### Geological heritage versus geological hazards

Ireland is generally considered to be a country with very low risk of major geological hazards: there are no active volcanoes, Ireland's location on stable tectonic plates means that earthquakes are relatively rare and its recorded human history is not peppered with disastrous landslides, mudflows or other geological catastrophes. There are of course risks of one-off events, and this section briefly looks at the specific record and nature of geological hazards in Cavan and the relationship of the County Geological Sites to those hazards.

The difference between human timescales and geological timescales can be difficult to comprehend but for many geological processes there are periods of sudden activity encompassing major events, and then quiet periods in between. The sites in this audit represent evidence of past geological environments and processes, such as tropical coral seas, swampy deltas, glacier erosion of the land surface and so on. However, a few sites represent the active geomorphological or land-forming processes of today. These sites, generally coastal in many counties, but mainly karstic or riverine in Cavan, are dynamic environments and can be subject to constant or intermittent, sometimes sudden, change.

#### Landslides and bog flows

The Geological Survey of Ireland has been compiling national data on landslides in the past decade. Numerous landslides and bog slides have been recorded in Cavan, particularly in upland areas such as Cuilcagh. Over 60 landslide events are recorded in Cavan, mostly in the uplands of the northwest, and many have occurred in recent times or been well documented in the historic geological literature. The details for many of the older slides are quite sketchy as they are historical, unwitnessed or interpreted from ground scars.

#### Flooding

There are two types of flooding which need consideration.

River flooding occurs inland when the rainfall exceeds the capacity of the ground to absorb moisture and the river channels cannot adequately discharge it to the sea. The OPW website <u>www.floods.ie</u> can be consulted for details of individual flood events in County Cavan. Some 191 events are recorded across the entire county. Many of these are in urban settings where rainfall exceeds the capacity of the local drains, and many are recurring events at the same places.

Karstic flooding can occur when underground passages are unable to absorb high rainfall events. The limestone in northwest Cavan is heavily karstified and there is an abundance of caves, springs, swallow holes and dolines. Despite this, local flooding events have occurred and will occur when rainfall exceeds the capacity of the underground drainage system. Such underground drainage systems can fill up rapidly when rainfall is heavy or prolonged and there are many cave systems known to be dangerous to enter in unsettled weather. Caving fatalities have occurred in the past, from such events.

#### Karstic collapse

The presence of dolines in karstic areas such as west Cuilcagh, are clear evidence of the potential for new ones to form. These can be sudden events. However, the potential for such collapses is present in other limestone areas within the county.

#### Groundwater pollution

Whilst not such an obvious hazard as physical collapses, flooding and landslides, the pollution of groundwater supplies carries a serious risk to human health. Cavan is not one of the counties most dependent on groundwater supplies but the risk is serious for specific areas. As the groundwater is largely contained within limestone, it should be noted that karstic springs are especially vulnerable to pollution since the flow is mainly within fissure conduits that allow rapid transmission of pollutants is far less in limestone fissures (as there are no natural barriers to stop pollutants) than it would be in granular deposits, which act as natural filters.

## Glossary of geological terms

Geological term	Definition
Adit	a horizontal or only gently inclined mine tunnel dug to access coal or mineral ore, or to drain, ventilate or further develop a mine.
Alluvial Deposit	unconsolidated clay, silt, sand and gravel, deposited by a body of running water.
Alluvium	a term for unconsolidated clay, silt, sand and gravel, deposited by a body of running water.
Aquifer	a water saturated rock unit.
Bedding Plane	the contact between individual beds of rock.
Bedrock	a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.
Biostratigraphy	using fossils to define the succession of rocks.
Blanket Bogs	bog covering a large, fairly horizontal area, which depends on high rainfall or high humidity, rather than local water sources for its supply of moisture.
Boulder Clay	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock or silt. Also known as till.
Brachiopods	a marine invertebrate of the phylum Brachiopoda - a type of shellfish. Ranging from Lower Cambrian to present.
Braided River	a river that consists of a network of small channels separated by small and often temporary islands.
Bryozoa	invertebrates belonging to the phylum Bryozoa, ranging from Ordovician to present, often found as frond-like, net-like or stick-like fossils.
Calcareous	containing significant calcium carbonate.
Calcite	a pale mineral composed of calcium carbonate, which reacts with dilute hydrochloric acid.
Carbonate	a rock (or mineral), most commonly limestone (calcite) and dolomite.
Cave	a natural underground space large enough for a human to enter, which is usually formed in either soluble limestone by karstic processes, or in exposed rock along the coastline, where the sea erodes natural rock fractures.
Clast	an individual constituent, grain or fragment of a sediment or rock, usually produced by mechanical weathering (disintegration) of a larger rock mass.
Cleavage	a finely spaced, flat plane of breakage caused by compressive deformation of rocks. e.g. the splitting of slate.
Clint	tabular block of limestone in a limestone pavement.
Crag and tail	a steep resistant rock mass (crag), with sloping softer sediments (tail) protected from glacial erosion or deposited as glacial debris on the crag's 'downstream' side.
Conglomerate	sedimentary rock comprising of large rounded fragments in a finer matrix.
Corrie	a horseshoe-shaped, steep-walled valley formed by glacial erosion.
Crinoid	a variety of sea-urchin, with a long flexible stem, usually anchored to the sea-floor and a body cup with arms which may be branching (a sea lily).
Cross-bedding	layering in sedimentary rocks at an inclined angle to bedding formed by current-ripples.
Crust	the outermost, solid, layer of the Earth.
Delta	a usually triangular alluvial deposit at the mouth of a river, or a similar deposit at the mouth of a tidal inlet, caused by tidal currents.
Dip/dipping	when sedimentary strata are not horizontal they are dipping in a direction and the angle between horizontal and the inclined plane is measured as the dip of the strata or beds.

Doline	circular/oval closed depression found in karst terrain.
Dolomite	calcium- and magnesium-bearing carbonate mineral; also a rock composed of the mineral.
Drumlin	a streamlined mound of glacial drift, rounded or elongated in the direction of the original flow of ice.
Epikarst	the shallow layer, near surface, of highly karstified rock, with many voids included.
Erratic	a rock fragment, often large, that has been transported, usually by ice, and deposited some distance from its source. It therefore generally differs from the underlying bedrock, the name "erratic" referring to the errant location of such boulders. Tracing their source can yield important information about glacial movements.
Facies	the character of the rock derived from its original sedimentary environment and process of deposition.
Fan	a usually triangular deposit of sand and gravel deposited by a glacial stream, either under a lake or under air.
Fault	planar fracture in rocks across which there has been some displacement or movement.
Fault Zone	a tabular volume containing many faults and fault rocks (rocks broken up by fault movement).
Fauna	collective term used to group all animal life.
Floodplain	a flat or nearly flat land area adjacent to a stream or river that experiences occasional or periodic flooding.
Flowstone	calcite or other minerals deposited as a surface crust by water flowing over cave or mine walls and floors.
Fluvial	pertaining to a river or stream.
Fold(ing)	flexure in layered rocks caused by compression.
Formation	a formal term for a sequence of related rock types differing significantly from adjacent sequences.
Fossiliferous	rich in fossils.
Fossils	any remains, trace or imprint of a plant or animal that has been preserved in the Earth's crust since some past geological or prehistorical time.
Glacial	of or relating to the presence and activities of ice or glaciers.
Grading	a sorting effect with the coarsest material at the base of the bed and finest grained material at the top.
Granite	a coarsely crystalline intrusive igneous rock composed mostly of quartz and feldspar.
Granodiorite	an igneous rock similar to granite but containing more of the mineral plagioclase and also more iron and magnesium-bearing minerals.
Greywacke	an impure sandstone, characterised by poorly-sorted, angular grains in a muddy matrix, that was deposited rapidly by turbidity currents (submarine avalanches).
Grike	a solutionally widened vertical fracture separating clints on a limestone pavement.
Gully	a deep valley created by running water eroding sharply into bedrock or subsoil.
Haematite	a mineral form of iron oxide, which is the main ore mined as iron.
Horizon	may refer to a single layer of rock such as a coal seam, an ash layer, or other geological 'event'.
Hummock	a small hill or knoll in the landscape, which may be formed by many different processes.
Ice margin	the edge of an ice sheet or glacier.
Igneous	a rock or mineral that solidified from molten or partially molten material i.e.

	from a magma.
Interglacial	the time interval between glacial stages, or pertaining to this time.
Joint	a fracture in a rock, which shows no evidence of displacement.
Karst	general term used for landscapes formed by weathering of soluble rocks, usually limestone, by surface water and/or groundwater.
Kettle hole	a shallow, sediment-filled body of water formed by retreating glaciers or draining floodwaters.
Knoll	a small hill or hillock sticking up from generally flat terrain.
Laminated	the finest example of stratification or bedding, typically exhibited by shales and fine-grained sandstones.
Limestone	a sedimentary rock consisting chiefly of calcium carbonate (CaCO <sub>3</sub> ), primarily in the form of the mineral calcite. It is mostly formed by the accumulation of calcareous shells, cemented by calcium carbonate precipitated from solution.
Lithification	the process of rock formation from unconsolidated sediment.
Lithology	the description of rocks on the basis of such characteristics as colour, composition and grain size.
Lodgement	process by which debris is released from the sliding base of a moving glacier/ice sheet and plastered or 'lodged' onto the glacier bed; also describes tills emplaced by this process (i.e. lodgement till).
Melt-out	process by which glacial debris is very slowly released from ice that is not sliding or deforming internally; also describes tills emplaced by this process (i.e. melt-out till).
Metamorphic	referring to the process of metamorphism or to the resulting metamorphic rock, transformed by heat and pressure from an originally igneous or sedimentary rock.
Misfit stream	a stream which is too small to have eroded the valley in which it flows, as is often the case with streams now flowing in meltwater channels.
Moraine	any glacially formed accumulation of unconsolidated debris, in glaciated regions, such as during an ice age.
Mudmound	Waulsortian limestone of Carboniferous age is characterised by forming as massive mounds or ridges or sheets of carbonate mud on the seafloor of the time. Mudmound is a general term to describe the varieties of forms.
Mudstone	a very fine grained sedimentary rock, containing quartz and clay minerals. Similar to shale, but not as easily split along the plane of bedding.
Ore	a mineral which is concentrated enough to be exploited by mining.
Orogeny	the creation of a mountain belt as a result of tectonic activity.
Outcrop	part of a geologic formation or structure that appears at the surface of the Earth.
Periglacial	very cold but non-glacial climatic conditions.
Phreatic	when a cave passage or void space in limestone rocks is filled with water it is said to be phreatic or in the phreas. When later found without water in them such passages have a characteristic cylindrical shape from solution in all directions and are called phreatic tubes.
Phreatic Zone	the area below the water table, where the rock is completely saturated with water.
Plate Tectonics	a theory that states that the crust is divided up into a number of plates, whose pattern of horizontal movement is controlled by the interaction of these plates at their boundaries with one another.
Pyrite	iron sulphide, pale yellow/gold coloured mineral, commonly occurring as cubes and often called 'fool's gold'.
Ribbed moraine	a subglacially ( <i>i.e.</i> under a glacier or ice sheet) formed type of moraine landform that mainly occurs in Fennoscandia, Scotland, Ireland and Canada. They cover large areas that have been covered by ice, and occur

	mostly in what is believed to have been the central areas of the ice sheets.
Sandstone	a fine to coarse sedimentary rock, deposited by water or wind, and composed of fragments of sand (quartz grains), cemented together by quartz or other minerals.
Sandur	a plain formed of glacial sediments deposited by meltwater outwash at the terminus of a glacier.
Sedimentary	a rock formed by the deposition of sediment, or pertaining to the process of sedimentation.
Shaft	a vertical or inclined hole dug in a mine for access, ventilation, for hauling ore out or for pumping water out.
Shale	a very fine-grained mudstone, containing quartz and clay minerals, that splits easily along the plane of bedding.
Siltstone	is similar to mudstone but with a predominance of silt-sized (slightly coarser) particles.
Sink	another name for a swallow hole, the point where a stream passes underground.
Slumping	the movement of a mass of unconsolidated sediment or rock layers down a slope, or pertaining to contorted sedimentary bedding features.
Solution pipe	a karstic feature of solution in a vertical narrow chimney or pipe shape.
Spring	the point where an underground stream reaches the surface.
Stratigraphy	the study of stratified (layered) sedimentary and volcanic rocks, especially their sequence in time and correlation between localities.
Sub-aerial	refers to processes occurring above ground level, such as the weathering of rocks.
Subduction	the sinking of one crustal plate beneath the edge of another through the process of plate tectonics.
Subsidence (zone)	the sudden sinking or gradual downward settling of the Earth's surface with little or no horizontal movement.
Swallow hole	the point where a stream passes underground, sinking below the ground surface.
Terrestrial	pertaining to the Earth's dry land.
Till	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock as sand, silt or clay; also known as boulder clay.
Transgression	an incursion of the sea over land area.
Trilobites	extinct arthropods.
Turbidite	deposit of a turbidity current.
Turbidity Current	underwater density current carrying suspended sediment at high speed down a subaqueous slope. The resulting deposit is called a turbidite.
Turlough	a seasonal lake that fills and empties through springs and sinkholes.
Unconformable	a sedimentary rock that is not following in sequence from the one below but has a significant time gap present between them.
Unconformity	a buried erosion surface separating two rock masses or strata of different ages, indicating that sediment deposition was not continuous.
Vadose Zone	the area between the surface and the water table.
Vein quartz	white thin veins of quartz injected in rock fractures during episodes of stress. Also found as durable beach pebbles, once it has been eroded.
Volcanic Rock	any rock produced from volcanic material, e.g. ash, lava.
Volcaniclastic	rock material, derived from a volcanic eruption, re-deposited as a sedimentary rock, e.g. a sandstone, as an aggregate of small particles.
Volcanism	the process by which magma and its associated gasses rise into the crust and are extruded onto the Earth's surface and into the atmosphere.

#### Volcano

a vent in the surface of the Earth through which magma and associated gasses and ash erupt.

### Data sources on the geology of County Cavan

This section is a brief summary of relevant GSI datasets, to assist any enquiry concerning geology and to target possible information easily. The GSI has very many datasets, accumulated since it began mapping Ireland's geology in 1845. A Document Management System (DMS) is freely available to any person at the GSI Customer Centre, into which about half a million documents and maps have been scanned. This means that any user can visit the GSI Customer Centre themselves and search on screen for data of relevance to them. High quality colour and black and white print-outs can be made or data supplied on CD, or *via* USB keys etc. **Data is available free of charge**. It is planned to make this resource available online but no date is yet set for when this may be achieved, although many subsets are already available within online data.

#### Key datasets include:

#### 1:100,000 Map Report Series

All historical, modern and other mapping has been compiled into very useful maps and reports that describe the geology of the entire country. Parts of Sheets 7, 8/9, 12 and 13 include Cavan.

#### **19<sup>th</sup> century 6 inch to the mile fieldsheets**

These provide an important historical and current resource, with very detailed observations of the geology of the entire country.

#### 19<sup>th</sup> century one inch maps and Memoirs

Information from the detailed 19<sup>th</sup> century mapping was distilled into one inch to the mile maps, of which parts of Sheets 44, 56, 57, 67, 68, 69, 79, 80 and 81 cover County Cavan. Each sheet or several sheets were accompanied by a Memoir which described the geology of that area in some detail. These still provide valuable records of observations even though interpretations may have changed with better geological understanding. Memoirs are in the Customer Centre library and scanned on the DMS.

Historical geological mapping is now available *via* a website: <u>http://www.geologicalmaps.net/irishhistmaps/history.cfm</u>

#### Open File Data

Each Mineral Prospecting Licence issued by the Exploration and Mining Division of the Department of Communications, Energy and Natural Resources (currently) carries an obligation on the exploration company to lodge records of the work undertaken, for the common good. These records are held by the Geological Survey and are available as Open File Data, once a period of time has expired. They may include geological interpretations, borehole logs, geophysical and geochemical surveys and so on.

#### MinLocs Data

The MinLocs Database records all known mineral occurrences, however small, from GSI records, such as 19<sup>th</sup> century fieldsheets and Open File data.

#### Historic Mine Records

Abandonment plans and various other material exists for the various mining ventures in the county, particularly in the gypsum mines of the Kingscourt - Carrickmacross district (mostly in Monaghan) and the iron mines of the Redhills district.

#### Subsoils Mapping

Since a Groundwater Protection Scheme has been completed (2007) for County Cavan by GSI, a recently completed map of the subsoil types and depths across Cavan exists, as well as the previously completed bedrock mapping. This provides a significant resource in general terms as well as for groundwater protection. Customised output is possible. Further more detailed compilation of glacial geology datasets, including a revision to be published by GSI in late-2013, will provide more options in the near future.

Digital mapping of many different datasets is now available via the GSI website: www.gsi.ie

#### **Tellus Border Data**

A very significant project undertaken over the last few years has been the Tellus Border project, in which enormous amounts of systematic data on geophysics and geochemistry of the border counties with Northern Ireland (including Cavan) has been gathered, extending the information gathered in Northern Ireland as part of the original Tellus Project. The GSI is one of 4 partners, and the project was funded under INTERREG IVA Programme. Airborne and ground based survey systematically gathered data on over 50 elements. This will have applications in environmental, health, mineral exploration and other areas. Public access to data from the project was launched on the 24<sup>th</sup> October 2013, and results will flow as analysis and research into the data proceeds. This project has its own website: <u>www.tellusborder.eu</u>



View of the TELLUS map of Iron concentrations in topsoil across County Cavan, as seen on the TELLUS map viewer at <u>www.gsi.ie</u>. See the high concentrations in northwestern Cavan and adjacent County Leitrim, where Slieve Anierin (Iron Mountain) is located.

#### Shortlist of Key Geological References

This reference list includes a few **key** papers, books and articles on the geology and geomorphology of Cavan that are recommended as access points to Cavan's fabulous geological heritage.

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MORRIS, J.H., SOMERVILLE, I.D. and MacDERMOT, C.V. 2003. *Geology of Longford-Roscommon*. Geological Survey of Ireland Bedrock Geology Sheet 12.

#### **Full Geological references**

See Appendix 2 for the full reference list of all papers, books, articles and some unpublished reports etc relating to the geology and geomorphology of Cavan that could be traced.

#### **Caving References**

The references in Appendix 3 relate significantly to caves and caving within the Cavan area. They may only be brief reports or newsletter items. They are generally available within the Speleological Union of Ireland Library which is housed in the Geological Survey of Ireland and is managed by Matthew Parkes.

#### Mining heritage references

Appendix 2 includes some references specifically pertaining to the mining heritage of County Cavan. Assistance with locating these references may be provided by the Mining Heritage Trust of Ireland if required.

#### **Quaternary References**

The references in Appendix 4 are all covering the Quaternary, or Ice Age, geology of Cavan. They are split into the specific ones covering Cavan sites or features and a section of national or regional papers with some Cavan data included.

### Further sources of information and contacts

Sarah Gatley of the Geological Survey of Ireland, who is the Head of the Geological Heritage and Planning Section, can be contacted in relation to any aspect of this report. Anne Marie Ward, the Heritage Officer of Cavan County Council, is the primary local contact for further information in relation to this report. Other contacts include the Conservation Rangers of the National Parks and Wildlife Service, currently in the Department of Arts, Heritage and the Gaeltacht. The names and phone numbers of current staff may be found in the phone book, or at www.npws.ie.

#### Web sites of interest

www.gsi.ie - for general geological resources

<u>www.geology.ie</u> – the website of the Irish Geological Association who run fieldtrips and lectures for members, including many amateur enthusiasts

<u>www.earthscienceireland.org</u> - for general geological information of wide interest [this website address is likely to change in 2012/2013. Suggestion search for 'Earth Science Ireland']

http://www.iqua.ie - for information, fieldtrips, lectures etc in relation to Ireland's Ice Age history

http://www.cavingireland.org/ - for information on caves and safe caving

<u>http://www.progeo.se/</u> - for information about ProGEO the European Association for the Conservation of Geological Heritage

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#### Appendix 1 – Geological heritage audits and the planning process

This appendix contains more detail on the legal framework behind geological heritage audits conducted by County Councils, and the process which operates as a partnership between the Geological Heritage and Planning Section of the GSI and the local authority Heritage Officer.

Geology is now recognised as an intrinsic component of natural heritage in three separate pieces of legislation or regulations, which empower and require various branches of Government, and statutory agencies, to consult and take due regard for conservation of geological heritage features: the Planning and Development Act 2000 [e.g. Sections 212 (1)f; Part IV, 6; First Schedule Condition 21], the Planning and Development Regulations 2001, the Wildlife (Amendment) Act 2000 (enabling Natural Heritage Areas) and the Heritage Act 1995. The Planning and Development Act 2000 and the Planning Regulations, in particular, place responsibility upon Local Authorities to ensure that geological heritage is protected. Implementation of the Heritage Act 1995, through Heritage Officers and Heritage Plans, and the National Heritage Plan 2002, allow County Geological Sites to be integrated into County Development Plans.

The chart below illustrates the essential process, established by the Irish Geological Heritage Programme in GSI, over the course of numerous county audits since 2004.
## **County Geological Sites - a step by step guide**



## Appendix 2 - Bibliography – Geology of County Cavan

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## Appendix 3 - Bibliography – Caves and karst of County Cavan

This reference list includes many references that may actually only refer to caves or karst in County Fermanagh, but all are included for convenience, as cavers tend to view the Fermanagh/Cavan karst as a single entity for literature and as many cave catchments are cross-border. For Geopark purposes it also serves better to be more inclusive.

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## Appendix 5 – Rejected sites

A range of sites had been previously flagged for consideration in the IGH Master site list, and some were assessed as unsuitable for County Geological Site status in this audit. Similarly a range of additional sites were assessed in the audit, based on the authors' expert knowledge of Cavan's geology. It was known, for example, that caves in Cavan had not been adequately considered in the preparation of the IGH Master site list. Other sites were visited on spec during fieldwork. The rejected sites are listed below with brief notes as to why they were assessed as unsuitable for inclusion.

## Lough Acanon

This site was very poorly defined on the IGH Master Site List, and its proposal may have been based on knowledge from a published paper by Phillips and Skevington from 1968. Since that time a reservoir has been created in Lough Acanon, which has enlarged the footprint of the natural lake that existed. From the map of the geology, some sections along streams into the lake have been inundated.

It is also possible that the original suggestion was a poor definition or naming of an intended site at Carrickallen Quarry, where some of the rocks in this district are well displayed. Reconnaissance fieldwork did not identify any sections of rock exposed nor any 'site' in the vicinity of Lough Acanon itself. Therefore the quarry is treated as equivalent or substitute and a site report provided.



Lough Acanon reservoir, looking north, taken from Mountain Lodge Windfarm.

## Lough Keelin

No lake named 'Lough Keelin' exists in County Cavan, or indeed in Ireland. This may have been a reference to Lough Sheelin, and as the topic for which the site was listed was 'fossil shorelines', the reference may have been to the Lough Sheelin-Lough Kinale deltas which are listed as a site.

## Shercock Crescentic drumlin

The Shercock Crescentic drumlin as defined and grid referenced in the IGH Master Site List is actually part of a larger ribbed moraine feature, hence cannot be defined as a drumlin.

## Belturbet-Cootehill drainage pattern

This site was also poorly defined on the IGH Master Site List, and its proposal may have been based on a notional knowledge of anastomosing (haphazard) drainage in the general area around Belturbet and Cootehill. No detailed scientific research has been conducted on the drainage pattern in this area, and in a sense the drainage pattern is less an aspect of the fluvial geomorphology as to the presence of very large ribbed moraine features, which have themselves been designated a County Geological Site.



The River Erne winding through drumlin features west of Belturbet.

## Lower Lough Erne

Lower Lough Erne is in County Fermanagh hence cannot be included in the Cavan IGH Audit.

## Kingscourt high sulphur well

A lack of original definition or information from the IGH Master site list meant this was not traced. The Dromod Spa Well is a good alternative representative for this type of site

## **Ballaghdorragh Quarry**

Small sulphide-bearing veins were discovered here in the 1960s as part of a mineral exploration programmes that subsequently led to discovery in neighbouring county Meath of the Oldcastle base metal deposit. This deposit, containing c. 3 million tonnes of ore (5% Zn+Pb), has not been mined. In Ballaghdorragh Quarry, narrow fractures in limestone are

filled with sphalerite, galena and barite. Despite its historic relevance in the context of mineral exploration, this site does not warrant CGS status. The quarry walls are overgrown and not readily accessible. Mineralization was not observed during the site visit. Some large boulders located beside the animal shelter on the northern side of the quarry do show thin calcite veining but without visible sulphide mineralization.

### Glangevlin/Dowra

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This listing (of two separate small communities) was for an example of the artesian wells of unusual chemistry in this district, under the IGH16 Hydrogeology theme. No wells were located in Dowra, and only of three near Glangevlin was located. It was far less interesting than the one of three in Swanlinbar that has been selected and reported on – Dromod Spa Well. This is the best representative of these mostly sulphurous spa wells, once taken as cures for various ailments. It is accessible, clean and maintained, and has been selected by the Geopark for an explanatory signboard.



## Appendix 6 - A detailed geological map of County Cavan

## Appendix 7 - Geoschol leaflet on the geology of County Cavan



## CAVAN

**AREA OF COUNTY:** 1,931 square kilometres or 745 square miles

COUNTY TOWN: Cavan

**OTHER TOWNS:** Arvagh, Bailieborough, Ballyconnell, Ballyjamesduff, Cootehill, Kingscourt, Shercock, Virginia.

**GEOLOGY HIGHLIGHTS:** Drumlins, Cuilcagh Mountain Geopark, Kingscourt inlier.

AGE OF ROCKS: Ordovician - Silurian; Carboniferous - Triassic



View of Cuilcagh Mountain

#### **COUNTY GEOLOGY OF IRELAND: Cavan**



Geological Map of County Cavan

Pink: Ordovician; **Red:** Granite; Grey: Ordovician & Silurian; Dark Blue: Lower Carboniferous sandstones; Light blue: Lower Carboniferous limestone; Brown: Upper Carboniferous shales; Orange: Permian & Triassic sediments.

### **Geological history**

The oldest rocks in County Cavan are 417-495 million years old [Ma] and consist of mudstones and volcanic rocks. At that time Ireland lay beneath a deep ocean, on the edge of an ancient continent made up of Scotland, north America and the north of Ireland. A huge ocean separated this continent from the rest of Ireland, England, Wales and Europe. Over millions of years, this ocean closed and the two ancient continents collided, heating and deforming the rocks to form slates. The same rock types occur from Longford, through Cavan, County Down and into the Southern Uplands of Scotland. Plate tectonic movements closed the ocean and the ocean floor rocks were faulted in slivers against the northern side. County Cavan now has these slivers of slate and sandstones stacked up across the southern half of the county. Only where a few graptolite fossils occur in the black slates can we work out the actual age and structure of the rocks.

#### Cavan: COUNTY GEOLOGY OF IRELAND



Drumlin landscape at Farranydaly, Co. Cavan.



3

Drumlin and lake landscape, Cavan and Fermanagh.



As the ocean finally closed around 400 Ma bodies of molten magma moved up through the Earth's crust, cooling slowly to form granite. Just one small area of granite is known from the county, at Crossdoney a little south-west of Cavan town.

The northern half of the county is composed of Carboniferous rocks, firstly limestones deposited in a shallow tropical sea with lots of animal life. The sea then shallowed and was filled in with delta sediments which became sandstones and shales. These rocks occur in the uplands around Lough Allen and especially in the Cuilcagh Mountain area. In the surrounds of Cuilcagh Mountain, there is a lot of limestone exposed which has developed karstic features since the Ice Age, including many caves and potholes and limestone pavements.

Ireland lay in the northern tropics during the Permian and Triassic periods, and the sedimentary rocks from this time, preserved around Kingscourt in Cavan (also in Monaghan and a little in Meath), record deposition of sediments in arid deserts and temporary seas that were periodically dried out to precipitate thick evaporite deposits of gypsum. The subsequent Jurassic, Cretaceous and Tertiary periods have largely left no trace as rocks preserved on land. It is inferred that Ireland was mostly a land area, subject to weathering and erosion, which supplied only offshore basins with sediment.

Geological timescale showing age of rocks in Cavan.

However, the Cavan landscape is actually dominated by drumlins, whose international name comes from the Irish 'druim' meaning 'mound'. These are humps of debris left behind by ice sheets, and are sometimes described as a 'basket of eggs' topography. They are streamlined and show the direction of flow of the ice sheets that covered Cavan up to around 10,000 years ago.

### **Cavan fossils**

A few localities are known in the Ordovician and Silurian rocks where graptolites (right) are found, but they are scattered. In one single locality a few trilobite specimens are known, but in general fossils are rare except for the planktonic graptolites. In Carboniferous rocks fossils may potentially be found anywhere in the limestones, but as glacial deposits often obscure the bedrock, fossils are not a highlight of Cavan.



### Geoparks

The Marble Arch Caves Geopark (a recognised international status) was recently extended to include parts of Cavan, making it the first international Geopark anywhere. This recognises the importance of the geological features and the landscape around Cuilcagh Mountain, preserving them and making their interest accessible to all.

### Mining & Building Stones

Whilst the Knocknacran Mine is actually just in Monaghan, the gypsum mineral it provides is mostly processed into plasterboard and other products at Kingscourt in Cavan. This mine fuelled the construction boom with plaster for construction needs and for the setting agent in cement, necessary for concrete. There are also pits extracting red mudstones to fire into bricks around Kingscourt.

Ball www.geoschol.com

Text by Matthew Parkes & Mike Simms

Map adapted with permission from Geological Survey of Ireland 1:1,000,000 map 2003. Image credits: Kirstin Lemon 1; Kieran Campbell 3 (left - licensed for reuse under the Creative Commons Licence); Geological Survey of Ireland 3 (right); Trinity College, Dublin 4.

## **Section 2 - Site Reports**

## Site reports – general points

The following site reports are brief non-technical summaries of the proposed County Geological Sites for County Cavan. These have been specially prepared for this Report in order to make the information accessible to planners and others without geological training. For most sites more detailed reports and information files are held in the IGH Section in the Geological Survey of Ireland. These are available for consultation if required. Further sites may become relevant as IGH Programme work develops.

Each site report has primary location information, a mention of the main rock types and their age, and a short description of the key aspects of scientific interest. A section outlining any particular management or other issues specific to the site is included, along with one or two low resolution photographs exemplifying the site. **A CD accompanying this report will include further pictures of most sites at higher resolution, should they be required for a glossy booklet or leaflet for the general public**. Grid references are given normally for a central point in the site, if the site is small, or two extreme points at opposite ends of the site if the site is extensive or linear. They are only indicative of the location, but the site extent is best shown on the included maps. Irish Transverse Mercator (ITM), which is the geographic projection co-ordinate system for Ireland, is used to describe all site localities in each of the site reports.

A series of maps are provided with an outline of the site boundary. It is important to note that these boundaries have no legal or definitive basis. They are indicative only of the limits of exposure or of geological interest, and not based on detailed field and boundary surveys, which were outside the scope of this contract. Boundaries are drawn to include the geological or geomorphological interest of the site, but are extended to the nearest mappable boundary, such as a field boundary, stream, road or edge of forestry. On a few sites, such as in open mountain terrain, it is impractical to find a boundary within a reasonable distance and an arbitrary line may be defined. County Geological Sites are non-statutory and so this is not problematic. If any such site is assessed for NHA status in the future, such a boundary may require small revisions.

For sites that have been recommended or will be recommended for NHA designation, detailed site boundary maps will become available to the Local Authority through NPWS as the designation process is undertaken. Some areas may already be available if they are proposed NHAs (pNHA), under the Wildlife (Amendment) Act 2000. Areas which have been designated as Special Areas of Conservation (SAC) under European Habitats Directives will also have statutory boundaries already determined. The geological interest may be included within these wider areas of nature conservation.

In terms of any geological heritage site designation as NHA, due process of site reporting, boundary survey and very importantly, consultation with landowners where they can be readily identified, will take place before GSI finalises recommendations with NPWS on the most important sites to be designated. Any landowner within areas or sites identified in this report with concerns over any aspect of this project is encouraged to contact Sarah Gatley, Head of the Heritage and Planning Programme, in the Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4. Phone 01-6782837. Email: sarah.gatley@gsi.ie



Simplified Geological Map of Cavan with site locations indicated.

## **CAVAN - COUNTY GEOLOGICAL SITE REPORT**

NAME OF SITE	
Other names used for site	

IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50,000 O.S. SHEET NUMBER Pollprughlisk

Pollprughlish, Border Pots, Swanlinbar Pots, Pollprughlisk-Pollnatagha-Polliniska System IGH1 Karst Alteen, Greenan Swanlinbar 7 616483E 828830N 26 GSI BEDROCK 1:100,000 SHEET NO.

7

### **Outline Site Description**

This cave is a pothole around 40m deep, which connects underground to two other potholes (Polliniska and Pollnatagha) just across the border in County Fermanagh.

### Geological System/Age and Primary Rock Type

The cave is formed within Lower Carboniferous limestone of the Dartry Limestone Formation. The facies of the formation vary greatly and in this area there are some 140m of well bedded cherty limestones.

### Main Geological or Geomorphological Interest

Pollprughlisk (and Pollnatagha – Polliniska) is part of an integrated system of fracture controlled vertical caves connected by bedding controlled horizontal caves and is one of the best examples of this geomorphological feature in Ireland. The part of the system in Northern Ireland has been evaluated for its scientific interest. A surface river sinks into Polliniska, but a slight dry valley that continues to the Pollprughlisk entrance suggests it originally also flowed to that cave. At the cavers entrance there are water-worn beds of limestone some of which have foundered into small cave sections.

### Site Importance – County Geological Site; recommended for Geological NHA

The Pollprughlisk – Pollnatagha – Polliniska Sytem is an excellent example of a horizontal cave system developed at a level controlled by bedding, with multiple fracture-controlled vertical shafts. It is of national importance and is recommended for geological NHA status.

### Management/promotion issues

Pollprughlisk is part of an interconnected system of vertical shafts and horizontal caves of which part is in Northern Ireland. The Northern Ireland portion has been assessed as part of the Earth Science Conservation Review and designated as an Earth Science Area of Special Scientific Interest (ASSI). Management should be a co-operative matter with the Northern Ireland Environment Agency, which currently has responsibility for protected areas.

The forestry surrounding the pothole is mature and has largely been felled, but the stormfallen trees across the pothole have damaged some of the wire fencing around the shaft.



Pollprughlisk main shaft is to the right of the tree stand, with the cavers entrance in the small trees in the near distance. Slabs of waterworn limestone beds have foundered into small cave passages in the foreground.



Pollprughlisk main shaft.

Polliniska, with surface stream sinking into the system.



## **CAVAN - COUNTY GEOLOGICAL SITE REPORT**

NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50.000 O.S. SHEET NUMBER Western Cuilcagh (OVERVIEW) Shannon System IGH1 Karst, IGH8 Lower Carboniferous Numerous Blacklion, Glangevlin, Dowra 1,2,3,4 605775E 835600N (centre of area) 26 GSI BEDROCK 1:100,000 SHEET NO. 7

### **Outline Site Description**

This site is an extensive area of upland karst on the western slopes of Cuilcagh Mountain, extending southwards from near Blacklion and Loughan on the shores of Lough Macnean Upper to the Burren Forest and further south to the western Cuilcagh slopes.

### Geological System/Age and Primary Rock Type

The rocks are primarily Lower Carboniferous limestone of the Dartry Limestone Formation, and comprise mostly the carbonate mudbank facies termed the Knockmore Limestone Member.

### Main Geological or Geomorphological Interest

This site is an extensive area of upland karst with glacially modified karst, pre- and postglacial karst, a karst watershed divided by a Tertiary igneous intrusive dyke, abundant surface and underground karstification, and complex hydrological catchments.

Many of the surface features that can be seen and visited are described separately as specific subsites, effectively as highlights, such as Shannon Pot, Burren Forest, Corratirrim, Garvagh Lough, Legeelan Quarry, Pollnaowen, Pollnagossan, Tullydermot Falls and White Father's Cave. The unifying characteristic of the Western Cuilcagh site is the subterranean drainage. Sinks in the upland area have been dye traced to springs and risings in the lowland parts of the site.

Other parts are highly significant yet not visible. The Cuilcagh Dyke, for example is a long intrusion running across the site. It is exposed in Fermanagh, but not seen in Cavan. It plays a very strong role as an impermeable barrier in separating water catchments, dividing karstic flows. The source of the River Shannon was traditionally known as Shannon Pot, but investigations by cavers have shown that big cave systems such as Shannon Cave and a variety of sinks all feed into it and the source of the river is actually high up on the flanks of Cuilcagh Mountain.

### Site Importance – County Geological Site; recommended for Geological NHA

The site as whole contains an enormous wealth of karstic landscapes and features. It has already been proposed as a geological NHA to NPWS by the GSI, but has not yet been designated. It is important to note that it complements the geological heritage designations of very similar outstanding geology as Areas of Special Scientific Interest (ASSI) in adjoining areas of County Fermanagh.

### Management/promotion issues

Most issues relating to these sites can best be addressed and developed within the framework of the Geopark. In society as a whole the understanding of groundwater, and its vulnerability to pollution, especially in karstic areas, is very poor. The Western Cuilcagh site, through the Geopark, offers many opportunities to raise awareness of the hidden geology of groundwater.

## **CAVAN - COUNTY GEOLOGICAL SITE REPORT**

NAME OF SITE
Other names used for site
IGH THEME
TOWNLAND(S)
NEAREST TOWN/VILLAGE
SIX INCH MAP NUMBER
ITM CO-ORDINATES
1:50,000 O.S. SHEET NUMBER

Western Cuilcagh – Burren Forest

IGH1 Karst; IGH7 Quaternary Burren, Gortnaleg, Lanliss Blacklion 4 607080E 834250N 26 GSI BEDROCK 1:100.000 SHEET NO.

7

### **Outline Site Description**

This site comprises the Burren Forest property of Coillte, in which public access roads, parking, paths and signage to geological and archaeological heritage have been developed. In addition an unmanned visitor centre was under construction in autumn 2013.

### Geological System/Age and Primary Rock Type

The rock here is Lower Carboniferous limestone of the Dartry Limestone Formation, with both bedded and mudbank type. A patchy covering of glacial till, including many erratic boulders, and peat is also present. The Cuilcagh Dyke, of igneous origin, crosses the site but is not exposed.

### Main Geological or Geomorphological Interest

A wealth of geological interest is present in this site, but the most visible features are the glacial erratics. These are large boulders of sandstone from Cuilcagh Mountain that have been dumped by ice onto limestone rocks. Because they are insoluble, the sandstone erratics protect the limestone underneath from solution by rainwater and thereby create a pedestal on which the sandstone boulder sits. The height of this pedestal (around 30 cm on average) reflects how much the limestone land surface has been lowered by weathering in the past 10,000 years or so since the Ice Age ended.

In the northeastern part of the Burren Forest is the Lost Valley, a large doline, or enclosed depression, into or from which no river flows. Such dolines are characteristic of karst landscapes developed on limestone rock. This one is one of the largest in the region and probably formed when the covering of sandstone rocks on top of the limestone was very different to today's pattern, before ice sheets removed vast thicknesses of it. A large river may have flowed down the valley in pre-glacial times, draining off the sandstone slopes above. Due to its size and complexity the Lost Valley may be considered as an uvala, or a series of coalesced dolines, rather than a single one.

### Site Importance – County Geological Site; recommended for Geological NHA

The site is a very important component of the West Cuilcagh site proposed for geological NHA status.

### Management/promotion issues

The Border Uplands Project, funded through INTERREG, is developing an unmanned visitor centre on site in the Burren Forest. The Geopark and Cavan County Council, in partnership with others, including Coillte, have already invested in this site as a key public amenity. This recognition and value will serve the geological heritage well. The educational publications produced by the Geopark serve the needs of formal school study visits.



A sandstone erratic on limestone pedestal.

The entrance to Burren Forest.



A sandstone erratic on limestone pedestal.



Split rock sandstone erratic is in two halves.



The Lost Valley uvala.



The Burren Forest seen from the south.



Walking infrastructure in the area is well developed with signed trails and stiles etc.


NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50,000 O.S. SHEET NUMBER Western Cuilcagh – Corratirrim

IGH1 Karst Corratirrim, Lanliss Blacklion 2 607650E 836010N 26 GSI BEDROCK 1:100.000 SHEET NO. 7

## **Outline Site Description**

This is an area of limestone pavement to the north of the Burren Forest, on the northern edge of the limestone plateau.

### Geological System/Age and Primary Rock Type

The rock here are limestones belonging to the Lower Carboniferous Dartry Limestone Formation. They are mudbank facies defined as the Knockmore Member.

### Main Geological or Geomorphological Interest

This site has an extensive area of limestone pavement which developed where cracks and fissures were enlarged by rainwater solution of the limestone to form grykes. The upstanding areas of limestone between the enlarged joints are called clints. There are areas of pavement with bare rock, others where grass has begun to overgrow the pavement and other areas within the site where a complex mosaic of acid soils and vegetation such as heather or rushes are covering the limestone in a thin veneer. A few small caves and dolines are present.

### Site Importance – County Geological Site; recommended for Geological NHA

The site is a very important component of the Western Cuilcagh site proposed for geological NHA status.

### Management/promotion issues

Maintaining grazing regimes should be important.



Limestone pavement at Corratirrim overlooking Lough Macnean Lower.



Limestone pavement with short grass is in a complex mosaic with acid soils and vegetation across the southern part of the site.



7

NAME OF SITE Other names used for site	Western Cuilcagh – Garvagh Lough
IGH THEME	IGH1 Karst; IGH7 Quaternary
TOWNLAND(S)	Tawnamakelly, Garvagh, Mullaghboy, Legeelan
NEAREST TOWN/VILLAGE	Blacklion
SIX INCH MAP NUMBER	4
ITM CO-ORDINATES	607612E 833308N
1:50,000 O.S. SHEET NUMBER	26 GSI BEDROCK 1:100,000 SHEET NO.

## **Outline Site Description**

This site is a lake and its surrounds on the limestone plateau of Western Cuilcagh.

## Geological System/Age and Primary Rock Type

The bedrock here is Lower Carboniferous limestone of the Dartry Limestone Formation, but the lake is probably perched on glacial till.

## Main Geological or Geomorphological Interest

Garvagh Lough is unusual within the western Cuilcagh site in that lakes do not usually form on limestone terrain as drainage is normally subterranean. Garvagh Lough is probably perched on a veneer of glacial till which serves to seal off the bedrock Several streams enter the lake and one outlet river sinks at Pollnaowen. This lake was the site of the first recorded water tracing experiment in 1872. Wheat chaff thrown into the lake sank at Pollnaowen and reappeared at Shannon Pot.

### Site Importance – County Geological Site; recommended for Geological NHA

The site is an important component of the Western Cuilcagh site proposed for geological NHA status.

### Management/promotion issues

There is public-road access to the lake and a Geopark interpretative signboard at the lake itself. The same is the case for Pollnaowen where the outlet stream sinks after a few hundred metres travel from the lake.



The signboard at Cuilcagh.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50.000 O.S. SHEET NUMBER Western Cuilcagh - Pollnaowen

IGH1 Karst Mullaghboy Blacklion 4 606982E 833200N 26 GSI BEDROCK 1:100.000 SHEET NO. 7

## **Outline Site Description**

Pollnaowen is a small karstic river sink of the river issuing from Garvagh Lough,

## Geological System/Age and Primary Rock Type

The rock here is part of the Lower Carboniferous Dartry Limestone Formation, but the subterranean drainage has developed only in the period since the last Ice Age.

## Main Geological or Geomorphological Interest

This site is a classic karstic feature of a surface river sinking into limestone and becoming underground drainage. The river draining from Garvagh Lough sinks into the bedrock over several tens of metres. It is reputedly the site of the first water tracing experiment in 1872, when chaff from harvesting wheat was put in the water and then seen emerging at Shannon Pot. The drainage connection is only one of many in the west Cuilcagh area that connect to Shannon Pot, traditionally considered to be the source of the River Shannon.

## Site Importance – County Geological Site; recommended for Geological NHA

The site is a good example of a sinkhole in a karstic terrain, and is within a large area of karstic landscape and subterranean drainage in West Cuilcagh.

### Management/promotion issues

The site has permissive access from the landowner to view the sinking river, and a short path from the road brings a visitor to a signboard explaining the site. The Marble Arch Caves Geopark has provided the signboard, and presumably will feature the site in future promotional materials.



A Geopark signboard explains the disappearing river at Pollnaowen.



At Pollnaowen the water seeps away in numerous spots ending finally in this pool.



The roadside sign and pull-in space for one car for visitors to Pollnaowen.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50.000 O.S. SHEET NUMBER Western Cuilcagh – Shannon Pot Source of the River Shannon IGH1 Karst Derrylahan Blacklion 4 605332E 831753N 26 GSI BEDROCK 1:100,000 SHEET NO.

7

## **Outline Site Description**

This is a spring rising, traditionally regarded as the source of the River Shannon.

## Geological System/Age and Primary Rock Type

The water rises through rocks mapped at the surface here as the Meenymore Formation or the Glenade Sandstone Formation, but it passed underground within the Dartry Limestone Formation, which cannot be far below surface. All rocks are of Carboniferous age, from around 330 million years ago. The very extensive network of water inputs from across the Cuilcagh range, indicates that extensive pre-glacial and inter-glacial development of drainage preceded all post-glacial developments.

## Main Geological or Geomorphological Interest

This spring rising is traditionally regarded as the source of the River Shannon, the longest river in Ireland. It is a large pool, 16 m in diameter, which has been dived to 9 m depth below which it becomes impassable. The water is sourced from very many sinks in the Cuilcagh uplands to the east, some coming from East Cuilcagh, 10 km away at Pigeon Pot in County Fermanagh. Although it largely travels underground in the Dartry Limestone Formation, it is capped by slightly younger sandstones and evaporite (gypsum-bearing) rocks. These have been breached where the rising occurs at Shannon Pot.

### Site Importance – County Geological Site; recommended for Geological NHA

The site is an important component of the Western Cuilcagh site recommended for geological NHA status.

### Management/promotion issues

As with many sites in the Geopark, very good infrastructure for visitors, with permissive access from landowners, has been put in place. A well signed public car park with picnic facilities, other walking routes and signboards, allows visitors to make a short walk on a hard surface path to Shannon Pot, where further interpretation signboards are in place.



The signposted access to Shannon Pot.

Signboard at Shannon Pot car park.



Shannon Pot.



Footpath and footbridge to Shannon Pot.



Signboards beside Shannon Pot.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50,000 O.S. SHEET NUMBER Western Cuilcagh – White Father's Caves St. Augustine's Cave IGH1 Karst Loughan, Killycarney, Termon Blacklion 2 605274E 837528N 26 GSI BEDROCK 1:100.000 SHEET NO.

7

## **Outline Site Description**

This site comprises a cave system in three parts with an open streamway in between the sections where erosion and collapse have removed the cave roof.

### Geological System/Age and Primary Rock Type

The limestone hosting the cave is the Knockmore Limestone Member, a carbonate mudmound facies within the Dartry Limestone Formation, of Lower Carboniferous age. The cave development is probably post-glacial, but may have an older origin.

### Main Geological or Geomorphological Interest

White Father's Caves are three short sections of one cave with unroofed sections between them. The river in the cave comes from the Barran rising about 2 km away to the southwest. It previously sank at Pollnagossan. The first cave is a dry bridge, a short natural bridge under the old road. Beside the new road the river passes into a 60 m long second cave section which passes under the road. The third cave is longer and runs for about 200 m before emerging to run into Lough Macnean. The entire cave is well decorated with speleothems.

## Site Importance – County Geological Site; recommended for Geological NHA

The site is an important component of the Western Cuilcagh site proposed for geological NHA status.

### Management/promotion issues

This site is a popular and accessible caving trip used by individual cavers and by organised outdoor pursuits centre groups. It has been the subject of various pollution and other problems over recent years. The White Father's Caves Conservation Plan commissioned by the County Council, and promotion of the cave within the context of the Geopark, will hopefully see no future issues arising.



Steps to viewing platform installed as public infrastructure at the second cave.



Left: Signposted access by gate to section of unroofed cave between first and second cave. Right: the first cave looking upstream.



Footpath access along unroofed cave section between first and second cave.



NAME OF SITE
Other names used for site
IGH THEME
TOWNLAND(S)
NEAREST TOWN/VILLAGE
SIX INCH MAP NUMBER
ITM CO-ORDINATES
1:50.000 O.S. SHEET NUMBER

**Cormeen Quarry** 

IGH2 Precambrian to Devonian Palaeontology Cormeen Stradone 26 653000E 803744N 35 GSI BEDROCK 1:100,000 SHEET NO. 8/9

### **Outline Site Description**

This site is a small quarry, intermittently used for farm materials, and some rock faces that have been more recently excavated behind a gun club premises.

## Geological System/Age and Primary Rock Type

The rocks are part of the Ordovician Carrickatee Formation, and some Silurian Lough Avaghon Formation sediments are juxtaposed by faults.

## Main Geological or Geomorphological Interest

This site is the best known current representative in Ireland of the 'Moffat Shale' graptolitic horizons which are widespread throughout the Longford-Down inlier. These horizons are composed of black shales that in places contain deep-sea planktonic fossils such as graptolites. The fossils are seen as thin serrated grey and white stripes in various forms. The Moffat shales are commonly found at the major bounding faults between large blocks of rock sequences, or 'tectonic tracts'. These tracts are displaced slices of former sea floor, which have been stacked almost vertically like cards. The shales form relatively weak horizons along which large blocks of rock, sometimes many tens of kilometres in width, were easily displaced. The name "Moffat" comes from the Southern Uplands of Scotland where the geological continuation of the Longford Down rocks was first properly studied and understood. The fossils at Cormeen quarry give an age for the rocks and help explain the regional geological structures.

### Site Importance – County Geological Site, recommended for Geological NHA

This site is the best known representative in Ireland of the 'Moffat Shale' graptolitic horizons which are widespread throughout the Longford-Down inlier, and the new faces excavated in recent years add to the value of the site.

### Management/promotion issues

The continued small scale excavation of rock for use locally as fill will maintain fresh rock exposures and prevent vegetation, but details of precise features to be seen in sections will change through time. It is important to prevent any subsequent dumping of other material so that rock faces remain accessible. The quarry and the new exposures in the gun club range are on private land and are not suitable for promotion, unless by explicit arrangement with the landowner.



A view from roadside gate of older quarry at Cormeen.



A view of the new exposures behind Clifferna Gun Club shelters and farm silage bales.



Looking northeast along new exposures. The older quarry viewed from the ford on west side.



NAME OF SITE	Moneycass Glebe
Other names used for site	
IGH THEME	IGH2 Precambrian to Devonian Palaeontology
TOWNLAND(S)	Moneycass Glebe
NEAREST TOWN/VILLAGE	Stradone
SIX INCH MAP NUMBER	2
ITM CO-ORDINATES	654312E 804660N
1:50,000 O.S. SHEET NUMBER	35 GSI BEDROCK 1:100,000 SHEET NO.

8/9

### **Outline Site Description**

This site is a heavily wooded and overgrown field with small guarried faces at the edges.

### Geological System/Age and Primary Rock Type

The rocks here are mudstones of the late Ordovician Carrickatee Formation.

#### Main Geological or Geomorphological Interest

The rock exposures around the margins of the field have yielded a very unusual collection of fossils. The fossils are mostly graptolites but they occur with a trilobite species that is only known from this locality. The combination of fossils is an important rarity for understanding the geology of the region, and dating the rocks in Cavan.

The graptolites of two biozones occur in succession, and a deep water trilobite, now classified as *Songxites cellulana* was washed in with a few other fossils of nautiloids and ostracods. In modern stratigraphical terminology, these are from the late Katian to Hirnantian Stages of the Upper Ordovician, formerly defined as Ashgill.

## Site Importance – County Geological Site; recommended for Geological NHA

The site is an important County Geological Site, and has already been proposed for designation as a geological NHA by the NPWS.

#### Management/promotion issues

The site is now strongly overgrown with vegetation and difficult to access. It is private land and not recommended for promotion. Any change in land use or clearance would be best conducted with a palaeontologist monitoring for more fossil material.



An overview of the site from the northeast. The tallest trees mark the southwestern limit of the site.



A view of the main southeastern exposure of rock, heavily vegetated.



Swanlibar River
IGH3 Carboniferous to Pliocene Palaeontology
Furnaceland, Hawkswood
Swanlinbar
7
619226E 827100N
26 GSI 1:100,000 BEDROCK Sheet No. 7

## **Outline Site Description**

This is a short stretch of river bed, where bedrock is often exposed.

### Geological System/Age and Primary Rock Type

The river bed is made up of horizontal layers (or beds) of Lower Carboniferous bedrock, most of which is limestone or shale belonging to the Benbulben Shale Formation.

### Main Geological or Geomorphological Interest

The main feature is the profusion of numerous well-preserved fossils exposed in the upper bedding surface of the bedrock, typical of the Benbulben Shale Formation. There are however many loose fossil-bearing cobbles in the river bed.

Some of the best preserved fossils include the solitary coral *Siphonophyllia benburbensis* but there are also easily visible scattered crinoid ossicles, and numerous brachiopods.

### Site Importance - County Geological Site

This is one of the best localities to see Carboniferous fossils within County Cavan.

### Management/promotion issues

This is an excellent site for accessing some prime examples of Carboniferous fossils, located within the boundary of the Marble Arch Caves Global Geopark. There is an interpretation panel adjacent to the site and a small amenity site including a children's play park and seating area.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50.000 O.S. SHEET NUMBER Bruse Hill Quarry

IGH4 Cambrian to Silurian Bruse Arvagh 24 631466E 798476N 34 GSI BEDROCK 1:100,000 SHEET NO. 8/9

## **Outline Site Description**

This site comprises a disused quarry into the northern side of Bruse Hill, east of Arvagh.

## Geological System/Age and Primary Rock Type

The rocks in the quarry are part of the Coronea Formation, which is within Tract 2 in the Northern Belt of the Longford - Down inlier. They are of middle Ordovician age.

## Main Geological or Geomorphological Interest

These rocks are representative of one of two formations comprising a major Tract (numbered 2 by geologists) of rocks in the Northern Belt of the Longford – Down inlier (extending and correlating with the Southern Uplands of Scotland). These Tracts are slices of the ocean floor that once separated northwestern Ireland from southeastern Ireland. The ocean is called the lapetus Ocean, and is a major element of the geological history of Ireland. Sections of ocean floor were squeezed and stacked up as vertical slivers of rock (now called Tracts) adjacent to the subduction zone that consumed the lapetus Ocean. The ocean closed over a long period during the Ordovician and early Silurian. The lapetus Ocean floor rocks are poorly exposed in general and so quarries such as this are important reference sections.

The Coronea Formation is best exposed in this quarry and it is defined as the type locality in the Geological Survey of Ireland map report Sheet 8/9 (although the named townland is in error). It is made up of green greywackes, red shales and minor spilitic lavas. Red shales are particularly abundant in the lower part of the formation, averaging 5-10 m thick but can be up to 30 m thick over several hundred metres laterally. Some of these contain thin beds of chert. The spilitic lavas and other rocks are thought to have been deposited in water depths of over 4000 m.

### Site Importance – County Geological Site

The site is an important representative of the Ordovician rocks from the Northern Belt of the lapetus Ocean floor which once separated Ireland in two halves.

### Management/promotion issues

The quarry is abandoned and is private property, and is not suitable for general promotion.



A view of the highest bench in the southern part of the quarry.



A view of the quarry from the roadside entrance.



A view of the main floor of the quarry.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50,000 O.S. SHEET NUMBER **Carrickallen Quarry** 

IGH4 Cambrian to Silurian Carrickallen Stradone 22, 27 656450E 804110N 35 GSI BEDROCK 1:100,000 SHEET NO. 8

### **Outline Site Description**

This site is an abandoned quarry.

## Geological System/Age and Primary Rock Type

The rocks here are defined as part of the Carrickatee Formation, and are mostly volcanic tuffs locally exposed and exploited in the quarry, although the formation as a whole comprises mostly mudstones. They are of Middle Ordovician to early Silurian age, based on graptolite fossils.

## Main Geological or Geomorphological Interest

These rocks are representative of the Moffat Shale horizons at the base of a major Tract (numbered 4b by geologists) of rocks in the Central Belt of the Longford – Down inlier (extending and correlating with the Southern Uplands of Scotland). These Tracts are slices of the ocean floor that once separated northwestern Ireland from southeastern Ireland. The ocean is called the lapetus Ocean, and is a major element of the geological history of Ireland. Sections of ocean floor were squeezed and stacked up as vertical slivers of rock (now called Tracts) adjacent to the subduction zone that consumed the lapetus Ocean. The ocean closed over a long period through the Ordovician and early Silurian. The lapetus Ocean floor rocks are poorly exposed in general and so quarries such as this are important reference sections.

In the eastern end of the quarry there are several well displayed faults that show the style of faulting in these rocks.

## Site Importance – County Geological Site

This is a good representative site of rocks that typically underlie the Lough Acanon district, demonstrating the broader geological history of much of Cavan.

### Management/promotion issues

The quarry was abandoned (in 2013) and is private property, unsuitable for general promotion.



A view of the eastern end of the quarry at Carrickallen.



A view of the western extension of the quarry, now flooded.



Left: Thin beds of greywacke sandstones showing complex extensional faulting. Right: Thick bedded greywacke sandstones in the main quarry face.


NAME OF SITE
Other names used for site
IGH THEME
TOWNLAND(S)
NEAREST TOWN/VILLAGE
SIX INCH MAP NUMBER
ITM CO-ORDINATES
1:50.000 O.S. SHEET NUMBER

Drumcarban

IGH15 Economic Geology Drumcarban Crossdoney 25 635593E 798976N 34 GSI BEDROCK 1:100.000 SHEET NO. 12

# **Outline Site Description**

The site comprises a series of small outcrops straddling the water line along the shore of a small lake.

# Geological System/Age and Primary Rock Type

The Crossdoney granite pluton is considered to be Caledonian in age (c. 400Ma). It is here host to quartz veins and alteration zones containing minor amounts of molybdenite and chalcopyrite mineralization.

# Main Geological or Geomorphological Interest

The Crossdoney pluton underlies a relatively small area (c. 15 km<sup>2</sup>) 5km southwest of Cavan town. It is of interest as the only granitic intrusion in the county and at Drumcarban it is host to Cu-Mo-sulphide mineralization, a common metal association in granite intrusions worldwide but relatively rare in Ireland. The best-known example of this kind of mineralization in the country is at Mace Head in county Galway.

The pluton comprises granodiorite, monzonite and quartz diorite in its northern part and granodiorite and quartz monzonite in the south. At Drumcarban, the medium-grained equigranular hornblende-biotite granodiorite contains thin (few mm – 20mm wide) quartz veins that trend generally northnorthwest–southsoutheast. The veins contain scattered grains of chalcopyrite (CuFeS<sub>2</sub>) and molybdenite (MoS<sub>2</sub>). The granodiorite surrounding the veins has been intensely altered in places, with the feldspar in the rock altered to sericite and the biotite and hornblende to chlorite. Redistribution of elements during alteration has given rise to light-coloured, "bleached" sericitic zones and greenish chlorite-rich zones in the granodiorite.

#### Site Importance – County Geological Site

The rarity of granite-hosted Cu-Mo mineralization in the country gives Drumcarban a significance that the relatively minor amounts of mineralization on display might not otherwise merit. The site also affords an opportunity to examine outcrop of the only granitic intrusion in County Cavan. For these reasons it should be designated as a CGS. Far better examples of Cu-Mo mineralization are displayed elsewhere in the country so NHA designation is not warranted.

#### Management/promotion issues

The site is on private land on the southern shore of White Lough, adjacent to pasture where cattle were grazing at the time of the field visit. A drainage ditch separates the site from the minor road 100m to the west. Given that the mineralization is minor and not easily seen, the site is likely to be mainly of scientific interest and would not lend itself to promotion among the wider public.



Southern shoreline of White Lough (view to southeast).





Exposure of altered granite with NNW-SSE-trending joint (left); fractured granite displaying irregular zones of sericitization (S) and chloritization (C).





Unmineralized NNW-SSE-trending 20mm-thick quartz vein in granite (left); strongly sericitized granite with disseminated molybdenite and chalcopyrite (not visible in photo) (right).



NAME OF SITE	Blackwater Valley	
Other names used for site	-	
IGH THEME	IGH7 Quaternary	
TOWNLAND(S)	Ballaghdorragh, Ryefield, Edenburt, Lisduff,	
	Stramatt, Carraghkeelty More, Knocknagartan,	
	Corronagh	
NEAREST TOWN/VILLAGE	Virginia	
SIX INCH MAP NUMBER	43, 44	
ITM CO-ORDINATES	663660E 782360N (centre of valley feature)	
1:50,000 O.S. SHEET NUMBER	35 GSI BEDROCK 1:100,000 SHEET NO.	13

# **Outline Site Description**

The Blackwater valley is the most significant river valley in the southernmost part of County Cavan. It extends southeastwards from the southern end of Lough Ramor near Lisduff. The pitted sandur that forms a striking hummocky terrain at the base of the valley is unique in the size and amplitude of its hummocks.

# Geological System/Age and Primary Rock Type

The valley is underlain by bedrock which is Silurian in age, and comprises quartz-greywackes and greywackes. The sandur sediments are Quaternary in age, having been deposited across the valley by meltwater rivers, when the ice sheets of the last Ice Age were melting.

#### Main Geological or Geomorphological Interest

This is one of the best examples of a pitted sandur in Ireland. Pitted sandur features are hummocky outwash plains, formed either because blocks of dead ice melted out from under the meltwater sediments after they were deposited, or because a large-scale, instantaneous meltwater flood occurred.

The source of the Blackwater River is at Lough Ramor and the sandur sediments flank the lake on its western and southern shores. The area between the lake and the Meath county boundary has the best expression of outwash sediments in the entire Blackwater Valley, where the hummocks are high, up to 10m in height, and interspersed with striking hollows, or kettle holes.

The theory that a large lake formed under the retreating ice sheet, where Lough Ramor now lies, and deposited the sand and gravel sediments along the Blackwater Valley when the lake burst out through the ice in a 'Jokulhlaup', cannot be discounted and is worthy of future investigation.

# Site Importance – County Geological Site

This is one of the finest examples of a pitted sandur in Ireland.

#### Management/promotion issues

This is an excellent site in terms of macro-scale Quaternary geomorphology. A signboard in Lisduff village detailing the importance and formation of the features within the valley, as well as the adjacent Bruse Hill, might prove useful.



View westwards across the Blackwater Valley, from the high ridge at Edenburt.



The source of the Blackwater River, flowing through the wide floodplain at Stramatt Bridge adjacent to Lough Ramor, with the hummocky sands and gravels in the distance.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S)

NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50,000 O.S. SHEET NUMBER Bruse Hill Carrigasimon Hill IGH7 Quaternary Carrigabruse, Bruse, Carrakeelty, Carrigasimon, Enagh, Fartagh Virginia, Mullagh 44 664471E 784020N (summit of crag) 35 GSI BEDROCK 1:100,000 SHEET NO. 13

#### **Outline Site Description**

This is an excellent example of a crag and tail ridge.

# Geological System/Age and Primary Rock Type

The crag comprises quartz-greywacke of the Castlerahan Formation. The crag-and-tail feature itself is Quaternary in age, having been formed at the base of the ice sheet moving northeast to southwest during the maximum period of the last Ice Age.

#### Main Geological or Geomorphological Interest

This is one of the few discrete examples of a crag and tail ridge throughout the drumlin belt, where composite crag-and-tail features are more common.

Crags are formed when a glacier or ice sheet passes over an area that contains a particularly resistant mass of rock (in this case the rock summit of Bruse Hill itself). The force of the glacier erodes the surrounding softer material, leaving the rocky block protruding from the surrounding terrain. The crag then serves as a partial shelter to softer material in the wake of the glacier, which remains as a gradual fan or ridge forming a tapered ramp (called the tail) up the leeward side of the crag. This is seen on the southeastwards side of the crag itself, tailing into Enagh and Fartagh townlands.

The Bruse Hill tail feature extends for a distance of just under 3 kilometres, and the crag reaches a height of 196m O.D. at its summit.

#### Site Importance – County Geological Site

This is probably the finest discrete crag-and-tail within the entire drumlin belt.

#### Management/promotion issues

This is an excellent site in terms of macro-scale Quaternary subglacial geomorphology. The feature is beside the N3 and is easily visible from the road itself.

A signboard in Lisduff village detailing the importance and formation of the feature, and the adjacent Blackwater Valley, might prove useful.



Bruse Hill, viewed from the west.



The rock 'crag' on Bruse Hill itself, at the break of slope with the 'tail'.



Cuilcagh Mountain
IGH9 Upper Carboniferous to Permian
IGH8 Lower Carboniferous; IGH7 Quaternary
Garvagh, Edenmore, Legnagrow, Legglass,
Eshveagh, Ardvagh, Tullvcrafton, Dunmakeever,
Commas, Bursan, Bellavally Lower, Legnadirk,
Aghnacollia, Altbrean, Tullydermot, Binkeeragh,
Aghaboy, Moneydoo or Tonycrom, Alteen,
Swanlinbar. Blacklion
4. 6. 7
612600E 826700N
26 GSI 1:100,000 BEDROCK Sheet No. 7

# **Outline Site Description**

This mountain is a long plateau-like ridge of sandstone and shale upland that straddles the boundary between counties Cavan and Fermanagh.

# Geological System/Age and Primary Rock Type

All of the bedrock is Carboniferous in age and is part of the Leitrim Group, which underlies much of Leitrim, Sligo and northern Roscommon, and extends into Fermanagh. The oldest part of the Leitrim Group is Dinantian in age and includes the Meenymore Formation, the Glenade Sandstone Formation, the Bellavally Formation and Carraun Shale Formation. Overlying these are the younger, Namurian formations of the Leitrim Group, including the Dergvone Shale Formation, the Briscloonagh Sandstone Formation, the Gowlaun Shale Formation and the Lackagh Sandstone Formation, which caps the mountain.

#### Main Geological or Geomorphological Interest

The mountain comprises a thick succession of Carboniferous Dinantian and Namurian rocks. The sequence as a whole represents an episode of delta formation as falling sea levels saw Namurian sands begin to fill the shallow limestone seas of the Dinantian. This episode of delta formation started in the northern part of Ireland and spread southward. The Meenymore Formation represents a very shallow sea, which locally dried up enough to form evaporate minerals such as gypsum. The shale formations are the 'background' deposition of muddy sediments from rivers entering the marine seas, from the north. Occasionally rapid deposition was accompanied by ironstone formation in the same rocks to the west. The sandstones mark major episodes of deltaic advance southwards. To the west in Leitrim and Roscommon, swamps sometimes formed on top of the deltas and left coal deposits, but not in Cuilcagh.

Evidence from the coals and fossil spores indicate that all these rocks were once buried under other rocks several kilometres thick, but these have since been eroded away. The Lackagh Sandstone Formation on the top of Cuilcagh forms a hard resistant cap that has prevented the erosion that has reduced adjacent areas to a much lower height. A corrie has been etched into the mountain along its eastern flank.

# Site Importance – County Geological Site; may be recommended for Geological NHA

The site is one of the best representations of the Carboniferous Leitrim Group within the region.

#### Management/promotion issues

Continued co-operation with Fermanagh District Council, especially through the Marble Arch Caves Global Geopark, is the best option for promotional efforts.



The Cuilcagh ridge viewed from the south west, showing the sandstone escarpment.



Left: The summit plateau looking northwest Right: typical Gowlaun Shale Formation exposure near the summit.



The large corrie to the south of the summit of Cuilcagh.



Cuilcagh Mountain viewed from the fence along the Cavan – Fermanagh border on the northeast side, showing the steep northern face compared to gentler southern slopes.



NAME OF SITE	Cuilcagh Meltwater Channels
Other names used for site	Blackrock's Cross channels (southwestern feature only)
IGH THEME	IGH7 Quaternary
TOWNLAND(S)	Altateskin, Altnadarragh, Legnaderk, Altachullion
	Upper, Altachullion Lower, Altbrean, Srahlahan,
	Drumcask, Knockroe, Knockranny, Gubrimmaddera,
	Cornalon, Gorteennaglogh, Furnaceland,
	Hawkswood, Aghaboy, Buinkeeragh
NEAREST TOWN/VILLAGE	Swanlinbar
SIX INCH MAP NUMBER	6, 7, 8, 9
ITM CO-ORDINATES	614200E 823230N (centre of largest channel at
	Altachullion)
1:50,000 O.S. SHEET NUMBER	26 GSI BEDROCK 1:100,000 SHEET NO. 7

# **Outline Site Description**

The Cuilcagh Meltwater Channels comprise three deep gullies that were formed by meltwater erosion on the southeastern flank of Cuilcagh Mountain.

The gullies are oriented generally northwest–southeast, with several localised variations. They extend for distances of 1 km to just over 3 km. The channels are named the Altachullion Channel, the Tullydermot Channel and the Gubbrinmaddera Channel.

# Geological System/Age and Primary Rock Type

The features are formed in an area of glacial till of varying thickness and bedrock crops out in some parts of the gullies. The till forms a field of ribbed moraines and drumlins in this area flanking Cuilcagh and was deposited at the maximum of the last Ice Age. The channels themselves date from deglaciation at the end of the last Ice Age.

The bedrock in the locality is varied, with Upper Carboniferous (Namurian) shales on the higher ground to the west, and Lower Carboniferous limestones on the lower ground to the east.

#### Main Geological or Geomorphological Interest

The channels are up to 35m deep and all have a U-shaped profile, typical of meltwater channels. All host misfit streams, which are watercourses that are much smaller than the channel hosting the watercourse.

Though no dating or detailed study has been completed on the features, they are considered to have formed completely in the late-glacial Period. The deepest channel at Altachullion (adjacent to Blackrock's Cross) may have been formed by the bursting of a glacial lake, given its unusual depth and size.

#### Site Importance – County Geological Site

This is a site with good teaching potential on glacial meltwater erosion, as the features are all accessible and easily viewed from roads. The site is definitely of County Geological Site importance but the channel at Altachullion may be considered to be of national importance when further work on the glacial history of the area is completed.

#### Management/promotion issues

The roadside location of the channels means they are easily accessible, although they are presumably either privately owned or in commonage. However, there is no parking nearby and it is difficult to stop safely on the road. Some wide gates are present at the edge of the Altachullion channel, but no more than two cars may stop and park at any one time.



Steep 'U' shaped profile along a stretch of the Altachullion channel, etched into bedrock along this portion.



The deep Tullydermot meltwater channel southeast of Tullydermot Falls, also etched into bedrock along this stretch.



NAME OF SITE	Lough Kinale-Lough Sheelin Deltas	
Other names used for site		
IGH THEME	IGH7 Quaternary	
TOWNLAND(S)	Carrick, Magheraboy Upper, Moat, Bracklagh,	
	Kilgolagh	
NEAREST TOWN/VILLAGE	Finnea (Westmeath), Mount Nugent (Cavan)	
SIX INCH MAP NUMBER	41	
ITM CO-ORDINATES	639600E 781970N (centre of Kilgolagh Delta)	
1:50,000 O.S. SHEET NUMBER	34 GSI BEDROCK 1:100,000 SHEET NO.	12

# **Outline Site Description**

These deltas comprise a number of wide, flat-topped sand and gravel ridges, which stand proud above the surrounding peat bog in southwesternmost County Cavan.

# Geological System/Age and Primary Rock Type

The deltas were formed on bedrock which of Lower Carboniferous limestone. The features themselves are Quaternary in age, having been deposited at the edge of the northwestward-retreating ice sheet during deglaciation after the last Ice Age.

# Main Geological or Geomorphological Interest

The delta features are fine examples of the type of ice-marginal, deglacial features that often form at the edge of glacial lakes. The ridges seem to be comprised of several individual deltas, which coalesced to form one large ice marginal standstill in the locality.

The deltas are chiefly made up of Lower Palaeozoic-age shale and sandstone clasts that were derived from the bedrock northwest of the site. These were carried by ice, released into a meltwater conduit on top of or within the ice, and then deposited subaqueously at the ice margin as the river left the ice. This water flowed off southeastwards into a lake much larger than modern-day Lough Sheelin. At that time, at the end of the Ice Age, both Lough Sheelin and Lough Kinale (as well as the adjacent Bracklagh Lough) would have formed part of the same lake.

#### Site Importance – County Geological Site

These deltas are excellent examples of deglacial, ice-marginal, meltwater-deposited features.

# Management/promotion issues

This system comprises a number of superb features and should be listed as a County Geological Site. The features can be seen very clearly from the junction of the R394 and R194 roads at Kilgolagh, and a signboard in the wide lay-by here might help promote the features.



The delta feature at Kilgolagh, along the northwestern side of Lough Kinale, viewed from the R394 road.



View from the flat-topped delta feature towards Lough Sheelin.



Mid-Cavan Drumlinised Ribbed Moraines
IGH7 Quaternary
Too many to list … this portion of the field covers over one hundred individual townlands, across an area of 180 km <sup>2</sup>
Cavan, Cootehill, Stradone
15, 16, 20, 21
654000E 811000N (centre of features)
27a, 28a GSI BEDROCK 1:100,000 SHEET NO. 8/9

# **Outline Site Description**

This field of ribbed moraines forms part of the largest field of ribbed moraines found anywhere in the world. The entire field includes over 3,000 individual features, but this subset covers an area of 15 by 12 kilometres and contains approximately 170 individual features.

#### Geological System/Age and Primary Rock Type

The ribbed moraines were formed on bedrock of either Silurian or Ordovician metasediments and volcanic rocks. The moraines themselves are Quaternary in age, having been deposited at the base of the ice sheet moving in a southeasterly direction during the maximum period of the last Ice Age.

#### Main Geological or Geomorphological Interest

These ribbed moraines each contain many superimposed drumlins on their crests, and the area has traditionally been known as the middle portion of the 'Drumlin Belt'. Owing to their size, the true scale and size of the ribbed moraines can only be seen using digital elevation modelling (DEM) and satellite imagery.

This ribbed moraine field is not only unusual in its size and for the size of individual features, but also for being interspersed with thick peat which allows the features to stand out in a quite striking fashion. They form the perfect 'ribbed' topography.

The moraines in this portion of the field are generally 1km to 2km long and 500m or so wide, with individual superimposed drumlins being c. 500m long and 100m to 200m wide. They are typically 20m high but can attain a maximum height of about 35m. The largest individual feature in this portion of the field is 4 km long, 650m wide and up to 35m high.

#### Site Importance – County Geological Site

This area forms part of the largest field of discrete ribbed moraines in the world, and is therefore a prime example of the kind of features found within the most important such field in Ireland.

#### Management/promotion issues

This is an excellent site in terms of macro-scale Quaternary subglacial geomorphology. The features are too large to undertake any conservation efforts on their part, but the landscape itself is noteworthy and should be promoted as unique amongst landscape elements within the Cavan County Development Plan, and in Landscape Characterisation. The features are especially well viewed from the high ridge at Artonagh-Edrans, on the Stradone to Cootehill road.



A view across the mid-Cavan Drumlinised Ribbed Moraines, White Lough, west of Cootehill.



Individual ribbed moraine ridge at Rakane, near Cootehill, looking north.



NAME OF SITE	Rockcorry-Cootehill Ribbed Moraines
Other names used for site	
IGH THEME	IGH7 Quaternary
TOWNLAND(S)	Too many to list this portion of the field covers over two hundred individual townlands, across an area of 180 km <sup>2</sup>
NEAREST TOWN/VILLAGE	Cootehill, Rockcorry (just inside Monaghan)
SIX INCH MAP NUMBER	Cavan 16, 17, 18
ITM CO-ORDINATES	666000E 891000N (centre of features)
1:50,000 O.S. SHEET NUMBER	28a GSI BEDROCK 1:100,000 SHEET NO. 8/9

# **Outline Site Description**

This field of ribbed moraines forms part of the largest field of ribbed moraines found anywhere in the world. The entire field includes over 3,000 glacial features, but this subset covers an area of 18 by 10 kilometres, containing approximately 160 individual features, and includes the largest individual ribbed moraines found anywhere in the world.

# Geological System/Age and Primary Rock Type

The ribbed moraines were formed on bedrock of metasediments and volcanic rocks of either Silurian or Ordovician age. The features themselves are Quaternary in age, having been deposited at the base of the ice sheet moving in a southeasterly direction during the maximum period of the last Ice Age.

#### Main Geological or Geomorphological Interest

These ribbed moraines each contain many superimposed drumlins on their crests, and the area has traditionally been known as the middle portion of the 'Drumlin Belt'. Owing to their size, the ribbed moraines can only be seen using digital elevation modelling (DEM) and satellite imagery.

This ribbed moraine field is not only unusual in its huge size and the large size of individual features around Rockcorry and Cootehill, but because they are interspersed with thick deposits of peat, the features are quite strikingly defined, forming the perfect 'ribbed' topography.

The moraines are generally 5–8km long and 800m or so wide, with individual superimposed drumlins being c. 600m long and 100–200m wide. They attain a maximum height of about 50m but are typically 30m or so high. The largest individual feature is 10 km long, 1 km wide and up to 45m high, meaning it comprises approx. 400 million tonnes of sediment.

#### Site Importance – County Geological Site; recommended for Geological NHA

These are the largest individual ribbed moraine features anywhere in the world, and therefore one of the most important geological terrains in Ireland. Study of these features will lend insights into how ribbed moraines form, which has always been difficult to ascertain as they form under ice sheets and can not be seen in modern analogue conditions.

# Management/promotion issues

This is an excellent site in terms of macro-scale Quaternary subglacial geomorphology. The features are too large to undertake any conservation efforts on their part but the landscape itself is noteworthy and should be promoted as unique amongst landscape elements within the Cavan County Development Plan, and in Landscape Characterisation.



A view across some of the Rockcorry-Cootehill ribbed moraines at Cargaghbane, east of Cootehill.



Ribbed moraines near Latton, County Monaghan, looking south.



NAME OF SITE	Scotshouse-Redhills Cross-cutting Ribbed Moraines
Other names used for site	
IGH THEME	IGH7 Quaternary
TOWNLAND(S)	Too many to list this portion of the field covers over 75 individual townlands, across an area of 70 km <sup>2</sup>
NEAREST TOWN/VILLAGE	Redhills, Scotshouse (just inside Monaghan)
SIX INCH MAP NUMBER	Cavan 11, 12, 15, 16, 17, 18
ITM CO-ORDINATES	644600E 818000N (centre of features)
1:50,000 O.S. SHEET NUMBER	28a GSI BEDROCK 1:100,000 SHEET NO. 8/9

# **Outline Site Description**

This site is part of the largest field of ribbed moraines found anywhere in the world. The entire field includes over 3,000 individual glacial features but this subset covers an area of 10 by 7 kilometres containing approximately 50 individual features. It includes the only mapped area of cross-cutting ribbed moraines yet found in the world.

# Geological System/Age and Primary Rock Type

The ribbed moraines were formed on bedrock of either Lower Carboniferous shales and limestones or Ordovician metasediments and volcanic rocks. The moraines themselves are Quaternary in age, having been deposited at the base of the ice sheet that initially moved in a southwesterly direction during the initial phase of the last glaciation, and then in a southeasterly diection during the glacial maximum.

#### Main Geological or Geomorphological Interest

These ribbed moraines each contain many superimposed drumlins on their crests, and the area has traditionally been known as the northern portion of the 'Drumlin Belt'. Owing to their size, the ribbed moraines can only be seen using digital elevation modelling (DEM) and satellite imagery.

Nowhere else in the world have ribbed moraines been noted where they record two separate ice flows. Here, the major orientation of the moraines is northwest to southeast, but there are also forms adjoined to these which are oriented northeast to southwest. The features therefore record flow from two different directions. In plan view they appear as irregular, wavy, snake-like forms.

The features are generally 1-2km long and 500m or so wide, with individual superimposed drumlins being c. 400m long and 100m-200m wide. The ribbed moraines are typically 20m high but can reach a maximum height of 30m.

#### Site Importance – County Geological Site; recommended for Geological NHA

These are the only mapped cross-cutting ribbed moraine features anywhere in the world and therefore form one of the most important geological terrains in Ireland. The area of cross cutting features is recommended for Geological NHA status.

# Management/promotion issues

This is an excellent site in terms of macro-scale Quaternary subglacial geomorphology. The features are too large to undertake any conservation efforts on their part, but the landscape itself is noteworthy and should be promoted as unique amongst landscape elements within the Cavan County Development Plan, and in Landscape Characterisation.



A view across some of the cross cutting ribbed moraines at Coolnacarte, west of Scotshouse.



Cross cutting ribbed moraines at Corraskea, north of Scotshouse, looking southeast.


NAME OF SITE	
Other names us	ed for site
IGH THEME	
TOWNLAND(S)	
<b>NEAREST TOW</b>	/N/VILLAGE
SIX INCH MAP	NUMBER
ITM CO-ORDIN	ATES
1:50,000 O.S. S	HEET NUMBER

Western Cuilcagh – Legeelan Quarry

IGH8 Lower Carboniferous Legeelan Blacklion 4 606696E 833988N 26 GSI BEDROCK 1:100.000 SHEET NO.

7

#### **Outline Site Description**

This is a small disused quarry beside the road from Blacklion to Burren Forest.

## Geological System/Age and Primary Rock Type

The rocks here are part of the Lower Carboniferous Dartry Limestone Formation, and the quarry displays a good example of the Knockmore Limestone Member, which is the carbonate mudbank facies of the formation.

## Main Geological or Geomorphological Interest

The quarry displays the internal structure of a Lower Carboniferous mud mound, typical of the Knockmore Limestone Member of the Dartry Limestone Formation. Mud mounds found in Ireland formed on the Lower Carboniferous sea floor, both by the vertical accumulation of lime mud and by lateral migration of mud banks over the sea floor surface. These mudmounds formed contemporaneously with the bedded, cherty limestone of the Dartry Limestone Formation so it is common to see beds of limestone flanking the massive mud mounds. At Legeelan Quarry a mud mound can be seen as massive limestone, with beds of limestone draped over the mound and dipping down the flanks.

#### Site Importance – County Geological Site; recommended for Geological NHA

This is a useful section to visualise and demonstrate the morphology of a carbonate mud mound.

#### Management/promotion issues

The quarry floor is usually filled with silage bales but these do not obscure the view of the carbonate mud mound from the road. The land is private but the view from the public road is perfectly adequate to visualise this small mound development.



A view of Legeelan Quarry from the road to the south.



A view of Legeelan Quarry from the road, showing the mudmound and draping beds.



NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATES 1:50,000 O.S. SHEET NUMBER **Crossdoney Granite Quarry** 

IGH11 Igneous intrusions, Gortnashangan Upper or Hermitage Crossdoney 25 637600E 800444N 34 GSI BEDROCK 1:100,000 SHEET NO. 8/9

## **Outline Site Description**

This site is a small, shallow disused quarry.

## Geological System/Age and Primary Rock Type

The quarry has been excavated into the Crossdoney Granite, a small intrusion of granite which underlies a small area of about 20 km<sup>2</sup> around the village of Crossdoney. The granite was intruded during the Caledonian Orogeny, around 417 million years ago.

## Main Geological or Geomorphological Interest

The Crossdoney Granite is one of a limited number of small early-Caledonian granitic intrusions across Ireland. These were emplaced during the early stages of the Caledonian orogeny that occurred as the lapetus Ocean closed near the end of the Silurian period. Larger granitic intrusions, including the Leinster Granite, formed slightly later in the orogeny, around 405 million years ago.

The Crossdoney Granite is composed of a number of different granite types. It is the only granite known to occur in county Cavan but it is generally very poorly exposed. This site is the best known exposure in the county. The quarry was opened between 2000 and 2005 and a small body of granite has been removed but it is a very shallow quarry, with little exposure of rock left except on the periphery of some excavations.

#### Site Importance – County Geological Site

This is a good representative site of the only known granite body in county Cavan.

#### Management/promotion issues

The quarry is apparently now disused. It is private property and is not suitable for promotion.



A view of the Crossdoney Granite Quarry.



A view of the best actual rock exposure in the Crossdoney Granite Quarry.



A view of the Crossdoney Granite Quarry, looking towards the entrance.



NAME OF SITE	Tullydermot Falls	
Other names used for site	-	
IGH THEME	IGH14 Fluvial and lacustrine geomorphology	
TOWNLAND(S)	Tullydermot, Altbrean	
NEAREST TOWN/VILLAGE	Swanlinbar	
SIX INCH MAP NUMBER	7	
ITM CO-ORDINATES	614935E 824797N	
1:50,000 O.S. SHEET NUMBER	26 GSI BEDROCK 1:100,000 SHEET NO. 7	

## **Outline Site Description**

This site comprises a waterfall on the Cladagh or Swanlinbar River, as well as the access footpath from the roadside car park, with an explanatory signboard.

## Geological System/Age and Primary Rock Type

The waterfall occurs at a thick bed of sandstone in the Lower Carboniferous Glenade Sandstone Formation.

## Main Geological or Geomorphological Interest

The waterfall is a small but well developed example of a waterfall occurring at a thick sandstone bed. The turbulence caused in the plunge pool where the water passes over the bed, has had the action of eroding out the underlying shale bed, which is much less resistant to erosion. As the shale is eroded out the thick sandstone becomes unsupported and eventually collapses. This causes the waterfall to recede upstream, and the process continues again.

## Site Importance – County Geological Site

This site is a good example of the geomorphological process of waterfall development and recession.

#### Management/promotion issues

The landowner has allowed permissive access and the public can walk right up to the side of the waterfall on a hard path from the car park at the road side. There is a Geopark signboard providing an explanation of the waterfall development.



Explanation of waterfall development.



Tullydermot Falls.



The waterfall before a 2004 collapse of the undercut sandstone bed



Left: The Geopark signboard at Tullydermot Falls. Right: The landowner conducting some path maintenance.



Kill

Kill

37

34

NAME OF SITE Other names used for site **IGH THEME** TOWNLAND(S) **NEAREST TOWN/VILLAGE** SIX INCH MAP NUMBER **ITM CO-ORDINATES** 1:50.000 O.S. SHEET NUMBER

**IGH15 Economic Geology** Kilnaleck

GSI BEDROCK 1:100.000 SHEET NO. 12

## **Outline Site Description**

The site comprises several outcrops and in-filled pits in a field of rolling grassland as well as a small spoil heap at the rear of a farm outbuilding.

642601E 790507N

## Geological System/Age and Primary Rock Type

The bedrock consists of grey Silurian shales of the Kilnaleck Shale Formation within which carbonaceous layers have been altered to coal.

## Main Geological or Geomorphological Interest

Kill is the only known location in the country where coal is found in Lower Palaeozoic rocks. Most coal found around the world resulted from lithification of plant material deposited in the Upper Carboniferous (Coal Measures). Hercynian deformations is considered to have remobilized graphite, converting the thin carbon(graphite)-rich horizons in the shale into a high-guality anthracite. The thickness of the coal-bearing layer varied from 3.4 m to mms (average 0.2m). Several pits were sunk in the 19<sup>th</sup> century and small amounts of the coal were raised but it proved to be practically incombustible and the workings were abandoned.

The site today is largely devoid of any trace of the former coal workings. A few flat outcrops of shale, without any apparent coal, occur near the road at the edge of the field in which the pits were sunk but the pits themselves are filled in. A grassed-over mound at the rear of the land-owner's farmhouse, adjacent the site of a former pit, contains shale fragments with small amounts of anthracite and is presumably a mine spoil heap.

#### Site Importance – County Geological Site

Although the occurrence of anthracitic coal in shale at Kill is, as far as is known, unique in Ireland, the site contains little trace of mining. Only the presumed spoil heap beside the farm outhouse provides tangible evidence of coal. Nevertheless, its uniqueness means it should be granted recognition as a CGS.

#### Management/promotion issues

The only visible remains of mining is the presumed spoil heap and, as this is essentially part of the back garden of the farmhouse, it is not a site that lends itself to promotion for public visits. Although the current landowner is aware of the spoil heap and the sites of former coal pits, the heap is vulnerable to removal or alteration as part of any future farm works.



Kill, view to east of area formerly mined for coal.



Area behind farmhouse with grassed-over spoil heap, to right of outhouse, in front of site of former pit.



Outcrop of shale at entrance to field shown in main image.







NAME OF SITE Other names used for site IGH THEME TOWNLAND(S) NEAREST TOWN/VILLAGE SIX INCH MAP NUMBER ITM CO-ORDINATE 1:50,000 O.S. SHEET NUMBER Redhills Claragh IGH15 Economic Geology Claragh Redhills 7 646877E 815675N 27 GSI BEDROCK 1:100.000 SHEET NO. 8/9

#### **Outline Site Description**

The site is a small, partly overgrown excavation into small hillside exposure, containing a number of exposed faces that are the remains of 19<sup>th</sup>-century mining. The site is in use for cattle pasture and feeding.

#### Geological System/Age and Primary Rock Type

The rocks exposed are red, ferruginous shales of the Ordovician Coronea Formation, part of the Northern Belt of the Longford-Down inlier.

#### Main Geological or Geomorphological Interest

The site is one of three in the Redhills area where the red shales of the Coronea Formation were mined for iron in the 19<sup>th</sup> century. The other sites are at Kilnacross, 600m southwest across the Redhills–Cootehill road, and Carrigmore, a further 2.6km southwest, some 1.8km north of Ballyhaise. While red shales can be seen to crop out at Kilnacross, the Carrigmore site appears to be reclaimed to farmland.

The original Fe content of the red shales at Claragh is 5-7% but local enrichment occurred, under conditions of faulting and folding, to produce a low-grade ore containing 17-24% soluble iron. The rock is broken up by a dense network of joint planes along which Fe enrichment has occurred. The ore is composed mainly of hematite (Fe<sub>2</sub>O<sub>3</sub>).

The Redhills Mining Company first worked the deposit in 1872, producing c. 5,000 tonnes by June of that year, but by 1878 production had ceased because of the high silica content of the ore. The Redhills Syndicate investigated the deposit in detail in 1959-60 but the estimated 68,000 tonnes of ore at an average grade of 20% was insufficient to warrant further development.

### Site Importance – County Geological Site; may be recommended for Geological NHA

The Redhills iron deposits have some significance as one of the few mineral deposits of any description in County Cavan. The Claragh site is the best remaining exposure and as such warrants CGS status.

#### Management/promotion issues

The site is in continuous use for keeping cattle and not readily accessible as a consequence. Exposure is limited to a few faces and a considerable portion of the original site, as defined on historical maps, is overgrown by shrubs and trees. Consideration should be given to clearing and fencing off a section of the site to preserve the excavations and allow access.



View of Redhills mine (quarry) from north







NAME OF SITE	Dromod Spa Well
Other names used for site	
IGH THEME	IGH16 Hydrogeology
TOWNLAND(S)	Drumod Glebe
NEAREST TOWN/VILLAGE	Swanlinbar
SIX INCH MAP NUMBER	7
ITM CO-ORDINATES	620025E 826607N
1:50,000 O.S. SHEET NUMBER	26 GSI BEDR
-	

GH16 Hydrogeology Drumod Glebe Swanlinbar 7 620025E 826607N 26 GSI BEDROCK 1:100.000 SHEET NO.7

#### **Outline Site Description**

This is a small natural spring, at the side of a minor road, that has been enclosed by a walled structure.

## Geological System/Age and Primary Rock Type

The Spa Well is a post-glacial (i.e. <10,000 years old) development of hydrogeology. The local bedrock is of Lower Carboniferous age.

## Main Geological or Geomorphological Interest

The Spa Well is a hydrogeological phenomenon, where groundwater, which has been suffused with sulphurous minerals, rises naturally from the limestone bedrock. This typically occurs where limestone rocks are juxtaposed against impermeable shale rocks. Water that can flow through enlarged conduits in limestone is in effect forced to the surface when it comes into contact with the impermeable rocks.

Most groundwater will have some dissolved minerals which control its chemistry, detrmining the hardness or softness of the water as well as its taste and colour. Sulphur rich groundwater is relatively unusual, and the sulphur gives the water a distinctive taste and smell, usually of the offensive 'rotten eggs' nature. It has been prized in the past as contributing to good health and as a cure for rheumatism, and at one time Swanlinbar was a Spa Town, receiving many visitors who came to take the waters.

This is one of two sulphur wells in Swanlinbar; a third was rich in magnesium.

#### Site Importance – County Geological Site

The site is a good representative example of the spa wells found in the district at Swanlinbar, Glangevlin and Dowra.

#### Management/promotion issues

The well is publicly accessible with an information signboard provided by the Geopark, and is in good order. It features in several trail leaflets but other wells listed in such leaflets were not found during this audit. Revisions of any promotional literature or new resources should update information to current status.



The Geopark information signboard alongside Dromod Spa Well.

