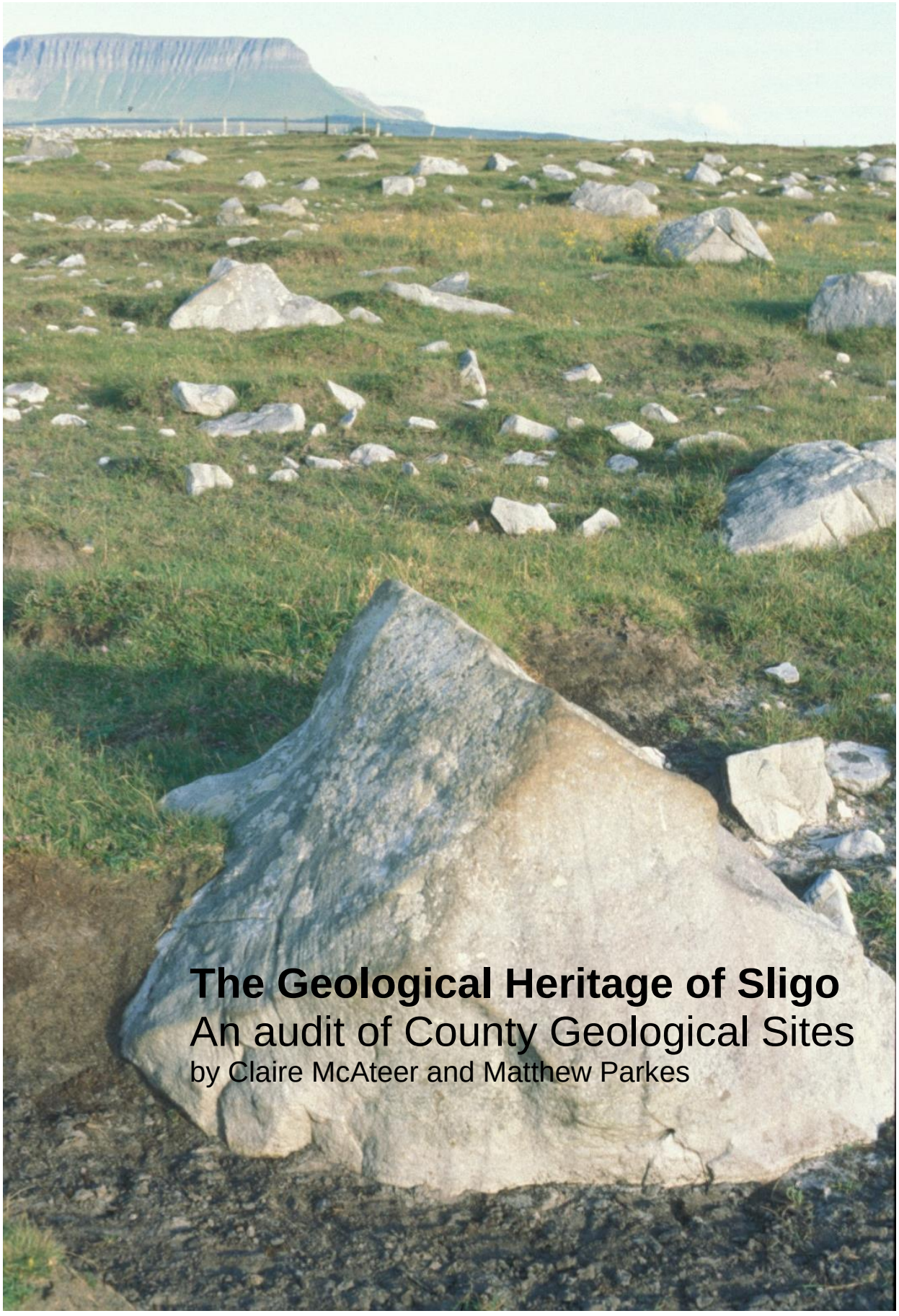

The Geological Heritage of Sligo

An audit of County Geological Sites

by Claire McAteer and Matthew Parkes

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by Claire McAteer and Matthew Parkes
2004

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Report Summary

This report documents what are currently understood to be the most important geological sites within Sligo by the Irish Geological Heritage Programme. It proposes them as County Geological Sites, for inclusion within the revised Sligo County Development Plan. 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, many 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 either have been, or will be, formally proposed by the Geological Survey of Ireland, for designation as NHAs by the National Parks and Wildlife Service after due survey and consultation with landowners. Commission of this report, and adoption of the sites within the County Development Plan places Sligo at the leading edge of geological conservation in Ireland.

[This report is written as a working document for use by the Heritage Officer and the Planning department of Sligo County Council. It is not intended for publication for the people of Sligo as it stands. A recommendation on how to best present the geological heritage of Sligo to the people of Sligo will be supplied separately.]

Sligo in the context of Irish Geological Heritage

This report places Sligo in the very forefront of geological heritage within Ireland, as it is the first county to commission such an audit within the scope of the Heritage Plan. It 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).

The Irish Geological Heritage Programme (IGH) in the Geological Survey of Ireland (GSI) complements other nature conservation efforts of the last decade, by assessing Ireland's geodiversity, which 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 Natural Heritage Areas (NHA) as the national nature conservation method. As a targeted conservation measure to protect the very best of Irish geology and geomorphology it fills a void which has been there since the abandonment of the Areas of Scientific Interest scheme, listed by An Foras Forbartha in 1981.

The IGH Programme does this by identifying and selecting the most important geological sites nationally for designation as NHAs. It looks at the whole of Irish geology and geomorphology under 16 different themes. A fundamental approach is that only the minimum number of sites necessary to demonstrate the particular geological theme is selected. This means that our first criterion is to identify the best National representative example of each feature or major sequence, and secondly any unique or exceptional sites. The third criterion, of any sites of International importance, is nearly always covered by the other two.

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

Designation of geological NHAs is by the partners in the Programme, the National Parks and Wildlife Service (NPWS – formerly a part of Dúchas) in the

Department of Environment, Heritage and Local Government. Once designated any geological NHAs will be subject to normal statutory process within the Sligo Planning Department and other relevant divisions.

As a result of extensive comparison of different similar sites to establish which is the best, we have a good picture 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. It is these various other sites that are proposed for CGS listing in the revised County Development Plan, along with the clear NHA selections.

At the time of writing this report, candidate sites have been established by Expert Panels for all the 16 themes, and for many themes the indicative site lists have been finalised. For three themes, the entire process has been completed and detailed site reports and boundary surveys have been done along with a Theme Report. Because the geology of Sligo happens to coincide with these three themes, many of the sites documented here are already selected and proposed for NHA designation, but due to competing priorities in NPWS, they have not been formally designated yet.

The sites proposed here as CGS have been visited and assessed specifically for this project, and represent our current state of knowledge. Although there are some additional areas that may merit inclusion, the state of work done by the Expert Panel for some themes is not sufficiently advanced to be clear on the importance of some sites for this report. Such sites are primarily landscapes exhibiting Quaternary or glacial features, for example an area of hummocky terrain around Skreen in West Sligo, and may be of an inappropriate scale to include as CGS, but may best be considered under the landscape characterisation process, and be considered in the planning system that way. The IGH13 – Coastal Geomorphology Panel work has only recently commenced and the entire Back Strand (dune capped barrier beach) and lagoon near Streedagh Point is a strong candidate for a site of National importance under this theme, but has not been included here as the present information is limited and a decision would be premature. It is already an SAC and so receives statutory protection.

Of the two themes which have only recently convened their Expert Panel, there are likely to be few sites within Sligo due to the geological make up of the county, although under IGH15 – Economic Geology, the former mine site at Abbeytown would merit some consideration, as will the barite mine of Glencarbury on the Ben Bulben – Gleniff Plateau. However, due to a multiplicity of other geological interests under different themes, it is expected that the barite mine will be part of a single site comprising the upland plateau, once IGH Programme work progresses further.

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 the same areas. In these areas, the geological case enhances and cements the value of these sites for nature conservation, but requires no additional designation of actual land areas.

There tend to be two broad types of site identified by the IGH Programme. Most geological sites tend to be small and discrete. They may be old quarries, natural exposures on hilly ground, coastal cliff sections, or other natural exposures, such as Glen, Scalpnacappaill, Slishwood Gap, Ballyconnell or the massive erratic Split Rock near Easky. They usually have a specific interest such as fossils, minerals or are a representative section of a particular stratigraphical sequence of rocks. The other type of site tends to be larger areas that represent a geomorphological interest – landscapes that illustrate processes which formed them. The Coastal Geomorphology theme, the Quaternary theme and the Karst theme include such sites. In Sligo, the Bricklieves, Geevagh and of course the Ben Bulben – Truskmore Plateau are characteristic of these larger 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 Sligo. A lack of awareness in the past, has led to the loss of important geological sites, throughout the country.

There are big contrasts in the management requirements for geological sites in contrast to biological sites. Most geology is actually 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 for the sites to be known about in the planning department, and more generally, so 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 influence the design so that access to exposures of rock is maintained for the future, or prevent completely inappropriate developments through a strong scientific case.

It is not the case in Sligo, but in other counties working quarries will be designated simply because they are the best representative sections available of entire sequences, in areas where exposure is otherwise poor. No restriction would be sought on the legitimate operation of these quarries. However, maintenance of exposure after quarry closure would be planned with the operator and planning authority in such a case.

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 general opportunity for collecting may need to be stopped. An example of this is at Streedagh Point and Ballyconnell, where superb coral and other shelly faunas are found on the beds of rock in the headlands. Each surface reflects a former sea floor community and provides great opportunity for palaeo-ecological research. Commercial collecting should be banned here, and only collecting of loose material suggested for the casual visitor. The main surfaces should be protected from collecting, but a permit could be issued for scientific research. A well thought out strategy for managing fossil collecting at these sites should avoid proliferation of damage and eyesores such as shown below, but allow continued academic study and responsible casual or amateur collecting.

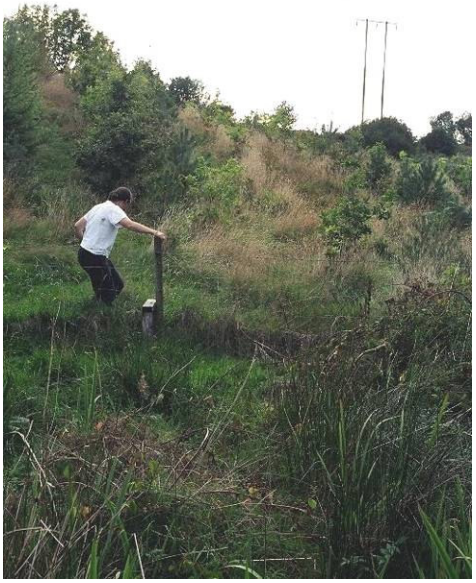
Two case studies from Sligo indicate the two main issues arising in relation to geological heritage – access, and competing interests in the case of sand and gravel resources.

Case Study 1 – Access

At the Slishwood Gap site a positive example of excellent landowner response is worthy of wider recognition, and subject to their approval it is intended to feature them in future articles on geological heritage matters.

Mr and Mrs Paraic McGarry have important exposures of serpentinite on the hundred metres or so of road leading to their farmhouse. They regularly receive visiting geological parties, as this is a well-known site for rarely exposed rocks from deep in the Earth's mantle. Mr McGarry takes the attitude that the rocks were there before him and they will be there after and has assisted visitors by construction of a set of steps down the embankment of his roadway, a footbridge across the stream and a stile across a fence to further exposures.

The steps built at Slishwood Gap (top).



The stile at Slishwood Gap (left).

The footbridge at Slishwood Gap (below)

Photos: Matthew Parkes

Case Study 2 – Sand and gravel extraction

What are important Quaternary landforms to the geomorphologist, capable of telling the story of how the landscape formed and of the many changes and processes it has undergone during the Ice Ages, are also important sand and gravel resources to others. The development requirement for aggregates has grown drastically in recent years and almost any feature may be under pressure of extraction. Sligo has very few eskers, but the two main ones checked for this report have both been discounted as CGS because they have largely been removed by quarrying and now bear little of their original character.

One important site is that at Meenamore in southwest Sligo. Here a spectacular fan moraine exists, but it has been quarried for sand and gravel in the past, and is currently being removed by contractors working on behalf of Coillte. It is only being used to make forest roads, but is easily extracted and close to the point of use, hence its attractiveness for the purpose.

The site exemplifies the conflicting interests of such Quaternary sites across the country. It is important that at least the very best landforms are protected as examples for scientific research and for education, yet they are rapidly disappearing, without even being documented and mapped. Since sand and gravel are low value, high volume materials that are costly to transport, demand exists everywhere, so no features are safe by virtue of their remoteness from urban centres like Meenamore.

Quarrying of Meenamore fan Moraine. Clast size ranging from sand to boulder.

A summary of the geology of Sligo

This is a non-technical summary written to be accessible for any reader, but occasionally some geological terms are unavoidable. A Glossary of these terms (in blue print) is provided at the end of the report.

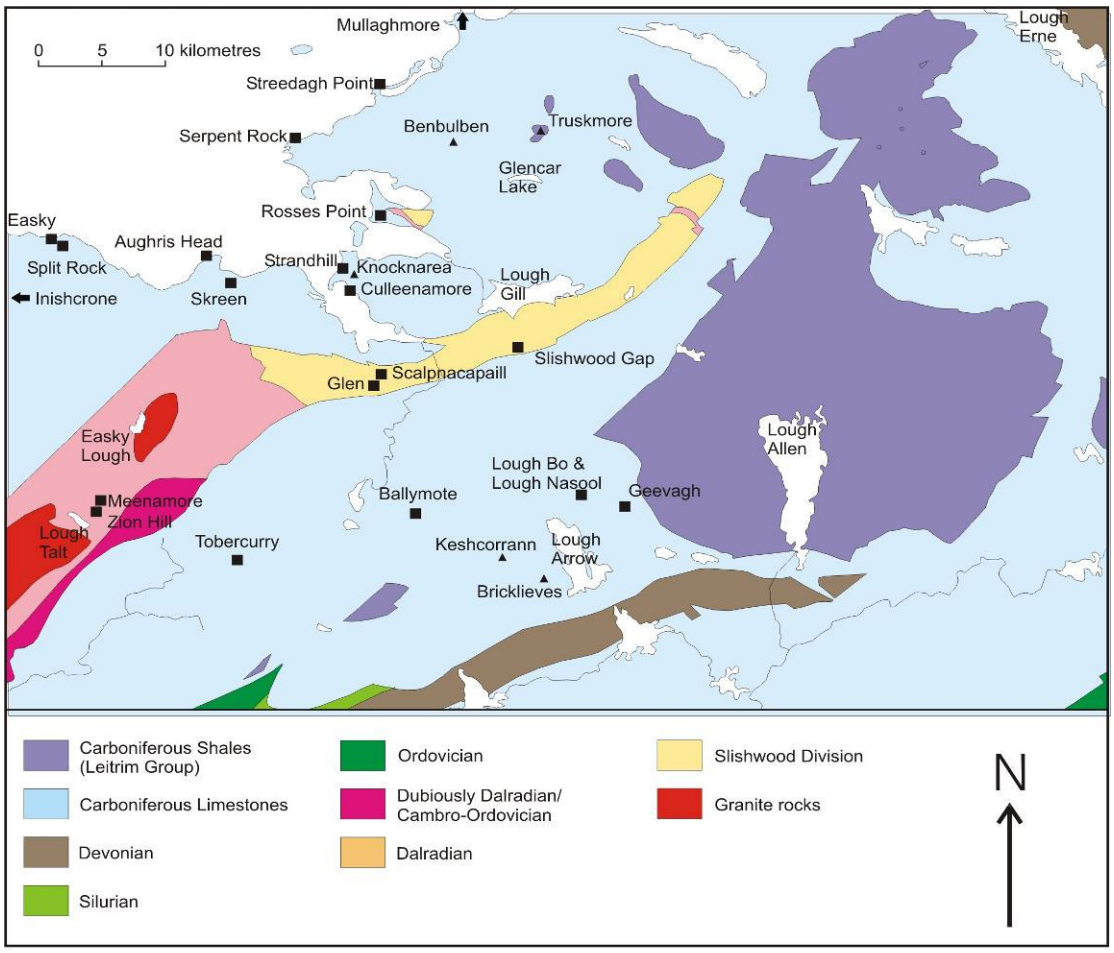
The scenic landscapes in the Sligo area formed over hundreds of millions of years by various geological processes, each one leaving its mark in the rock record. Careful examination of the rocks in the region can help unravel the mysteries surrounding their formation and thus shed light on the evolution of the Sligo terrain.

Rocks can be divided into three main groups, sedimentary, igneous and metamorphic. All three groups are exposed in Sligo. Sedimentary rocks are laid down as particles of material such as sand or mud and then hardened by compaction and lithification into sandstones, siltstones, mudstones and limestones. Fossils, often preserved in these rocks, can give us an idea of when the rock formed and what the climate and environment were like at that time. Igneous rocks crystallise from magma originating deep beneath the Earth's surface and may be extrusive (i.e. lava flows at the Earth's surface) or intrusive (emplaced within the Earth's crust, below the surface). Metamorphic rocks are sedimentary or igneous rocks that have been altered by changes in temperature and/or pressure. New minerals grow in response to these changes and their composition depends on the composition of the original rock, and the temperatures and pressures that affect it.

At any one locality there is usually more than one rock type, or lithology and they are generally inter-layered. Ranges of lithologies over a small area are largely consistent and sequences of rock often share common characteristics allowing them to be grouped together as packages or geological units. The most important of these 'units' is the formation, which is defined as a sequence of related rock types differing significantly from adjacent sequences.

The oldest rocks in the Sligo area are exposed in the northeast Ox Mountains and on Rosses point. Where they don't reach the surface they underlie younger rocks and extend deep into the Earth's crust. These rocks, belonging to the Slishwood Division, are thought to have originated as sedimentary rocks during Precambrian times, approximately 1550 million years ago (the exact timing of deposition is a subject of debate amongst researchers with some suggesting that deposition took place between 750 and 700 million years ago and others proposing a depositional age of 1700 million years). Since their deposition they have been repeatedly folded and metamorphosed deep within the Earth's crust producing the banded gneisses that we see today at localities such as Slishwood, Glen and Scalpnacappaill. Mountain building episodes more than 600 million years ago and 460 million years ago were responsible for this intense deformation and metamorphism (the timing

of the first event is uncertain). Mountains are formed when continents collide, increasing the thickness of the crust. The first phase of mountain building pushed the Slishwood Division rocks so deep beneath the Earth's surface (approximately 47km) that they interleaved with mantle material. This mantle material, or peridotite, was subsequently metamorphosed to serpentinite, a sliver of which is exposed at the Slishwood Gap.



Simplified geology of the Sligo-Leitrim area with site localities

Figure 1 Simplified geological map of Sligo-Leitrim, adapted from MacDermot et al. 1996.

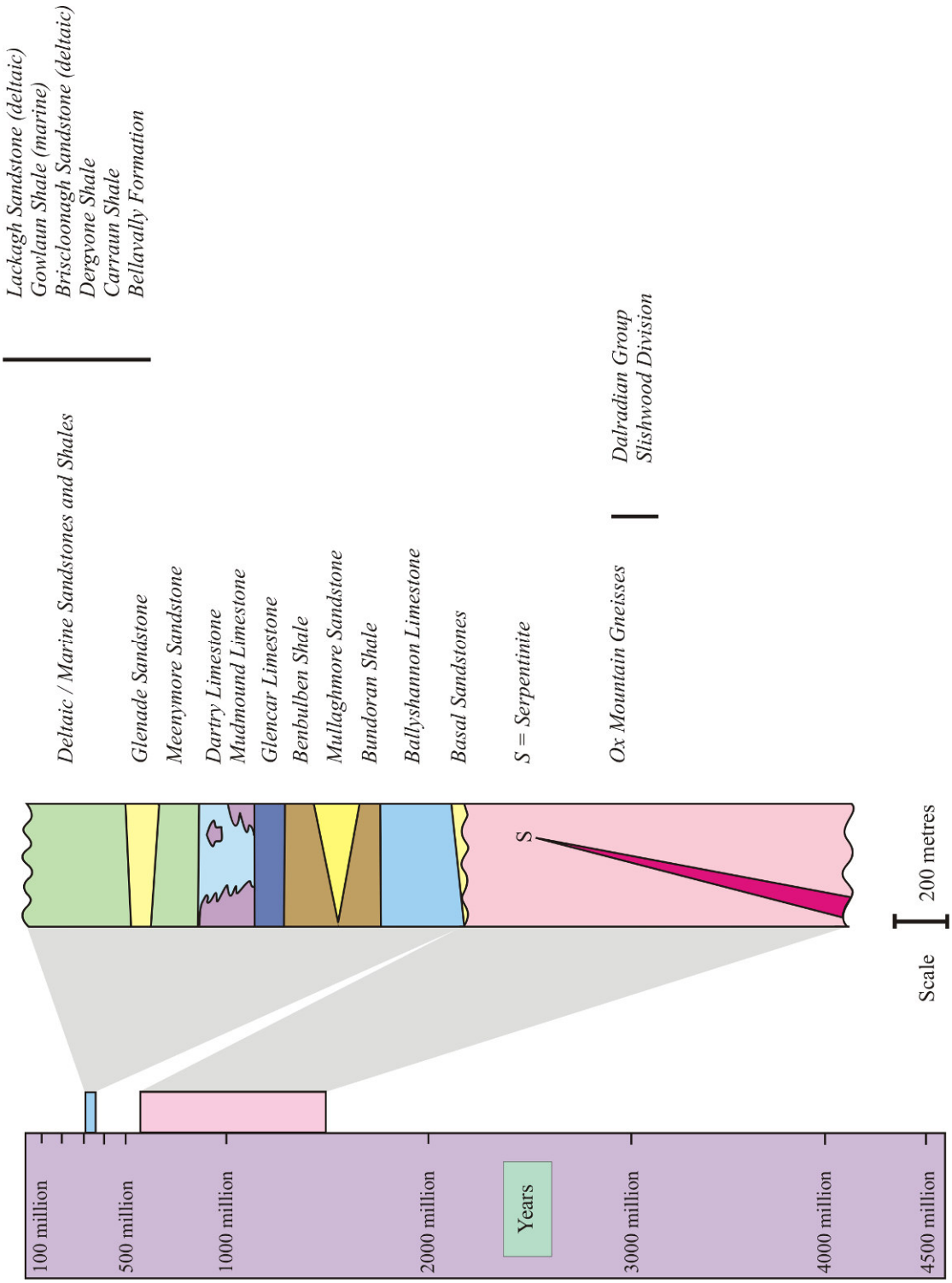


Figure 2 Simplified Stratigraphical Column for the Sligo Area, adapted from Tietzsch Tyler 1996.

AGE (Million Years)	ERA	PERIOD		Events Relating to the Sligo Area
1.6	Cenozoic	Quaternary		A series of ice ages followed by spread of vegetation, growth of bogs and the arrival of man.
65		Tertiary		Erosion. Opening of the North Atlantic ocean with associated igneous intrusions.
135	Mesozoic	Cretaceous		Erosion. Probable incursion of the sea. Chalk deposition preserved today in northern Ireland.
205		Jurassic		Uplift and erosion. Sediments deposited offshore.
250		Triassic		Desert conditions on land. Sands and gypsum deposited in east Ireland.
290	Palaeozoic	Upper	Permian	
355			Carboniferous	• Variscan mountain building phase during late Carboniferous. • Land became submerged; rivers, coastal sandstones and limestones deposited in tropical seas, interrupted by a period of delta building from the north.
410			Devonian	Caledonian mountain building phase. Some early Devonian volcanism and intrusions near Lough Talt and Lough Easky.
438		Lower	Silurian	Shallow sea deposition following closure of Iapetus ocean. Late Silurian igneous intrusions in the Ox Mountains.
510			Ordovician	Peak metamorphism of Dalradian rocks during Grampian mountain building phase.
544			Cambrian	Opening of Iapetus Ocean initiating the Grampian mountain building phase during the late Cambrian/early Ordovician.
2500	Pre-cambrian	Proterozoic		• Dalradian Sediments deposited from about 810-600 million years ago. • Grenville phase of mountain building may have affected Slishwood Division rocks 1100-900million years ago • Deposition of Slishwood Division rocks approximately 1550 million years ago.
4000		Archaean		Oldest known rocks on Earth.
Formation of the Solar System approximately 4600 million years ago				

Figure 3 Geological Timescale

In contact with the Slishwood Division rocks are the slightly younger Dalradian rocks. The contact between the two is everywhere tectonic (i.e. bounded by faults). Both rock units are thought to have experienced different depositional and deformational histories until some time between 500-430 million years ago when crustal movement brought them side-by-side. This crustal movement (the Grampian orogeny) resulted in the deformation and metamorphism of the rocks. The Dalradian sediments were converted to metamorphic schists as a result. Analysis of some of the metamorphic minerals within the Dalradian Group show that they were subjected to depths no greater than 27km beneath the Earth's surface. Had they been buried more deeply different metamorphic minerals would have grown. Dalradian rocks are exposed in a number of locations in Sligo most notably at Zion Hill and Rosses Point.

The dominant rock types in Sligo belong to the Carboniferous System (355 – 310 million years). These rocks have only been mildly affected by folding and metamorphism and as such retain many of their original sedimentary and depositional structures. Analysis of these features can help us to understand the changing depositional environments or landscapes of this time. Carboniferous rocks in Ireland are extremely important economically as they host many valuable mineral deposits. Some such mineral deposits are found in the Sligo area and include the barite vein at Glencarbury. Carboniferous limestones are often easily dissolved by surface water and/or groundwater. This characteristic has resulted in the development of many cave systems and karsts in the Sligo area (like those seen at Geevagh, Bricklieves, Keshcorran and Gleniff).

At the beginning of the Carboniferous, some time after the continental collision that saw the juxtaposition of the Slishwood Division and the Dalradian rocks, sea level began to rise. The shoreline moved northwards from Cork flooding the land as it passed. This Carboniferous marine transgression resulted in the deposition of shallow marine sandstones in the Sligo area. During this time Ireland had a latitude of 10º and experienced a tropical climate. The Ballyshannon limestone was then deposited in a clean, shallow, tranquil sea, teeming with life. Limestone deposition was interrupted when a major river delta built out into the tropical sea from a landmass to the north. The northern landmass was the result of uplift associated with fault-movements beneath the Carboniferous rocks. This event saw the deposition of the Bundoran Shale formation followed by the Mullaghmore Sandstone Formation. The Mullaghmore Formation is spectacularly exposed at its type locality at Mullaghmore. As the delta retreated the Benbulben Shale Formation (named after its type area at Benbulben) was deposited. Deposition of the Glencar Limestone Formation marked the return to shallow sea conditions. Streedagh Point and Serpent Rock at Ballyconnell both host exceptionally well-preserved, fossil-rich sections of the Glencar Formation.

The succeeding period saw the maximum extent of the Carboniferous sea. Continued fault-movement deepened the sea floor in places leading to unfavourable conditions for many forms of marine life. The dark coloured, largely fossil-free limestones and shales of the Dartry Formation (also exposed at Serpent Rock) reflect these deep-water conditions. Upstanding features like reefs developed within the deeper water. A fine example of these mudmounds or mudbanks is found defining the top of Slievemore. Lime mud was deposited above these upright structures. The Bricklieve Limestone Formation was deposited in shallower water over other parts of Sligo at this time. As its name suggests this formation is best exposed on the Bricklieve Mountains.

Sea level began to fall as the landmass to the north was uplifted again. The shallow sea deposits of the Meenymore Sandstone Formation marks the beginning of this changing environment. As the shoreline moved southwards again (a regression) the Glenade Sandstone Formation was deposited in a deltaic environment. This deltaic episode left behind a flat landscape over which the sea transgressed and regressed a number of times depositing the sediments of the Bellavally Formation. Glenade sandstone and Meenymore evaporites are well exposed on the summit of Truskmore. The succeeding Carraun and Dergvone Shale Formations represent marine depositional environments. The subsequent Briscloonagh, Gowlaun and Lackagh Formations reflect deltaic, marine and deltaic conditions respectively.

At the end of the Carboniferous, the rocks were deformed by the Variscan orogeny. Deformation and metamorphism associated with this mountain building event was very mild in the north of the country. For much of the 300 million years following the Carboniferous, Ireland was mostly land, dominated by erosion rather than sedimentation. This geologically quiet period was interrupted approximately 75 million years ago when Ireland may have been covered by the sea (although no record of this is found in the Sligo area) and again 60 million years ago as Europe and North America split apart producing the North Atlantic Ocean. Hot magma rose up along fractures and cracks that formed in the limestone, in response to this event, cooling to form dykes like those seen at Inishcrone and Carrowhubbuck.

For the last 1.6 million years Ireland's climate has oscillated between arctic and temperate conditions. A large sheet of ice deposited glacial sediments in Sligo during the last Glaciation (the Midlandian), which ended 10,000 years ago. At the maximum extent of the Midlandian Glaciation ice covered the entire Sligo area reaching thicknesses of up to 650m in places. Earlier glacial and interglacial deposits were either buried by the Midlandian deposits or removed by the large sheet of ice. As the ice moved over the ground, loose debris was incorporated into it producing an abrasive base to the ice sheet, resulting in an ice-sculpted mountain landscape. The ice also carried large boulders, or erratics, far from their source area. The Ox Mountain erratics, the most common of these boulders, were strewn across the lowland north of the

mountain range (e.g. Split Rock). Large valleys were further sculpted by the ice producing classic U-shaped valleys such as Glencar.

Towards the end of the last glaciation, as the ice melted, oversteepened valley walls, once supported by the ice, collapsed as large-scale landslips like those seen today in the Swiss Valley by Glencar. Rivers, which developed beneath and within the melting ice sheets deposited sand and gravel in the form of striking, often bead-like ridges. Tobercurry hosts the largest such ridge deposit, or esker system in the Sligo area. Smaller examples are found at Moygara and at Cloverhill. Other melt-water features include flat-floored valleys like that exposed northwest of Lough Talt (running parallel with the main R294 road), which formed when large lakes of meltwater from the ice carved out channels as they overflowed a barrier.

The loose debris entrained in the ice sheets was deposited directly by the ice as till or by melt waters as gravel and sand. Glacial deposits are thinner in upland areas and thicker in lowland areas. Drumlins, roche moutonées and moraines are common glacial features in the Sligo area. Drumlins are low, smoothly rounded elongate hills, which formed beneath the sheet of ice. Largely composed of till, their long axis is parallel to the direction of ice flow (e.g. the area south of Ballymote). The hummocky terrain in the area of Skreen is however, of uncertain origin. Moraines, taking the form of ridges of till and sand, were deposited at the margins of the ice sheet. A spectacular fan moraine is exposed in the Meenamore area. The abrasive base of the ice sheet sculpted roche moutonées, whaleback rock exposures with a smooth slope in the direction from which the ice flowed and a steeper, rougher slope at the opposite end (e.g. Slishwood Gap exposures). Periglacial features such as those seen on Truskmore record the intense freeze-thaw conditions that shattered and moved the local bedrock towards the end of the last glaciation. Freeze-thaw features are also seen north of Lough Easky where large solifluction lobes are found.

As the climate oscillated so too did sea level. Glacial periods saw the development of large sheets of ice, locking up available water and thus lowering the sea level. Warmer periods melted the ice allowing water back into the oceans causing sea level to rise. Former beach deposits sometimes exposed at Strandhill (below the Atlantic end of the Airport runway) record a post-glacial phase where sea level was different to what it is today. Other deposits such as at Culleenamore, near Strandhill, consist of great banks of oyster shells, have a strong resemblance to raised beach deposits, but archaeological evidence indicates that these are probably shell middens. Great forests and peat bogs spread across the land during the most recent warm and wet post-glacial phase.

GLOSSARY

Aquifer	a water saturated rock unit.
Basic	any igneous rock rich in iron and/or magnesium and containing little or no quartz.
Bedding Plane	the contact between individual beds of rock.
Convolution	contorted layering within a sedimentary bed often formed by water expulsion.
Corrie	a horseshoe-shaped, steep-walled valley formed by glacial erosion.
Cross-bedding	layering in sedimentary rocks at an inclined angle to bedding formed by current-ripples.
Delta	a fan-shaped body of sediment situated at a river mouth, often extending beyond the coastline.
Dolerite	an igneous intrusion equivalent in composition to basalt.
Doline	circular/oval closed depression found in karst terrain.
Erratic	a rock fragment carried far from its source area by glacial ice.
Evaporite	a deposit from which various salts can be extracted. Forms by precipitation of minerals as a result of evaporation.
Fault	a 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).
Foliation	a finely spaced planar parting caused by compressive deformation of rocks.
Formation	a sequence of related rock types that differs significantly from adjacent sequences.
Grading	a sorting effect with the coarsest material at the base of the bed and finest grained material at the top.
Granodiorite	an igneous rock similar to granite but containing more of the mineral plagioclase and also more iron and magnesium-bearing minerals.
Intrusion	igneous rock emplaced within the Earth's crust, not extruded like lava.
Joint	a fracture in a rock, which shows no evidence of displacement.
Karst	topographic features, typically cave systems, formed usually by the dissolution of limestone by surface water and/or groundwater.
Lithification	the process of rock formation from unconsolidated sediment.
Mantle	the main part of the Earth between the crustal plates and the core.
Orogenesis	the process of creation of a mountain belt by tectonic activity, generally by the collision of continental plates.
Pegmatite	a very coarse-grained igneous rock of granitic compostition.
Periglacial	cold but non-glacial climatic conditions.
Phreatic Zone	the area below the water table, where the rock is completely saturated with water.
Porphyroblast	a large well-shaped crystal within a finer-grained matrix that formed during metamorphic recrystallisation.
Regression	a recession of the sea from a land area.
Solifluction lobes	lobes of debris that have accumulated as a result of the slow, downslope movment of water saturated material under the influence of gravity.
Till	unconsolidated, unsorted glacial deposits consisting of boulders and cobbles mixed with very finely ground-up rock or silt.
Transgression	an incursion of the sea over land area.
Turlough	a seasonal lake that fills and empties through springs and sinkholes.
Vadose Zone	the area between the surface and the water table.

Bibliography

This reference list includes all papers, books, articles and some unpublished reports etc relating to the geology and geomorphology of Sligo that could be traced. It includes any papers cited in the individual site reports. Many papers exist on the geology or caves of Leitrim, Fermanagh and other nearby counties which may have some relevance to Sligo's geology, because of the continuity of the stratigraphical sequences. They have not been included here as they are outside the scope of this report, but any detailed research project may need to encompass them.

References marked with an asterisk (*) relate significantly to caves and caving within the Sligo 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. Most other papers etc should be available in the GSI.

****

ALDWELL, C.R. 1981. *The geology and mineral resources of Co.Sligo with special emphasis on groundwater and its protection*. Lecture to Institute of Engineers of Ireland, Sligo. Unpublished manuscript.

ALEXANDER, R.W., COXON, P. and THORN, R. 1986. A bog flow at Straduff townland, Co.Sligo. *Proceedings of the Royal Irish Academy* **86B(4)**,107-119.

ALSOP, G.I. and JONES, C.S. 1991. A review and correlation of Dalradian stratigraphy in the southwest and central Ox Mountains and southern Donegal, Ireland. *Irish Journal of Earth Sciences* **11**, 99-112.

AN FORAS FORBARTHA. 1974. *Observations on the proposed development of the old barytes mine at Glencarbury, Ballintrillick, Co.Sligo*. An Foras Forbartha, Dublin. Unpublished report.

AN FORAS FORBARTHA. 1977. *Inventory of Outstanding Landscapes*. An Foras Forbartha, Dublin.

AN FORAS FORBARTHA. 1981. *Areas of Scientific Interest in Ireland*. An Foras Forbartha, Dublin.

ANDREWS, J.R., PHILLIPS, W.E.A. and MOLLOY, M.A. 1978. The metamorphic rocks of part of the north central Ox Mountains inlier of Counties Sligo and Mayo. *Journal of Earth Sciences Royal Dublin Society* **1**, 35-40.

*ANON. 1840. The caves of Kish-Corran. *The Irish Penny Journal* **1(2)**, 9-10.

*ANON. 1901. News gleanings. The cave committee's work. *Irish Naturalist* **10**, 141-142.

*ANON. 1901. Notes. Geology. Exploration of the Keish caves. *Irish Naturalist* **10**, 256.

ANON. 1912. Irish Societies. Belfast Naturalists' Field Club. *Irish Naturalist* **21**, 20-24.

ANON. 1921. The Connacht Coalfied. *In*: Comission of Inquiry into the Resources and Industries of Ireland. *Memoir on the Coalfields of Ireland* **1**. Dublin.

*ANON. 1952. Cave exploration - new discoveries. *Yorkshire Ramblers' Club Journal* **7**, 340-343.

*ANON. 1973. Carrowmore, *The Reyfadeer* **1**, 29.

*ANON. 1985. Pots/Digs In Sligo/Leitrim, *Irish Speleology* **3** (2), 34.

ARCHER, J.B. 1980. Patrick Ganly: Geologist. *Irish Naturalists' Journal* **20(4)**, 142-148.

BAILY, W.H. 1871. On fossil plants from the south of Ireland (Part II). *Proceedings of the Natural History Society of Dublin (for the sessions 1865-1869)* **5**, 47-53.

BARTLETT, J.M. 1990. *An assessment of regional variation in metamorphic temperature within the Ox Mountains Inlier using Garnet-Pyroxene thermometry*. Unpublished B.Sc. thesis, University of Dublin.

BISHOPP, D.W. 1946. The occurrence of nickel and magnetite in some Irish serpentines, in conjunction with a magnetic survey. *Scientific Proceedings of the Royal Dublin Society* **24**, 125-133.

BRANDON, A. 1977. The Meenymore Formation - an extensive intertidal evaporitic formation in the Upper Viséan (B2) of North-west Ireland. *Report Institute Geological Science* No.**77**/**23**.

BRANDON, A. and HODSON, F. 1984. The stratigraphy and palaeontology of the Late Viséan and Early Namurian rocks of North-East Connaught. *Geological Survey of Ireland, Special paper Number* **6**, 1-54 (with coloured map 1:63,630).

BRENNAN, D. 1984. *Geochemistry and Primary Ultramafic Mineralogy of the Slishwood Serpentinite*. Unpublished B.Sc. thesis, University of Dublin.

BROWNE, P.R. 1982. *Aspects of the glaciation of the north Sligo/Leitrim border*. B.A.(Mod.) dissertation. Department of Geography, University of Dublin.

BUCKMAN, J.O. 1992. An unusual new trace fossil from the Lower Carboniferous of Ireland: *Intexalvichnus magnus*. *Journal of Palaeontology* **71 (2)**, 316-323.

CAFFERKY, J.P.P. 1977. *The petrofabric analysis of psammite from the Ox Mountains*. Unpublished B.Sc. thesis, University of Dublin.

CALDWELL, W.G.E. 1957. *The Lower Carboniferous rocks of the Carrick Syncline*. Unpublished Ph.D. thesis, University of Glasgow.

CALDWELL, W.G.E. 1959. The Lower Carboniferous rocks of the Carrick-on-Shannon syncline. *Quarterly Journal of the Geological Society of London* **115**, 163-187.

CALDWELL, W.G.E. and CHARLESWORTH, H.A.K. 1961. Visean Coral Reefs In The Brecklieve Mountains Of Ireland. *Proceedings of the Geologists' Association* **73(4)**, 359–382.

*CAMPBELL, M. and BURNS, G. 1985. Sligo/Leitrim. Poiticoghlan, Dragonfly Pot, Polliska, Carrowmore Cavern, Pollnagossan, C.M.A. Cave, Pollprughlisk, Gortalughany Rising, Pollnaclanawley, Black Pot. *Irish Speleology* **3 (2)**, 34-36.

CARTER, H.J. 1881. On fossil sponge-spicules from the Carboniferous strata of Ben Bulben, near Sligo. *Proceedings of the Belfast Naturalists' Field Club* **Appendix, 1880-1881**, 190-194.

CARTER, R.W.G. and WILSON, P. 1991. Chronology and geomorphology of the Irish dunes. *In*: QUIGLEY, M.B. (ed.), *A Guide to the Sand Dunes of Ireland*. European Union for Dune Conservation and Coastal Management, c/o Trinity College Dublin.

CHAPMAN, P. 1993. *Caves and Cave Life*. The New Naturalist, HarperCollins, London.

CHARLESWORTH, H.A.K.1960. The Lower Palaeozoic inlier of the Curlew Mountains anticline. *Proceedings of the Royal Irish Academy* **61B(2)**, 37-50.

CHARLESWORTH, H.A.K.1960. The Old Red Sandstone of the Curlew Mountains inlier. *Proceedings of the Royal Irish Academy* **61B(3)**, 51-58.

CHARLESWORTH, H.A.K. and CHARLESWORTH, J.K. 1955. The dissolution of the ice in Co.Leitrim and the adjacent parts of Co.Sligo and Co.Roscommon. *Irish Naturalists' Journal* **11**, 330-334.

CHARLESWORTH, J.K. 1928. The glacial geology of north Mayo and west Sligo. *Proceedings of the Royal Irish Academy* **38B(6)**, 100-115 (with 1 plate).

CHARLESWORTH, J.K. 1929. Abstract of lecture 'On Palaeolithic man in Sligo?' *Proceedings of the Belfast Naturalists' Field Club Series 2*, **9(1)**, 25-26.

CHARLESWORTH, J.K. 1937. Recent progress in Irish geology. *Irish Naturalists' Journal* **6**, 266-274.

CHARLESWORTH, J.K. 1959. Recent progress in Irish geology. *Irish Naturalists' Journal* **13(3)**, 49-65.

CHARLESWORTH, J.K. 1963. The bathymetry and origin of the larger lakes of Ireland. *Proceedings of the Royal Irish Academy* **63B**, 61-69 (with plates III & IV).

CHARLESWORTH, J.K. 1972. Recent progress in Irish geology. *Irish Naturalists' Journal (Special Geological Supplement)*, 1-37.

CHARLESWORTH, J.K. and MacALISTER, R.A.S. 1930. The alleged palaeolithic implements of Sligo: a summary. *Proceedings of the Royal Irish Academy* **39C**, 18-32 with 4 plates.

CLARINGBOLD, K., FLEGG, A., MAGEE, R. and VONHOF, J. 1994. *The Directory of active quarries, pits and mines in Ireland*. Geological Survey of Ireland, Report Series **94/4**.

*COE, R. 1970, Irish Meet - Co. Sligo – 1970. *Journal Of The Craven Pothole Club* **4**, 4.

COFFEY, G. 1903. The exploration of the caves of Kesh, County Sligo. Human occupation. *Transactions of the Royal Irish Academy* **32B**, 209-212.

COLE, G.A.J. 1903. The intrusive gneiss of Tirerrill and Drumahair. *Proceedings of the Royal Irish Academy* **24B(10)**, 361-370.

COLE, G.A.J. 1904. Irish Field Club Union. Report of the Fourth Triennial Conference and Excursion, held at Sligo, July 12th to 18th, 1904. IV. Geology. *Irish Naturalist* **13**, 214-215.

COLE, G.A.J. 1913. The geology of the Mallaranny and Sligo Districts. *Proceedings of the Geologists' Association* **24(2)**, 62 – 69.

COLE, G.A.J. 1998. *Memoirs of Localities of Minerals of Economic Importance and Metaliferous Mines in Ireland*. The Mining Heritage Society of Ireland, Dublin.

COLE, G.A.J. and LAMPLUGH, G.W. 1903. The exploration of the caves of Kesh, County Sligo. Geology. *Transactions of the Royal Irish Academy* **32B**, 178-181.

COLEMAN, J.C. 1947. Irish cave excavations. *Journal of the Royal Society of Antiquities of Ireland* **77**, 63-80.

*COLEMAN, J.C. 1955. Notes on the cave region of North West Ireland. *Cave Research Group Newsletter No.***52**, 25-28.

*COLEMAN, J. C. 1965. *The Caves of Ireland*. Anvil Books, Tralee.

*COLEMAN, J. and TRATMAN, E. 1964. A Vanishing Lake Co. Sligo Eire, *Cave Research Group* **92**, 10-11

CONMY, 1997. *A magnetic investigation of the Central Ox Mountains Inlier with a view to evaluating potential landfill sites*. Unpublished M.A. thesis, National University of Ireland.

CORBEL, J. 1968. Peat Bogs And Karst Morphology In The Sligo Region (Ireland). *Revue De Geographie Alpine (Grenoble)* **56**, 517-531.

COTTON, D.C.F. and WILLIAMS, J. 1996. *Nature Trail. Dooney Rock, Lough Gill*. Sligo County Council/Coillte/Sligo Regional Technical College. Leaflet.

COXON, C. & THORN, R.H. 1989. Temporal variability of water quality and the implications for monitoring programmes in Irish limestone aquifers. *In*: *Groundwater Management : Quantity and Quality*. Proceedings of the Benidorm Symposium, IAHS Publication no.**188**, 111-120.

COXON, P. l985. Quaternary Geology and Gleniff - Protalus rampart, *In*: THORN, R.H. (ed.), *Sligo and West Leitrim*. Irish Association for Quaternary Studies Field Guide **No. 8**, pp 1-l2. IQUA. Dublin.

COXON, P. 1988. Remnant periglacial features on the summit of Truskmore, Counties Sligo and Leitrim, Ireland. *Zeitschrift fur Geomorphologie* **71**, 81-91.
COXON, P. and BROWNE, P. 1991. Glacial deposits and landforms of central and western Ireland. *In*: EHLERS, J., GIBBARD, P.L. and ROSE, J. (eds.), *Glacial Deposits in Great Britain and Ireland*. A.A. Balkema, Rotterdam.

COXON, P., COXON, C.E. and THORN, R.H. 1989. The Yellow River (County Leitrim Ireland) flash flood of June 1986. *In*: BEVEN, K & CARLING,

P. (eds.), *Floods: Hydrological Sedimentological and Geomorphological Implications*. Wiley & Sons Ltd.

CRANE, N. 1984. *Geology of the Slieve Gamph Igneous Complex, western Ireland*. Unpublished Ph.D. thesis, Luton College.

CRANE, N.R. and TAYLOR, W.E.G. 1984. The Slieve Gamph Igneous Complex: A study of a tectonized Caledonide granitic pluton. *Abstracts, International Geological Congress, Moscow* **4**, 284-285.

CRANE, N.R. and TAYLOR, W.E.G. 1985. Geochemistry of the Slieve Gamph igneous complex, Western Ireland: a tectonised, Caledonide granite. *Geological Society of London Newsletter.*

CREIGHTON, J.R. 1990. *Exploration Focus – Abbeytown*. Geological Survey of Ireland, Pamphlet Series **90**/**1**.

CRUISE, R.J. 1878. *Explanatory memoir to accompany sheets 66 and 67 of the maps of the Geological Survey of Ireland illustrating part of the Counties of Sligo, Leitrim, Roscommon and Mayo*. Memoirs of the Geological Survey, Dublin.

CUNNINGHAM, D.J. 1903. The exploration of the caves of Kesh, County Sligo. Man. *Transactions of the Royal Irish Academy* **32B**, 208.

CUNNINGHAM, M.A.C. 1954. *Mineral Deposit at Abbeytown, Co. Sligo*. Geological Survey of Ireland. Unpublished Report.

CURRALL, A.E. and TAYLOR, W.E.G. 1965. Geological history of the Slieve Gamph mountains, western Ireland. *Nature* **207**, 1143-1144.

CURTIS, T.G.F. 1991. A site inventory of the sandy coasts of Ireland. Their types and distribution. *In*: QUIGLEY, M.B. (ed.), *A Guide to the Sand Dunes of Ireland*. European Union for Dune Conservation and Coastal Management, c/o Trinity College Dublin.

CURTIS, T., GOODWILLIE, R. and YOUNG, R. 1978. *Heritage Inventory Reports for Co. Sligo. Areas of Scientific Interest in Co. Sligo*. (Revised and expanded report). An Foras Forbartha, Dublin. Unpublished report.

DALY, E.P. 1975. *Report on the Groundwater Potential around Sligo Town*. Geological Survey of Ireland. Unpublished Report.

DALY, J.S. 1975. *The Pre-Quaternary Geology of Killery Mountain and Ballintogher, Co. Sligo, Ireland*. Unpublished B.Sc. thesis, University of Dublin.

DISKIN, S.M.V. 1993. *Along strike variation of Metamorphic P-T conditions in the Ox Mountains: Application of Garnet-Pyroxene thermometry*. Unpublished B.Sc. thesis, University of Dublin.

*DIXON, J. 1970. Dermot And Grania's Bed Cave Co. Sligo. *Irish Caver* **3**, 18.

*DIXON, J. 1973. Some Cave Sites In Co. Sligo. *Irish Speleology* **2**, (2), 33-34.

DIXON, O.A. 1965. *The Lower Carboniferous rocks between the Curlew and Ox Mountains, N.W. Ireland*. Unpublished Ph.D. thesis, Glasgow University.

DIXON, O.A. 1970. Variation in the Viséan coral *Caninia benburbensis* from north-west Ireland. *Palaeontology* **13**, 52-53.

DIXON, O.A. 1972. Lower Carboniferous rocks between the Curlew and Ox Mountains, Northwestern Ireland. *Journal of the Geological Society* **128**, 71-101, 12 figures.

DOLAN, J. 1980. *Geology of the Aughris-Templeboy area, Co. Sligo (and 1:10,560 geological map)*. Unpublished B.Sc. mapping thesis. University College, Galway.

DREW, D. and JONES, G.Ll. 2000. Post-Carboniferous pre-Quaternary karstification in Ireland. *Proceedings of the Geologists' Association* **111**, 345-353.

DUKE, R.A. 1892. Geology of Sligo. *In*: WOOD-MARTIN, W.G. *History of Sligo. Volume 3.* Hodges Figgis & Co., Dublin.

EMELEUS, C.H. and PRESTON, J. 1969. *Field excursion guide to the Tertiary volcanic rocks of Ireland*. Published by the authors for the I.A.V.C.E.I. Symposium (Oxford) 1969 with the help of the Queen's University, Belfast.

FAUGHNAN, D. 1943. *Topographical Survey made for Irish Tourist Association*. Irish Tourist Association. Unpublished report.

*FINCHAM, A. 1960. Explorations In Counties Sligo And Leitrim Eire 1959-1960. *Leeds University Speleological Society* pp32.

*FINCHAM, A. 1962. Speleological Surveys In Co. Sligo And Co. Leitrim Eire. *Proceedings Of The Leeds Philosophical And Literary Society* **8(10)**, 225-242.

*FINCHAM, A. 1963. Note On A Recent Exploration Of The Carrowmore Cavern System Exploration In Co. Leitrim & Sligo. *Cave Research Group Of Great Britain Newsletter* 32.

*FINCHAM, A., GIBSON, J. and POWELL, R. 1957. Report of a Speleological Reconnaissance in Counties Sligo & Leitrim, Eire. *Cave Research Group Newsletter* **67**, 9-13.

FLOWERDEW, M.J., DALY, J.S., GUISE, P.G. and REX, D.C. 2000. Isotopic dating of overthrusting, collapse and related granitoid intrusion in the Grampian orogenic belt, northwestern Ireland. *Geological Magazine* **137**, 419-435.

FLOWERDEW, M. and McKEEVER, P.J. 2000. *Landscapes from Stone. Explore West Sligo*. Geological Survey of Ireland, Dublin.

FLOWERDEW, M. & McKEEVER, P.J. 2000. *Landscapes from Stone. Walk Sligo-Leitrim*. Geological Survey of Ireland, Dublin.

FOX, K. 1982. *The geology of the Benbulben area, County Sligo, Ireland*. Unpublished B.Sc. thesis, University of Dublin.

FRASER, J. 1844. *Hand Book for Travellers in Ireland*. Longman &Co., London.

GARDINER, M.J. (ed.). 1973. County Leitrim Resource Survey. Part 1 Land Use Potential (Soils, grazing potential and forestry). *An Foras Taluntais, Soil Survey Bulletin No.***29**.

GEORGE, T.N. 1953. The Lower Carboniferous rocks of north-western Ireland. *Adv.Sci*. **10**, 65-73.

*GILHUYS, D. 1970. Kings Mountain Co. Sligo. *Irish Caver* **3**,17.

*GILHUYS, D. 1975. Potholes In The Counties Of Sligo And Leitrim. *Irish Speleology* **2** (4), 8-9.

*GILHUYS, D. 1978. Three Minor Discoveries In Counties Mayo And Sligo. *Irish Speleology* **3** (1), 42-45.

GOODWILLIE, R. 1972. *Heritage Inventory Reports for Co.Sligo. Areas of Scientific Interest in Co.Sligo. (Preliminary report)*. An Foras Forbartha, Dublin. Unpublished report.

GOODWILLIE, R. 1976. *Condition of the second beach at Rosses Point, Co.Sligo with suggestions for management*. An Foras Forbartha, Dublin. Unpublished report.

GOODWILLIE, R. 1996. *Environmental Impact Study. Proposed Quarry Extension at Aughamore near Carrownamaddoo, County Sligo. Appendix A*. Roger Goodwillie & Associates, Kilkenny. Unpublished Report.

GOODWILLIE, R.N. 1992. *Turloughs over 10ha.: vegetation survey and evaluation*. National Parks and Wildlife Service, Dublin. Unpublished report.

GÖRANSSON, H. 1981. Pollen analytical investigations in Ballygawley Lough and Carrowkeel, Co.Sligo, Ireland. *In*: BURENHULT, G. *The Carrowmore Excavation Season 1981*. Stokholm Archaeological Reports No.8 Appendix 4, 180-195.

GÖRANSSON, H. 2002. Pollen analytical investigations in the Sligo area. *In*: TIMONEY, M.A. (ed.), *A Celebration of Sligo*. First Essays for Sligo Field Club. Sligo Field Club, Sligo.

GWYNN, A., RILEY, F. and STELFOX, A. 1940. Report On A Further Exploration (1929) Of The Caves Of Keshcorran Co. Sligo. *Proceedings Of The Royal Irish Academy* **46B**, 81-95.

HACKNEY, P., JAMES, K.W. and ROSS, H.G.C. 1983. *A list of the photographs in the R.J. Welch Collection in the Ulster Museum. Botany, Geology and Zoology* **2**. Ulster Museum, Belfast.

HARDMAN, E.T. 1880. On a travertine from Ballisodare, near Sligo, containing a considerable amount of strontium. *Journal of the Royal Geological Society of Ireland* **6**, 8-9.

HARDMAN, E.T. 1880. On a travertine from Ballisodare, near Sligo, containing a considerable amount of strontium. *Scientific Proceedings of the Royal Dublin Society* **3**, 12-13.

HARDMAN, E.T. 1881. Preliminary report on soundings taken in Lough Gill, Sligo. *Proceedings of the Royal Irish Academy Series 2* **3(69)**, 473-474.

HARDMAN, E.T. 1883. On the metamorphic rocks of Counties Sligo and Leitrim and the enclosed minerals with analysis of serpentine, &c, with microscopical notes on the serpentine by Prof. Hull. *Scientific Proceedings of the Royal Dublin Society* **3**, 1-14, (plate XXXIII).

HARTLEY, J.J. 1945. Notes on the "Yoredale rocks" of Tyrone. *Irish Naturalists' Journal* **8**, 255-260.

HAYES, R.J. (ed.). 1970. *Sources for the History of Irish Civilisation. Articles in Irish Periodicals. Volume 9. Places - Dates*. G.K. Hall & Co., Boston, Massachusetts.

HAZELTON, M. 1974. Irish hypogean fauna and biological records 1856-1971. Irish vice-county records of fauna collected from the hypogean and

related zones. *Transactions of the Cave Research group of Great Britain* **15(4)**, 203-215.

HELEY, T.P. 1980. *Application of statistical analysis to the Slieve Gamph granite pluton, Ireland*. Unpublished M. Phil. Thesis, Luton College.

HITZMAN, M.W. 1986. Geology of the Abbeytown mine, Co. Sligo, Ireland. *In*: ANDREW, C.J., CROWE, R.W.A., FINLAY, S., PENNELL, W.M. and PYNE, J.F. (eds.), *Geology and Genesis of Mineral Deposits in Ireland*. Irish Association for Economic Geology, Dublin.

HITZMAN, M.W. 1995. Mineralization in the Irish Zn-Pb-(Ba-Ag) orefield. *In*: ANDERSON, K., ASHTON, J., EARLS, G., HITZMAN, M. and TEAR, S. (eds.), *Irish Carbonate-Hosted Zn-Pb Deposits*. Society of Economic Geologists, Guidebook Series **21**, 25-61.

HITZMAN, M.W. and BEATY, D.W. 1996. The Irish Zn-Pb-(Ba) Orefield. *In*: SANGSTER, D.F. (ed.), *Society of Economic Geologists Special Publication No.* **4**.

HOBSON, B. 1913. Report of an excursion to West Mayo and the Sligo District. *Proceedings of the Geologists' Association* **24**, 78-86.

HOGARTY, P. 1976. *Geology of part of the Curlew Mountains of Counties Sligo and Roscommon*. Unpublished B.Sc. thesis, University of Dublin.

*HOLDEN, W. and BRINDLE, C. 1955. Caving In Co. Sligo. *Northern Pennine Club Newsletter*. **4**, 1-3.

*HOLDEN, W. and CROSSLEY, C. 1956. New Caves In Co. Sligo Ireland. *Speleologist* **1**,158-159.

HOLLAND, C.H. 1997. Reviews. Geology of Sligo-Leitrim by C.V. MacDermott, C.B. Long and S.J. Harney. *Irish Naturalists' Journal* **25(11/12)**, 466.

HOLLAND, C.H. (ed.). 2001. *The Geology of Ireland*. Dunedin Academic Press, Edinburgh.

HORNE, R.R. 1975. Possible transverse fault control of base metal mineralisation in Ireland and Britain. *Irish Naturalists' Journal* **18(5)**, 140-144.

HUBBARD, J.A.E.B. 1966. *The Ballyshannon Limestone and basal beds of the Carboniferous of North-west Ireland with particular reference to the conditions of deposition*. Unpublished Ph.D. Thesis, University of London (Bedford College).

HUBBARD, J.A.E.B. 1966. Facies patterns in the Carrowmoran Sandstone (Visean) of western County Sligo, Ireland. *Proceedings of the Geological Society* **77 (2)**, 233-254.

HUBBARD, J.A.E.B. 1966. Population studies in the Ballyshannon Limestone, Ballina Limestone, and Rinn Point beds (Viséan) of N.W. Ireland. *Palaeontology* **9**, 252-269.

HUBBARD, J.A.E.B. 1967. Organic evidence for small scale prediodicity in Visean limestone-shale sequences of Co. Sligo, Ireland. *7th International Sedimentary Congress*.

HUBBARD, J.A.E.B. 1970. Sedimentological factors affecting the distribution and growth of Viséan caninioid corals in north-west Ireland. *Palaeontology* **13**, 191-209.

HUBBARD, W.F. and SHERIDAN, D.J.R. 1965. The Lower Carboniferous stratigraphy of some coastal exposures in County Sligo, Ireland. *Scientific Proceedings of the Royal Dublin Society* **2**, 189-195.

HULL, E. 1878. *Physical Geology and Geography of Ireland*. London.

JENNETT, S. 1970. *Connacht; the counties Galway, Mayo, Sligo, Leitrim and Roscommon in Ireland*. Faber, London.

JONES, C.S. 1989. *The structure and kinematics of the Ox Mountains, Western Ireland; a mid-crustal transcurrent shear zone*. Unpublished Ph.D. thesis, University of Durham.

JONES, C.S. and LEAT, P.T. 1988. Discussion on trace element geochemical correlation in the reworked Proterozoic Dalradian metavolcanic suites of the western Ox Mountains and NW Mayo Inliers, Ireland. *Journal of the Geological Society, London* **145**, 1037-1040.

JONES, G.L. 1985. Top pots and rave caves 1984. *Irish Speleology* **3(2)**, 8-10.

JUKES, J.B. and FOOT, F.J. 1866. On the occurrence of flestone traps and ashes on the Curlew hills north of Boyle. *Journal of the Royal Geological Society of Ireland* **1**, 249-250.

KELLY, J. and JONES, G. Ll. 1995. Longest and deepest. *Irish Speleology* **15**, 36.

KENDALL, C.G. 1962. *The Geology of the Bricklieve Mountains and the Riverstown Anticline*. Unpublished B.Sc. thesis, University of Dublin.

KENNARD, A.S. and WOODWARD, B.B. 1903. The exploration of the caves of Kesh, County Sligo. Mollusca. *Transactions of the Royal Irish Academy* **32B**, 181-182.

KILGANNON, T. 1926. *Sligo and its Surroundings: a descriptive and pictorial guide to the history, scenery, antiquities and places of interest around Sligo*. Kilgannon & Sons Limited, Sligo.

KILROE, J.R. 1885. *Explanatory memoir to accompany sheet 55 of the maps of the Geological Survey of Ireland, comprising portions of the Counties of Sligo and Leitrim, with palaeontological notes by W.H. Baily, F.G.S*. Memoirs of the Geological Survey of Ireland.

KINAHAN, G.H. 1881. Report on the rocks of the Fintona and Curlew Mountains district. (With palaeontological remarks by W.H. Baily). *Proceedings of the Royal Irish Academy Series 2 Volume* **3**, 475-500 with 2 plates.

KINAHAN, G.H. 1882. Palaeozoic rocks of Galway and elsewhere in Ireland, said to be Laurentians. *Scientific Proceedings of the Royal Dublin Society* **3**, 348.

KINAHAN, G.H. 1886. Irish metamorphic rocks. *Geological Magazine* **3**, 7-10.

KINAHAN, G.H. and McHENRY, A. 1882. *A Handybook on the Reclamation of Waste Lands, Ireland*. Hodges Figgis & Co., Dublin.

KISSANE, S. 1976. *Quantitative evaluation of the composition of the perthites from the Ox Mountains*. Unpublished B.Sc. thesis, University of Dublin.

*KNIBBS, A. 1967. Notes On Lecarrow Swallet Co. Sligo Carrowmore Caves & St Augustines Cave Co. Cavan. *Journal of the Mendip Caving Group* **4**, 28-34.

*KNIBBS, A.J. 1967. Ireland - 1962. *Journal of the Mendip Caving Group* **4**.

LALLY, P. 1976. *Atomic spectrum studies of Garnets and Pyroxenes from the Ox Mountains*. Unpublished B.Sc. thesis, University of Dublin.

LARGE, A.R.G. 1991. The Slievenakilla bog-burst: investigations into peat loss and recovery on an upland blanket bog. *Irish Naturalists' Journal* **23(9)**, 354-359.

LEMON, G.G. 1952. The Moinian Inlier of Rosses Point, near Sligo. *Geological Magazine* **89**, 124-128.

LEMON, G.G. 1965. *The metamorphic rocks of the Sligo District, N.W. Ireland*. Unpublished Ph.D. thesis, University of Wales.

LEMON, G.G. 1966. Serpentinites in the NE Ox Mountains, Eire. *Geological Magazine* **103**, 124-137.

LEMON, G.G. 1971. The Pre-cambrian rocks of the N.E. Ox Mountains, Eire. *Geological Magazine* **108**, 193-200.

LONG, C.B. 1983. The Ox Mountains Inlier. The Central Ox Mountains Inlier. The Lough Anaffrin Area. *In*: ARCHER, J.B. and RYAN, P.D. (eds.), *Geological Guide to the Caledonides of Western Ireland*. Geological Survey of Ireland, Field Guide Series no. **4**, 47-50.

LONG, C.B. and MAX, M.D. 1977. Metamorphic rocks in the SW Ox Mountains inlier, Ireland; their structural compartmentation and place in the Caledonian orogen. *Journal of the Geological Society, London* **133**, 413-432.

LONG, C.B., MAX, M.D. and O'CONNOR, P.J. 1984. Age of the Lough Talt and Easky Adamellites in the central Ox Mountains, NW Ireland, and their structural significance. *Geological Journal* **19**, 389-397.

LONG, C.B., MAX, M.D. and YARDLEY, B.W.D. 1982, Compilation metamorphic map of Ireland: *In*: SCHENK, P.E. (ed.), *N.A.T.O. Advanced Study Institute on Regional Trends*, A.M.H. 425.

LONG, C.B. and McCONNELL, B.J. 1999. *Geology of South Donegal: a geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 3 and part of Sheet 4, South Donegal*. Geological Survey of Ireland, Dublin.

LONG, C.B. and YARDLEY, B.W.D. 1979. The distribution of pre-Caledonian basement in the Ox Mountains Inlier, Ireland. *In*: HARRIS, A.L., HOLLAND, C.H. and LEAKE, B.E. (eds.), *The Caledonides of the British Isles - reviewed*. Geological Society of London Special Publication **8**, 153-156.

LYELL, Sir C. 1886. "Account of the bursting of a peat moss near Bloomfield, Co.Sligo", being an extract from the "Principles of Geology" by the foregoing. *Journal of the Royal Hist. and Arch. Association of Ireland Series 4* **7(2)**, 668.

M'HENRY, A. 1903. Report on the Ox Mountain rocks and their probable continuation from Galway and Mayo into Donegal, Tyrone and Londonderry. *Proceedings of the Royal Irish Academy* **24B(11)**, 371-378.

MacDERMOT, C.V., LONG, C.B. and HARNEY, S.J. 1996. *A geological description of Sligo, Leitrim & adjoining parts of Cavan, Fermanagh, Mayo*

and Leitrim to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 7, Sligo-Leitrim. Geological Survey of Ireland, Dublin.

MacDERMOT, C.V., PHILCOX, M.E. and SEVASTOPULO, G.D.S. 1983, *Palaeontological Association Carboniferous Group: Field Conference in North-west Ireland, 15-18 April 1983*. Unpubl. Field Guide. 31pp.

MacINTYRE, R.M., McMENAMIN, T. and PRESTON, J. 1975. K-Ar results from western Ireland and their bearing on the timing and siting of Thulean magmatism. *Scottish Journal of Geology* **11**, 227-249.

MacMULLEN, T.W.J. 1976. *The geology of Kilmactranny, Co. Sligo*. Unpublished B.Sc. thesis, University of Dublin.

MATHYS, N. *et al*. 1963. *Knocknarea caves, Co.Sligo. 25 May 1963*. Dublin University Caving Club (caving group). Unpublished report.

MAX, M.D. 1984. Geology of the metamorphic rocks of the Rosses Point Inlier, County Sligo, Ireland. *Geological Survey of Ireland Bulletin* **3**, 221-227.

MAX, M.D., LONG, C.B. and SONET, J. 1976. The geological setting and age of the Ox Mountains Granodiorite. *Geological Survey of Ireland Bulletin* **2**, 27-35.

MAX, M.D., O'CONNOR, P.J. and LONG, C.B. 1984. New age data of the pre-Caledonian basement of the NE Ox Mountains and Lough Derg Inliers, Ireland. *Geological Survey of Ireland Bulletin* **3**, 206-209.

McCAFFREY, K.J.W. 1989. *The emplacement and deformation of granitic rocks in a transpressional shear zone: The Ox Mountains Igneous Complex*. Unpublished Ph.D. thesis, University of Durham.

McCAFFREY, K.J.W. 1992. Igneous emplacement in a transpressive shear zone: Ox Mountains igneous complex. *J. Geol. Soc. Lond.* **149**, 221-235.

McCAFFREY, K.J.W. 1994. Magmatic and solid state deformation partitioning in the Ox Mountains granodiorite. *Geol. Mag.* **131**, 639-652.

McARDLE, P. 1990. A review of carbonate-hosted base metal barite deposits in the Lower Carboniferous rocks of Ireland. *Chronique de la Recherché Miniere,* 500, 3-29.

McGEE, E. and BRADSHAW, R. 1990. Erosion of high level blanket peat. *In*: DOYLE, G.J. (ed.), *Ecology and Conservation of Irish Peatlands*. Royal Irish Academy, Dublin.

McGLOIN, A. and MOORE, S. (eds.), 1996. *Aspects of Geevagh and Highwood, County Sligo*. Arrow Community Enterprise/FAS, Sligo.

McGOWAN, J. 1993. *In the Shadow of Benbulben*. Aeolus/Drumlin Publications, Manorhamilton.

McGOWAN, J. 1998. *Inishmurray. Gale, Stone and Fire. Portrait of a fabled island*. Aeolus, Sligo.

McGRATH, W. 1958. The Mullaghmore barytes railway. *Journal of the Irish Railway Record Society* **5(22)**, 1-7.

McHENRY, A. 1903. Report on the Ox Mountain rocks and their probable continuation from Mayo into Donegal, Tyrone and Londonderry. *Proceedings of the Royal Irish Academy* **24B (4)**, 371-378.

McNESTRY, A. 1983. *A new species of* Craniocrinus wanner *from the Lower Carboniferous, Asbian, of County Sligo*. Unpublished B.Sc. thesis, University of Dublin.

*McSHEA, H. and McSHEA, J. 1969. Caving Expedition To Sligo August 1967. *Proceedings Of The University Of Bristol Speleological Society* **12**, (1), 113-116.

MITCHELL, F. 1976. *The Irish Landscape*. Collins, London.

MITCHELL, G.F. 1951. Studies in Irish Quaternary deposits. *Proceedings of the Royal Irish Academy* **53B**, 111-206 (with 4 plates).

MOHR, P. 1987. The Cill Ala dike swarm, Cos Sligo and Mayo: Physical parameters. *Irish Naturalists' Journal* **22(8)**, 326-334.

MOHR, P. 1988. Correspondence. Archdeacon Verchoyle and the geology of Cos Mayo and Sligo. *Irish Naturalists' Journal* **22(11)**, 497.

MOLLOY, M.A. and SANDERS, I.S. 1983. The NE Ox Mountains Inlier: The Coolaney area. *In*: ARCHER, J.B. and RYAN, P.D. (eds), *Geological Guide to the Caledonides of Western Ireland*. Geological Survey of Ireland, Field Guide Series no. **4**, 52-55.

MOORE, E.W.J. and HODSON, F. 1958. Goniatites from the Upper Viséan shales of County Leitrim, Eire. *Liverpool and Manchester geol. Journal* **2**, 86-105.

MOULD, D.D.C.P. 1976. *The Mountains of Ireland*. 2nd edition. Gill and Macmillan, Dublin.

MULHALL, M. 1979. *Garnet-clinopyroxene geothermometry of metabasites from the NE Ox Mountains, determining ferrous iron by Mossbauer Spectroscopy*. Unpublished B.Sc. thesis, University of Dublin.

MURPHY, M.E. 1980. *Management of Sand Dune Areas in the West of Ireland: a neglected aspect of Land Reform*. Unpublished M.Sc. thesis, The New University of Ulster.

*MURPHY, S., 1962. Expedition To The Counties Of Sligo And Leitrim. *Sheffield Uni. Spel. Society Report for 1962*.

NAUGHTON, M. 1983. Pollution at Teesan Springs, Co. Sligo - a case study. *Irish Journal of Environmental Science* **2(2)**, 52-56.

NAWAZ, R. 1972. Deweylite from Inishcrone, Co. Sligo, *The Scientific Proceedings of the Royal Dublin Society* **4,** 371-372.

NAWAZ, R. 1974. Killalaite, a new mineral from Co.Sligo, Ireland. *Mineral Mag*. **39**, 544-548.

NEWTON, E.T. 1903. The exploration of the caves of Kesh, County Sligo. Birds. *Transactions of the Royal Irish Academy* **32B**, 184-186.

NI SCANNLAIN, B. 1979. *Comparitive geochemistry of the metabasites of the Lough Derg Inlier and the NE Ox Mountains*. Unpublished B.Sc. thesis, University of Dublin.

NICHOLS, G. and JONES, T. 1992. Fusain in Carboniferous shallow marine sediment, Donegal, Ireland: the Sedimentological effects of wildfire. *Sedimentology* **39**, 487-502.

NUNN, J.D. (compiler). 2000. *Programme. Irish Field Club Union. Sligo Meeting. 18-23 August 2000*. Belfast Naturalists' Field Club.

O'SULLIVAN, J., CONNOLLY, N., COTTON, D. and HERAUGHTY, M. 2002. *Inishmurray. An island off County Sligo*. Archaeology Ireland, Heritage Guide No.**18**.

OSWALD, D.H. 1952. *The Carboniferous rocks between the Ox Mountains and Donegal Bay*. Unpublished Ph.D. thesis, University of Glasgow.

OSWALD, D.H. 1955. The Carboniferous rocks between the Ox Mountains and Donegal Bay. *Quarterly Journal of the Geological Society of London* **111**, 167-186.

PANKHURST, R.J., ANDREWS, J.R., PHILLIPS, W.E.A., SANDERS, I.S. and TAYLOR, W.E.G. 1976. Age and structural setting of the Slieve Gamph

Igneous Complex, Co.Mayo, Eire. *Journal of the Geological Society of London* **132**, 327-334.

PHILLIPS, W.E.A. 1981. The Pre-Caledonian basement. *In*: HOLLAND, C.H. (ed.), *A Geology of Ireland*. Scottish Academic Press.

PHILLIPS, W.E.A. 1983. The Ox Mountains Inlier. Introduction. *In*: ARCHER, J.B. and RYAN, P.D. (eds.), *Geological Guide to the Caledonides of Western Ireland*. Geological Survey of Ireland, Field Guide Series no. **4**, 45-47.

PHILLIPS, W.E.A. 1983. Central Ox Mountains Inlier: The Callow area. *In*: ARCHER, J.B. and RYAN, P.D. (eds.), *Geological Guide to the Caledonides of Western Ireland*. Geological Survey of Ireland, Field Guide Series no. **4**, 50-52.

PHILLIPS, W.E.A., TAYLOR, W.E.G. and SANDERS, I.S. 1975. An analysis of the geological history of the Ox Mountains Inlier. *Scientific Proceedings of the Royal Dublin Society Series A* **5**, 311-329.

*POWELL, R. 1958. Irish Discoveries (Geevagh & Drumshanbo). *Journal Of The Craven Pothole Club* **2**, 218-219.

PRAEGER, R.L. 1896. Irish caves. *Irish Naturalist* **5**, 123-124.

PRAEGER, R.L. 1897. Bog-bursts, with special reference to the recent disaster in Co.Kerry. *Irish Naturalist* **6**, 141-162.

PRAEGER, R.L. 1903. The exploration of the caves of Kesh, County Sligo. Introduction. *Transactions of the Royal Irish Academy* **32B**, 171-174.

PRAEGER, R.L. 1903. The exploration of the caves of Kesh, County Sligo. Summary of results. *Transactions of the Royal Irish Academy* **32B**, 213-214.

PYNE, J.F. 1972. *The geology of the metamorphic rocks between Collooney and the Ladies Brae (Co. Sligo)*. Unpublished M.Sc. thesis, University of Dublin (TCD).

QUINN, A.C.M. 1972. *Sand dunes at Rosses Point, Co.Sligo*. An Foras Forbartha, Dublin. Unpublished report.

QUINN, A.C.M. 1977. *Sand Dunes. Formation, Erosion and Management*. An Foras Forbartha, Dublin.

READ, R.E.H. 1963. *Spiractinella hinde* is a demosponge. *Irish Naturalists Journal* **14**, (7) 129-131.

REFFAY, A. 1967. Tourbieres et morphologie kerstique dans la region de Sligo (Irlande). Quelques observations sur la decomposition des calcaires sous la tourbe dans la region de Sligo, Irlande. *Revue de Geographie* **56**, 521-527.

SANDERS, I.S. 1979. Observations on eclogite- and granulite-facies rocks in the basement of the Caledonides. *In*: HARRIS, A.L., HOLLAND, C.H. and LEAKE, B.E. (eds.), *The Caledonides of the British Isles Reviewed*. Geological Society of London Special Publication **8**, 96-100.

SANDERS, I.S., DALY, J.S. and DAVIES, G.R. 1987. Late Proterozoic high-pressure granulite facies metamorphism in the north-east Ox inlier, north-west Ireland. *Journal of Metamorphic Geology* **5**, 69-85.

SCHARFF, R. F. 1895. Cave At Ballymote Co. Sligo. *Irish Naturalist* **4**, 94.

SCHARFF, R. F. 1902. The Exploration Of Kesh Caves Co. Sligo Ireland. *Geological Magazine* **9**, 505-510.

SCHARFF, R.F. 1903. The exploration of the caves of Kesh, County Sligo. Fishes. *Transactions of the Royal Irish Academy* **32B**, 183.

SCHARFF, R.F. 1903. The exploration of the caves of Kesh, County Sligo. Amphibians. *Transactions of the Royal Irish Academy* **32B**, 183-184.

SCHARFF, R.F. 1903. The exploration of the caves of Kesh, County Sligo. Mammals (exclusive of Man). *Transactions of the Royal Irish Academy* **32B**, 189-207.

SCHARFF, R.F., COFFEY, G., COLE, G.A.J., USSHER, R.J. and PRAEGER, R.L. 1903. The Exploration Of The Caves Of Kesh, County Sligo, *Transactions Of The Royal Irish Academy* **32 B**, 171-214.

SCHWARZACHER, W. 1961. Petrology and structure of some Lower Carboniferous reefs in north-west Ireland. *American Association of Petrol. Geol. Bulletin* **45**, 1481-1503.

SCHWARZACHER, W. 1964. An application of statistical time-series analysis of a limestone-shale sequences. *Journal of Geology* **72**, 195-213.

SCHWARZACHER, W. 1968. The vertical and lateral variation of a Carboniferous Limestone area near Sligo (Ireland). *In*: ROMANOVA, M.A. and SARMONOY, O.V. (eds.), *Topics in Mathematical Geology*. Consultants Bureau, New York.

SEEDS, W.E. and POOLE, J.H.J. 1946. The magnetic properties of the serpentine deposits in the Slishwood Gap, County Sligo, Ireland. *Scientific Proceedings of the Royal Dublin Society* **24(15)**, 135-148.

SEYMOUR, H.J. 1906. Papers relating to Irish geology. Published during the years 1903, 1904 and 1905. *Irish Naturalist* **15**, 6-11.

SHERIDAN , M. 1980. *Sulphide mineralogy of Abbeytown Mine, Co. Sligo*. Unpublished B.Sc. thesis, University of Dublin.

STCHOUZKOY, T. 1967. Tourbieres et morphologie kerstique dans la region de Sligo (Irlande). Les eaux de tourbieres de la region de Sligo. *Revue de Geographie* **56**, 527-531.

STEPHENS, N and GLASSCOCK, R.E. (eds.). 1970. *Irish Geographical Studies*. Department of Geography, Queen's University of Belfast.

SYMES, R.G. 1879. *Explanatory memoir to accompany sheets 41, 53, and 64 of the maps of the Geological Survey of Ireland, including the country around Ballina, Crossmolina, Killala, Foxford and, Ballycastle, with palaeontological notes by W.H. Baily, F.G.S*. Memoirs of the Geological Survey of Ireland.

SYMES, R.G. and KILROE, J.R. 1880. *Explanatory Memoir to accompany sheet 54, and the south-west portion of 42 of the maps of the Geological Survey of Ireland, including the country around Easky, Dromore West and Colooney, in the Counties of Sligo and Mayo, with palaeontological notes*. Memoirs of the Geological Survey of Ireland.

SYMES, R.G., WILKINSON, S.B. and KILROE, J.R. 1881. *Explanatory memoir to accompany sheet 65 of the maps of the Geological Survey of Ireland, including the country around Tobercurry, Swinford and Bellahy, or Charlestown, in the Counties of Sligo and Mayo, with palaeontological notes by W.H. Baily F*. Memoirs of the Geological Survey of Ireland.

TAYLOR, W.E.G. 1966. *The structural history of the metamorphic and igneous rocks of Slieve Gamph, western Ireland*. Unpublished Ph.D. thesis, University of Sheffield.

TAYLOR, W.E.G. 1968. The Dalradian rocks of Slieve Gamph, western Ireland. *Proceedings of the Royal Irish Academy* **67B**, 63-82 (with 1 plate).

TAYLOR, W.E.G. 1969. The structural geology of the Dalradian rocks of Slieve Gamph, Cos. Mayo and Sligo, western Ireland. *Geologische Rundschau* **58**, 564-587.

THIRLAWAY, H. 1951. Measurement Of Gravity In Ireland: Gravimeter observations between Dublin, Sligo, Galway and Cork. *Dublin Institute For Advanced Studies, Geophyisical Memoirs* **2(2)**, 1-26.

THORN, R. 1985. Aspects Of The Geology And Geomorphology Of The north Sligo/north Leitrim Border. *Geographical Viewpoint* **13**, 46-53.

THORN, R. (ed.). 1985. Sligo and West Leitrim. *Irish Association for Quaternary Studies. Field Guide No*. **8**.

*THORN, R. 1987. The Geevagh Karst. *Irish Speleology* **4(1)**, 19-22.

THORN, R. 1989. Position, geology, soils and climate of Inishmurray. *In*: COTTON, D.C.F. (ed.), *The Heritage of Inishmurray*. Regional Technical College, Sligo.

THORN, R. 2002. Benbulbin - Geology and scenery. *In*: TIMONEY, M.A. (ed.), *A Celebration of Sligo. First Essays for Sligo Field Club*. Sligo Field Club, Sligo.

THORN, R. and COXON, C. 1989. Groundwater quality in karst areas of Ireland. *Irish Speleology* **13**, 32-35.

THORN, R., DOYLE, M. and HENRY, H. 1986. *The Groundwater Resources of South County Sligo – A Preliminary Appraisal*. Sligo Regional Technical College Report **86**/**1**.

THORN, R., DREW, D. and COXON, C. 1990. The Hydrology And Caves Of The Geevagh And Bricklieve Karsts Co. Sligo. *Irish Geography* **23 (2)**, 120-135.

THORN, R.H. 1986. *A preliminary assessment of dune and beach erosion in the vicinity of Strandhill, Co. Sligo*. Strandhill Development Association. Unpublished report.

TIETZSCH-TYLER, D. 1996. *Geology and landscapes in Yeats country: ancient Earth's crust and tropical seas*. Pamphlet, Geological Survey of Ireland and Bord Fáilte.

TOHALL, P. 2002. The surroundings of Truskmore. *In*: TIMONEY, M.A. (ed.), *A Celebration of Sligo. First Essays for Sligo Field Club*. Sligo Field Club, Sligo.

TOHER, T. 1994. *Exploring Sligo and North Leitrim. 70 walks in the Yeats Country*. Sligo Chamber of Commerce & Industry, Sligo.

TRATMAN, E.K. and HAZELTON, M. 1974. Irish hypogean fauna and biological records 1856-1971. Notes on the Irish cave sites from which fauna has been collected. *Transactions of the Cave Research group of Great Britain* **15(4)**, 217-222.

USSHER, R. 1902. The British Association in Belfast. Report of the committee appointed to explore Irish Caves. *Irish Naturalist* **11**, 272-273.

USSHER, R. 1904. Summary Of Kesh & Co. Clare Cave Excavations, *Irish Naturalist* **13**, 3.

USSHER, R.J. 1903. The exploration of the caves of Kesh, County Sligo. Narrative of the investigations. *Transactions of the Royal Irish Academy* **32B**, 174-178.

USSHER, R.J. 1903. The exploration of the caves of Kesh, County Sligo. Remarks on the birds. *Transactions of the Royal Irish Academy* **32B**, 187-189.

USSHER, R.J. 1906. Discoveries in Irish and other bone caves. *Journal of the Waterford and south east Ireland Archaeological Society* **9**, 1-11.

USSHER, R.J. 1910. Cave hunting. *Irish Naturalist* **19**, 37-43.

VAN DER FLIER, E. 1979. *Garnet-clinopyroxene geothermometry of metabasites from the NE Ox Mountains Inlier, determining ferrous iron by wet chemical methods*. Unpublished B.Sc. thesis, University of Dublin.

VERSCHOYLE, Archdeacon 1838. Notices on the geology of the north coast of the counties of Mayo and Sligo in Ireland. *Transactions of the Geological Society of London* (2nd Series) **5(11)**, 149-170 (with 1 map).

WARNEKE, K. 1994. Die under-karbonischen Mudmounds in den Counties Sligo und Leitrim, Nordwest-Irland, Fazies Bildungsbedingungen und Diagenese. *Documenta Naturae* **88**, 1-72.

WARNEKE, K. 1995. Calcification processes of siliceous Sponges in Viséan limestones (Counties Sligo and Leitrim, Northwestern Ireland). *Facies* **33**, 215-228.

WHITTOW, J.B. 1975. *Geology and Scenery in Ireland*. Penguin, Harmondsworth.

WILLIAMS, C.E. and McARDLE, P. 1978. Ireland. *In*: BOWIE, S.H.U., KVALHEIM, A. & HASLAM, H.W. (eds.), *Mineral Deposits of Europe. Volume 1 Northwest Europe*. Institution of Mining and Metallurgy.

WILLIAMS, P.W. 1966. Limestone pavements: with special reference to western Ireland. *Trans. Inst. Brit. Geog.* **40**, 155-172.

*WILSON, R. 1965. Notes On Some Caves On Knockarea Co. Sligo. *Irish Speleology* **1 (1)**, 18.

WINCHESTER, J.A. and MAX, M.D. 1988. Pre-Dalradian rocks in NW Ireland. *In*: WINCHESTER, J.A. (ed.), *Later Proterozoic stratigraphy of the northern Atlantic regions*. Blackie, Glasgow and London.

WINCHESTER, J.A., MAX, M.D. and LONG, C.B. 1987. Trace element geochemical correlation in the reworked Proterozoic Dalradian metavolcanic suites of the western Ox Mountains and NW Mayo Inliers, Ireland. *In*: PHARAOH, T.C., BECKINSDALE, R.D. and RICKARD, D. (eds.), *Geochemistry and Mineralization of Proterozoic Volcanic Suites*. Geol. Soc. Lond. Spec. Publ. **33**, 489-502.

WOOD-MARTIN, W.G. 1882-1892. *History of Sligo, county and town. Volumes 1-3*. Hodges Figgis & Co., Dublin.

WOODMAN, P.C. 2002. The search for an Irish Palaeolithic: Rosses Point revisited. *In*: TIMONEY, M.A. (ed*.), A Celebration of Sligo. First Essays for Sligo Field Club*. Sligo Field Club, Sligo.

WOODMAN, P.C. and MONAGHAN, N. 1993. From mice to mammoths. Dating Ireland's earliest faunas. *Archaeology Ireland* **7(3)**, 31-33.

WRIGHT, J.W. 1881. Sponge remains from the Carboniferous limestone of Ben Bulben, Co.Sligo. *Proceedings of the Belfast Naturalists' Field Club* **N.S.2 Appendix 4, 1880-1881**, 189-190.

WYNNE, A.B. 1863. On the geology of parts of Sligo etc. *Journal of the Geological Society of Dublin* **10**, 33-41.

WYNNE, A.B. 1885. *Explanatory memoir to accompany sheets 42 and 43 of the maps of the Geological Survey of Ireland, comprising portions of the Counties of Sligo and Leitrim, with palaeontological notes by W.H. Baily, F.G.S*. Memoirs of the Geological Survey of Ireland.

YARDLEY, B.W.D., BARBER, J.P. and GRAY, J.R. 1987. The metamorphism of the Dalradian rocks of western Ireland and its relation to tectonic setting. *Philosophical Transactions of the Royal Society* **A321**, 243-270.

YATES, P.J. 1962. The palaeontology of the Namurian rocks of Slieve Anierin, Co. Leitrim, Eire. *Palaeontology* **5**, 355-443.

YOUNG, R. 1977. *Coastal erosion and suggestions for site management at Streedagh and Mullaghmore, together with brief comments on problems at Rosses Point, Strandhill and Inishcrone*. An Foras Forbartha, Dublin. Unpublished report.

Further sources of information

The GSI now has the expertise, knowledge and experience to be able to assist Local Authorities in all matters relating to geological heritage, including incorporation into Development and Heritage Plans. A document outlining generic issues for all local authorities is available on request. For further information or advice please contact:
Matthew Parkes [01-6782858 : matthew.parkes@gsi.ie]

or download from the IGH section of the GSI web site at:
www.gsi.ie/workgsi/heritage/heritage-frame.htm
[please note the precise URL may change as the GSI website evolves]

GSI publishes a very wide range of maps, reports and products on various aspects of geology, some of which will include information relevant to specific interests, even if they are not specifically about Sligo. For information about such paper products, visit the GSI website
www.gsi.ie

In addition local specialists who may have information or references related to this report include:

Ms Siobhán Ryan
Heritage Officer
Sligo County Council

Dr Don Cotton & Mr Eamonn Grennan
Department of Environmental Science
Institute of Technology
Sligo

Ms Miriam Crowley, Mr Robert Lundy & Mr Tim Roderick
Conservation Rangers
National Parks and Wildlife Service

Additional sites

The sites included here are those which have been considered by the relevant Expert Panel of each Irish Geological Heritage Programme theme. Inevitably additional sites may be put forward locally or subsequently to the completion of this report. Several additional sites have recently been drawn to the attention of the authors by Dr Don Cotton of Sligo Institute of Technology. They include:

Colgagh Lough NHA – collapsed doline and shallow hole underwater
Lough Achree & Lough Minnaun on Knockachree/Knockalongy SAC – corrie lakes
Donagh Point – dykes
Raghly – blowholes
Ardnaglass Bridge – glacio-fluvial deposits with cross-bedding in quarry face
Dunneill river gorge NHA – tufa deposits, dyke-guided gorge
Strandhill / Inishcrone / Lower Rosses SAC's – sand spits
Turloughmore – turlough

Field examination by the authors or other IGH Programme staff of these site proposals to assess the geological interest is outside the scope of this project but could be undertaken in due course. Where an existing designation is present such as SAC or NHA, it is highly desirable to fully represent the geological or geomorphological component of the natural interest, as well as any biological features.

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Siobhan Ryan and Lisa Henry of the Sligo Heritage Office are thanked for their contributions and enthusiasm for this Heritage Plan Action. The Heritage Office also supported Matthew Parkes in giving an oral presentation of the project results at the Sligo Heritage Seminar in November 2003. Sophie Preteseille of the Irish Geological Heritage Programme also assisted with this project and GSI Cartograhic Unit staff, Padraig Connaughton, John Dooley and Ray Weafer assisted with scanning of images etc. Martin Timoney and other members of the Sligo Field Club are thanked for their suggestions and especially for information on the shell deposits at Culleenamore Strand. Dr Don Cotton of the Department of Environmental Science at Sligo Institute of Technology undertook a patient review of the report and is thanked for many useful improvements and additional references.

Site Reports – General Points

The following site reports are brief non-technical summaries of the proposed County Geological Sites for Sligo. 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, or two extreme points at opposite ends of the site. They are only indicative of the location, but the site extent is best shown on a map.

A map is provided with an outline of the site boundary. It is important to note that no legal or definitive basis should be based on these boundaries. They are indicative only of the limits of exposure or of geological interest, and not based on detailed field surveys, which were outside the scope of this contract.

For sites that have been proposed or will be proposed for NHA designation detailed site boundary maps will become available to the Local Authority, through NPWS as the designation process is undertaken. Some areas such as the Bricklieves and Keshcorran will already be available as they are proposed NHAs (pNHA), preceding 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 the wider area 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 makes recommendations to 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 Matthew Parkes at the Irish Geological Heritage Programme, in the Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4.
Phone 01-6782858. Email: matthewparkes@gsi.ie

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Benbulben**		
Other names used for site			
TOWNLAND(S)	many		
NEAREST TOWN	Grange		
SIX INCH MAP NUMBER	5		
NATIONAL GRID REFERENCE	169000 346000 = G 69 46		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

Outline Site Description
The Benbulben Plateau

Geological System/Age and Primary Rock Type
Lower Carboniferous limestones and shales.

Main Geological or Geomorphological Interest
The Benbulben Shale Formation (which overlies the Mullaghmore Sandstone Formation) is well exposed on the lower slopes of Benbulben and in some stream sections. Limestones defining the base of this formation are succeeded by a 90m package of thinly bedded black shales with occasional impure limestone bands. The shales are rich in fossils including brachiopods, corals, bryozoa, and caniniids. The top of the formation is characterized by the reappearance of limestone beds. A transitional phase from predominantly deltaic sedimentation to predominantly carbonate sedimentation is reflected in the overlying limestone and shale of the Glencar Limestone Formation. The gradual upward transition from the Benbulben Shale Formation to the Glencar Limestone Formation is well exposed in a stream section at Tievebaun (GR 17730 35080). Individual Glencar limestone beds average 10cm-20cm in thickness. Some beds are bioturbated (reflecting the burrowing activity of the organisms that lived in the sediment) and fossils are locally abundant. Overlying the Glencar Formation are the blue/grey limestones of the Dartry Limestone Formation. The limestone here is rich in fossils and also contains blue/grey nodules of chert, which formed during compaction and lithification early in the rocks history. A mud-bank limestone mound caps the Benbulben range. This upstanding structure could have formed in an environment analogous to modern day coral reefs.

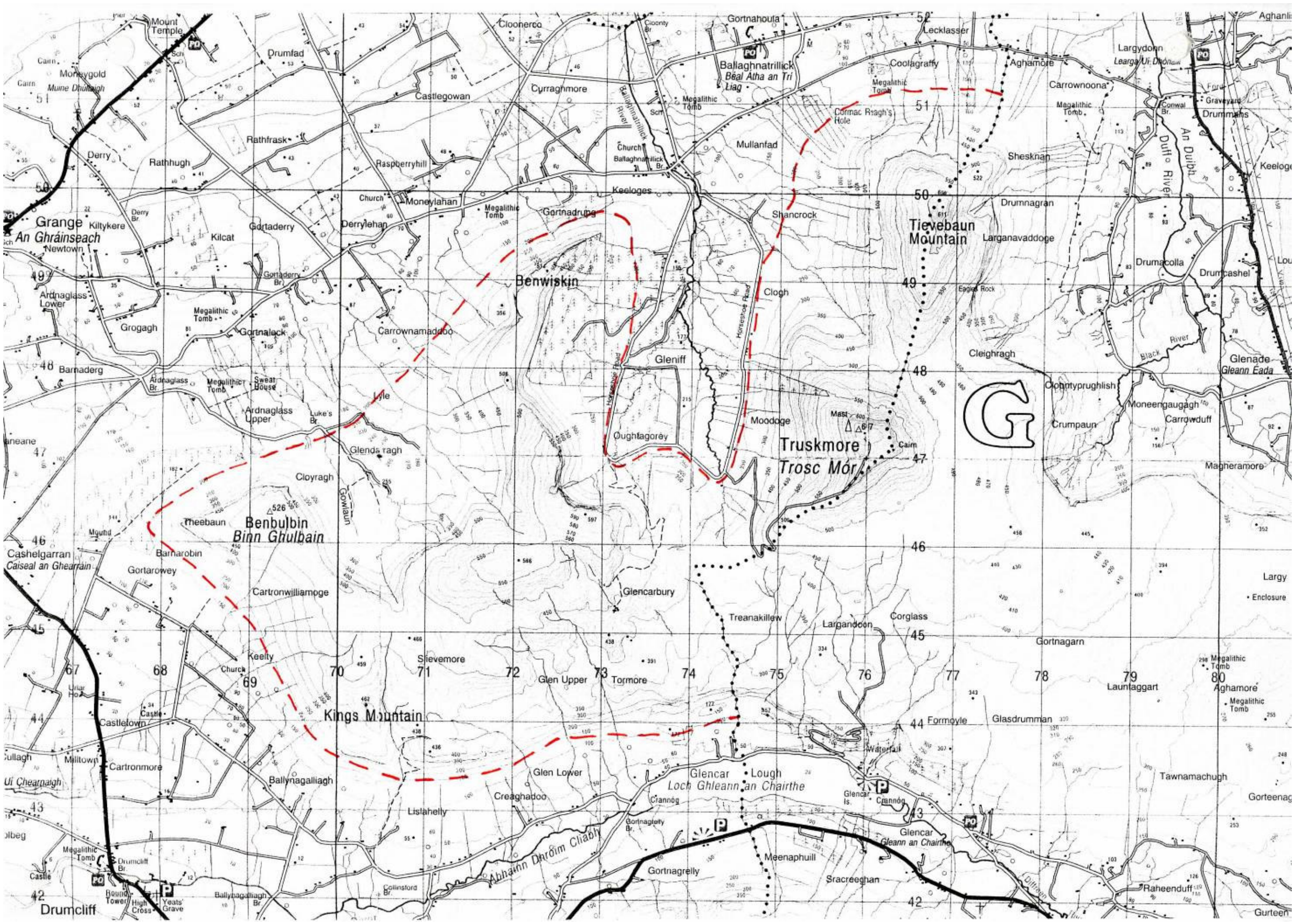
As well as excellent exposures of Carboniferous rocks Benbulben displays important quaternary structures including Nunatak landscapes (where an isolated rock peak projects through an ice-sheet) and scree slopes.

Site Importance
This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made.

Management/promotion issues
Ben Bulben is an icon for Sligo that may be under no threat of damage, but needs to be protected as a landscape feature from inappropriate development such as houses at its base or other visually intrusive changes. As a representative geological section, the whole plateau is important, and individual parts such as Ben Whiskin are as significant as Ben Bulben itself.

Ben Bulben from the south.
Photo: Matthew Parkes.

Benbulben


Benbulbin
Binn Ghulbain
Benwiskin
Truskmore
Trosc Mór
Tievebaun Mountain
Kings Mountain
Glencar Lough
Loch Ghleann an Chairthe
Grange
An Ghráinseach
Drumcliff
Gleniff
Glencarbury
Cloyragh
Slievemore
Gortnagarn
Cleighragh
Glenade
Gleann Éada

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Truskmore**		
Other names used for site			
TOWNLAND(S)	Moodoge		
NEAREST TOWN	Cliffony		
SIX INCH MAP NUMBER	6		
NATIONAL GRID REFERENCE	176000 347400 = G 76 474		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

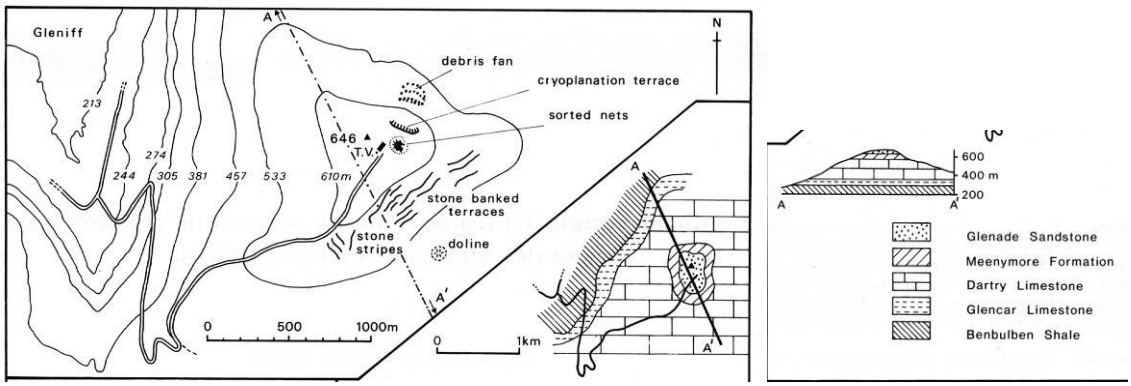
Outline Site Description
Exposures of rock weathering features adjacent to summit of Truskmore.

Geological System/Age and Primary Rock Type
Remnant periglacial features which formed during the later stages of the last glaciation (the Midlandian Glaciation) approximately 10,000 years ago.

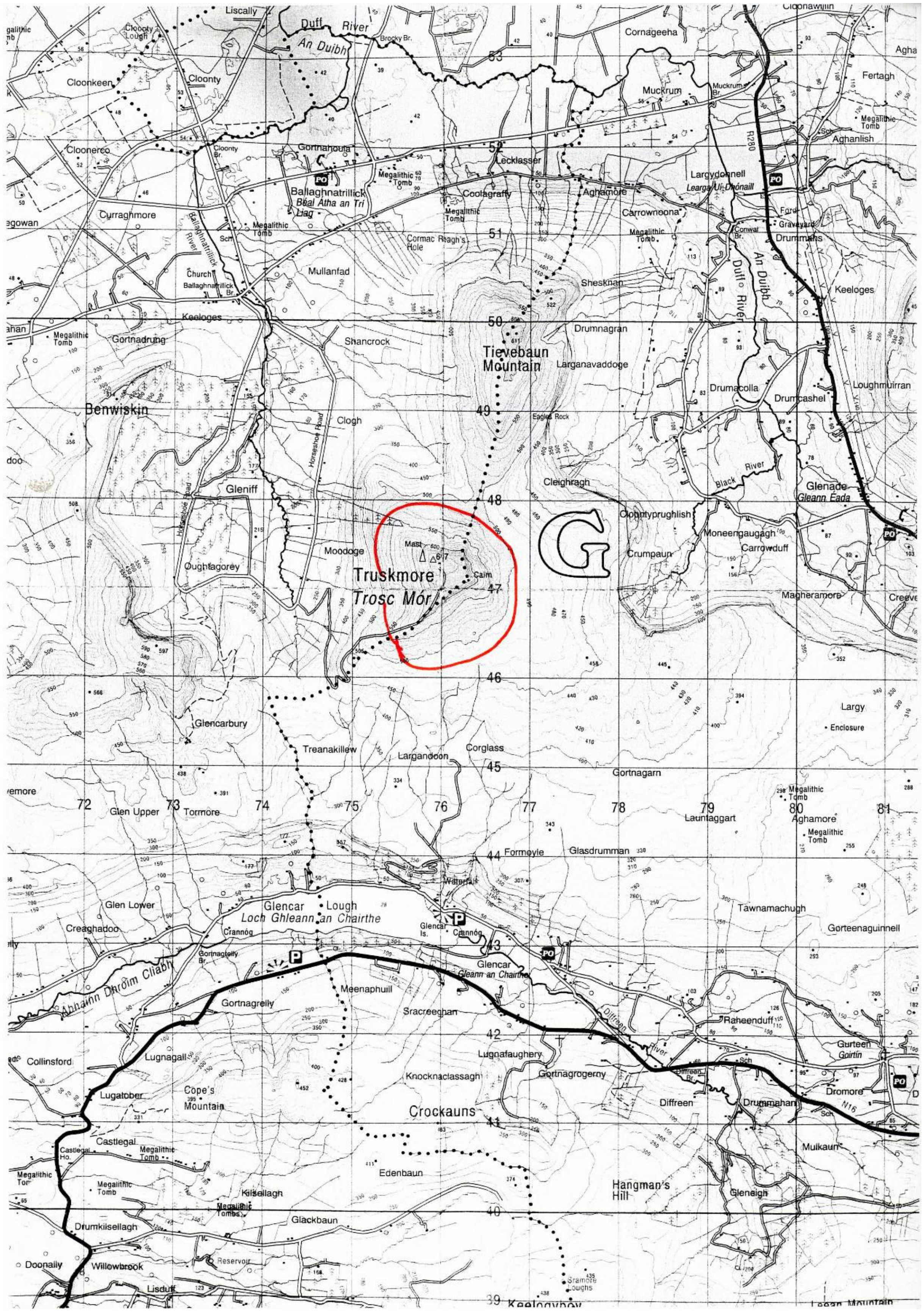
Main Geological or Geomorphological Interest
A thin layer of horizontally bedded, lower Carboniferous Glenade Sandstone caps the summit of Truskmore producing a flat plateau area above the less resistant Meenymore evaporites and Dartry Limestone. Remnant periglacial features flank the sandstone plateau including sorted nets, stone banked terraces, stone stripes and a bedrock terrace with associated debris fan. Sorted nets displaying a fish-net-tights-pattern are exposed close to the summit of Truskmore. The nets occur as vegetated centres with stone borders and exhibit varying diameter sizes from approximately 1m-5m. They probably formed due to frost sorting and heave. The stone borders, consisting of Glenade sandstone clasts ranging in size from pebble to boulder, are quite angular indicating that they have not travelled far from their source. The northeastern side of the plateau hosts a 120m long bedrock terrace that has been cut into the Glenade sandstone as a result of frost shattering. A large debris fan associated with the terrace covers the slope below. Mass movement of weathered Glenade sandstone has produced stone stripes (up to 4m wide and 100m long) and stone banked terraces on the southeastern side of Truskmore. These features formed as seasonally thawed material moved slowly downslope under the influence of gravity. It is believed that the summit of Truskmore remained ice-free during the last glaciation allowing for the many freeze-thaw cycles required to shatter and move the local bedrock.

Site Importance
This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made.

Management/promotion issues
Any disturbance will damage the scientific value of the patterned ground, including roads or trackways, windfarm development, use of off-road vehicles over these features.



Truskmore


Liscally
Duff River
An Duibh
Cornageeha
Cloonkeen
Cloonty
Muckrum
Fertagh
Cloonerco
Gortnahoula
Lecklasser
Aghanlish
Ballaghnatrillick
Béal Átha an Trí Liag
Coolagrafty
Aghamore
Largydonnell
Carrownoona
Curraghmore
Megalithic Tomb
Cormac Reagh's Hole
Church
Mullanfad
Sheskinan
Keeloges
Gortnadrung
Shancrock
Drumnagran
Tievebaun Mountain
Larganavaddoge
Benwiskin
Clogh
Eagles Rock
Drumacolla
Drumcashel
Loughmuirran
Black River
Gleniff
Cleighragh
Glenade
Gleann Éada
Cloontypruglish
Moneengaugagh
Carrowduff
Moodoge
Mast
Oughtagorey
Truskmore
Trosc Mór
Cairn
Crumpaun
Magheramore
Creeve
Glencarbury
Largy
Enclosure
Treanakillew
Corglass
Largandoon
Gortnagarn
Glen Upper
Tormore
Launtaggart
Aghamore
Formoyle
Glasdrumman
Waterfall
Glen Lower
Glencar Lough
Loch Ghleann an Chairthe
Tawnamachugh
Creaghadoo
Glencar
Gleann an Chairthe
Gorteenaguinnell
Meenaphuill
Gortnagrelly
Sracreeghan
Raheenduff
Collinsford
Lugnagall
Lugnafaughery
Gortnagrogerny
Gurteen
Lugatober
Cope's Mountain
Knocknaclassagh
Diffreen
Drummahan
Dromore
Castlegal
Crockauns
Mulkaun
Edenbaun
Hangman's Hill
Kilsellagh
Gleneigh
Glackbaun
Drumkilsellagh
Doonally
Willowbrook
Reservoir
Lisduff
Sramore Loughs
Keeloguboy

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**King's Mountain Rift**		
Other names used for site			
TOWNLAND(S)	Ballynagalliagh, Lislahelly		
NEAREST TOWN	Drumcliff		
SIX INCH MAP NUMBER	8, 9		
NATIONAL GRID REFERENCE	170900 343700 = G 709 437		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

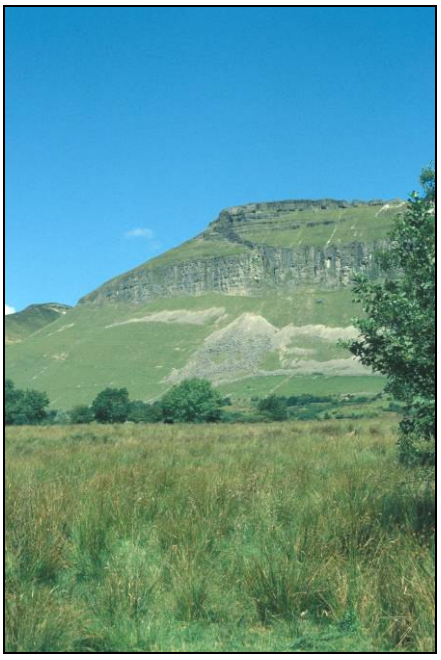
Outline Site Description
Long linear rift in the mountainside.

Geological System/Age and Primary Rock Type
The rift is in Carboniferous limestone, but probably formed at the end of the Ice Age c. 10,000 years ago.

Main Geological or Geomorphological Interest
This rift is like the Glen on Knocknarea and the Swiss Valley at Glencar in that it results from the same process – removal of ice support from oversteepened hill sides leading to slope failure. Like the Glen, this rift has moved only a few metres before stabilising. Parallel sided walls sometimes only 2-3 metres apart provide a long straight canyon, whose lower end appears in the cliff face as a cave due to some toppling of the higher walls.

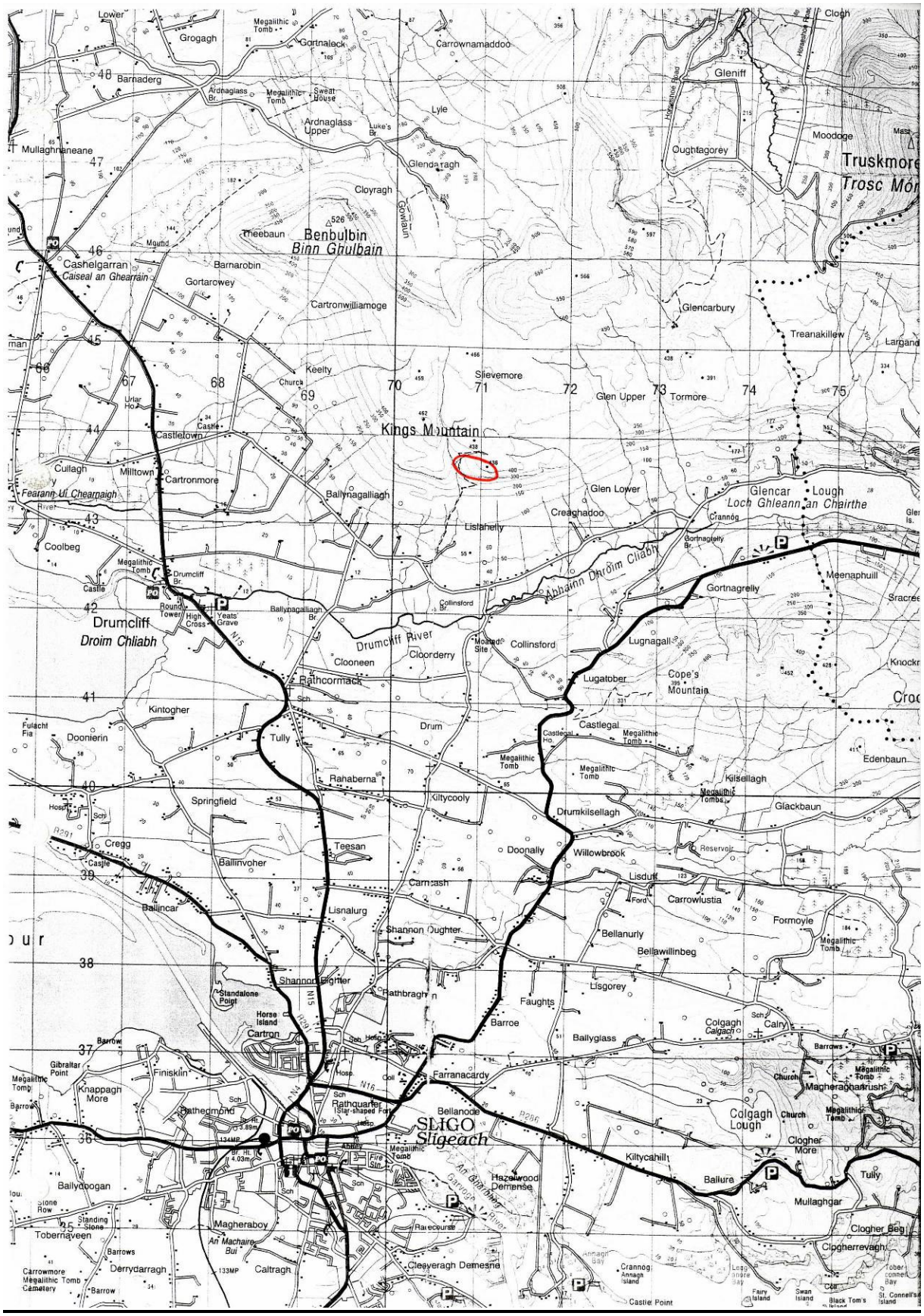
Site Importance
Massive features of mass movement, especially from glacial oversteepening, are not common in Ireland and Sligo has some of the best in this site and the Glen and Swiss Valley. It is certainly a County Geological Site in its own right. This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made.

Management/promotion issues
Access may be an issue if the site was promoted at all, but there may be a public right of way to the site, from the path marked on the 1:50,000 OS map.



View of King's Mountain Rift from Glencar road. Photo: Matthew Parkes.

King's Mountain Rift



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Swiss Valley**		
Other names used for site	Glencar		
TOWNLAND(S)	Tormore		
NEAREST TOWN	Drumcliff		
SIX INCH MAP NUMBER	9		
NATIONAL GRID REFERENCE	174000 344000 = G 74 44		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

Outline Site Description
Mass movement landscapes.

Geological System/Age and Primary Rock Type
10,000-year-old ice-sculpted valley side with landslips.

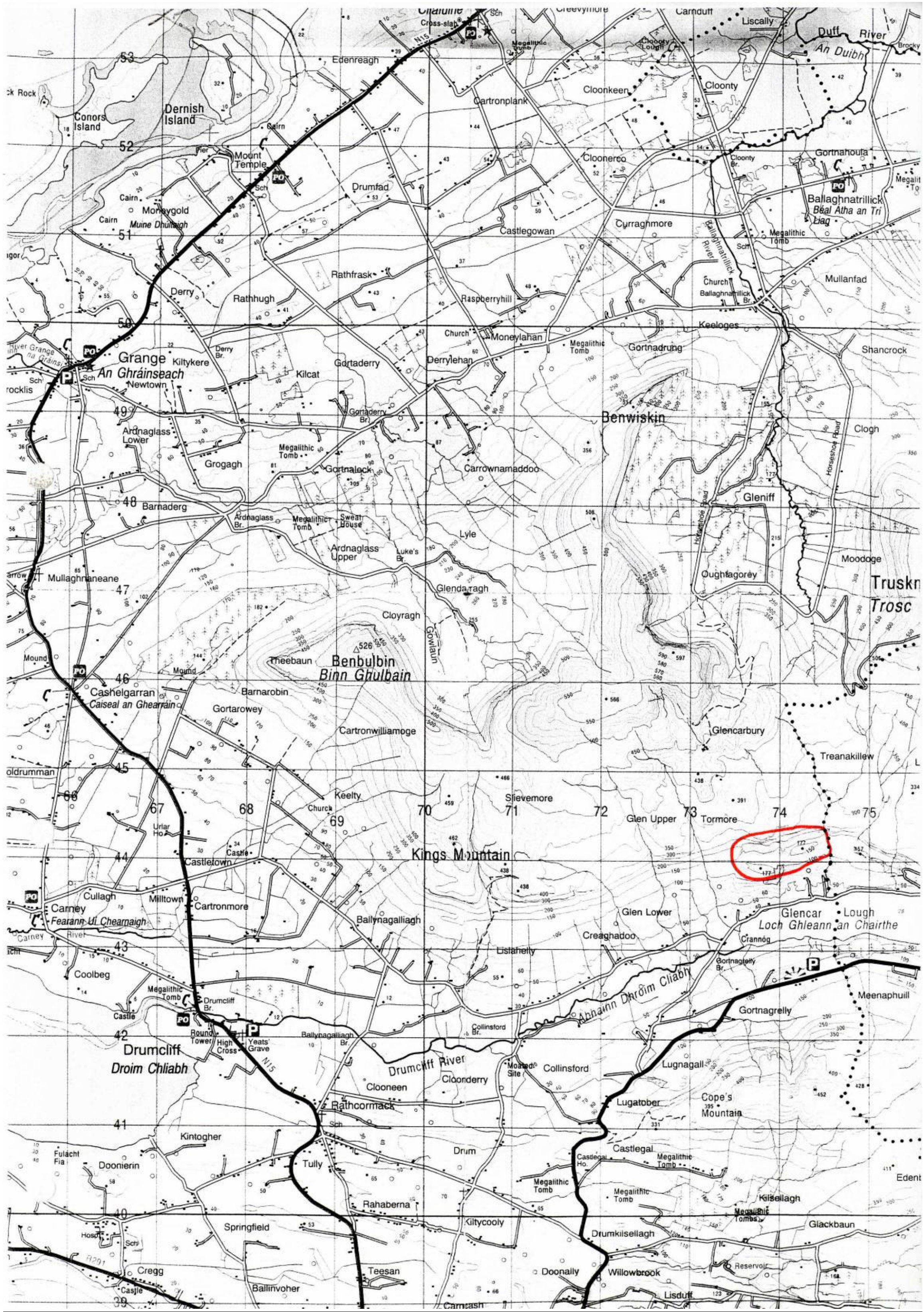
Main Geological or Geomorphological Interest
The Swiss Valley is situated at the base of the Dartry limestone cliffs of Glencar. Towards the end of the last glaciation (approximately 10,000 years ago) as the ice grew thinner, ice flow was channelled around higher mountains accentuating glaciated valleys such as that at Glencar. As the ice melted large-scale landslips occurred where unstable, oversteepened valley walls lost the support of the ice and slid downwards in enormous slices on spoon shaped fractures. These landslips now take the form of huge steps ascending the valley walls.

Site Importance
This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made.

Management/promotion issues
New house building could detract from the integrity of these features if permitted. They could be promoted as interesting landscape features if access is not problematic

Two landslipped blocks visible looking west from the plateau edge on the Leitrim side of the border where the Swiss Valley boreen reaches the plateau edge.

Swiss Valley



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glencarbury Barite Mine**		
Other names used for site	Gleniff Mine		
TOWNLAND(S)			
NEAREST TOWN	Grange		
SIX INCH MAP NUMBER	6		
NATIONAL GRID REFERENCE	173200 345300 = G 732 345		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

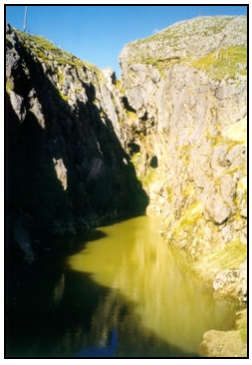
Outline Site Description
Abandoned mine site. Almost vertical barite vein through Slievemore.

Geological System/Age and Primary Rock Type
Carboniferous (Asbian) limestone hosting a younger (late Carboniferous) barite vein.

Main Geological or Geomorphological Interest
The barite vein deposit at this site is the only deposit of its type known in Ireland. The vein cuts through lower Carboniferous (Asbian) limestone of the Dartry and Glencar Formations. These limestones are jointed and faulted and have been subjected to intense karstification (a very deep pothole named Barytes Pot intersects the vein). The almost vertical vein cutting steeply through the Slievemore mud-mound has a north-northwest orientation and is approximately 3m wide and 2.5km long. It consists of pink/white coloured barite and minor amounts of the minerals calcite and chalcopyrite (or fool's gold). The vein is centred along a fault zone, which moved periodically over a prolonged period of time. The barite vein clearly cuts through rocks of Asbian age and is therefore younger than 335Ma. No precise upper age limit has been determined but as deformation of the vein is thought to have occurred during the late Carboniferous it has been assumed that the vein can be no younger than late Carboniferous. Barite extracted from Glencarbury mine between 1894 and 1979 was used in the paint industry and especially to add weight to drilling fluids in the oil industry. Both extensive underground workings and open cast extraction took place and buildings and machinery of mining heritage interest remain on site.

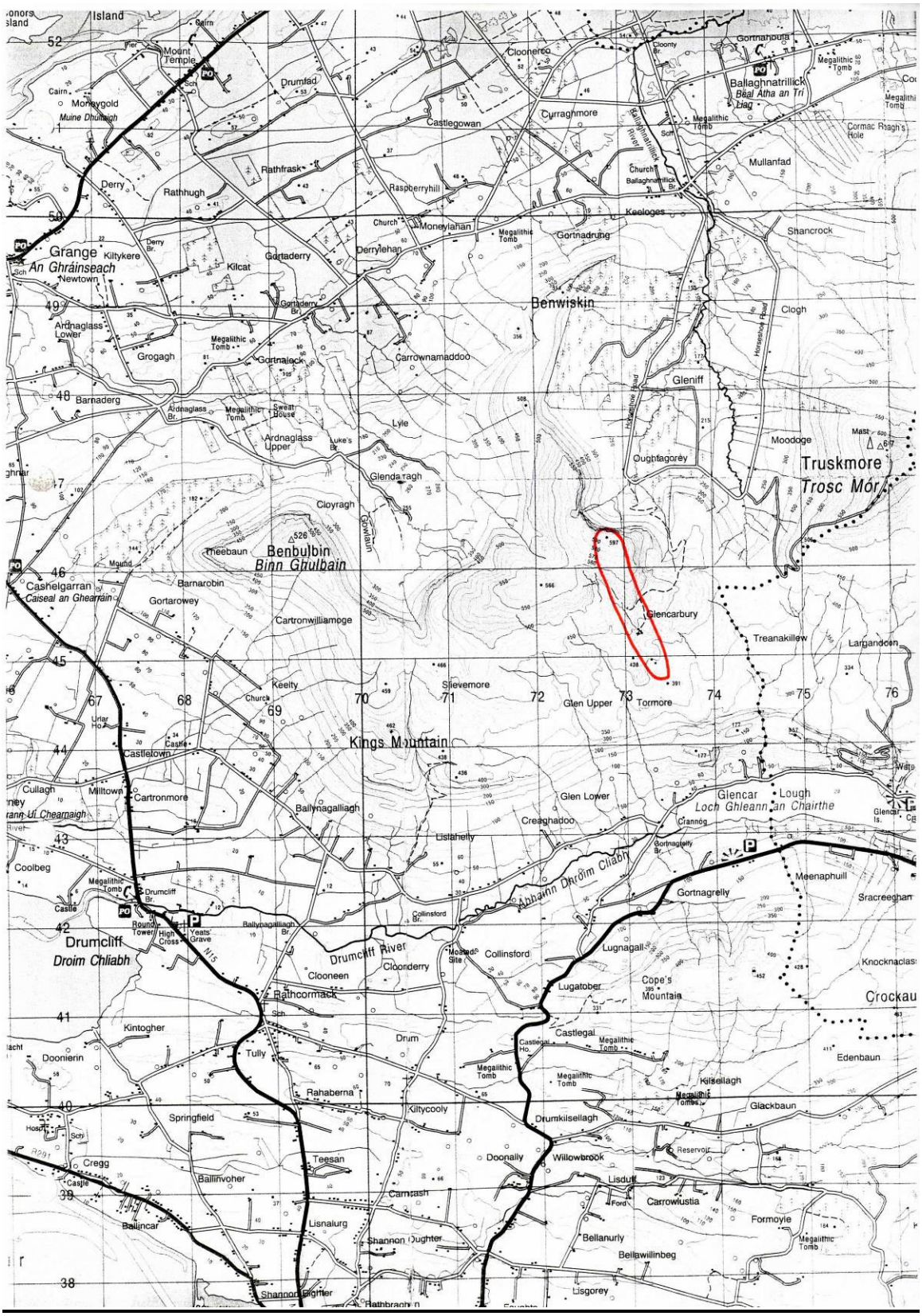
Site Importance
This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made.

Management/promotion issues
Access to parts of the valley are known to be problematic for walkers, but members of the Mining Heritage Trust of Ireland have been able to visit freely. No active geological promotion to visitors of Gleniff, other than of driving tour type, is advisable without some resolution of this issue.



Left. The worked out vein is clearly visible to the left of the ruin of the former miner's hostel. Right: an opencast worked area ends in underground mine tunnels.

Glencarbury Barite Mine



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Gleniff**		
Other names used for site			
TOWNLAND(S)			
NEAREST TOWN	Grange		
SIX INCH MAP NUMBER	6		
NATIONAL GRID REFERENCE	173000 346500 = G 730 465		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

Outline Site Description
Rock exposures in an incised valley.

Geological System/Age and Primary Rock Type
Lower Carboniferous (Asbian) limestones, shales and exceptional fauna.

Main Geological or Geomorphological Interest
Exposures of the Benbulben Shale, Glencar Limestone, the mudbank facies of the Dartry Limestone and a large "raft" of the Meenymore Formation (let down by solution) are to be found in the deeply incised Gleniff Valley (Hubbard and Sheridan 1965). This area is the type locality for the Glencar Limestone and Dartry Limestone. The Glencar Formation consists of alternating calcareous shales and limestones, which are bioturbated. Locally abundant fauna can be found here with some of the corals suggesting an Asbian age. The Dartry Limestone Formation in the area belongs to the mudbank facies – these mudbank limestones occur as mounds.

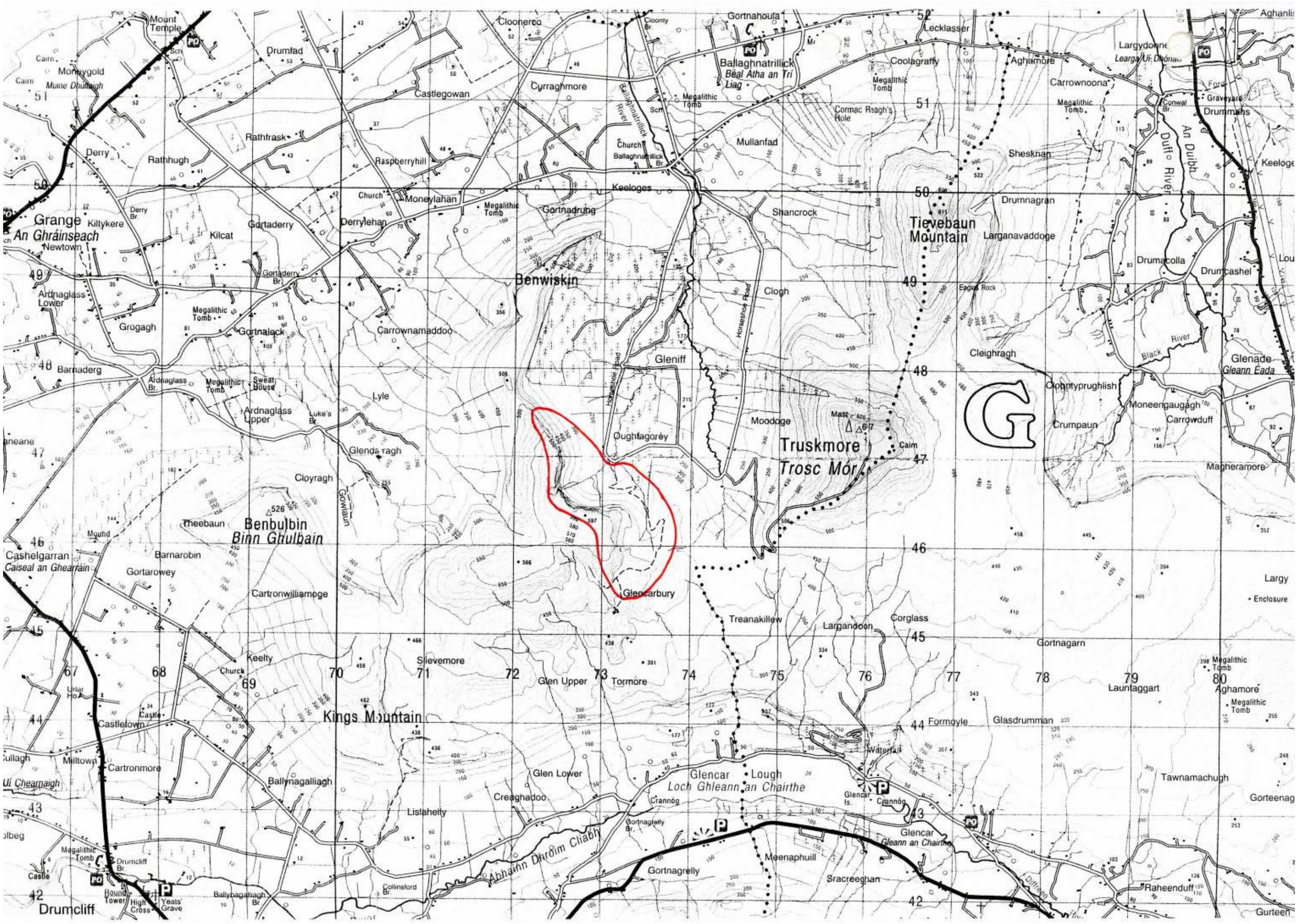
The large "raft" of Meenymore Formation contains an exceptional fauna including brachiopods, bryozoans, rugose coral, bivalves, gastropods, nautiloids, goniatites, trilobites, ostracods and echinoids.

Site Importance
This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made. The boundary of the site shown here is illustrative of the best area to see the stratigraphy and fossiliferous rocks but is not exclusive.

Management/promotion issues
Long-standing access and other issues in this valley make it problematic to promote the geology other than as visible from the Gleniff horseshoe public road at present. In general, access is an issue for hill walkers but individual or small groups of geologists seeking permission may find local landowners willing to grant permission.

The view into the south western corner of the Gleniff valley illustrating the clear division of mudbank Dartry Limestone Formation cliffs on top of bedded Glencar Limestone Formation and older units.

Gleniff


Benwiskin
Gleniff
Oughtagorey
Glencarbury
Truskmore
Trosc Mór
Tievebaun Mountain
Benbulbin
Binn Ghulbain
Kings Mountain
Grange
An Ghráinseach
Glencar Lough
Loch Ghleann an Chairthe
Drumcliff
Ballaghnatrillick
Béal Átha an Trí Liag
Mullanfad
Shancrock
Keeloges
Moneylahan
Gortnadrung
Cloonerco
Curraghmore
Castlegowan
Rathfrask
Raspberryhill
Rathhugh
Derry
Kiltykere
Gortaderry
Derrylehan
Kilcat
Newtown
Ardnaglass Lower
Grogagh
Gortnalack
Carrownamaddoo
Barnaderg
Lyle
Ardnaglass Upper
Glendsragh
Cloyragh
Theebaun
Cashelgarran
Caiseal an Ghearráin
Barnarobin
Gortarowey
Cartronwilliamoge
Keelty
Slievemore
Glen Upper
Tormore
Glen Lower
Creaghadoo
Lislahelly
Castletown
Milltown
Cartronmore
Ballynagalliagh
Treanakillew
Largandoon
Corglass
Formoyle
Glasdrumman
Gortnagarn
Launtaggart
Aghamore
Tawnamachugh
Gorteenagh
Meenaphuill
Sracreeghan
Gortnagrelly
Glencar
Gleann an Chairthe
Raheenduff
Gurteen
Cleighragh
Cloontyprughlish
Moneengaugagh
Carrowduff
Crumpaun
Magheramore
Glenade
Gleann Eada
Drumacolla
Drumcashel
Larganavaddoge
Drumnagran
Sheskinan
Carrownoona
Coolagraffy
Lecklasser
Gortnahoula
Largydonnell
Drummans
Duff River
An Dubh
Black River
Cloogh
Moodoge
Cleigh
Mast
Cairn
Megalithic Tomb
Church
Abhainn Dhroim Cliabh
Yeats' Grave
High Cross
Round Tower
Waterfall
Crannóg
Cormac Reagh's Hole
Horseshoe Road
Largy
Enclosure

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Diarmuid and Gráinne's Cave**		
Other names used for site			
TOWNLAND(S)	Gleniff, Glencarbury		
NEAREST TOWN	Grange		
SIX INCH MAP NUMBER	6		
NATIONAL GRID REFERENCE	172500 346800 = G72500 46800		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

Outline Site Description
Ancient cave system in dissected cliffs above steep valley.

Geological System/Age and Primary Rock Type
Carboniferous limestone displaying evidence of ancient pre-glacial karstification.

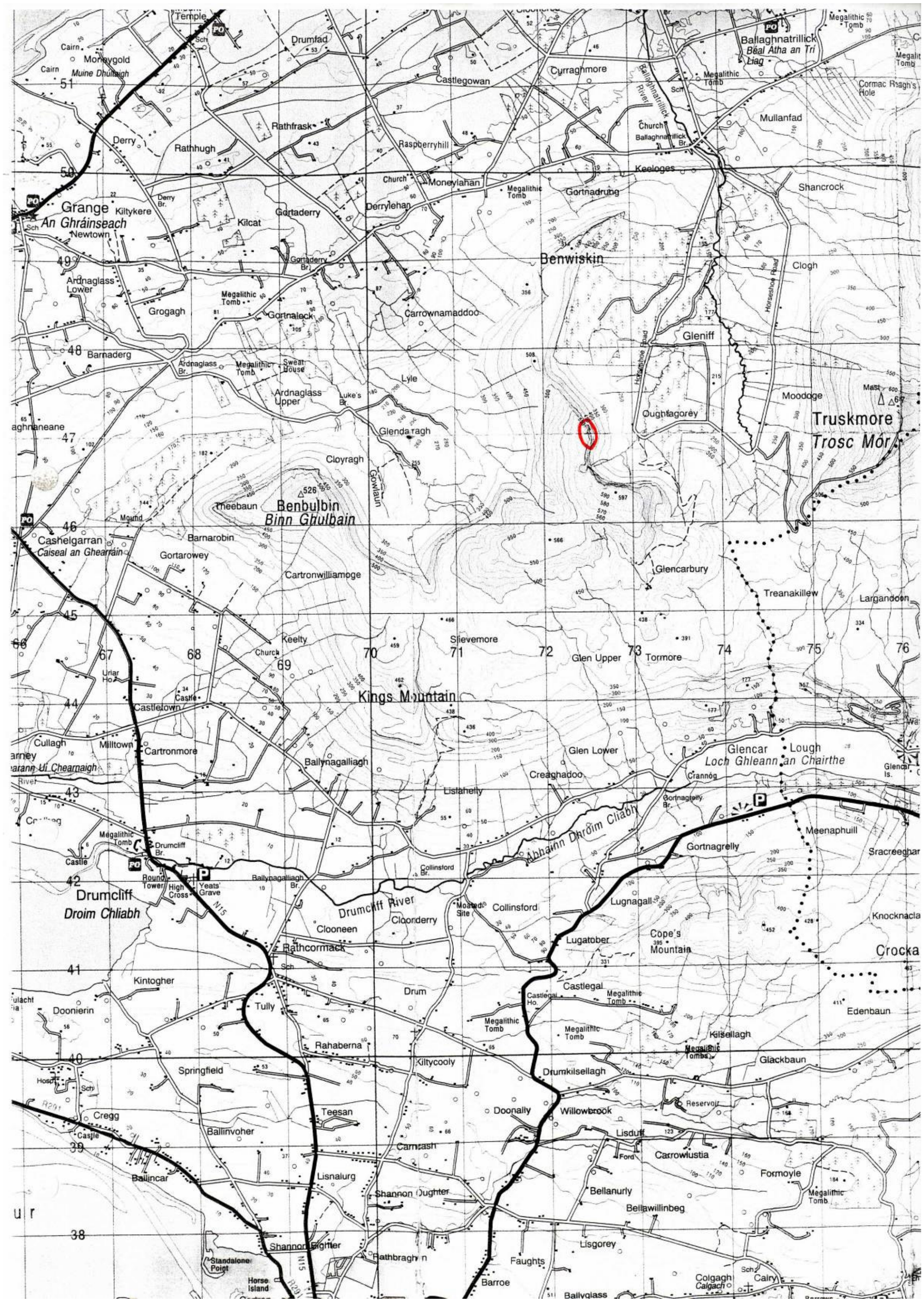
Main Geological or Geomorphological Interest
Situated on the Slievemore mud-mound the entrance to Diarmuid and Gráinne's Cave lies approximately 400m above the valley. The geology of Slievemore (reef limestone/mud-mound of the Dartry Formation overlying thinly bedded limestone and shale of the Glencar Formation) is ideal for the intense karstification that led to the development of solution cavities and caves in this area. Although it is difficult to ascertain the exact timing of karstification it is believed to have been an ancient event, predating glacial activity in the area. The cave itself is thought to be the highest located cave in Ireland and consists of a number of large chambers connected by narrower cave passages, which have developed on two distinct levels. The cave system originally formed below the water table (in the phreatic zone) by the dissolution of the limestone by groundwater.

The cave is on one wall of the horseshoe shaped, steep-walled valley or corrie. During the last glaciation snow that accumulated here was compacted into an ice-pocket and eventually flowed out as a local glacier. The corrie deepened into a U-shaped valley gradually as the flowing ice plucked limestone from the rear wall, dissecting the cave and leaving it open in the cliff face.

Site Importance
This site is expected to be part of a large multi-interest geological NHA comprising Benbulben and the Truskmore Plateau (including parts in Leitrim) once IGH programme work is completed and final recommendations are made.

Management/promotion issues
Access to parts of the valley are known to be problematic for walkers. No active geological promotion, other than of driving tour type, is advisable without some resolution of this issue.

Diarmuid and Gráinne’s Cave



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Slishwood Gap, Ox Mountains**		
Other names used for site			
TOWNLAND(S)	Cartronhugh		
NEAREST TOWN	Ballintogher		
SIX INCH MAP NUMBER	21		
NATIONAL GRID REFERENCE	174600 329300 = G 746 293		
1:50,000 O.S. SHEET NUMBER	25	**1/2 inch Sheet No.**	7

Outline Site Description
Rock exposures in narrow valley cutting through the Ox Mountains.

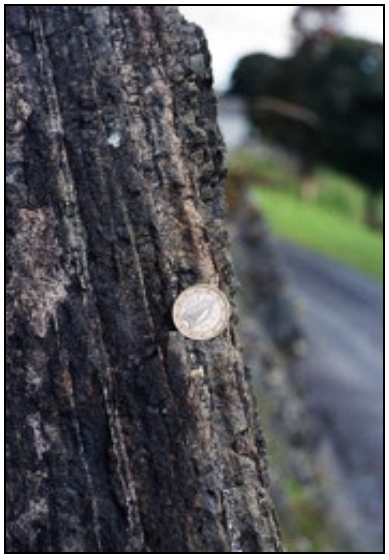
Geological System/Age and Primary Rock Type
Precambrian, metamorphic rock known as serpentinite and gneiss in adjacent outcrops.

Main Geological or Geomorphological Interest
Dark green serpentinite, about 900 million years old, is exposed at the Slishwood gap. The serpentinite contains serpentine minerals and is criss-crossed by thin veins of the asbestos mineral chrysotile. The rock here was originally a peridotite (containing the minerals pyroxene and olivine) and as such was formed approximately 50 km beneath the Earth's surface in the mantle. A period of mountain building (where continents collided) more than 600 million years ago resulted in the interleaving of the peridotite with the rocks of the Slishwood Division when the latter were pushed to depths close to the crust/mantle boundary. Following this phase the peridotite was then altered to serpentinite.

The Slishwood Gap exposures are often as ice-smoothed roche moutonées. Roches moutonées are ice-sculpted rocks produced by abrasion of the bedrock by material carried in the ice. They generally have a smooth slope at one end, in the direction from which the ice flowed and a steeper, rougher slope at the opposite end. Ice erosion through the softer serpentine carved out the gap in the mountain. The green valley here owes its relative fertility to the magnesium derived from the serpentine.

Site Importance
The site is of National importance and is proposed for NHA designation under the IGH5 Precambrian theme of the GSI's IGH Programme.

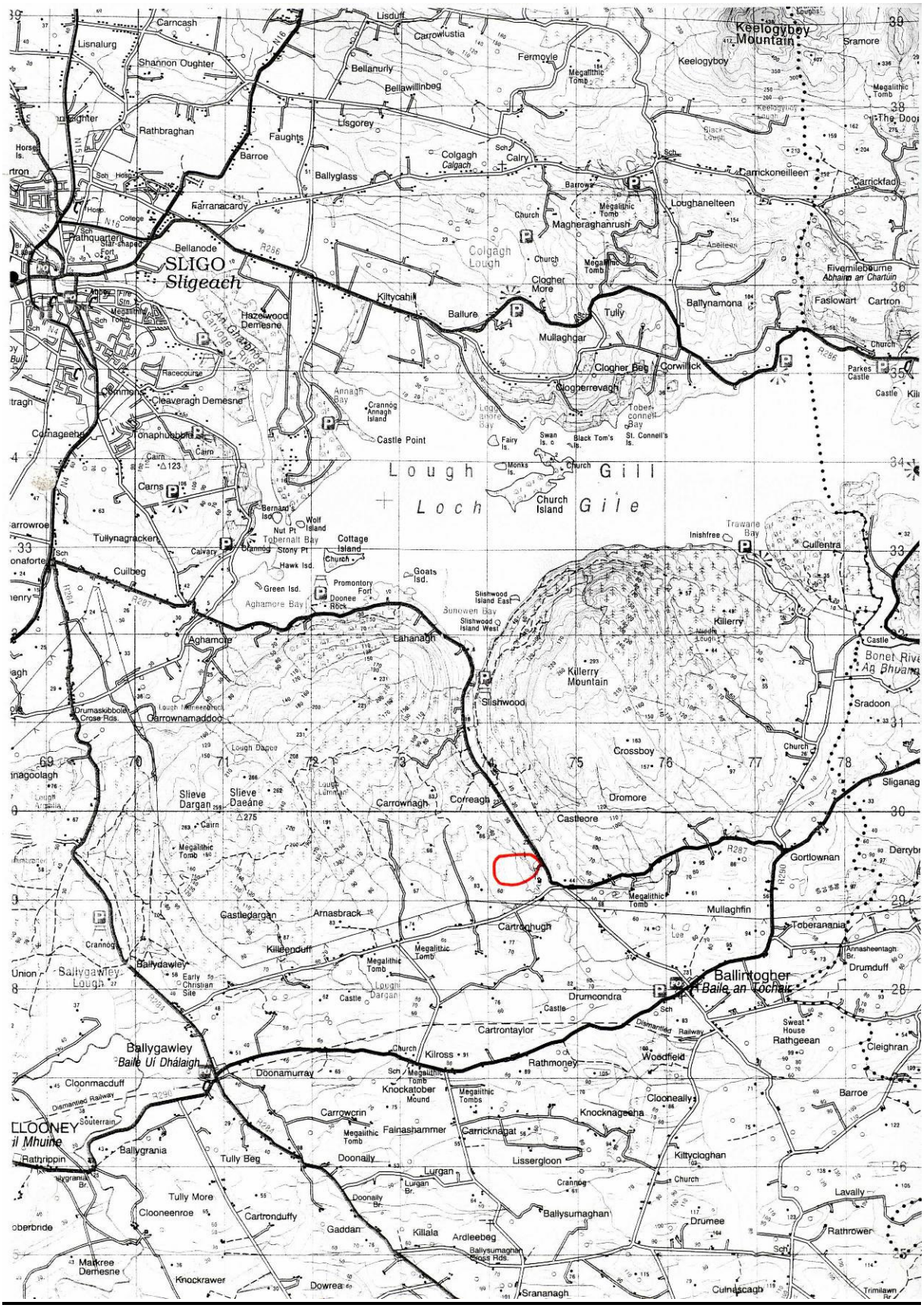
Management/promotion issues
This site provides a model for management of other sites. The landowner, Mr Padraic McGarry is very welcoming to the regular geological visitors he receives, and has constructed steps, a footbridge and a stile to facilitate access to the best exposures.



Serpentinite containing veins of chrystolite (left).

Large Serpentinite exposure at southern end of Slishwood Gap.

Slishwood Gap, Ox Mountains



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Glen**		
Other names used for site			
TOWNLAND(S)	Glen		
NEAREST TOWN	Coolaney		
SIX INCH MAP NUMBER	20		
NATIONAL GRID REFERENCE	164200 326850 = G 642 268		
1:50,000 O.S. SHEET NUMBER	25	**1/2 inch Sheet No.**	7

Outline Site Description
Roadside rock exposure.

Geological System/Age and Primary Rock Type
Precambrian metamorphic rocks.

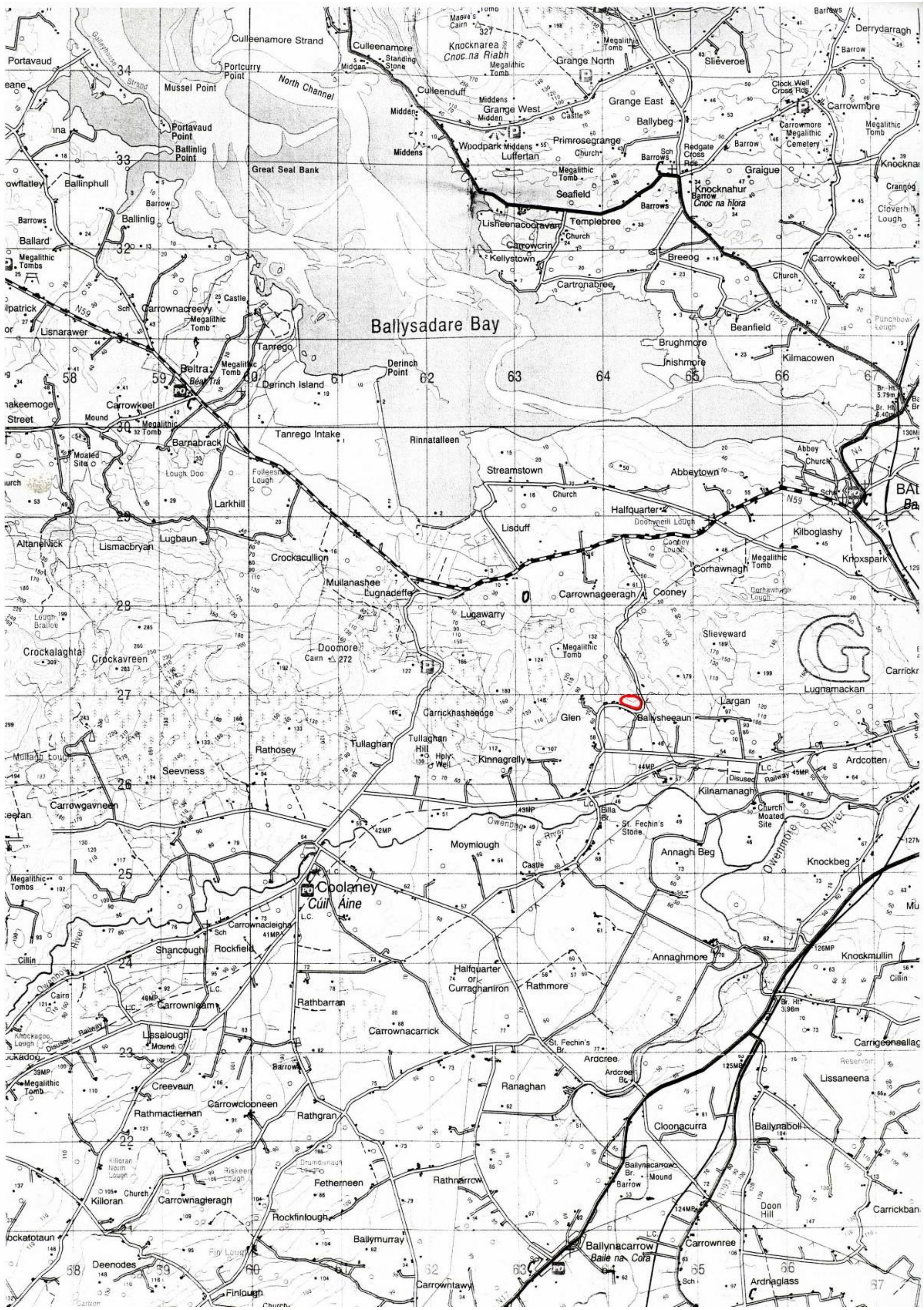
Main Geological or Geomorphological Interest
Glen plays host to hillside exposures of Precambrian metamorphic rocks collectively known as the Slishwood Division. These gneisses, are characterised by pink, white and grey bands of the minerals feldspar, quartz and mica (which are pink, glassy grey/white and silver respectively). These rocks originated as sedimentary rocks approximately 1500 million years ago. More than 600 million years ago a phase of mountain building pushed the sediments to depths of 47km beneath the Earth's surface. Under these increased pressures and temperatures the sedimentary rocks recrystallised to form the banded gneisses that we see today. A second continental collision approximately 460 million years ago resulted in the fracturing of the gneisses providing pathways for granitic magma to be injected into them. The rocks were pushed up over adjacent continental crust. Melting of the underlying slab generated granitic magma. Evidence for magma 'injection' can be seen at this locality where pegmatite veins crosscut the banded gneisses. Folding, a very obvious feature of the gneisses, developed slowly in response to the high pressure and temperature conditions and deformation associated with the various phases of mountain building. The younger pegmatite veins (as they display a crosscutting relationship to the gneisses) are also distorted. This suggests yet another phase of deformation. Small masses or 'pods' of dark green igneous rock are found within the gneisses at this locality. These pods represent igneous bodies that were intruded into the Slishwood division rocks prior to their metamorphism.

Site Importance
The site is of National importance and is to be proposed for NHA designation under the IGH5 Precambrian theme of the GSI's IGH Programme.

Management/promotion issues
Vegetation growth may need control; house building etc could damage site if permitted.

Slishwood gneisses exposed at Glen

Glen



Culleenamore Strand
Culleenamore
Knocknarea
Cnoc na Riabh
Grange North
Slieveroe
Derrydarragh
Portavaud
Portcurry Point
Mussel Point
North Channel
Culleenduff
Grange West
Grange East
Carrowmore
Ballybeg
Portavaud Point
Ballinlig Point
Woodpark
Primrosegrange
Luffertan
Great Seal Bank
Graigue
Knocknahur
Cnoc na hIora
Ballinphull
Seafield
Ballinlig
Templebree
Ballard
Carrowcrin
Kellystown
Breeog
Carrowkeel
Cartronabree
Carrownacreevy
Ballysadare Bay
Beanfield
Lisnarawer
Brughmore
Kilmacowen
Tanrego
Beltra
Béal Trá
Derinch Point
Derinch Island
Inishmore
Carrowkeel
Street
Barnabrack
Tanrego Intake
Rinnatalleen
Streamstown
Abbeytown
Lough Doo
Larkhill
Halfquarter
Lisduff
Kilboglashy
Altanelvick
Lismacbryan
Lugbaun
Crockacullion
Corhawnagh
Knoxspark
Mullanashee
Lugnadeffe
Carrowngeeragh
Cooney
Lugawarry
Slieveward
Crockalaghta
Crockavreen
Doomore
Lugnamackan
Carrickhasheeoge
Glen
Ballysheeaun
Largan
Rathosey
Tullaghan
Tullaghan Hill
Holy Well
Kinnagrelly
Ardcotten
Seevness
Kilnamanagh
Carrowgavneen
Owenbeg River
St. Fechin's Stone
Moymlough
Annagh Beg
Knockbeg
Owenmore River
Coolaney
Cúil Áine
Carrownacleigha
Shancough
Rockfield
Annaghmore
Knockmullin
Halfquarter or Curraghaniron
Rathmore
Carrownleam
Rathbarran
Lissalough
Carrownacarrick
St. Fechin's Br.
Ardcree
Carrigeenaallag
Creevaun
Ranaghan
Lissaneena
Carrowclooneen
Rathmactiernan
Rathgran
Cloonacurra
Ballynaboll
Killoran
Carrownagleragh
Fetherneen
Rathnarrow
Ballynacarrow Br.
Doon Hill
Carrickban
Rockfinlough
Ballymurray
Ballynacarrow
Baile na Cora
Carrownree
Deenodes
Carrowntawy
Ardnaglass
Finlough

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Scalpnacapaill**
Other names used for site	Skalpnacapple
TOWNLAND(S)	Carrownageeragh
NEAREST TOWN	Ballysadare, Collooney, Coolaney
SIX INCH MAP NUMBER	20
NATIONAL GRID REFERENCE	164180 327740 = G 641 277
1:50,000 O.S. SHEET NUMBER	25 **1/2 inch Sheet No.** 7

Outline Site Description
Near vertical cliff face exposure.

Geological System/Age and Primary Rock Type
Precambrian metamorphic rocks.

Main Geological or Geomorphological Interest
Precambrian banded gneisses of the Slishwood Division are exposed on the near vertical cliff face at this locality (see Glen Site Report for Slishwood Division description). The cliff face here is divided into lozenge-shaped blocks. This 'shear zone' effect occurs when one block of rock is pushed past another at sufficient depths to behave in a ductile manner. A dark coloured igneous mass or 'pod' can be seen within the gneisses here and contains a variety of interesting minerals. One such mineral is hornblende, which contains the radioactive element argon. Analysis of the argon present can yield an age for the time of crystallisation of hornblende. This process is called radiometric dating. As the hornblende here is a metamorphic mineral (i.e. grew as the rock was being metamorphosed) radiometric analysis will yield an age of metamorphism. Small green-coloured veins are found within the gneisses and contain the green/blue, bladed mineral kyanite. The presence of kyanite is extremely important as it only crystallises under extremely high pressure and temperature conditions. Other interesting features of this locality include small orange/brown marble (metamorphosed limestone) bands and a small serpentinite body.

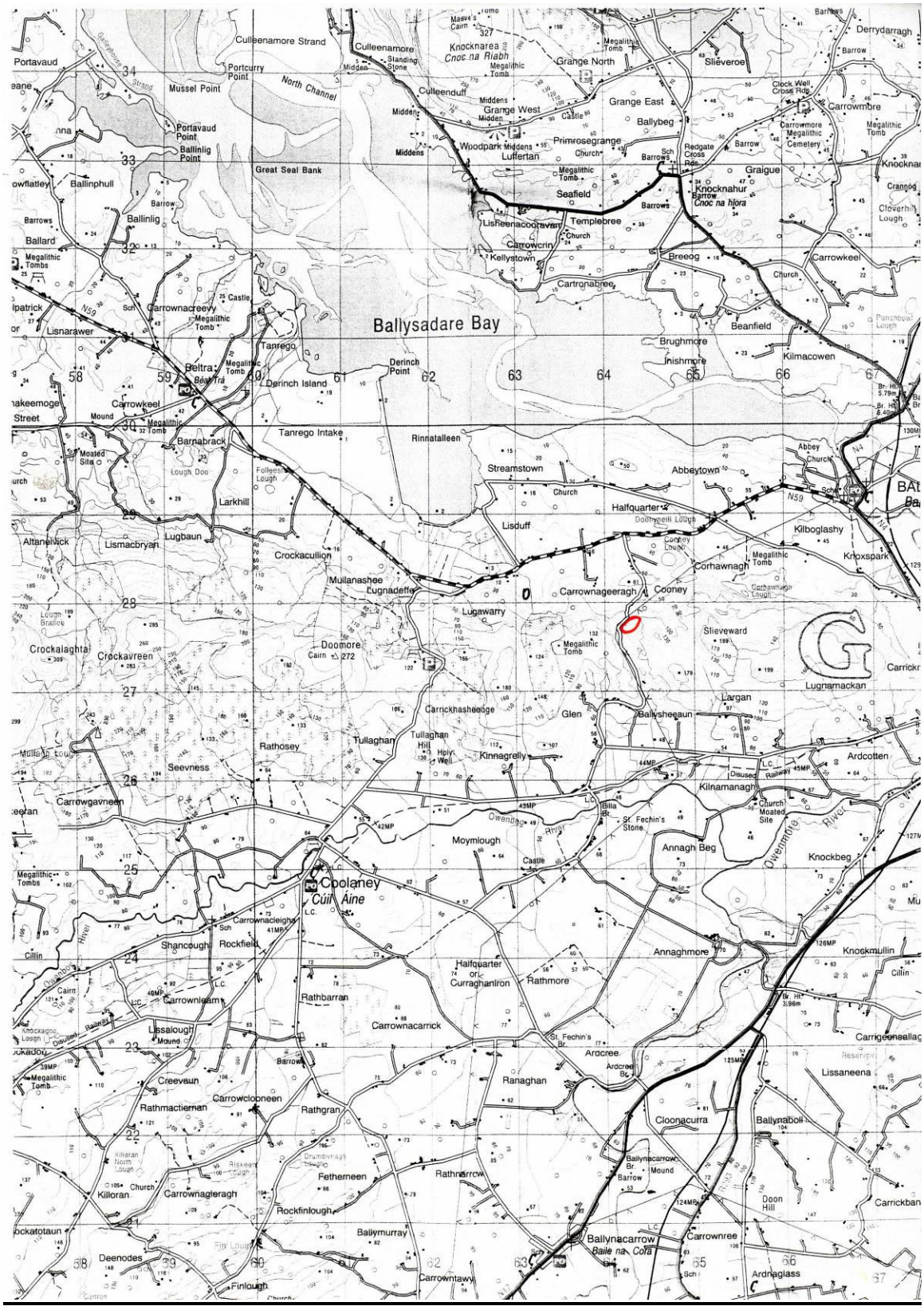
Site Importance
The site is of National importance and is to be proposed for NHA designation under the IGH5 Precambrian theme of the GSI's IGH Programme.

Management/promotion issues
The site is quite robust and only major roadworks are likely to impact greatly. Landowners unknown.

Lozenge-shaped shear zone (left). Photo: Claire McAteer

A general view of the cliff Photo: Matthew Parkes

Scalpnacapaill



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Zion Hill**		
Other names used for site			
TOWNLAND(S)	Ounagh		
NEAREST TOWN	Tobercurry		
SIX INCH MAP NUMBER	31		
NATIONAL GRID REFERENCE	142300 316800 = G 423 168		
1:50,000 O.S. SHEET NUMBER	24	**1/2 inch Sheet No.**	7

Outline Site Description
Hill exposures.

Geological System/Age and Primary Rock Type
Dalradian metamorphic rocks.

Main Geological or Geomorphological Interest
The metamorphic rocks exposed on Zion Hill belong to the Dalradian Ummoon Formation. These pelitic schists (i.e. originally mudstones) have developed very interesting minerals in response to metamorphism. The ridge north of the summit hosts some of the best examples of these minerals including coarse (up to 1cm in size) crystals (or porphyroblasts) of kyanite, staurolite and almandine garnet. Also of interest are the basic metavolcanics of the Newantrim member of the Ummoon Formation exposed on the northwestern slopes of Zion Hill. Originally volcanic, these rocks have been metamorphosed and are now composed predominantly of amphibole minerals. The process of mountain building (or orogenesis) is rarely simple and usually involves more than one phase of deformation, each phase leaving its own mark (e.g. folding, foliation). Where one deformation phase is much more intense than its predecessor all traces of the earlier event may be overprinted by the younger episode. Some of the large metamorphic minerals discussed above contain evidence for phases 2 and 3 of the Grampian Orogeny (phase three occurring approximately 460 million years ago). Analysis of these minerals indicates peak metamorphic temperatures and pressures of 620±30^{o}C and 8±2kbar, respectively, equivalent to conditions approximately 27km below the Earth's surface.

More recently (30,000-10,000 years ago) ice-sheets from the last glaciation (the Midlandian) left their mark on these rocks by creating roches moutonnées. Roches moutonnées are ice-sculpted rocks produced by abrasion of the bedrock by material carried in the ice. They usually have a smooth slope, in the direction from which the ice flowed and a steep, rougher slope at the downstream end.

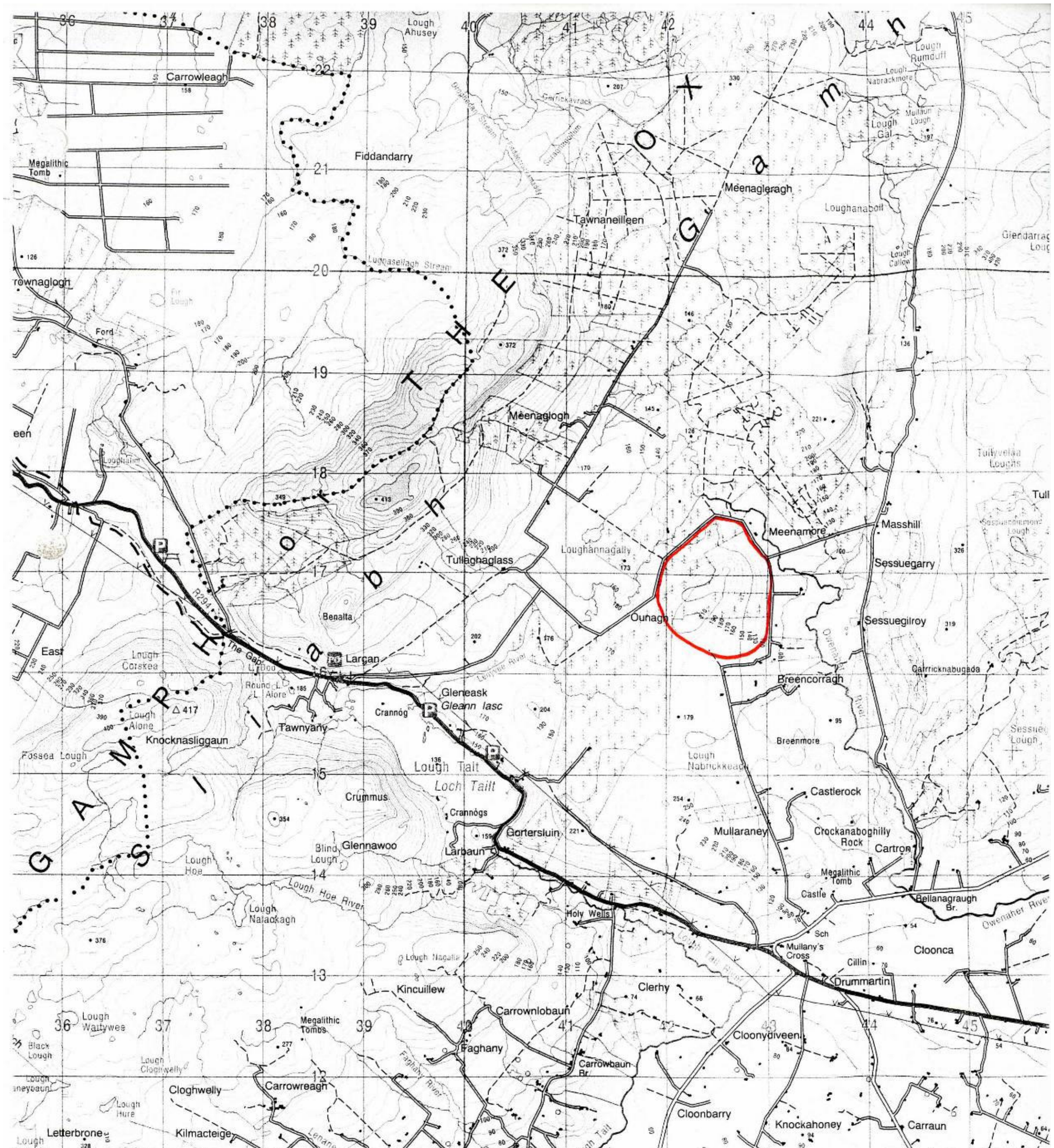
Site Importance
The site is of National importance and is to be proposed for NHA designation under the IGH5 Precambrian theme and the IGH6 Mineralogy theme of the GSI's IGH Programme.

Management/promotion issues
Access is impeded by forestry plantation but site can be reached from sand pit entrance.

View of Zion Hill from Meenamore Wood (left)

Metamorphic rocks on Zion Hill (right) – Conor Mac Dermot

Zion Hill



Carrowleagh
Lough Ahusey
Fiddandarry
Megalithic Tomb
Meenagleragh
Tawnaneilleen
Loughanaboll
Meenaglogh
Loughannagally
Tullaghaglass
Benalta
Meenamore
Masshill
Sessuegarry
Sessuegilroy
Ounagh
Largan
The Gap
Lough Corskea
Lough Alone
Knocknasliggaun
Tawnyany
Crannóg
Gleneask
Gleann Iasc
Breencorragh
Breenmore
Lough Nabrickkeagh
Lough Talt
Loch Tailt
Crummus
Crannógs
Castlerock
Mullaraney
Crockanaboghilly Rock
Cartron
Gortersluin
Glennawoo
Blind Lough
Larbaun
Lough Hoe
Lough Hoe River
Holy Wells
Castle
Bellanagraugh Br.
Mullany's Cross
Cloonca
Cillin
Drummartin
Lough Nalackagh
Kincuillew
Clerhy
Carrownlobaun
Lough Wattywee
Megalithic Tombs
Faghany
Cloonydiveen
Carrowbaun Br.
Cloghwelly
Carrowreagh
Letterbrone
Kilmacteige
Cloonbarry
Knockahoney
Carraun
Gortermone
Lough Awaughran
Carrowreagh Br.
Killure
Lislea
Toberroddy
Holy Well
Kilmacteige
Oughaval
Aclare
Ath an Chláir
Toorlestraun
Tuar Loistreáin
Corray Hill
Corray
Carns Hill
Carns
Graveyard
Culdaly Br
Seraigh
Bellanamean River
Lisheen Bridge
Old Town
New Town
Maghera
Coolrecuill
Curragh
Belclare
Cartron
Claddagh
Ballygallagart
Cooleen
Dawros
G A M P H
S l i a b h
T H E
O X
G a m h

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Mullaghmore Head**		
Other names used for site			
TOWNLAND(S)	Mullaghmore		
NEAREST TOWN	Mullaghmore		
SIX INCH MAP NUMBER	2		
NATIONAL GRID REFERENCE	170200 358400 = G 702 584		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

Outline Site Description
Rock-platform, coastal exposure.

Geological System/Age and Primary Rock Type
Carboniferous sandstone, siltstone and shale.

Main Geological or Geomorphological Interest
Mullaghmore Head is the type area for the Mullaghmore Sandstone Formation, a major stratigraphical unit of the northwest. The alternating shales and thick sandstone of this formation were deposited by a major river delta that built out into a tropical sea from a landmass to the north during the Carboniferous. Sedimentary structures, crucial in unravelling the depositional history of the rocks, are abundant and include cross-bedding, grading, convolution and evidence of scouring by river channels. Whilst body fossils are quite scarce (occasional corals, brachiopods, crinoids and orthocones are found) trace fossils are in abundance here. Trace fossils are sedimentary structures left by animals, for example by crawling or burrowing.

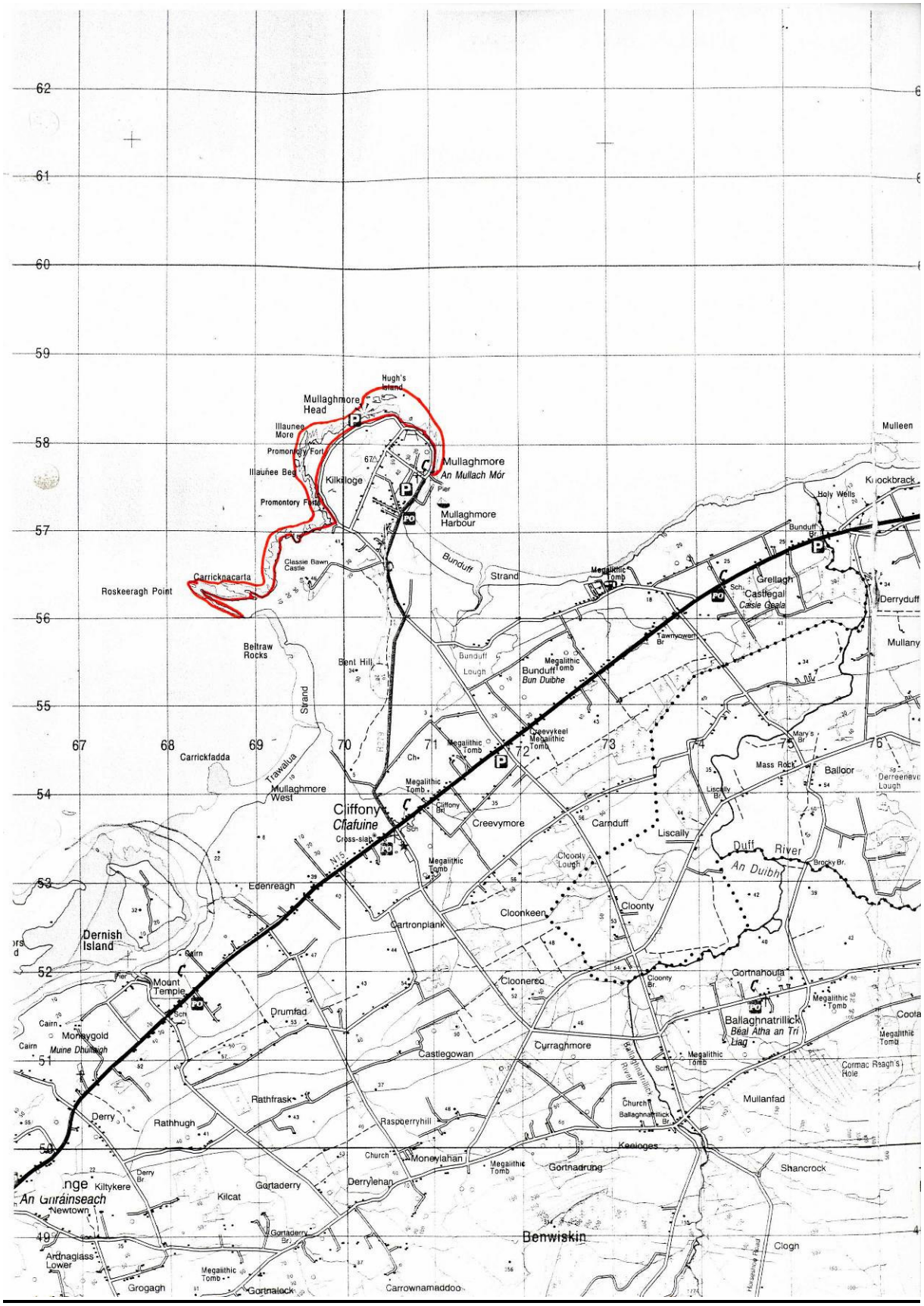
Site Importance
The site is of National importance and is to be proposed for NHA designation under the IGH8 Lower Carboniferous theme of the GSI's IGH Programme.

Management/promotion issues
The site is subject to coastal erosion. There are no major problems with the section around the headland, but the western part by Classiebawn Castle may only be accessed along the foreshore and when tides permit.

The cliff section in this photo is approximately 8m in height and displays layers of sandstones dipping to the left. River channels that flowed across a delta during the Carboniferous deposited the two thick beds at the top of the section. These channels cut into the underlying sediments leaving the distinctive shape that we see today.

West coast of Mullaghmore Head
Photos: Conor MacDermot.

Mullaghmore Head



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Streedagh Point**		
Other names used for site			
TOWNLAND(S)	Streedagh		
NEAREST TOWN	Grange		
SIX INCH MAP NUMBER	2, 5		
NATIONAL GRID REFERENCE	163000 351000 = G 63 51		
1:50,000 O.S. SHEET NUMBER	16	**1/2 inch Sheet No.**	7

Outline Site Description
Rock exposures on a coastal platform.

Geological System/Age and Primary Rock Type
Early Carboniferous Limestone (from the Asbian Stage)

Main Geological or Geomorphological Interest
Streedagh Point has spectacular exposure of the Glencar Limestone Formation consisting of thinly bedded dark grey muddy limestones, crinoidal limestones, shales and mudstones. These rocks were deposited in warm, shallow seas during the Carboniferous. There is an abundance of exceptionally preserved fossils at this site including corals, bryozoa, brachiopods, crinoids and foraminifera. Some of the corals found here indicate that the rocks were deposited during the Asbian (around 339 million years ago). It is very similar to Serpent Rock at Ballyconnell, but the faunas show variation and the preservation style is different.

The coastal geomorphology of Streedagh Point is also of importance; a lagoon and barrier strand are on the draft candidate site list of the Coastal Geomorphology Theme, IGH13 [as of Jan 2004].

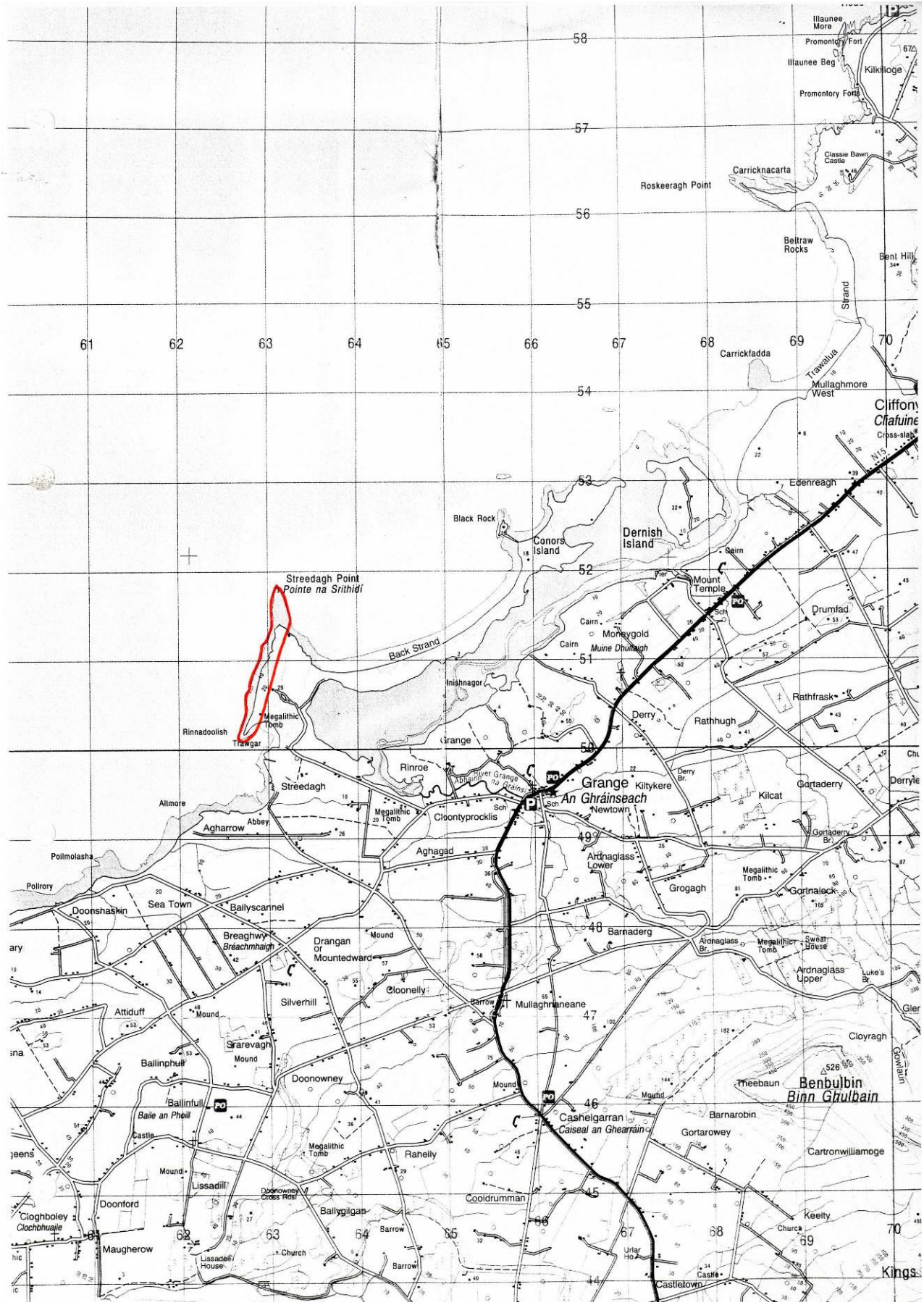
Site Importance
The site is of National importance and is to be proposed for NHA designation under the IGH3 Carboniferous - Pliocene Palaeontology theme and may be incorporated into a larger site including the lagoon and dune barrier **if** these are selected under the IGH13 Coastal Geomorphology theme of the GSI's IGH Programme.

Management/promotion issues
Sea-erosion is unavoidable but prevention of commercial fossil collecting needs to be maintained. A code of conduct and information panels could be provided.

A typical colonial coral at Streedagh Point, about 50cm across.
Photo: Matthew Parkes

A view of the barrier strand and lagoon at Streedagh.
Photo: Matthew Parkes

Streedagh Point



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Serpent Rock**
Other names used for site	Ballyconnell
TOWNLAND(S)	Ballyconnell
NEAREST TOWN	Drumcliff
SIX INCH MAP NUMBER	4, 7
NATIONAL GRID REFERENCE	156400 346400 = G 564 464
1:50,000 O.S. SHEET NUMBER	16 **1/2 inch Sheet No.** 7

Outline Site Description
Rock exposures on a coastal platform.

Geological System/Age and Primary Rock Type
The rocks are limestone, from early in the Carboniferous (Asbian Stage of the Dinantian).

Main Geological or Geomorphological Interest
The most complete section of the Carboniferous Glencar Limestone Formation is spectacularly exposed along the coast at Serpent Rock with grey muddy limestone and crinoidal limestone. Excellently preserved fossils are found at this site and include solitary corals, bryozoa, brachiopods, crinoids and foraminifera. These fossils, originally of a carbonate composition, were replaced by quartz and in some cases gold coloured pyrite, early in the rocks history. Quartz and pyrite are more resistant than carbonates and are therefore less easily weathered hence the exceptional preservation of the fossils at this locality.

After a gap in the rock succession there are exposures of the Dartry Limestone Formation, again with abundant fossils including brachiopods, bryozoan and especially the coral *Lithostrotion* sp. Some of the fossils in the Serpent Rock area provide valuable information as to the age of the rocks (they are approximately 339 million years old) as well as the palaeoecology.

Site Importance
The site is of National importance and is proposed for NHA designation under the IGH3 Carboniferous - Pliocene Palaeontology theme of the GSI's IGH Programme.

Management/promotion issues
Damaging factors include unavoidable sea-erosion and the actions of probably commercial fossil collectors who have crudely and visibly removed fossils from this site in the past.

A view of part of Ballyconnell's Serpent Rock left, and some of the typical corals right. Photos: Matthew Parkes

Serpent Rock

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Aughris Head**		
Other names used for site			
TOWNLAND(S)	Aughris		
NEAREST TOWN	Drumard		
SIX INCH MAP NUMBER	12		
NATIONAL GRID REFERENCE0	151000 337000 = G 51 37		
1:50,000 O.S. SHEET NUMBER	25	**1/2 inch Sheet No.**	7

Outline Site Description
Coastal cliffs and rock exposures.

Geological System/Age and Primary Rock Type
Carboniferous Limestone.

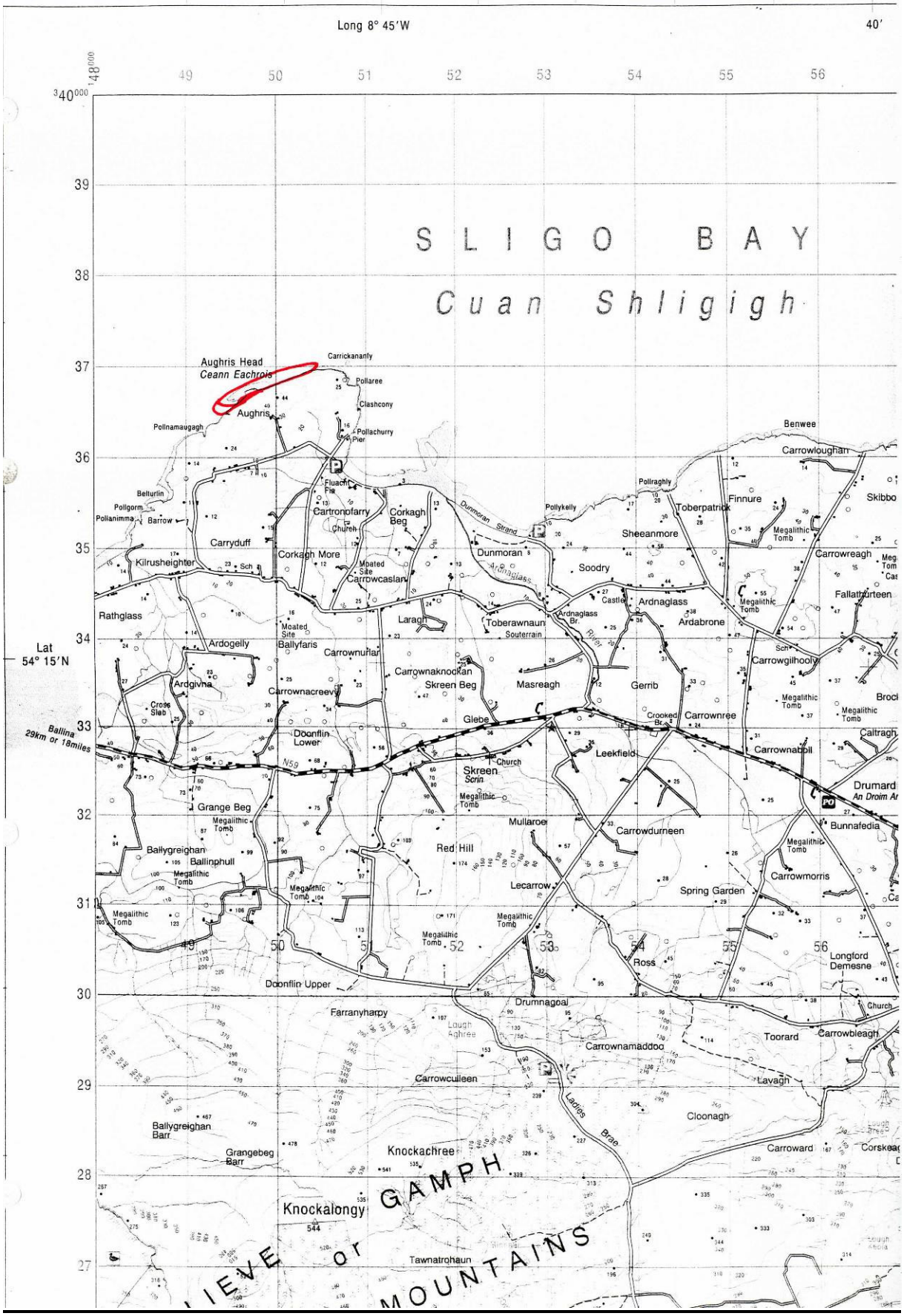
Main Geological or Geomorphological Interest
A good series of Lower Carboniferous (Viséan) strata is exposed on the cliffs.

Site Importance
This is a County Geological Site for the Lower Carboniferous stratigraphy.

Management/promotion issues
The site is already an SPA for the bird interest and promoted as such as in NPWS (Dúchas) publications, and as cliffs there are no management issues for protection in a dynamic environment. Safety of visitors and access may be issues, but generally it may not be advisable to promote this site for its geological interest with anyone other than specialists.

The site boundary may be taken as the existing SPA boundary definition.

Aughris Head



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Inishcrone**		
Other names used for site			
TOWNLAND(S)	Carrowhubbuck		
NEAREST TOWN	Inishcrone		
SIX INCH MAP NUMBER	16		
NATIONAL GRID REFERENCE	128600 330500 = G 286 305		
1:50,000 O.S. SHEET NUMBER	24	**1/2 inch Sheet No.**	7

Outline Site Description
Foreshore rock exposures.

Geological System/Age and Primary Rock Type
Tertiary igneous intrusions and some contact or thermal metamorphism of host limestones.

Main Geological or Geomorphological Interest
A good series of Tertiary dykes occur on the foreshore north of Inishcrone. These dykes formed approximately 58 million years ago when Europe and North America split apart to produce what is now the North Atlantic Ocean. Hot magma rose up along fractures and cracks that formed in the limestone as the North Atlantic opened up. The magma cooled and hardened as vertical sheets or dykes of dolerite baking the adjacent limestone as it cooled. Bands of white marble formed as a result of this contact metamorphism as did some skarn mineral deposits (calcium-rich ore deposits). This site is also the type area for the mineral Killalaite ($Ca_3Si_2O_7.O.5H_2O$), produced by contact (heat) metamorphism of limestones by the igneous dykes intruded as hot magma.

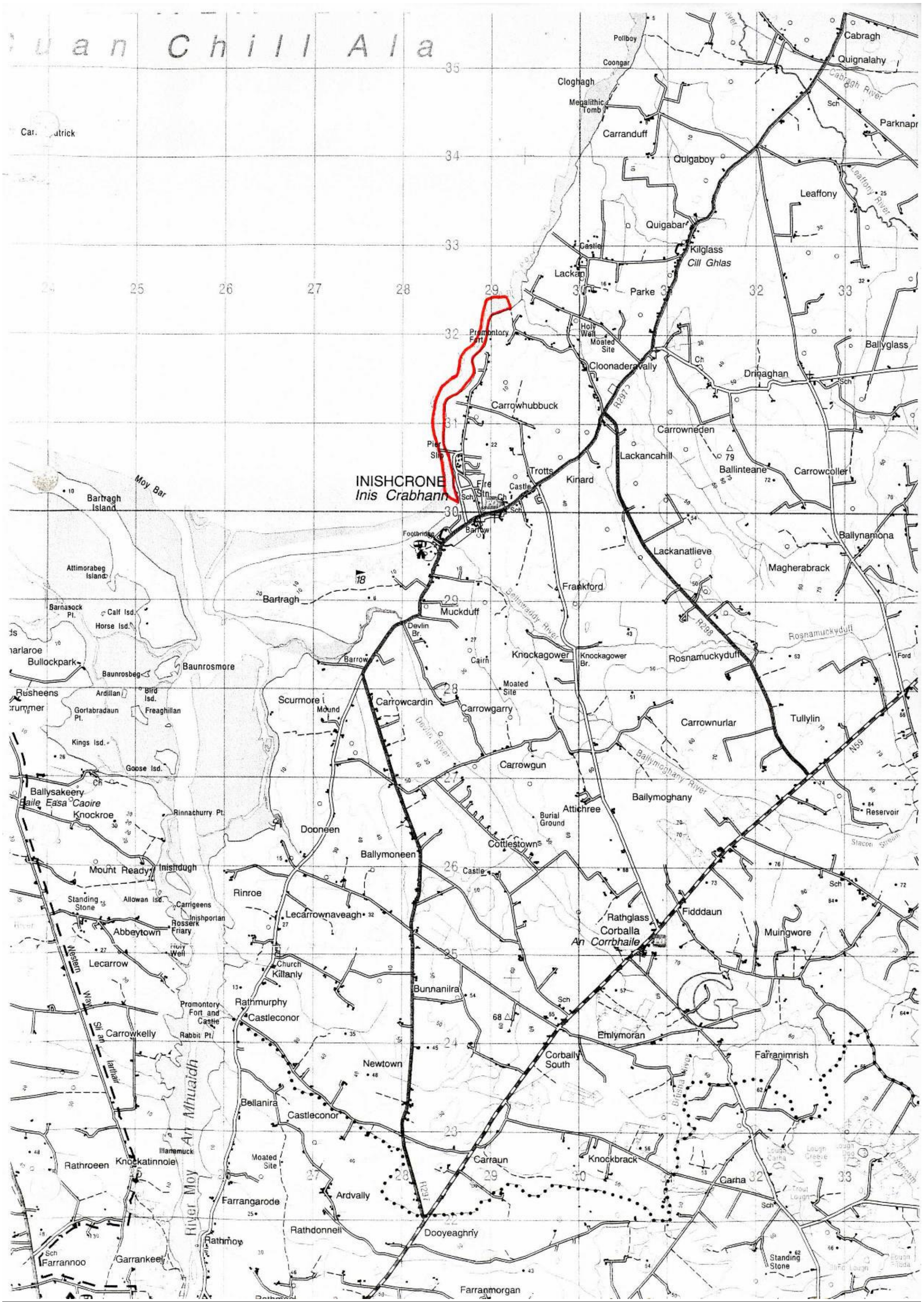
The site also shows interesting tectonic features and displacements of rock by glacial activity. This is a unique site showing new evidence for subglacial erosion and shearing, such as shunting of large slabs of Carboniferous limestone with brecciation and detachment along major bedding planes and northward displacement of a Tertiary dyke. This rock fracture is due to high porewater pressures under an ice sheet and not mechanical crushing as is normally envisaged for subglacial rock fracture.

Site Importance
The site is of National importance and is to be proposed for NHA designation under the IGH11 Igneous Intrusion theme of the GSI's IGH Programme, and also probably under IGH7 Quaternary.

Management/promotion issues
As foreshore exposures there are few issues to be concerned with in relation to this site, although specific cliff sections at the back of the foreshore may need protection.

Tertiary dykes at Inishcrone

Inishcrone


Cuan Chill Ala
INISHCRONE
Inis Crabhann
Moy Bar
Bartragh Island
Cloghagh
Carranduff
Quigaboy
Quigabar
Kilglass
Cill Ghlas
Lackan
Parke
Leaffony
Cabragh
Quignalahy
Parknapr
Promontory Fort
Holy Well
Moated Site
Cloonaderavally
Drinaghan
Carrowhubbuck
Carrowneden
Lackancahill
Ballinteane
Carrowcoller
Trotts
Kinard
Castle
Pier
Slip
Footbridge
Barrow
Lackanatlieve
Magherabrack
Ballynamona
Ballyglass
Frankford
Bartragh
Muckduff
Devlin Br.
Knockagower
Rosnamuckyduff
Attimorabeg Island
Barnasock Pt.
Calf Isd.
Horse Isd.
Baunrosbeg
Baunrosmore
Bullockpark
Rusheens
Ardillan
Bird Isd.
Gortabradaun Pt.
Freaghillan
Kings Isd.
Goose Isd.
Scurmore
Mound
Carrowcardin
Carrowgarry
Moated Site
Carrownurlar
Tullylin
Carrowgun
Ballysakeery
Baile Easa Caoire
Knockroe
Rinnachurry Pt.
Dooneen
Ballymoneen
Attichree
Burial Ground
Cottlestown
Bailymoghany
Reservoir
Mount Ready
Inishdugh
Standing Stone
Allowan Isd.
Carrigeens
Inishporian
Rosserk Friary
Abbeytown
Holy Well
Rinroe
Lecarrownaveagh
Rathglass
Corballa
An Corrbhaile
Fidddaun
Muingwore
Lecarrow
Church
Killanly
Bunnanilra
Promontory Fort and Castle
Rabbit Pt.
Rathmurphy
Castleconor
Carrowkelly
Emlymoran
Corbally South
Farranimrish
Newtown
Bellanira
Castleconor
Rathroeen
Knockatinnole
Moated Site
Carraun
Knockbrack
Carha
Farrangarode
Ardvally
Rathdonnell
Dooyeaghny
Rathmoy
Garrankeel
Farrannoo
Standing Stone
Farranmorgan
River Moy
An Mhuaidh
Western Way
Slí an Iarthair
Ballymoghany River
Devlin River
Bellawaddy River
R297
R298
N59
R294

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Bricklieves/Keshcorran**
Other names used for site	
TOWNLAND(S)	Numerous
NEAREST TOWN	Geevagh/Castlebaldwin
SIX INCH MAP NUMBER	33, 34, 39 and 40
NATIONAL GRID REFERENCE	175000 310000 = G 75 10
1:50,000 O.S. SHEET NUMBER	25, 33 **1/2 inch Sheet No.** 7

Outline Site Description
Upland limestone karst plateau.

Geological System/Age and Primary Rock Type
Carboniferous limestones and shales (Bricklieve and Lisgorman Formations respectively).

Main Geological or Geomorphological Interest
The Bricklieve Karst is a well-documented and researched karst drainage unit exhibiting many classic karst features. The drainage consists of a widespread diffuse (percolation) input with minor point recharge. The hydrology and karst interest is well described in Thorn *et al.* (1990) and Thorn (1987). The karst unit is an excellent example of upland karst dominated by percolation input to the aquifer and contains many surface karst features in a good state of preservation, including a number of aillts – dry valleys.

Keshcorran Hill and the surrounding drumlin fields, in conjunction with the remnant phreatic maze caves at Keshcorran, clearly illustrates the glacial processes and lowering of the topography and karst baselevels in the Keshcorran area. As such, Keshcorran has many features not seen in other isolated hills in Ireland and is the best example of its type.

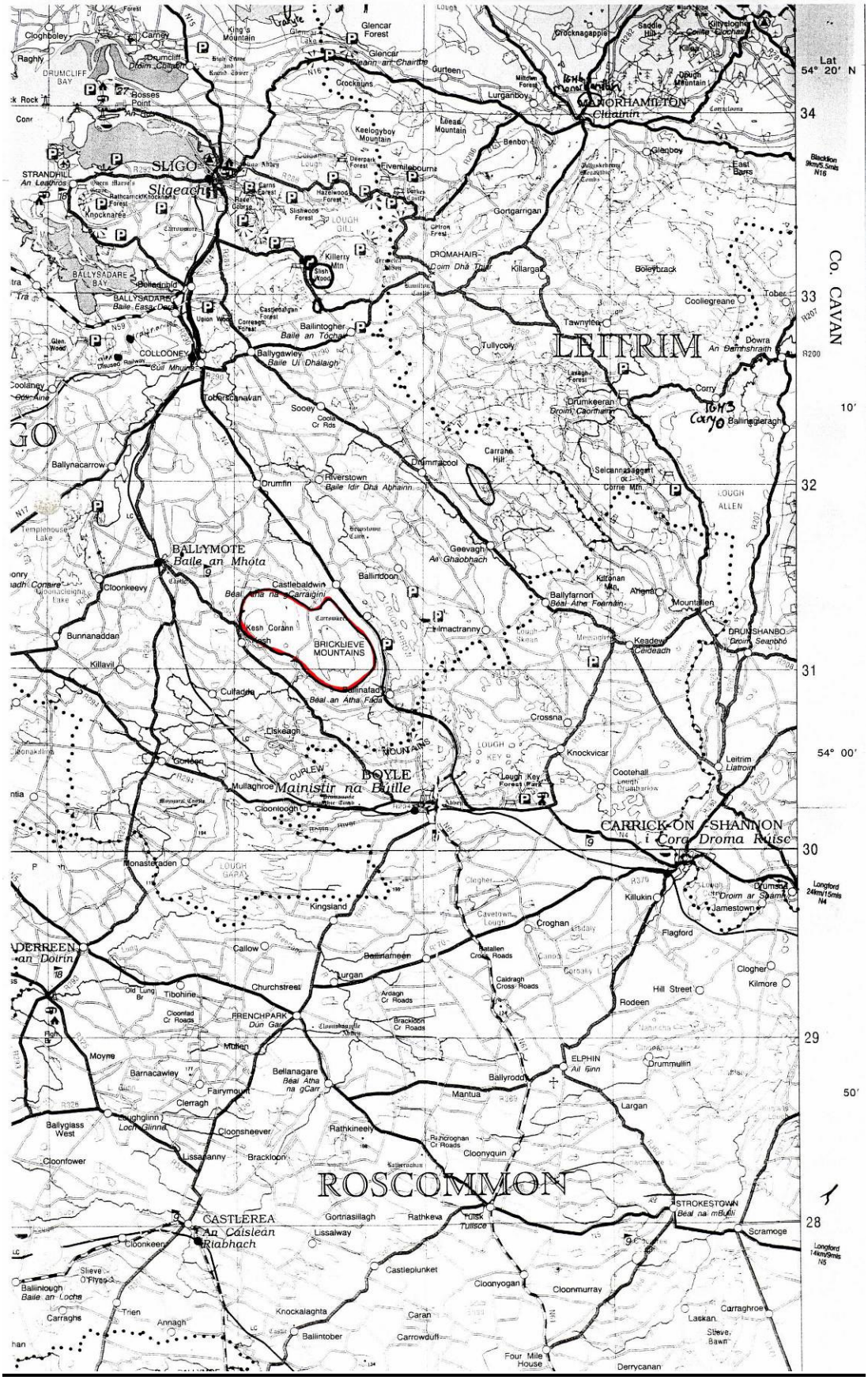
Site Importance
The site is of National importance and is proposed for NHA designation under the IGH1 Karst theme of the GSI's IGH Programme, [Site IGH1-10] as of August 2003.

Management/promotion issues
The site is coincident with a pNHA, already defined for biological reasons.

Limestone scarp on southwestern side of Keshcorran Hill showing series of entrances to glacially truncated remnant phreatic maze cave system. Photo: Donal Daly

Dry valleys or 'Aillts' are a feature of the Bricklieves karst. Photo: Matthew Parkes

Bricklieves / Keshcorran



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Geevagh**
Other names used for site	Carrowmore Caverns, Seighmairebawn, Pollnagollum, Polliska, Dragonfly Pot
TOWNLAND(S)	Carrownyclowan, Carrowmore, Carrownadargny, Tap, Carrowcashel, Tullynure, Straduff, Ballynashee, Aughnacloy
NEAREST TOWN	Geevagh
SIX INCH MAP NUMBER	28 and 35
NATIONAL GRID REFERENCE	183000 316000 = G 83 16
1:50,000 O.S. SHEET NUMBER	25 **1/2 inch Sheet No.** 7

Outline Site Description
Upland karst area with many well developed karst features.

Geological System/Age and Primary Rock Type
Carboniferous limestones, shales and evaporites.

Main Geological or Geomorphological Interest
The Geevagh Karst is a well documented and researched karst drainage unit exhibiting many classic karst features including swallowholes, vertical caves, natural bridges, dolines, glacially modified/derived dry valleys and springs. The drainage consists of a well-demonstrated vertical shaft vadose input zone with a phreatic mixing zone with multiple water discharge points (springs). The hydrology and karst interest is well described in Thorn *et al*. (1990) and Thorn (1987). The karst unit is the best example of a vadose cave fed phreatic mixing zone with multiple springs in Ireland and contains many surface karst features in a good state of preservation. The Geevagh site, notably in the Carrowmore Caverns, contains three of the most extensive and deepest vertical cave systems in Ireland (Pollnagollum and Seighmairebawn, Polliska and Dragonfly Pot) and is an excellent example illustrating cave development which has been controlled by both jointing and bedding planes.

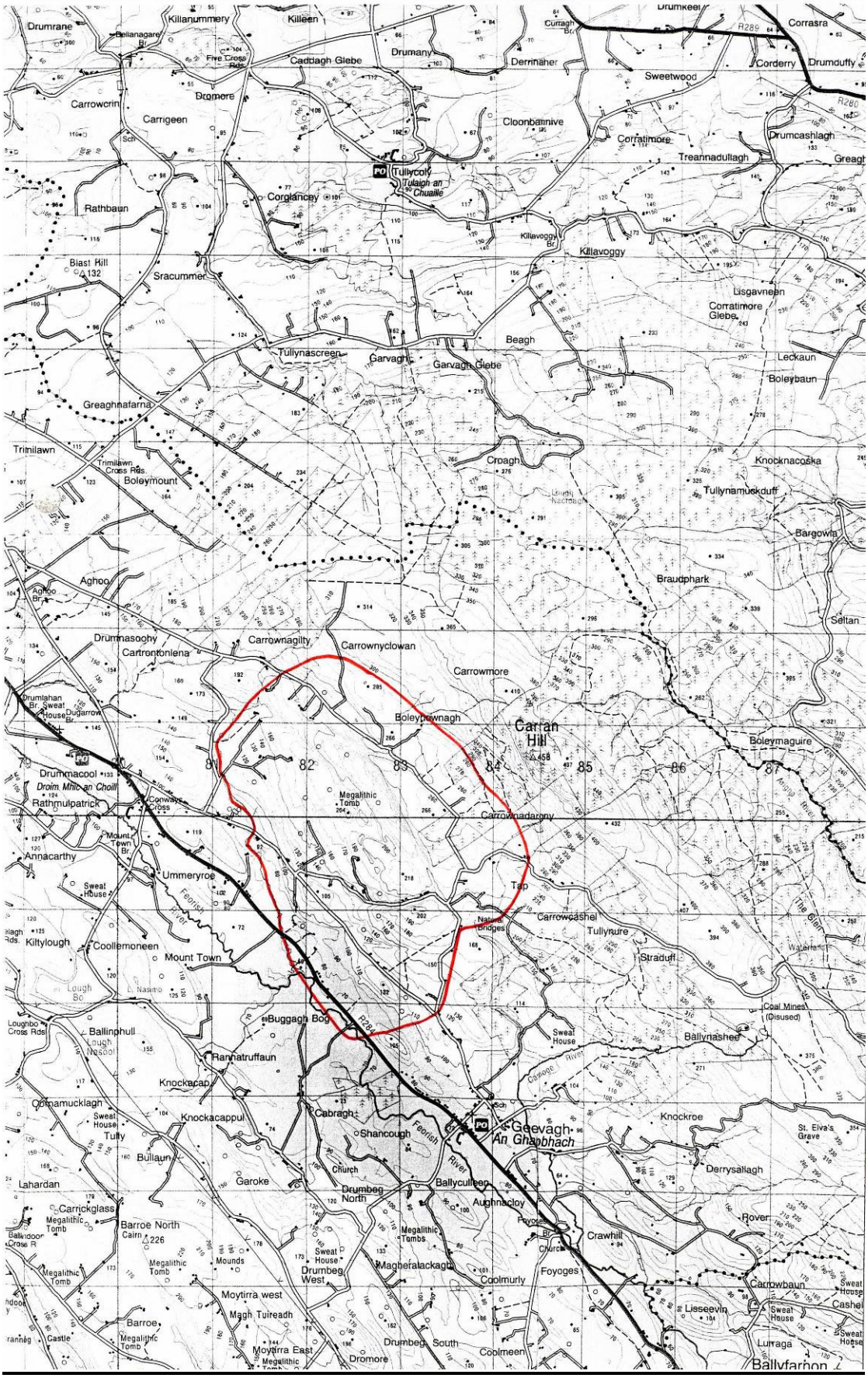
Site Importance
The site is of National importance and is proposed for NHA designation under the IGH1 Karst theme of the GSI's IGH Programme, [Site IGH1-14] as of August 2003.

Management/promotion issues
Refuse dumping into swallow holes and dolines has taken place in the past and, if continued, would be detrimental to this site.

Looking east across large closed depression and sinkhole at the entrance to Carrowmore Cavern (Seighmairebawn and Pollnagollum entrances). (J. Kelly).

Steep sided dry valley at Geevagh (J. Kelly).

Geevagh


Drumrane
Killanummery
Killeen
Drumkeel
Corrasra
Caddagh Glebe
Drumany
Derrinaher
Corderry
Drumduffy
Sweetwood
Carrowcrin
Dromore
Carrigeen
Cloonbannive
Corratimore
Drumcashlagh
Treannadullagh
Tullycoly
Tulaigh an Chuaille
Corglancey
Rathbaun
Killavoggy
Biast Hill
Sracummer
Lisgavneen
Corratimore Glebe
Beagh
Tullynascreen
Garvagh
Garvagh Glebe
Leckaun
Boleybaun
Greaghnafarna
Trinilawn
Croagh
Knocknacoska
Boleymount
Tullynamuckduff
Bargowla
Aghoo
Braudphark
Seltan
Drumnasohy
Carrownagilty
Carrownyclowan
Cartrontonlena
Carrowmore
Boleybrownagh
Carran Hill
Boleymaguire
Drumlahan Br
Sweat House
Drumacool
Droim Mhic an Choill
Rathmulpatrick
Megalithic Tomb
Carrowmadarogy
Annacarthy
Mount Town Br
Ummeryroe
Tarp
Feorish River
Carrowcashel
Nature Bridges
Tullynure
Straduff
Kiltylough
Coollernoneen
Mount Town
Buggagh Bog
R280
Coal Mines (Disused)
Ballinphull
Ballynashee
Rannatruffaun
Knockacap
Knockacappul
Knockroe
Cabragh
Shancough
Geevagh
An Ghaobhach
St. Eiva's Grave
Derrysallagh
Bullaun
Garoke
Church
Drumbeg North
Ballyculleen
Aughnacloy
Lahardan
Carrickglass
Megalithic Tomb
Barroe North
Cairn 226
Megalithic Tombs
Crawhill
Rover
Foyoges Br
Foyoges
Drumbeg West
Magheralackagh
Coolmurly
Moytirra west
Magh Tuireadh
Carrowbaun
Lieseevin
Cashel
Barroe
Castle
Moytirra East
Drumbeg South
Coolmeen
Dromore
Lurraga
Ballyfarnon

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Lough Nasool – Lough Bo**
Other names used for site	
TOWNLAND(S)	Kiltylough, Coollemoneen, Ballinphull, Doongelagh, Cornamucklagh
NEAREST TOWN	Geevagh/ Castlebaldwin
SIX INCH MAP NUMBER	34
NATIONAL GRID REFERENCE	179000 317000 = G79000 17000
1:50,000 O.S. SHEET NUMBER	25 **1/2 inch Sheet No.** 7

Outline Site Description
Vanishing Lake / Lakes connected by karstic drainage?

Geological System/Age and Primary Rock Type
The development of the karstic drainage is probably post glacial, i.e. within the last 12,000 years.

Main Geological or Geomorphological Interest
Recorded historical accounts indicate that Lough Nasool is a good example of the phenomenon of a vanishing lake which drains occasionally via a discrete sinkhole, rather than being a turlough which is related to seasonally fluctuating groundwater levels. It is essentially an inter-drumlin lake with a leaky floor where the glacial drift above the limestone bedrock is a bit thin. The lake is more prone to drain under highwater conditions, suggesting that a significant hydrostatic pressure is required to force open the sinkhole via which the water drains from the lake. Evidence suggests that Lough Nasool may drain underground to Lough Bo. Lough Nasool is the best example of a vanishing lake in Ireland and, if connected to Lough Bo, is also the best example of a vanishing lake connected to another lake via underground drainage. If the connection between Lough Nasool and Lough Bo can be proved via tracing this would be a unique example of this feature. Coleman (1965) noted that Lough Nasool drained completely in August 1933 and July 1964. An estimated 600,000 gallons drained from the lake revealing a sinkhole in the floor of the lake at its southern end. Coleman states that the draining took place in just over 1 hour, although local evidence suggests that the draining took weeks rather than hours. There is a sinkhole recorded at the northern end of the lake

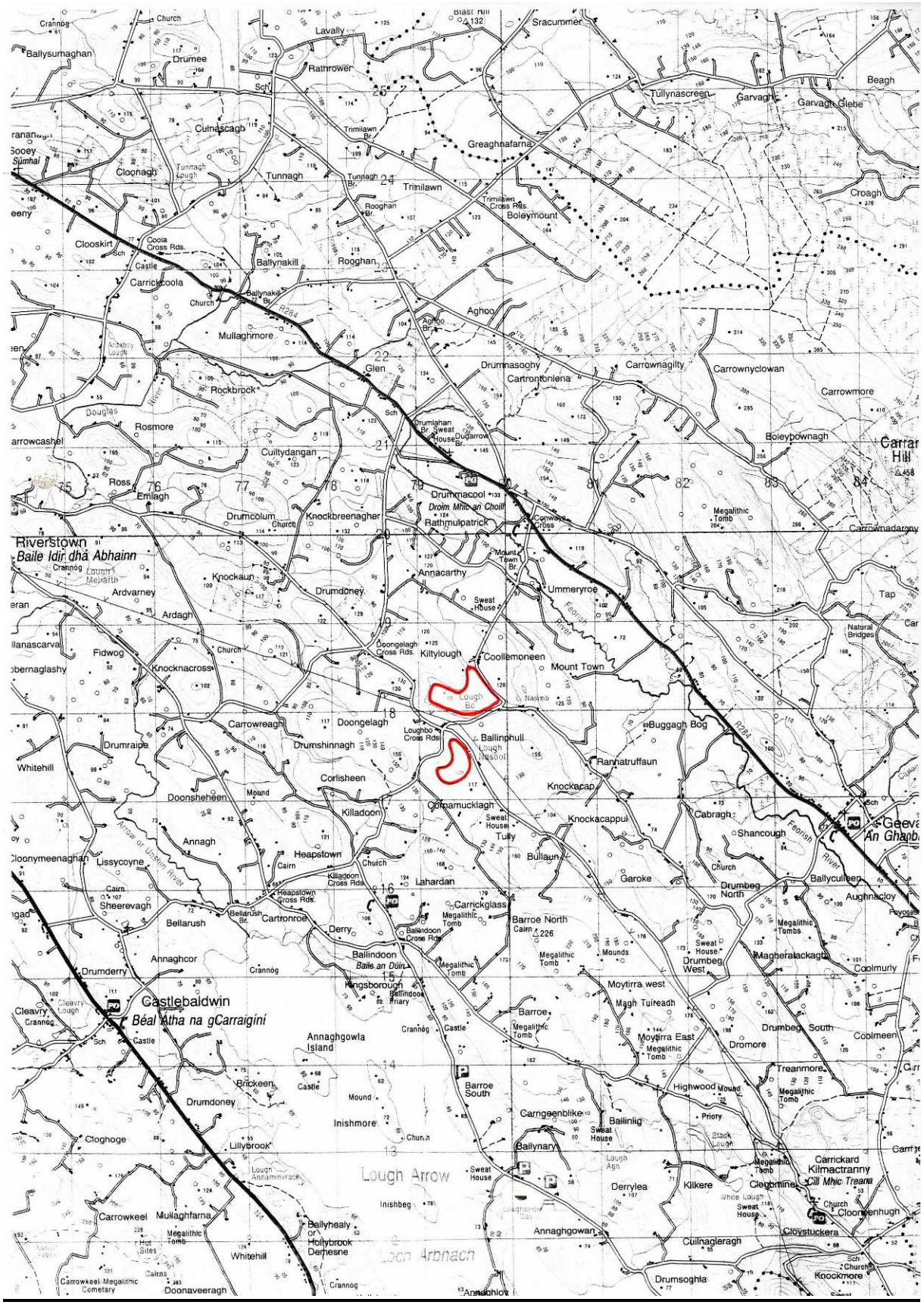
Site Importance
The site is of National importance and is proposed for NHA designation under the IGH1 Karst theme of the GSI's IGH Programme, [Site IGH1-29] as of 2003.

Management/promotion issues
Modification through drainage would damage the scientific interest of the loughs.

Lough Bo looking west Photo: John Kelly.

Lough Nasool Photo: Conor Mac Dermot

Lough Nasool – Lough Bo



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Knocknarea Glen**		
Other names used for site	The Glen		
TOWNLAND(S)	Knocknarea		
NEAREST TOWN	Strandhill		
SIX INCH MAP NUMBER	14		
NATIONAL GRID REFERENCE	162700 333400 = G 627 334		
1:50,000 O.S. SHEET NUMBER	25	**1/2 inch Sheet No.**	7

Outline Site Description
Linear narrow gorge – a limestone rift.

Geological System/Age and Primary Rock Type
The gorge is within Carboniferous Limestone, but it is uncertain when it was formed. It is most likely to be post glacial. There are also active and relict tufa deposits.

Main Geological or Geomorphological Interest
This limestone rift is a very regular parallel sided and very straight gorge. It runs for approximately one kilometre, and is generally about 6m wide but can be up to about 15m wide. It is probably the result of slope failure and mass-movement of the downslope side. Movement has occurred along a fracture like those in the Swiss Valley at Glencar, once the side of the Knocknarea hill lost the support of the ice sheet at the end of the last glaciation (about 10-12,000 years ago). Rather than a spoon shaped slope failure, like at Glencar, it would seem as if the entire block slid out on one particular bedding surface, probably lubricated by groundwater under pressure, and a single fracture line formed the Glen.

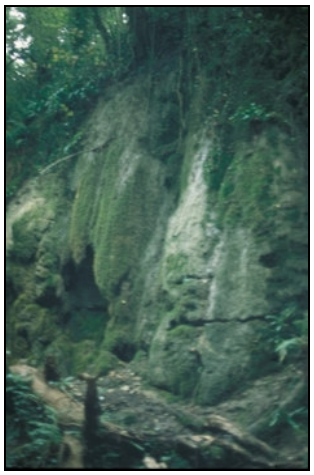
There are also active and relict tufa deposits, which indicate lime charged waters seeping on horizons in the limestone.

Site Importance
The site is an interesting and important County Geological Site.

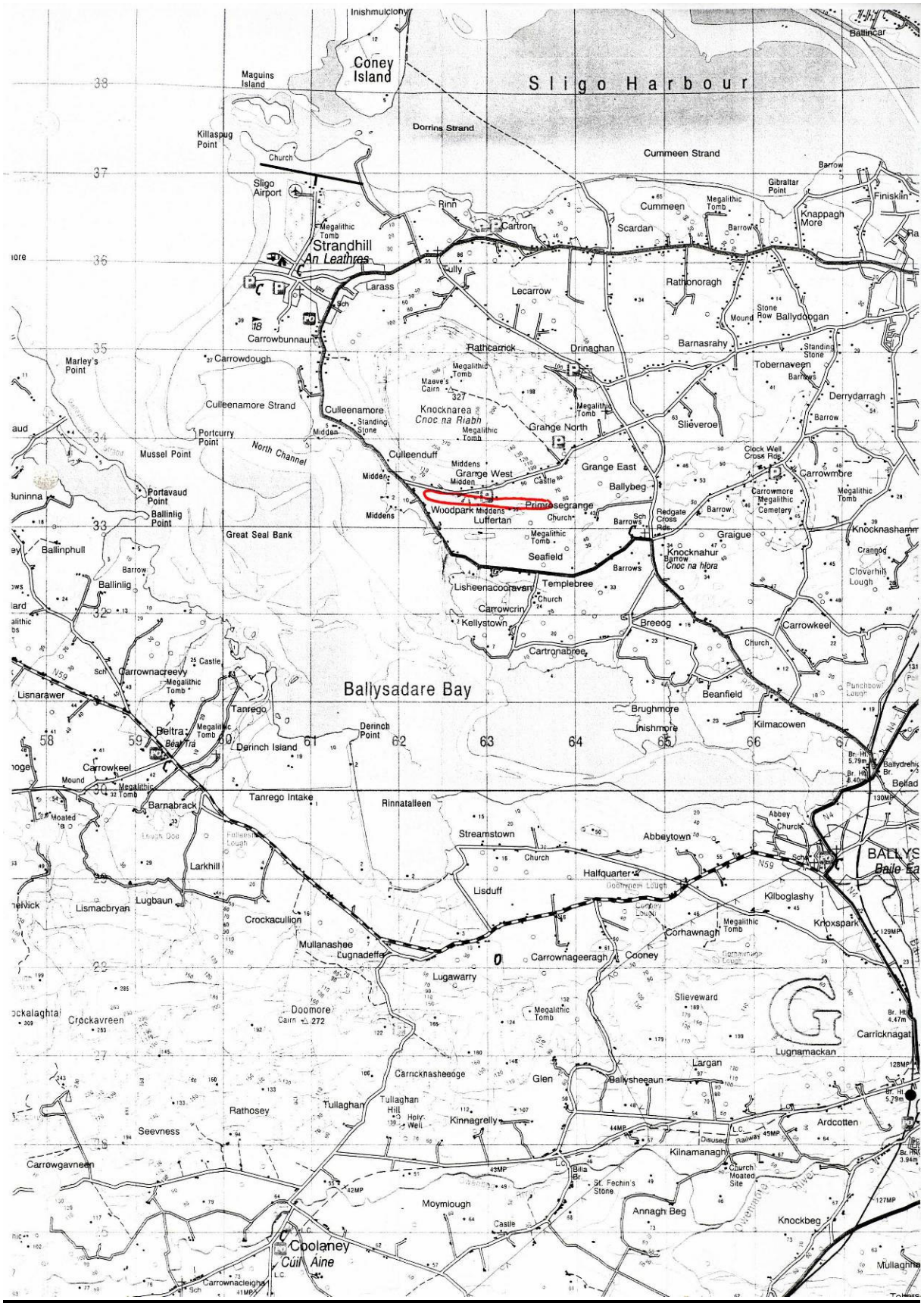
Management/promotion issues
Although there appears to be easy public access, the site is probably a wildlife refuge, and encouragement of too many visitors would spoil the peace and wildness. It should be protected but not promoted widely in order to maintain the site as it is. There is parking close to entrance.

The Glen
Photos: Matthew Parkes

Tufa deposits



Knocknarea Glen



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Knocknarea**
Other names used for site	
TOWNLAND(S)	Culleenamore, Culleen Duff, Grange West, Grange North, Rathcarrick
NEAREST TOWN	Strandhill
SIX INCH MAP NUMBER	14
NATIONAL GRID REFERENCE	162500 334500 = G 62 34
1:50,000 O.S. SHEET NUMBER	25 **1/2 inch Sheet No.** 7

Outline Site Description
Isolated karstic hill.

Geological System/Age and Primary Rock Type
Carboniferous Limestone.

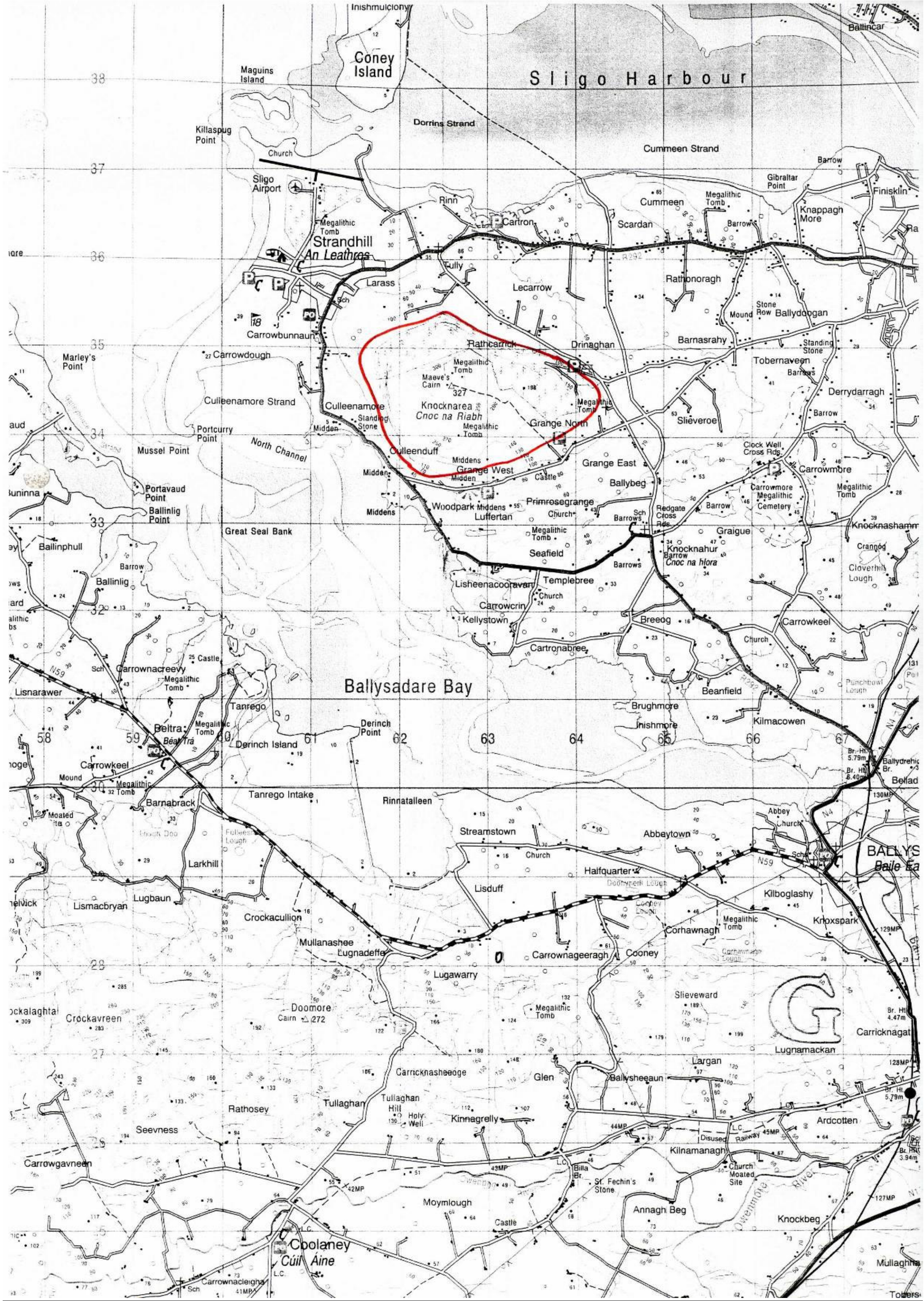
Main Geological or Geomorphological Interest
Blue/grey limestone of the Dartry Limestone formation defines the Hill of Knocknarea. The limestone here is rich in fossils and also contains blue/grey nodules of chert. These chert nodules formed during compaction and lithification early in the rocks history. Fossils include bush-like colonial corals, brachiopods (shells) and crinoids (sea-lillies). Where quartz has replaced the original composition, fossils appear to sit above the beds that contain them. This is because quartz is more resistant to weathering than limestone. Weathering along planes of weaknesses such as bedding planes and fractures has resulted in the formation of a natural limestone stairway along the path to the summit of Knocknarea Hill. Flooding of the lower end of this path occurs during the winter when a turlough on the shoulder of the hill fills up as a result of increased groundwater levels. Knocknarea is also an isolated hill, indicating part of the regional history of extensive glacial and karstic erosion. It also has tundra frost polygons, blockfields, protalus ramparts and other features of periglacial weathering.

Site Importance
The site is proposed as a County Geological Site under the IGH12 Mesozoic and Cenozoic theme and the IGH7 Quaternary theme of the GSI's IGH Programme.

Management/promotion issues
No known problems at time of writing.

Photos looking northeast at Knocknarea

Knocknarea



Sligo Harbour
Coney Island
Maguins Island
Dorrins Strand
Cummeen Strand
Killaspug Point
Sligo Airport
Strandhill
An Leathras
Rinn
Cartron
Cummeen
Scardan
Gibraltar Point
Finisklin
Knappagh More
Larass
Tully
Lecarrow
Rathonoragh
Ballydoogan
Carrowbunnaun
Carrowdough
Marley's Point
Rathcarrick
Drinaghan
Barnasrahy
Tobernaveen
Maeve's Cairn
327
Knocknarea
Cnoc na Riabh
Megalithic Tomb
Culleenamore Strand
Culleenamore
Standing Stone
Grange North
Slieveroe
Derrydarragh
Portcurry Point
Mussel Point
North Channel
Culleenduff
Grange West
Grange East
Clock Well Cross Rds
Carrowmore
Portavaud Point
Ballinlig Point
Ballybeg
Carrowmore Megalithic Cemetery
Woodpark
Luffertan
Primrosegrange
Redgate Cross Rds
Knocknashammer
Great Seal Bank
Graigue
Knocknahur
Cnoc na hIora
Seafield
Ballinphull
Ballinlig
Lisheenacooravan
Templebree
Clover Hill Lough
Carrowcrin
Kellystown
Breeog
Carrowkeel
Cartronabree
Carrownacreevy
Ballysadare Bay
Lisnarawer
Beanfield
Tanrego
Brughmore
Inishmore
Kilmacowen
Beltra
Béal Trá
Derinch Point
Derinch Island
Carrowkeel
Tanrego Intake
Barnabrack
Rinnatalleen
Streamstown
Abbeytown
Abbey
Church
BALLYS
Larkhill
Halfquarter
Lisduff
Kilboglashy
Lugbaun
Lismacbryan
Crockacullion
Corhawnagh
Knoxspark
Mullanashee
Lugnadeffe
Carrownageeragh
Cooney
Lugawarry
Slieveward
Doomore
Cairn 272
Crockavreen
Lugnamackan
Carrignagat
Carricknasheeoge
Glen
Largan
Ballysheeaun
Tullaghan
Tullaghan Hill
Holy Well
Rathosey
Kinnagrelly
Seevness
Ardcotten
Kilnamanagh
Carrowgavneen
Moated Site
St. Fechin's Stone
Moymlough
Castle
Annagh Beg
Knockbeg
Coolaney
Cúil Áine
Carrownacleigha
Mullaghna

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Split Rock or Giant's Rock**		
Other names used for site	Fionn Mac Cumhail's Stone		
TOWNLAND(S)	Easky		
NEAREST TOWN	Easky		
SIX INCH MAP NUMBER	11		
NATIONAL GRID REFERENCE	139800 336500 = G 398 365		
1:50,000 O.S. SHEET NUMBER	24	**1/2 inch Sheet No.**	7

Outline Site Description
Roadside massive boulder exposure.

Geological System/Age and Primary Rock Type
Ox Mountain Precambrian granodiorite erratic transported northwards by ice sheets.

Main Geological or Geomorphological Interest
Split Rock is the largest erratic boulder from the central area of the Ox Mountains found strewn across the coastal lowlands north of the mountain range. These blocks of granodiorite were carried far from their source area and deposited in their current positions by large sheets of ice during the last glaciation (30,000 – 10,000 years ago). The boulders differ in composition to the rocks in the surrounding area indicating that they have travelled far from their source. As the only nearby rock type with the same composition is found in the Ox Mountains it can be inferred that this must be the source area.

According to Irish folklore the legendary Fionn MacCumhail threw the boulder from the mountains in a fit of rage. Further angered by the fact that he missed the sea he cut the stone in two with his sword producing the large gap seen in the boulder today. In fact the split is a natural fracture in the stone.

Site Importance
The site is of National importance and is likely to be proposed for NHA designation under the IGH7 Quaternary theme of the GSI's IGH Programme.

Management/promotion issues
This site allows visitors to see the rock easily from the road, but the only safe parking is in front of the adjacent house, itself opposite a school. This is a site where a management agreement with the landowner could allow public access by stile over the wall.

Three views of Split Rock
The person in one view is 2 metres tall for scale. Photos: Matthew Parkes

Split Rock or Giant's Rock

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Meenamore**		
Other names used for site			
TOWNLAND(S)	Meenamore		
NEAREST TOWN	Tobercurry		
SIX INCH MAP NUMBER	31		
NATIONAL GRID REFERENCE	142450 317440 = G 4245 1744		
1:50,000 O.S. SHEET NUMBER	24	**1/2 inch Sheet No.**	7

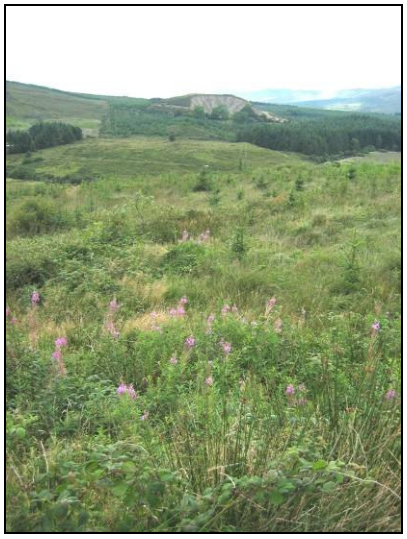
Outline Site Description
A prominent ridge of sand and gravel on a hillside.

Geological System/Age and Primary Rock Type
Quaternary ice margin deposits.

Main Geological or Geomorphological Interest
The Meenamore area hosts a spectacular fan moraine. These glacial deposits formed at the margin of the ice sheet during the last glaciation, 30,000 – 10,000 years ago. It is composed of a poorly sorted mixture of sand, gravel and boulders.

Site Importance
The site is a candidate site under the IGH7 Quaternary theme of the GSI's IGH Programme and may be proposed for NHA designation but is definitely a County Geological Site.

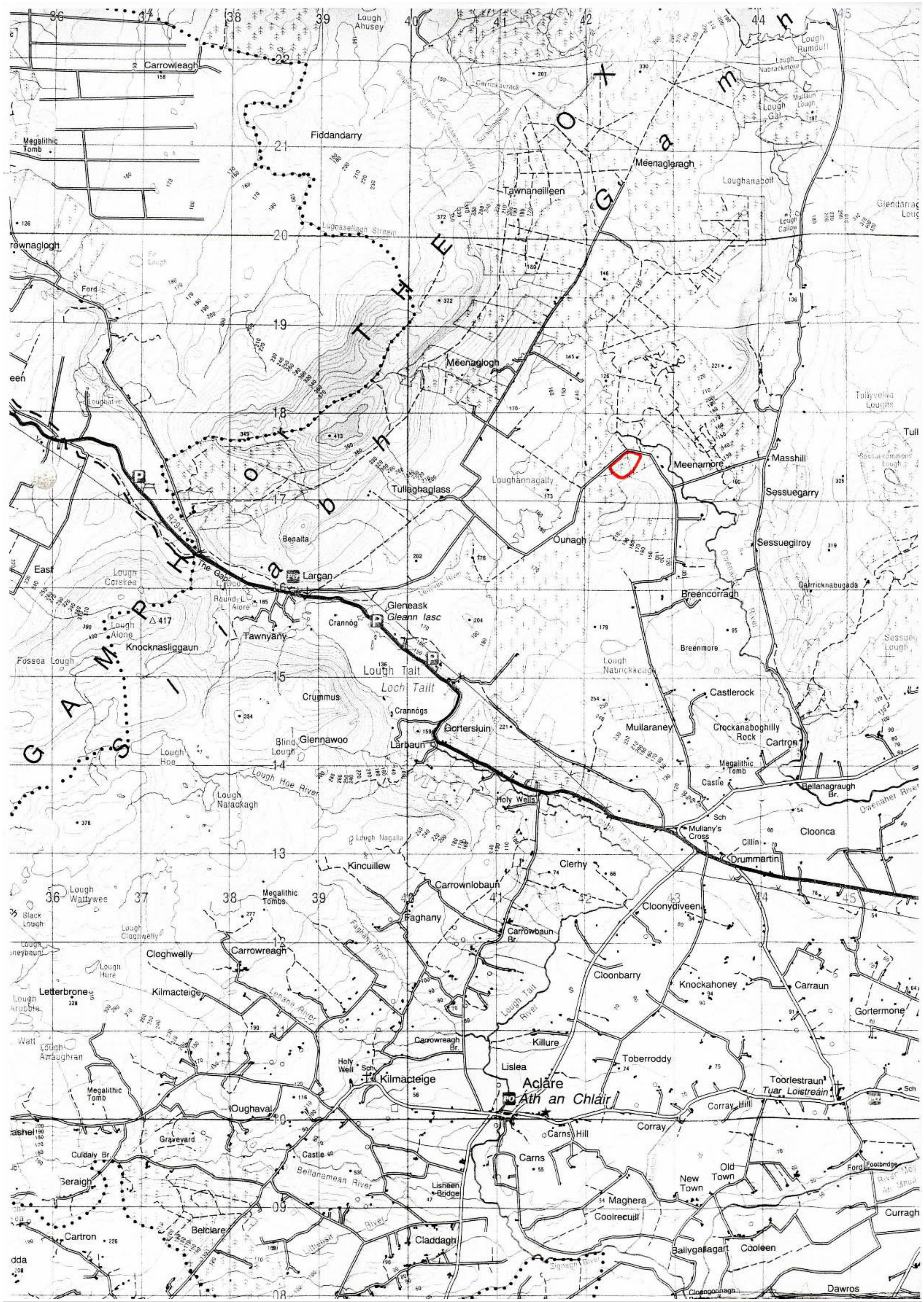
Management/promotion issues
The feature is currently being quarried for making forest roads locally, by contractors for Coillte. It exemplifies the difficulty of preserving significant landforms against competing demand for sand and gravel aggregate. [see geological conservation issues and site management section of main report].



View of Fan Moraine
from Meenamore Wood.

View of Fan Moraine from road SW
of Meenamore.

Meenamore



Carrowleagh
Fiddandarry
Megalithic Tomb
Meenagleragh
Tawnaneilleen
Loughanaboll
Meenaglogh
Meenamore
Masshill
Sessuegarry
Tullaghaglass
Loughannagally
Ounagh
Sessuegilroy
Benalta
Larcan
Carricknabugada
Breencorragh
Gleneask
Gleann Iasc
Tawnyany
Knocknasliggaun
Breenmore
Lough Nabrickkeagh
Lough Talt
Loch Tailt
Crummus
Castlerock
Mullaraney
Crockanaboghilly Rock
Cartron
Gortersluin
Glennawoo
Larbaun
Holy Wells
Lough Nalackagh
Mullany's Cross
Cloonca
Drummartin
Kincuillew
Clerhy
Carrownlobaun
Faghany
Cloonydiveen
Cloghwelly
Carrowreagh
Carrowbaun Br.
Cloonbarry
Knockahoney
Carraun
Letterbrone
Kilmacteige
Gortermone
Killure
Lislea
Toberroddy
Kilmacteige
Aclare
Ath an Chláir
Toorlestraun
Tuar Loistreáin
Oughaval
Corray Hill
Corray
Graveyard
Carns Hill
Carns
Beltare
Claddagh
New Town
Old Town
Maghera
Coolrecuill
Ballygallagart
Cooleen
Dawros
Cartron
THE OX
GAMPH
Slieve Gamh

SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**The Gap (NW of Lough Talt)**		
Other names used for site			
TOWNLAND(S)	Largan		
NEAREST TOWN	Ballina		
SIX INCH MAP NUMBER	30		
NATIONAL GRID REFERENCE	139000 315900 = G 390 159		
1:50,000 O.S. SHEET NUMBER	24	**1/2 inch Sheet No.**	7

Outline Site Description
A valley.

Geological System/Age and Primary Rock Type
Quaternary meltwater drainage landscape feature.

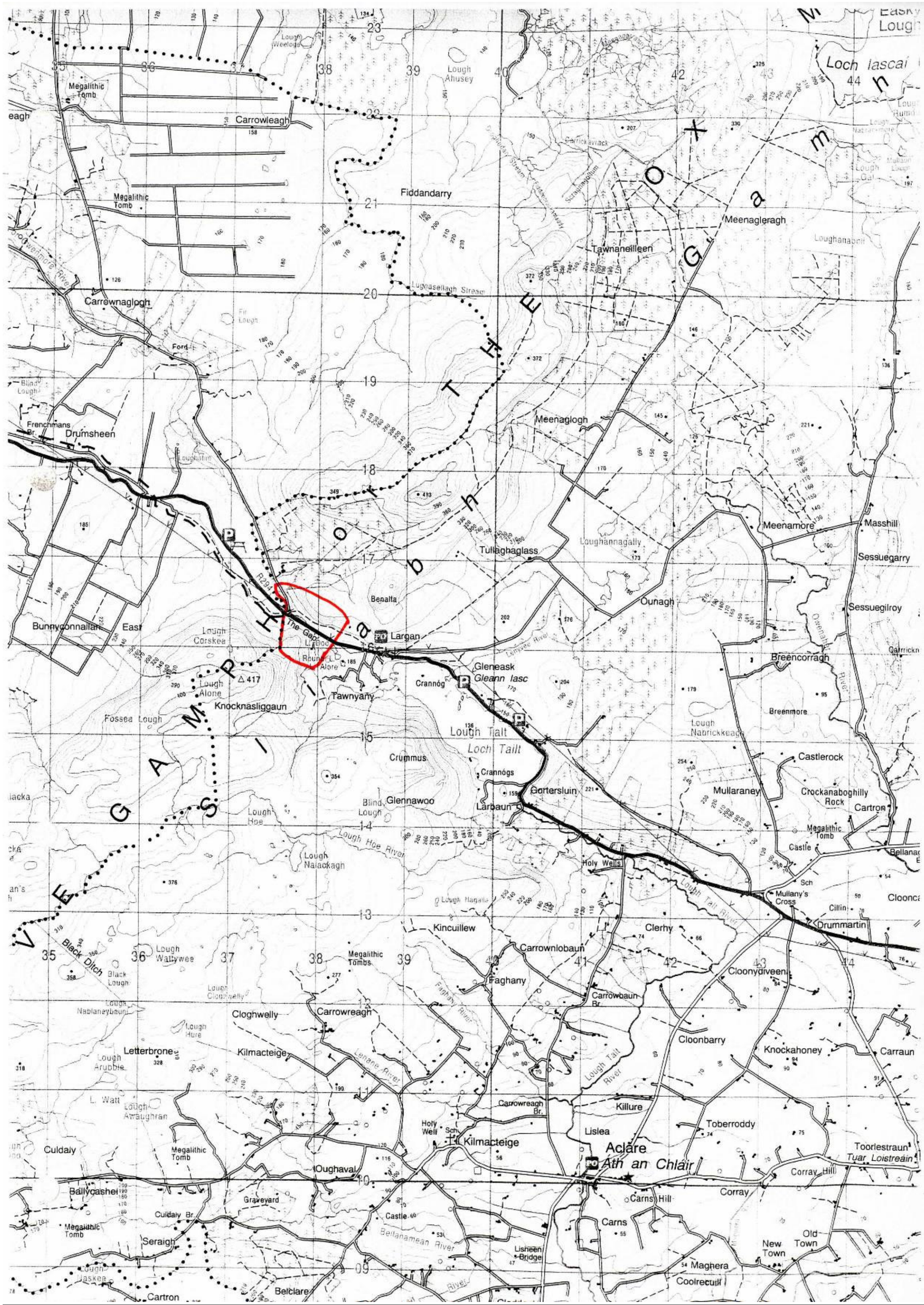
Main Geological or Geomorphological Interest
The area northwest of Lough Talt, including just across the border into Mayo, hosts an excellent example of a meltwater channel. This channel formed towards the end of the last glaciation, when large rivers of ponded ice meltwater breached the watershed of Slieve Gamph and carved out a channel as they flowed out of temporary lakes during deglaciation of the area. It is flat floored and has no relation to present drainage.

Site Importance
The site is a County Geological Site under the IGH7 Quaternary theme.

Management/promotion issues
The site is robust and large scale, but housing or other development should be avoided as it would significantly detract from the quality of the site.

Views of melt-water channel from Mayo side of R294.

The Gap (NW of Lough Talt)



SLIGO - COUNTY GEOLOGICAL SITE REPORT

NAME OF SITE	**Easky River solifluction lobe**		
Other names used for site			
TOWNLAND(S)	Trasgarve		
NEAREST TOWN	Dromore West		
SIX INCH MAP NUMBER	24		
NATIONAL GRID REFERENCE	144000 325000 = G 44 25		
1:50,000 O.S. SHEET NUMBER	24	**1/2 inch Sheet No.**	7

Outline Site Description
A lobed surface deposit of unconsolidated material at foot of hillslope.

Geological System/Age and Primary Rock Type
Periglacial deposits.

Main Geological or Geomorphological Interest
The area north of Easky Lough displays fine examples of solifluction lobes. These 'lobes' of sediment formed during the later stages of the last glaciation as seasonally thawed material moved slowly down slope under the influence of gravity during repeated freezing and thawing episodes.

Site Importance
The site is a County Geological Site under the IGH7 Quaternary theme of the GSI's IGH Programme.

Management/promotion issues
The turf cutting does not seriously impinge on the overall feature, but bulldozing or other earthworks will degrade it further.

Solifluction lobe viewed from road.

Easky River solifluction lobe