

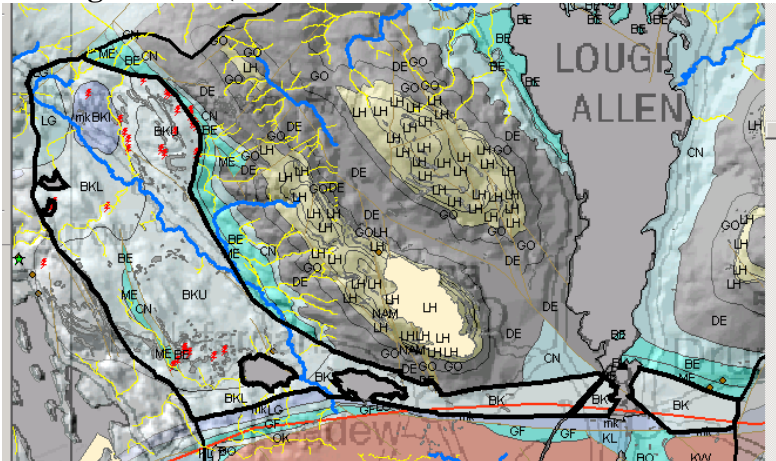
Geevagh GWB Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface features	Associated terrestrial ecosystem(s)	Area (km ²)
26 – Shannon Upstream Rooskey Sligo, Roscommon & Leitrim Co. Co.'s	Rivers: Feorish, Kilmactranny, Arigna, Camoge. Streams: Loughs: Bo, Nasool, Nasimb, Black, Skean, White.	None currently listed (NHA, SAC, SPA)	60
Topography	This GWB has a varied topography comprising both lowland and upland areas, with ground elevations ranging from 50-280 mAOD. In the western side of the GWB upland areas of 100-280 mAOD occur to the north and the south of the River Feorish which flows in a south-easterly direction through the body. The highest point of the body (280 mAOD) occurs in the Geevagh Uplands in the north of the body, east of the River Feorish. Ground elevations are lower along the course of the River Feorish (70-90 mAOD). There is a large flat marshy area, Buggagh Bog (60-80 mAOD), alongside the River Feorish just northwest of Geevagh. East of Lough Skean, in the extended eastern limb of the body elevations are lower (50-80 mAOD). The land slopes gently to the south. There are large flat boggy areas between Lough Skean and Lough Meeglan and further west adjacent to the River Shannon. East of the River Shannon and the southernmost part of Lough Allen near Drumshambo, the land is more hilly (50-100 mAOD) as drumlins are more frequent.		
Geology and Aquifers	Aquifer categories	The main aquifer category in this GWB is: Rk^c : Regionally important karstified aquifer dominated by conduit flow. There are some small areas within the body with aquifer categories of: Ll : Locally important aquifer which is moderately productive only in local zones Pl : Poor aquifer which is generally unproductive except for local zones	
	Main aquifer lithologies	This GWB is composed primarily of Dinantian Pure Bedded Limestones. There is a small area (1.4 km ²) of overlying Dinantian Mixed Sandstones, Shales and Limestones and Dinantian Shales and Limestones northwest of Lough Skean. In the extreme northwest of the body, a small area (2.6 km ²) of the underlying Dinantian Shales and Limestones is exposed. There is also an area (2.5 km ²) of Dinantian Pure Unbedded Limestones in the north of the body.	
	Key structures	Two major faults run just north and south of this GWB. The Belhavel Fault, just north of the body, has a northeast-southwest trend. The Curlews Fault has an east-west trend and forms the northern margin of the Curlew Mountains Inlier south of the body. The tensional regime between these two faults has resulted in the north-northwest trending faults observed within this body, part of an overall dextral stress pattern (MacDermott 1996). There is also faulting at the contact with younger shaly rocks of the adjoining Lough Allen Uplands GWB to the north and east of the body. Dips over the body are generally less than 10°, except near faults, where steeper dips result from fault drag.	
	Key properties	The Dinantian Pure Bedded Limestones in the GWB are highly karstified. As with most karstic systems, permeability and transmissivity data will be very variable. Transmissivity in karstified aquifers with conduit flow can range up to a few thousand m ² /d. This GWB includes an area of upland karst known as the Geevagh Karst where tracer tests have been carried out. The variability of the flow rates recorded (c. 3 to 90 m/hr depending on the flow conditions) and the actual flow rate under medium to high flow (90 m/hr) suggests that conduit rather than fissure flow operates (Thorn <i>et al.</i> , 1990). In karstified Pure Bedded Limestone such as that found in this GWB, enlargement of the fracture network by solution, and the generally well connected and widespread fracture systems result in a highly permeable aquifer with rapid groundwater flow. Storativity in this aquifer will be low.	
	Thickness	The Dinantian Pure Bedded Limestones are generally well over 100 m thick. Most groundwater flows in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. Deeper inflows can occur in areas associated with faults or dolomitisation.	
Overlying Strata	Lithologies	Currently available subsoil mapping is limited to County Roscommon and the narrow eastern part of the GWB south of the Lough Allen Uplands. A variety of Namurian and Devonian Sandstone and Shale tills are identified with areas of cut peat, often reclaimed for forestry or grassland, in lowland areas. Areas of Alluvium are also recorded. The subsoil in the County Roscommon part of this GWB is considered to be of 'low' permeability. Areas of rock outcrop or rock close to the surface are common, particularly in the narrow eastern part of the GWB just east of Lough Meeglan, west of Lough Skean, and northeast of the River Feorish in the northeast of the body (Geevagh upland karst area). [Information to be added at a later date]	
	Thickness	There are few data on depth to bedrock within this groundwater body. Based on the frequency of rock outcrop and shallow rock there are likely to be large areas with < 3 m subsoil in the northeast of the body north of Geevagh village, in the upland areas west and northwest of Lough Skean, and north and west of Lough Meeglan. Deeper subsoil (>3 m) may be encountered in the lowlying bog areas between Loughs Skean and Meeglan, around Buggagh Bog along the River Feorish, and in the vicinity of the River Shannon in the extreme east of the body.	
	% area aquifer near surface	[Information to be added at a later date]	

	Vulnerability	<p>There will be large areas of Extreme vulnerability in this body, coinciding with areas of shallow (<3 m) subsoil. Extremely vulnerable areas will include the upland area north of Geevagh village, part of the upland areas west and northwest of Lough Skean and areas around Lough Meeglan and just northwest of Keadew. Areas of Moderate and Low vulnerability occur in the vicinity of the River Feorish between Lough Skean and Lough Meeglan and west of the River Shannon. Groundwater vulnerability in those portions of the GWB outside of County Roscommon have not been mapped.</p> <p>A Groundwater Vulnerability Map has been prepared for County Roscommon as part of a Groundwater Protection Scheme. [Information to be added at a later date]</p>
Recharge	Main recharge mechanisms	<p>Both point and diffuse recharge occur in this GWB. Swallow holes and collapse features provide the means for point recharge. Point recharge dominates in the upland area north of Geevagh village where streams carrying runoff from the adjoining low permeability Lough Allen Uplands GWB sink on contact with the Pure Bedded Limestone in a series of swallow holes. Diffuse recharge will also occur over the entire GWB via rainfall percolating through the subsoil. The subsoil in the body is expected to be primarily of 'low' permeability which may restrict the percolation of recharge in some areas, however in many places this 'low' permeability subsoil is thin or absent. The lack of surface drainage in several parts of this GWB indicates that potential recharge readily finds its way into the groundwater system in those areas.</p> <p><i>Note: Subsoil permeability has only been mapped in detail in the part of the GWB in County Roscommon where a Groundwater Protection Scheme has been prepared.</i></p>
	Est. recharge rates	[Information to be added at a later date]
Discharge	Springs and large known abstractions (m³/d)	<p>Ballyfarnon WS (Spring – 182 m³/d) – Data from EPA Groundwater Sources List</p> <p>[Information to be added at later date]</p>
	Main discharge mechanisms	The main discharges are to the streams, rivers and lakes within the body. The large marshy area of Buggagh Bay is suspected to be a zone of groundwater discharge (Thorn <i>et. al.</i> , 1990). In winter groundwater will discharge to any turloughs found in the area.
	Hydrochemical Signature	<p>The hydrochemistry of the carbonate rocks, especially pure limestones, is dominated by calcium and bicarbonate ions. Hardness can vary from slightly hard to very hard (typically ranging between 380–450 mg/l). Spring waters tend to be softer, as throughput is often quicker with less time for the dissolution of minerals into the groundwater. Groundwater alkalinity is variable, but can be high. Alkalinity is generally less than hardness indicating that ion exchange (where calcium or magnesium are replaced by sodium) is not a significant process. Lime-scale can be problematic. Like hardness and alkalinity, electrical conductivities (EC) can vary greatly. Typical limestone groundwater conductivities are of the order 500–700 µS/cm. Lower values suggest that groundwater residence times are very short. Hydrochemical analyses were carried out on groundwater from two risings (St James' Well and Rising D) in the Geevagh area, between October 1987 and September 1988 (Thorn <i>et. al.</i>, 1990). St James Well showed typical a hydrochemistry for a pure limestone. Hardness ranging from 257-326 mg/l, alkalinity from 236-312 mg/l and EC from 505-606 µS/cm. At Rising D hardness ranged from 67-191 mg/l, alkalinity from 65-135 mg/l and EC from 173-337 µS/cm illustrating a very close link with surface water, short residence time and likely conduit flow from sink to rising.</p>
Groundwater Flow Paths	<p>These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours, as shown by several tracing studies (Drew and Daly, 1993). Flow velocities can be rapid and variable, both spatially and temporally. Results of water tracing experiments in the Geevagh Karst showed variability in flow rates (3 to 90 m/hr) depending on flow conditions. The actual flow rate measured under medium to high flow (90 m/hr) suggests that flow takes place in enlarged conduit systems. (Thorn <i>et. al.</i>, 1990). Flow path lengths can be up to a several kilometres in length. Overall groundwater flow in the western side of the body will be towards the River Feorish. In the extreme east of the body overall groundwater flow will be towards the River Shannon and the southern part of Lough Allen. The karstified nature of the bedrock means that locally groundwater flow directions can be highly variable. Groundwater is generally unconfined in this GWB. Water levels in karstified limestone which is dominated by conduit flow, generally show rapid response to rainfall.</p>	
Groundwater & Surface water interactions	<p>There is a high degree of interconnection between groundwater and surface water in this GWB. Numerous karst features are recorded, in particular caves and swallow holes. Streams flowing off the younger shaly rocks of the Lough Allen Uplands GWB sink at the contact with the pure bedded limestones. This provides rapid point recharge to groundwater. Streams re-emerge as springs, after flowing as groundwater for some distance, to once again form surface streams. Lough Nasool in the west of the body is known to discharge to groundwater (Coleman 1965). Because of the close interaction between surface water and groundwater in karstified aquifers, surface water and groundwater quality are also closely linked. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.</p>	

Conceptual model	<ul style="list-style-type: none"> • This body occupies an L-shaped area west of Lough Allen. It is bounded to the west by groundwater divides and topographic highs which coincide with surface water catchment boundaries and the Shannon RBD/Western RBD boundary. It is bounded to the north and east by the contact with the Namurian Shales and Dinantian Mixed Sandstones, Shales and Limestones of the Lough Allen Uplands GWB. It is bounded to the south by the contact with the Dinantian Pure Unbedded Limestones. In the extreme east of the body the eastern boundary is formed by a groundwater divide and topographic high which coincides with the Shannon RBD/Eastern RBD boundary. • This GWB has a varied topography comprising both lowland and upland areas, with ground elevations ranging from 50-280 mAOD. In the western side of the GWB upland areas of 100-280 mAOD occur to the north and the south of the River Feorish. In the extended eastern limb of the body ground elevations area lower. Flat boggy areas occur between Lough Skean and Lough Meeglan and west of Keadew near the River Shannon. • The GWB is composed primarily of high transmissivity karstified limestone. Groundwater flows through a network of solutionally enlarged fissures and conduits. Karst features such as caves, swallow holes occur within the body. • Groundwater flows along interconnected fractures, joints, faults and bedding planes, many of which have been enlarged by solution. Much of the groundwater flow is concentrated in conduits. Rapid groundwater flow velocities have been recorded through groundwater tracing. • Recharge to this GWB is both point, through swallow holes and collapse features, and diffuse via rainfall percolating through the subsoil. Streams flowing off the shaly rocks of the adjoining Lough Allen Uplands GWB sink on contact with the pure bedded limestones. The lack of surface drainage in several parts of this GWB indicating that potential recharge is readily transported into the groundwater system. Groundwater in this body generally shows a rapid response to recharge. • The groundwater in this body is generally unconfined. Most groundwater flow will occur in the upper epikarstic layer and in a zone of interconnected fissures, enlarged by karstification, generally extending to a depth of 30 m. Deep water strikes in more isolated faults/fractures can be encountered. • In general in karstic aquifers, the degree of interconnection between fractures zones is high and they support regional scale flow systems. Flow paths can potentially be several kilometres in length. • Some areas in this GWB are of extremely vulnerable due to the thin nature of the subsoil, as well as the frequency of karst features. Groundwater storage in karstified bedrock is low and the potential for contaminant attenuation in such aquifers is limited. • Groundwater discharges to springs and to the streams and rivers crossing the body • There is a high degree of interaction between surface water and groundwater in this GWB.
Attachments	None
Instrumentation	Stream gauges: 26030, 26073, 26077, 26117. EPA Water Level Monitoring boreholes: None. EPA Representative Monitoring boreholes: None.
Information Sources	Coleman, J.C. (1965) <i>The Caves of Ireland</i> . Tralee Lee, M. & Daly D. (2003) <i>County Roscommon Groundwater Protection Scheme</i> . Main Report. Roscommon County Council & Geological Survey of Ireland, 54pp. MacDermot, C.V. Long C.B. and Harney S.J (1996) <i>Geology of Sligo-Leitrim: A geological description of Sligo, Leitrim and adjoining parts of Cavan, Fermanagh, Mayo and Roscommon, to accompany bedrock geology 1:100,000 scale map, Sheet 7, Sligo - Leitrim</i> . With contributions from K. Carlingbold, G. Stanley, D. Daly and R. Meehan. Geological Survey of Ireland, 100pp. Thorn, R., Drew, D. and Coxon, C. (1990). The Hydrology and Caves of the Geevagh and Bricklieve Karsts, Co. Sligo. <i>Irish Geography</i> 23(2) (1990) 120-135. Geographical Society of Ireland, Dublin. Thorn, R. (1987). The Geevagh Karst. <i>Irish Speleology</i> . Journal of the Speleological Union of Ireland. Vol. 4 No. 1 1987.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Geevagh GWB (For Reference)



List of Rock units in Geevagh GWB

Rock unit name and code	Description	Rock unit group
Carraun Shale Formation	Grey/black shale with minor limestone	Dinantian Shales and Limestones
Bellavally Shale Formation (BE)	Grey micrite, shale, laminite evaporite	Dinantian Mixed Sandstones, Shales and Limestones
Meenymore Formation (ME)	Shale, laminated carbonate, evaporite	Dinantian Mixed Sandstones, Shales and Limestones
Bricklieve Limestone Formation (BK)	Bioclastic cherty limestone	Dinantian Pure Bedded Limestones
Bricklieve Limestone Formation (lower) (BKL)	Bioclastic cherty limestone	Dinantian Pure Bedded Limestones
Bricklieve Limestone Formation (upper) (BKU)	Bioclastic cherty limestone	Dinantian Pure Bedded Limestones
Bricklieve Limestone Formation lower & Mudbank Limestones (mkBKL)	Bioclastic cherty limestone	Dinantian Pure Unbedded Limestones
Lisgorman Shale Formation (LG)	Thin-bedded calcareous shale, limestone	Dinantian Shales and Limestones

NOTES ON Geevagh GWB

Groundwater Flow west of Lough Meeglan

In the narrow part of the GWB west of Lough Meeglan the topography is subdued. The land is relatively flat and low-lying, sloping very gently to the south. A zone of known mineralisation occurs along the fault boundary between the pure bedded limestones and the Curlew Mountains GWB to the south. This may act as a barrier to flow.

1st name – Skean Meeglan, now Geevagh

Lough Bo and Lough Nasool: Coleman in Caves of Ireland noted that water in Lough Nasool discharged via a swallow holes

Impermeable cover of Lough Allen Uplands concentrates flow – get point recharge via sinking streams running off juxtaposed non-carbonate rocks

Geevagh karst – recharged predominantly by runoff from non-carbonate shale cover

Geevagh Karst

c. 3 to 90 m/hr depending on flow conditions

actual flow rate under medium to high flow (90m/hr)

The concentration of recharge by runoff from the adjoining Lough Allen Uplands In karstified pure bedded limestone groundwater flow is at a regional scale.

