Slieve Rushen GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
Hydrometric Area 36 Cavan Co. Co. N.I.	***Rivers:*** Owengarr, Blackwater, Bawnboy, Drumane Stream. ***Streams:*** 18 unnamed streams. ***Lakes:*** Macmartin.	None identified (O'Riain, 2004).	35

Topography		As the name suggests, this GWB is located around Slieve Rushen (upper slopes, western and northern flanks), although it also covers Molly Mountain and the lower lying area to the northeast. The body is bordered by less productive aquifers to the south and west (Slieve Rushen South), and a karst aquifer to the north-east (Newtown-Ballymaconnell GWB). The northern boundary is a SW-NE trending fault and the south-eastern boundary comprises a topographic divide. Elevations increase from c.50 mAOD (north of Molly Mountain) to c.400 mAOD on the summit of Slieve Rushen. Surface water predominantly flows downslope to the north to join the River Swanlibar.
Geology and Aquifers	**Aquifer categories**	Approximately 50% of the GWB is underlain by **Lm:** Locally important aquifer which is generally moderately productive. In the central areas, c.20% comprises **Rk^c:** Regionally important karst aquifer dominated by conduit flow, and the remaining northern zone is **Ll:** Locally important aquifer, moderately productive only in local zones. (These percentages are based on the RoI bedrock geology map, which extends across the border in this GWB).
	Main aquifer lithologies	Dinantian Sandstones are the main rock group in this GWB (51.59%), occurring to the south, west and east. Dinantian Mixed Sandstones, Shales and Limestones (26.31%) are located to the north, and Dinantian Pure Bedded and Unbedded Limestones (19.22%) occur in the centre of the body. A small strip of Dinantian Shales and Limestones lies along the north western boundary (2.88%). Refer to Table 1 for details.
	Key structures	There has been a large amount of deformation in this region, resulting in a large number of faults, predominantly trending NW-SE and SW-NE, and the rocks dipping no the north, east and west by upto 55°.
	Key properties	No hydrogeological data are available for this GWB however, the dominant sandstone lithology of Dinantian Sandstones will generally results in a higher fissure permeability and therefore, the potential to have moderately high transmissivity values – in the order of 10-50 m^2/d, although they may be higher in the vicinity of the large number of faults (c.100-150 m^2/d). Transmissivity values for the remaining Dinantian rocks are expected to be <20 m^2/d, and possibly <10 m^2/d in the shale-dominated lithologies. Similarly, storativity in the Sandstones is likely to be good and higher than in the Shales and Limestones. Yields, transmissivities and storativity in the Dinantian Limestone can be extremely variable, depending on the degree of karstification. However, high abstractions are frequently achievable. Two karst caves have been recorded in Pure Bedded Limestones in this GWB. This suggests that there is some karstification in these limetones, although with additional data, no further conclusions about the extent of karstification can be drawn. There are also likely to be a number of unrecorded karst features in this are, especially as the limestones in this general region are known to be highly karstified (e.g. Marble Arch caves c.20 km to northeast). Groundwater gradients cannot be determined, although are likely to be steeper in the lower permeability rocks than in the Sandstones. The overall flow directions are expected to follow topography and surface water flow i.e. downslope to the north. *(Dinantian Sandstones Aquifer Chapter*)
	Thickness	Most groundwater flux in these rock groups is expected to be in the uppermost part of the aquifer. This is thought to comprising a broken and weathered zone typically less than 3 m thick, a zone of interconnected fissuring, and a zone of isolated poorly connected fissuring typically less than 150 m. In the Limestones, the upper weathered zone may equate to a epikarst layer, of a similar thickness. The fissure permeability is generally expected to be more developed in the Sandstone and possibly Limestones rock groups, with the zone of interconnected fissuring extending to between 30-40 m thick. This zone is likely to be in the region of 10-15 m thick in the mixed Sandstones, Shales and Limestones group. This zone may be karstified in the Limestones, which would further increase the overall permeability of the rock.
Overlying Strata	**Lithologies**	The GWB is predominantly covered by peat (17%) and till (17%) with a small area of rock outcrop (4%) in the RoI. There are no data for NI (c.55%).
	Thickness	Given the limited topography and outcrop information for Cavan, subsoil is expected to be absent or thin (<3 m thick) over the summit and flanks of Slieve Rushen and Molly Mountain. No data are available for the lower lying areas to the north of the GWB (NI).
	% area aquifer near surface	*[Information will be added at a later date]*
	Vulnerability	*No vulnerability maps are available for either Cavan or NI.*

FsRecharge	**Main recharge mechanisms**	Both point and diffuse recharge occur in this GWB. Diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. In the pure limestones, point recharge to the underlying aquifer is likely to occur via swallow holes, dolines and caves. Although recharge along 'losing' sections of streams is also associated with this particular type of karst aquifer, to date none have been recorded in this GWB. A proportion of the effective rainfall will discharge to the streams in the GWB, especially where low permeability subsoil is present (till or peat). In addition, the steeper slopes will promote surface runoff. The stream density, which may be influenced by the upland topography, is lower than the adjacent Pu/Pl/Ll GWBs.
	Est. recharge rates	*[Information will be added at a later date]*
Discharge	**Large springs and high yielding wells (m^3/d)**	***Sources:*** None identified. ***Springs:*** None identified. ***Excellent Wells:*** None identified. ***Good Wells:*** None identified.
	Main discharge mechanisms	The main groundwater discharges are to the streams, rivers, lakes and any springs – which may be large if karstic – within the GWB. Given the generally higher transmissivities associated with Lm and Rk^c aquifers, the baseflow proportion of the total streamflow is expected to be higher than in the Ll aquifers. Groundwater may also discharge to the adjacent, more productive aquifers (Rk^c) along the north-eastern boundary.
	Hydrochemical Signature	There are no data available for this GWB. ***National classification:*** Dinantian Sandstones Calcareous. Generally Ca-HCO_3 signature. Alkalinity (mg/l as $CaCO_3$): range of 5-524; mean of 153 (65 'non limestone subsoils' data points) Total Hardness (mg/l): range of 5-502; mean of 162 (67 'non limestone subsoils' data points) Conductivity (μS/cm): range of 39-1184; mean of 408 (69 'non limestone subsoils' data points) ***National classification:*** Dinantian Rocks (excluding Sandstones) Calcareous. Generally Ca-HCO_3 signature. Due to possible dissolution of evaporite minerals in the Monaghan-Cavan-Leitrim area,Na/K/Mg-HCO_3 and Ca-SO_4 signatures may also occur. Alkalinity (mg/l as $CaCO_3$): range of 10-990; mean of 283 (2454 data points) Total Hardness (mg/l): range of 10-1940; mean of 339 (2146 data points) Conductivity (μS/cm): range of 76-2999; mean of 691 (2663 data points) *(Calcareous/Non calcareous classification of bedrock in the Republic of Ireland report)*
Groundwater Flow Paths		In the absence of inter-granular permeability, groundwater flow is expected to be through fissures, faults, joints and bedding planes and weathered zones. In the pure bedded limestones, these openings are frequently enlarged by karstification resulting in significantly enhanced rock permeability and the upper weathered zone may in fact be an epikarst layer. Groundwater flow is thought to be mainly unconfined and of a regional scale i.e. long flow path lengths (up to 2000 m) in the Sandstones and Limestones, although are likely to be shorter in less permeable Dinantian rocks (c.30-300 m). Generally, groundwater flow directions are expected to follow topography i.e. to the north, although it is accepted that flow through karst aquifers is frequently extremely complex and difficult to predict.
Groundwater & Surface water interactions		Generally groundwater is expected to contribute a large proportion of baseflow to the streams and rivers flowing across the Sandstone and Limestone aquifers in this GWB, due to their relatively high transmissivity. There is also the potential for a high degree of interconnection between groundwater and surface water in any karstified limestone areas. Swallow holes, dolines, caves, turloughs, springs, and 'losing' and 'gaining' streams all provide a direct route between surface water and groundwater systems. This rapid interchange between surface water and groundwater is often reflected in their similar water quality as contamination is also rapidly transported between the two systems.

Conceptual model	• The GWB is bounded by differing aquifer types to the northeast (karst), south and west (poorly productive). The eastern boundary is a topographic divide. The topography in this body ranges from steep in Slieve Rushen and Molly Mountain, to lower-lying and flatter to the northeast of the body. Elevations ranging from c.50-400 mAOD and surface water generally flows downslope to the north. • Dinantian Sandstone is mapped in the southern, western and eastern areas of the GWB, and is considered to have the potential for relatively high fissure permeability. The permeability in the Dinantian Pure Bedded and Unbedded Limestones (central area) may also be enhanced by dissolution along the joints, fissures and fractures. Dinantian mixed Sandstones, Shales and Limestones underlie the northern region and are expected to have a lower transmissivity. In all groups, most of the unconfined groundwater flux is likely to be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3 m thick, which may be an epikarst layer in the limestones, a zone of interconnected fissuring – less than c.30-40 m thick in the Sandstones and less than 10-15 m in the mixed Sandstones, Shales and Limestones – and a zone of isolated fissuring typically less than 150m. • Transmissivity values are thought to be higher in the Sandstones – 10-50 m^2/d (or as high as 100-150 m^2/d faults zones) as opposed to <20 m^2/d in the mixed Sandstones, Shales and Limestones. Storativity is likely to be relative good in the Sandstones. Transmissivity and storativity values can be very variable in karstified limestones, although high yields and transmissivity values are frequently associated with these rocks. • High fissure permeability (Sandstones) and karstified (Limestones) aquifers can generally support regional scale flow systems, with flow paths up to 2000 m. Flow paths in the remaining rocks are likely to be short (30-300 m), with groundwater discharging rapidly to the streams crossing the aquifer, and to small springs and seeps. • Recharge will occur diffusely through the subsoil and rock outcrops although is limited by any thicker low permeability subsoil and bedrock. Additional point recharge mechanisms may exist in the karstified Limestones (e.g. swallow holes). Most of the effective rainfall over the mixed Sandstones Shales and Limestones is not expected to recharge the aquifer. • The main discharges are to the streams, rivers, lakes and springs within the GWB. Overall, the flow direction is likely to be to the north, as determined by the topography.
Attachments	Figure 1. Table 1.
Instrumentation	**Stream gauges:** None identified. **EPA Water Level Monitoring boreholes:** None identified. **EPA Representative Monitoring points:** None identified.
Information Sources	Geraghty, M., Farrelly, I., Claringbold, K., Jordan, C., Meehan, R., and Hudson, M., 1997. *Geology of Monaghan-Carlingford. A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 8/9, Monaghan-Carlingford*. Geraghty, M. (ed.). Geological Survey of Ireland. 60 p. O' Riain, 2004. *Water Dependent Ecosystems and Subtypes (Draft)*. Compass Informatics in association with National Parks and Wildlife (DEHLG). WFD support projects.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.

Figure 1. Location and boundaries of Slieve Rushen GWB

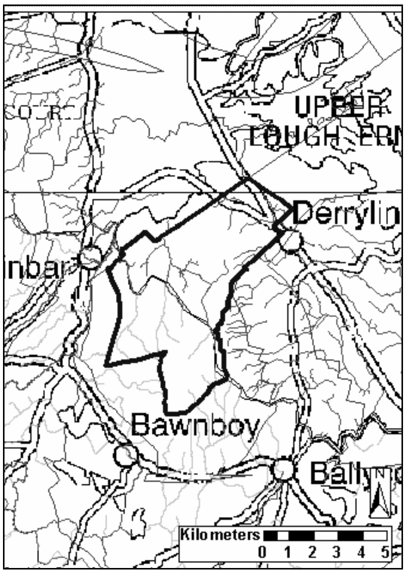

Table 1. List of Rock units in Slieve Rushen GWB

Rock Unit Name	Code	Description	Rock Unit Group	**Aquifer Class.**	% Area
Glenade Sandstone Formation	GD	Pale orthoquartzitic sandstone	Dinantian Sandstones	Lm	51.59%
Meenymore Formation	ME	Shale, laminated carbonate, evaporite	Dinantian Mixed Sandstones, Shales and Limestones	Ll	26.31%
Dartry Limestone Formation	DA	Dark fine-grained cherty limestone	Dinantian Pure Bedded Limestones		14.62%
Mudbank Limestones	mk	Massive grey micritic limestone	Dinantian Pure Unbedded Limestones	Ll	4.60%
Benbulben Shale Formation	BB	Calcareous shale with minor calcarenite	Dinantian Shales and Limestones	Ll	2.88%