

*1<sup>st</sup> Draft St. John's Point GWB Description – July 2004*

**St. John's Point: Summary of Initial Characterisation.**

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystems	Area (km <sup>2</sup> )
Hydrometric Area 37 Donegal Co. Co.	<b>Rivers:</b> Bunlacky. <b>Streams:</b> 95 unnamed streams. <b>Lakes:</b> None identified.	St. John's Point (O'Riain, 2004)	17
<b>Topography</b>	This is a narrow, N-S orientated GWB extends from St' John's Point to c.8 km north of Dunkineely, in South Donegal (Figure 1). The northern half of the GWB is bounded by differing rock types and the southern half by coastline (St John's Point peninsula). Along the peninsula, elevations range from <10-30 mAOD and the topography is gently sloping. The northern area ranges from 30-200 mAOD, becoming steeper towards the northern boundary and with a small number of drumlins in the central area. The main surface water flow direction is southwards, towards the coast.		
<b>Geology and Aquifers</b>	<b>Aquifer type(s)</b>	<b>Rk<sup>d</sup>:</b> Regionally important karst aquifer dominated by diffuse flow, is the dominant aquifer in this GWB (95%). Approximately 1 km <sup>2</sup> is underlain by <b>Lm:</b> Locally important aquifer which is generally moderately productive.	
	<b>Main aquifer lithologies</b>	The GWB comprises two rock groups: Dinantian Pure Bedded Limestones (94.71%) and Dinantian Sandstones (5.29%). Refer to Table 1 for details.	
	<b>Key structures.</b>	Within this GWB, there are 6 faults cutting across the peninsula and the rocks are dipping to the E/SE by 5-15°.	
	<b>Key properties</b>	<p>Data are negligible within this GWB however, they are available for Pure Bedded Limestones in other parts of South Donegal (Ballyshannon and Donegal-Ballintra GWBs) – 9 well yields 109-1090 m<sup>3</sup>/d and 5 specific capacities of between 4-168 m<sup>3</sup>/d/m (averaging 64 m<sup>3</sup>/d/m). Nationally, transmissivity values in Rk<sup>d</sup> aquifers range from 2-2000 m<sup>2</sup>/d. The implied transmissivity values in the Donegal aquifers are at the lower-mid end of this scale, indicating that highly permeable <i>zones</i> are present. The rapid response to rainfall in the Parkhill Spring (Ballyshannon GWB) suggests the potential for low storativity.</p> <p>Although no karst features have been recorded in this GWB, from the minimal karst work undertaken in Donegal, c.30 karst features have been recorded in this rock type and it is likely that there are more unrecorded features.</p> <p>Only one groundwater level is available: 0.9 m below ground level. Although groundwater gradients cannot be calculated, the overall flow directions are to the south, with groundwater discharging to the sea.</p> <p><i>(Minerex Reports; Donegal GWPS; Pure Bedded Limestones Aquifer Chapter)</i></p>	
	<b>Thickness</b>	In the pure limestones, most groundwater flows in an epikarstic layer 2-3 m thick, and in a zone of interconnected, solutionally-enlarged fissures and conduits that are likely to extend approximately 30 m below this. Most groundwater flux in the Lm aquifer is also likely to be in uppermost top 30 m (c.3 m broken, weathered material underlain by interconnected fissuring), although there will also be a zone of isolated, poorly connected fissures – typically less than 150 m bgl – in both types of aquifer.	
<b>Overlying Strata</b>	<b>Lithologies</b>	Till is the predominant subsoil in this GWB (c.70%), with a small proportion of peat (17%).	
	<b>Thickness</b>	Subsoil is absent or thin over much of the southern half of the GWB and in the northern area. Thicker deposits (>3 m) are found along the western shoreline of the peninsula and northeast of Dunkineely. The central area also contains areas of >10 m of subsoil (drumlin deposition).	
	<b>% area aquifer near surface</b>	<i>[Information will be added at a later date]</i>	
	<b>Vulnerability</b>	From the Donegal GWPS, groundwater vulnerability is mainly classed as Extreme in this GWB. In the limited areas where subsoil deposits are thicker, they are categorised as High vulnerability.	
<b>Recharge</b>	<b>Main recharge mechanisms</b>	Both point and diffuse recharge will occur in this GWB. Diffuse recharge occurs via rainfall percolating through thin subsoil and rock outcrops. Point recharge to the underlying aquifer occurs by means of swallow holes, dolines and caves. Although recharge along 'losing' sections of streams is also associated with this particular type of aquifer, none are recorded in this GWB. The presence of low permeability, thick till drumlins will promote surface runoff. The runoff may either discharge to the streams in the GWB or be diverted to the inter-drumlin areas, where recharge to the aquifer is more likely to occur. The low stream density in this GWB, as compared to the surrounding GWBs, suggests a high proportion of aquifer recharge, which is often associated with karstified rocks.	
	<b>Est. recharge rates</b>	<i>[Information will be added at a later date]</i>	
<b>Discharge</b>	Important springs and high yielding wells	Sources: None identified. Springs: None identified. Excellent wells: None identified. Good wells: None identified.	

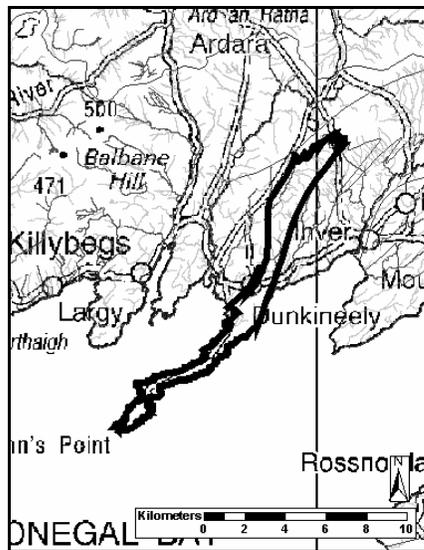
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Main discharge mechanisms	The main groundwater discharges are to the limited number of streams, rivers, lakes and any springs within the GWB. Seepages will also develop on the coastal cliff faces.
Hydrochemical Signature	<p><b>National classification:</b> Dinantian Pure and Impure Limestones            Calcereous. Generally Ca-HCO<sub>3</sub> signature.            Alkalinity (mg/l as CaCO<sub>3</sub>): 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)</p> <p><b>National classification:</b> Dinantian Sandstones            Calcereous. Generally Ca-HCO<sub>3</sub> signature.            Alkalinity (mg/l as CaCO<sub>3</sub>): 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)</p> <p><i>(Calcereous/Non calcereous classification of bedrock in the Republic of Ireland report)</i></p>
<b>Groundwater Flow Paths</b>	<p>As these rocks are generally devoid of inter-granular permeability, groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones, these openings are frequently enlarged by karstification resulting in significantly enhanced rock permeability. Karstification can be also accentuated along structural features such as fold axes and faults. An epikarst layer in the upper few metres of the rock is likely to be present on top of the diffusely karstified aquifer. Shallow groundwater flow will probably dominant, although a component of deep groundwater flow would be expected.</p> <p>Continuous water tables that reflect topography are considered to exist in diffusely karstified aquifer as the flow regimes are likely to be hydraulically connected. However the degree of interconnect depends on the frequency of fissures, faults, and joints.</p> <p>Groundwater flow is thought to be mainly unconfined. In the karstified aquifers, groundwater flow is regional scale – flow path lengths of several kilometres are not unusual although are likely to be shorter in discharge areas (c.100-300 m), as may be the case along the coastline. This is also likely to be the case for the sandstones. Overall, groundwater flow will be southwards, towards the coastline, but the karstified nature of the pure limestone means that locally groundwater flow directions can be highly variable.</p>
<b>Groundwater &amp; surface water interactions</b>	<p>In karstified areas, there is a high degree of interconnection between groundwater and surface water. Any swallow holes, dolines, caves, turplough, springs and 'losing' and 'gaining' streams 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.</p> <p>Although there will be less interaction between groundwater and surface water in the Lm aquifer, groundwater is still expected to contribute a large proportion of baseflow to the streams and rivers flowing across this GWB due to the relatively high transmissivity of this aquifer.</p>
<b>Conceptual model</b>	<ul style="list-style-type: none"> <li>• The northern half of the GWB is bounded by different aquifer types and the southern half forms a peninsula into Donegal Bay. Over the peninsula, the topography is low-lying and gently sloping but becomes steeper towards the north of the GWB with an area of drumlins across the central region.</li> <li>• The main rock type in this GWB is a karstified limestone that is dominated by diffuse groundwater flow (aquifer category <b>Rk<sup>d</sup></b>). The southern tip (c.1 km<sup>2</sup>) is underlain by sandstones, which are considered to be characterised by a productive fracture flow system (<b>Lm</b>).</li> <li>• Most of the unconfined groundwater flux is in the uppermost 30 m of the aquifers. This occurs through a few metres (c.3 m) of broken, weathered bedrock and an underlying zones of interconnected joints, fissures, fractures and faults. In the pure limestones, the upper weathered zone is likely to equate to an epikarst layer and the underling joints, fissures, fractures and faults will be karstified (solutionally enlarged). Deeper groundwater flow can occur along permeable fault or fracture zones.</li> <li>• Transmissivity values and well yields are expected to be variable, reflecting zones of higher and lower permeability. In the pure limestones in Donegal, rapid response of springs to rainfall events indicates that there is the potential for high groundwater flow velocities through this rock, and low storativity.</li> <li>• In general, the degree of interconnection in karstic systems is high and they support regional scale flow systems. Long flow paths (kilometres in length) can be expected although are likely to be shorter in discharge areas (100-300 m), in the southern portion of the GWB. Similar flow path lengths would be expected in the sandstones.</li> <li>• Recharge occurs by:             <ul style="list-style-type: none"> <li>• diffuse means in both aquifer types – via outcrops and through thin subsoil, although may be limited by thicker, low permeability subsoil in some (northern) areas, and</li> <li>• additional point mechanisms in the karstified limestones; swallow holes, dolines, caves and along lengths of losing streams – mainly occurring where subsoils are thin i.e. areas of extreme vulnerability.</li> </ul> </li> <li>• Due to the combination of point recharge and rapid flow through solutionally enlarged joint/fissure/fracture zones, there is minimal potential for contaminant attenuation in the limestone aquifer.</li> <li>• The main discharges are to the rivers and springs within the GWB, and seeps along the coastline. Overall, the flow direction is to the south, as determined by the topography.</li> <li>• There is a high degree of interaction between surface water and groundwater in karstified zones within this GWB.</li> </ul>

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<b>Attachments</b>	Figure 1. Table 1.
<b>Instrumentation</b>	<b>Stream gauges:</b> None identified. <b>EPA Water Level Monitoring boreholes:</b> None identified. <b>EPA Representative Monitoring points:</b> None identified.
<b>Information Sources</b>	Lee M. and Fitzsimons V. (2004). <i>County Donegal Groundwater Protection Scheme</i> . Main Report. Draft Report to Donegal County Council. Geological Survey of Ireland 58pp.  Long, C.B. and McConnell (1999) <i>Geology of South Donegal: A geological description, to accompany bedrock geology 1:100,000 scale map, Sheet 3, South Donegal</i> . With contributions by G.I. Alsop, P. O'Connor, K. Carlingford and C. Cronin. Geological Survey of Ireland, 116pp.  Minerex Environmental Ltd. (2003). <i>Ballyshannon and Rosstown Water Supply Scheme – Groundwater Supply. BH1, BH2, BH3, BH4 and Spring 2 pumping test supervision, monitoring, interpretation and reporting</i> . MEL Doc.Ref.:1492-103 (First draft).  O' Riain, 2004. <i>Water Dependent Ecosystems and Subtypes (Draft)</i> . Compass Informatics in association with National Parks and Wildlife (DEHLG). WFD support projects.
<b>Disclaimer</b>	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 GWB.**



**Table 1. List of Rock units in St. John's Point GWB**

Rock Unit Name	Code	Description	Rock Unit Group	Aquifer Class.	% Area
Ballyshannon Limestone Formation	BS	Pale grey calcarenite limestone	Dinantian Pure Bedded Limestones	Rk	94.71%
Muckros Sandstone Formation	MK	Calcareous sandstone & sandy oolite	Dinantian Sandstones	Lm	5.29%