

*1<sup>st</sup> Draft Carndonagh Gravel GWB Description March 2005*

**Carndonagh Gravel GWB: Summary of Initial Characterisation.**

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km <sup>2</sup> )
40 Donegal Co. Co.	<b>Rivers:</b> Glenagannon, Donagh	North Inishowen Coast (002012)	9.5
<b>Topography</b>	This sand/gravel aquifer is roughly circular and lies to the north of Carndonagh, between the town centre and Trawbreaga Bay. It is located in a flat, low-lying area, and ranges in elevation from 0 mAOD to about 30m OAD. The gravels abut higher ground to the west, south and southeast. In the east, the ground is very flat-lying. The sea bounds the GWB to the north. Two north flowing rivers traverse the centre of the GWB, where they flow into the Bay. North flowing streams cross the east and the west of the GWB. The location of the GWB is shown in Figure 1.		
<b>Geology and Aquifers</b>	<b>Aquifer categories</b>	The sand/gravel deposits are considered to continue underneath the locally mapped peat to the west. However, the sand/gravel aquifer is mapped as the area that is interpreted to have at least 5 m saturated thickness (Donegal GWPS), giving an area of 9.5 km <sup>2</sup> . Drilling data show that the thickness ranges from 4.5 to >8.0 m, so despite the areal extent, these deposits are classified as a <b>Locally Important Sand and Gravel Aquifer (Lg)</b> (DELG/EPA/GSI (1999). The gravels overlies bedrock aquifers that are generally unproductive except for local zones (PI).	
	<b>Main aquifer lithologies</b>	Drilling records show SILT with bands of gravel over sandy SILT (KT Cullen & Co., 1992). Particle size analyses indicate 70-90% sand and gravel or larger sized fragments (Solmec, 1974; Farrell, 1989).	
	<b>Key structures</b>	The sands/gravels are interpreted to have been deposited in a fluvio-glacial outwash fan or delta (McCarron, 2002), with the result that the material is likely to grade from coarser sand and gravel near Carndonagh town to finer material at the coast.	
	<b>Key properties</b>	Estimated transmissivity is 350-600 m <sup>2</sup> /d with a bulk permeability of 80 m/d is computed. Storativity is expected to be high (20%) (Donegal GWPS). Water levels are about 1.5 mbgl, but will be closer to ground surface near the rivers and streams and in the north of the GWB where ground elevations are lower. Groundwater is generally unconfined, but may become slightly confined where low permeability deposits (clays or peat) overlies the gravels. Groundwater gradients are likely to be around 0.007 to 0.01 (Carndonagh WS Source Report and map estimates).	
	<b>Thickness</b>	Drilling data show that the thickness ranges from 4.5 to >8.0 m (Donegal GWPS).	
<b>Overlying Strata</b>	<b>Lithologies</b>	Blanket peat occupies areas over the sand/gravel deposits in the northwest and east (Meehan, 2004). Drilling records indicate CLAY overlies the sands/gravels (K.T. Cullen & Co., 1992) at least in some areas.	
	<b>Thickness</b>	The overlying clay ranges from 0.7-0.8 m. The thickness of the Blanket Peat is not known but is considered to be originally thin, then cut and/or drained (Meehan pers comm. in Carndonagh WS Source Report).	
	<b>% area aquifer near surface</b>	[Information to be added at a later date]	
	<b>Vulnerability</b>	Extreme (xx%), and High (xx%) in the south of the GWB.	
<b>Recharge</b>	<b>Main recharge mechanisms</b>	Diffuse recharge occurs via rainfall percolating through the unsaturated sand/gravel. Due to the high permeability of sand/gravel, a high proportion of the available recharge will percolate down to the water table, particularly in the south of the deposit where groundwater is deeper. In the north of the GWB, higher runoff is indicated by drainage channels. The rivers flowing across the aquifer also provide additional recharge. Recharge is induced from a surface drainage channel to the pumping well at Carndonagh WS. During a particularly dry summer about 15 years ago, the flow in the River Donagh sank into the gravels (Carndonagh WS Source Report).	
	<b>Est. recharge rates</b>	In southern part of GWB, estimated recharge (90% of effective rainfall) is 595 mm (Carndonagh WS Source Report). Closer to the coast, where drainage is poorer due to a higher water table, recharge will be lower.	
<b>Discharge</b>	<b>Large springs and large known abstractions (m<sup>3</sup>/d)</b>	Carndonagh WS, 1680 m <sup>3</sup> /d in winter, 1440 m <sup>3</sup> /d in summer. From infiltration galleries augmented by boreholes in winter.	
	<b>Main discharge mechanisms</b>	Groundwater discharges to the rivers/streams that flow through the deposits, to the drainage channels and to the sea at Trawbreaga Bay	
	<b>Hydrochemical Signature</b>	Data available for the infiltration gallery at Carndonagh WS indicate that the GWB has a calcium bicarbonate signature. Groundwater analyses indicate a hard (251-350 mg/l CaCO <sub>3</sub> ) groundwater, with conductivity ranging from 650-700 µS/cm (Carndonagh WS Source Protection Report). Alkalinity ranges from 174 to 400 mg/l as CaCO <sub>3</sub> . Chloride concentrations average 29 mg/l (range 15-35 mg/l).	

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<b>Groundwater Flow Paths</b>	Flow path lengths depend on the size of the sand/gravel deposit and on the spacing of internal groundwater divides. Assuming that groundwater and surface water divides are coincident, groundwater flow path lengths in this GWB are probably on the order of 300-1000 metres.
<b>Groundwater &amp; Surface water interactions</b>	Hydraulic connection between the groundwater in the aquifer and river water is expected to be high, thus water will be able move into and out of the aquifer depending on the river stage. Works on the Donagh and Glenagannon riverbeds found the alluvium to be thin and underlain by gravel (Carndonagh WS Source Report). Water level data indicate that recharge from a stream to the aquifer is induced by groundwater abstraction at Carndonagh WS. Anecdotal evidence indicates that during very dry weather, the Donagh River sinks into the aquifer. In the northern part of the GWB, groundwater discharges to streams, rivers and drainage channels, and to Trawbreaga Bay.
<b>Conceptual model</b>	<ul style="list-style-type: none"> <li>• The GWB consists of sand/gravel deposits located between Carndonagh Town and Trawbreaga Bay.</li> <li>• The deposits are located in a low-lying flat area, at elevations between 0-30 mAOD. The deposits are bounded to the southwest and southeast by steeply rising ground, to the north by the coast, and to the NW, NE and south by non-gravel subsoil.</li> <li>• The surface drainage is northwards to Trawbreaga Bay. Drainage is good in the south of the deposit, but poorer in the north, closer to the sea.</li> <li>• The aquifer comprises fluvio-glacial sand/gravel deposits deposited in an outwash fan or delta.</li> <li>• Estimated transmissivity is 350-600 m<sup>2</sup>/d. The saturated thickness of the sand/gravel aquifer is roughly 5 m. Bulk permeability is estimated as 80 m/d.</li> <li>• Overall, groundwater flows from south to north. Locally, groundwater will flow towards or away from the rivers and streams, depending on the relative water levels in the groundwater and surface water features. Groundwater gradients are estimated to be about 0.007 to 0.01.</li> <li>• Diffuse recharge occurs via rainfall percolating through the unsaturated sand/gravel. River water also recharges the aquifer in the south of the deposit during low groundwater conditions, and because of lowered water levels related to abstraction.</li> <li>• Groundwater discharges to the rivers and streams that flow across the deposits. In the north of the GWB, groundwater discharges to the drainage channels and to the sea at Trawbreaga Bay.</li> <li>• Relative water levels and hydrogeological observations indicate that the hydraulic connection between the groundwater in the aquifer and river water is high.</li> <li>• The lengths of the flow paths range from several hundred metres to over 1000 m.</li> <li>• The groundwater has a calcium bicarbonate signature and is hard. Chloride concentrations are relatively high due to the aquifer's proximity to the sea.</li> </ul>
<b>Attachments</b>	Figure 1.
<b>Instrumentation</b>	Stream gauges: 40007. EPA Water Level Monitoring boreholes: none EPA Representative Monitoring points: DON 4
<b>Information Sources</b>	<p>DELG/EPA/GSI (1999) <i>Groundwater Protection Schemes</i>. Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland.</p> <p>Farrell, E. (1989). Site investigation information including borehole and PSA information.</p> <p>K.T. Cullen &amp; Co. Ltd. (1992) <i>Proposed Groundwater Protection Policy for the Carndonagh Gravel Aquifer</i>. Report for Donegal County Council.</p> <p>Lee, M. and Fitzsimons, V. (2004) <i>County Donegal Groundwater Protection Scheme</i>. Volume 1 Main Report, Draft, July 2004. 58 pp. Geological Survey of Ireland.</p> <p>Lee, M. (2004) <i>Carndonagh Water Supply Groundwater Protection Zones</i>, 19 pp. Geological Survey of Ireland.</p> <p>McCarron, S. (2002) <i>Aggregate Potential Mapping of County Donegal</i>. <i>Geological Survey of Ireland</i>. Report for Donegal County Council. Geological Survey of Ireland.</p> <p>Meehan, R.T., (2004) <i>Subsoils Map for County Donegal</i>. Map produced as part of EPA Soil and Subsoil Mapping Project (formerly FIPS-IFS). Teagasc, Kinsealy.</p> <p>O' Riain, G., (2004). <i>Water Dependent Ecosystems and Subtypes Draft Report</i>. WFD Support Projects. Compass Informatics in association with National Wildlife and Parks Service (DEHLG).</p> <p>Solmec (1974) Lough Inn Regional Water Supply Scheme Carndonagh Section – Trial Boreholes Logs and PSA.</p>
<b>Disclaimer</b>	Note that all calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

**Figure 1 Location and extent of Cardonagh Gravel**

