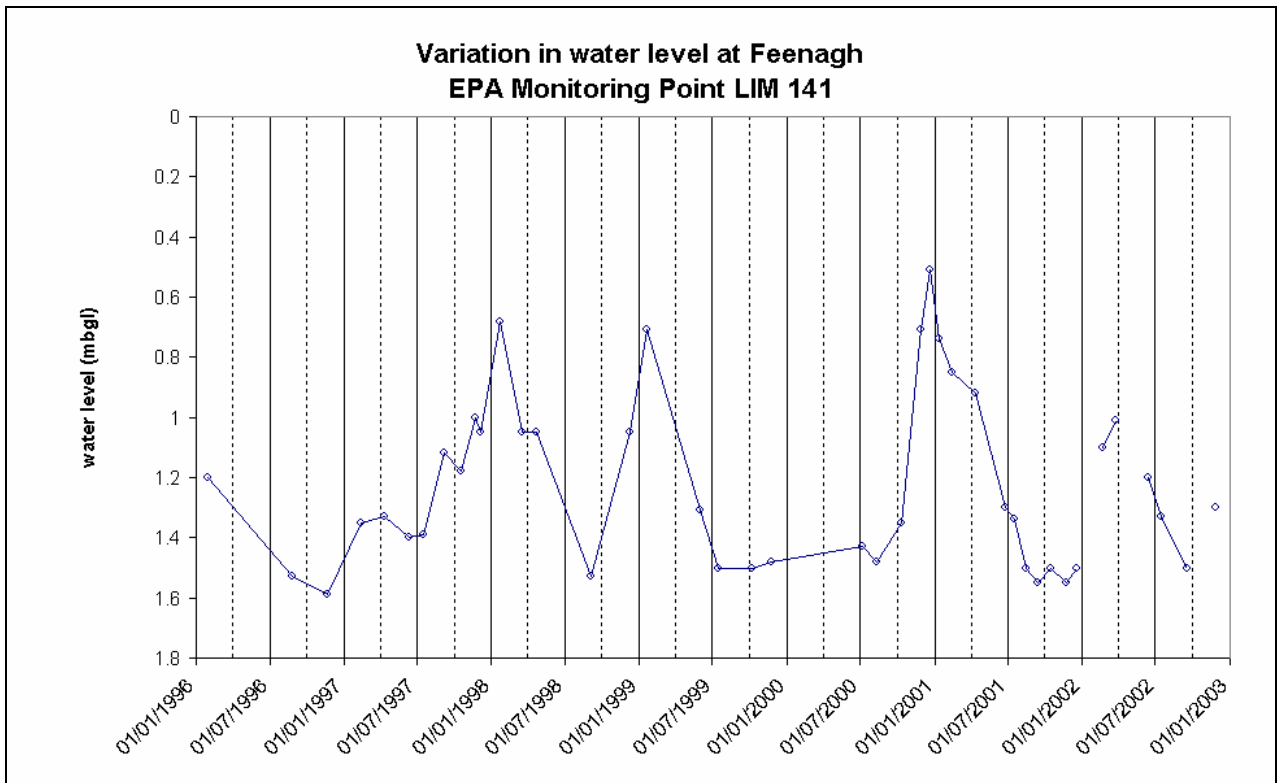


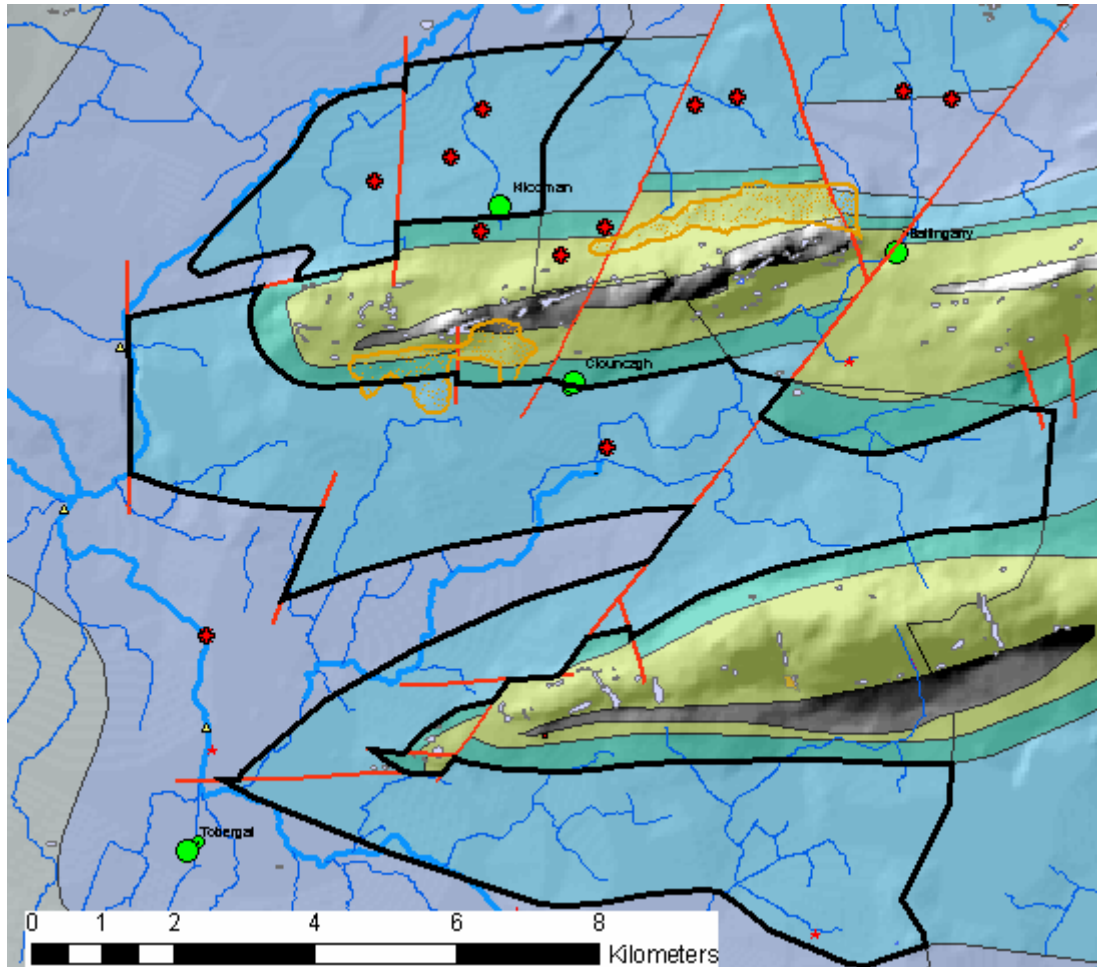
**Feenagh-Ballyallinan GWB: Summary of Initial Characterisation.**

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystem(s)	Area (km <sup>2</sup> )
24 - Deel Limerick Co. Co.	Rivers: Deel, Owenskaw.	None.	60
<b>Topography</b>	This GWB occupies an area of the lowlands in west Co. Limerick. It is situated to the north, west and south of the hillier areas of the Knockaderry and Kilmeedy GWBs, and is shaped like an 'ε'. Elevation ranges between 40 mAOD and 120 mAOD. Elevation is lowest in the northern and the western areas of the GWB, where it is around 40-60 mAOD, rising to 80-120 mAOD in the east. Drainage density is highest in the north and the SE but lower in the west. Overall, many small tributaries draining to the Deel.		
<b>Geology and Aquifers</b>	Aquifer categories	The GWB comprises an <b>LI</b> : Locally important aquifer which is moderately productive only in local zones.	
	Main aquifer lithologies	Dinantian Lower Impure Limestones.	
	Key structures	The strata are on the NW, western and SW limbs of two major, relatively tightly folded anticlines that plunge to the WSW. Bedding dips to the north, west and south at angles of around 15-30°. NNE-SSW and NNW-SSE trending faults cross-cut the rocks. There are also faults parallel to the fold axis. Deformation during the folding and faulting caused some fracturing and jointing of the rocks.	
	Key properties	Transmissivity in the Lower Impure Limestones will typically be in the range 2-20 m <sup>2</sup> /d. However, in the adjacent Hospital GWB, a pumping test at Hospital WS provided transmissivity estimates of approximately 75 m <sup>2</sup> /d, and at Bruff No 1 WS, aquifer transmissivity is approximately 40 m <sup>2</sup> /d, showing that higher transmissivities can be achieved in local zones. Groundwater gradients will be approximately 0.08-0.015, and follow topography. <i>(data sources: Rock Unit Group Aquifer Chapters, Source Reports see references; estimation from maps)</i>	
	Thickness	The rocks in this succession are several hundreds of metres thick. However, most groundwater flow occurs within the top 15-20 m of the aquifer, in the layer that comprises a weathered zone of a few metres and a connected fractured zone below this. Permeabilities can be high in the upper few metres, but generally decrease rapidly with depth. Deeper groundwater flow may occur along faults or significant fractures.	
<b>Overlying Strata</b>	Lithologies	The subsoil is Limestone Till and, particularly in the west of the GWB, subsoils comprise Till with Gravel. Along part of the Deel River, subsoils comprise Undifferentiated Alluvium.	
	Thickness	There is virtually no outcropping rock in this GWB. Subsoil thicknesses vary widely, from 4 m to more than 50 m. Thicker subsoils may be associated with fault zones, but there is not a systematic relationship since, at another fault zone, subsoils are thin and the only outcrops occur. The modal subsoil thickness is 12 m.	
	% area aquifer near surface	<i>[Information to be added at a later date]</i>	
	Vulnerability	Groundwater vulnerability is Low over most of the GWB. Vulnerability is High along some of the western edge of the GWB. Vulnerability is Extreme and High in the vicinity of Ballygulleen.	
<b>Recharge</b>	Main recharge mechanisms	Diffuse recharge will occur via rainfall percolating through the subsoil. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope. In recharge areas, due to the generally low permeability of the aquifers within this GWB, a high proportion of the recharge will discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater resource in the aquifer. In lowland areas where water tables are high, recharge may be rejected.	
	Est. recharge rates	<i>[Information to be added at a later date]</i>	
<b>Discharge</b>	Important springs and high yielding wells (m <sup>3</sup> /d)	There are no known large springs or very high-yielding boreholes in this GWB. At Kilmurray, there is one borehole with a known Good yield (100 m <sup>3</sup> /d < yield < 400 m <sup>3</sup> /d); the yield is at the bottom end of this range. Kilcolman and Clounagh WSs are capable of yielding more than 500 m <sup>3</sup> /d. However, although geographically within this low-flow GWB, they abstract groundwater from the underlying high transmissivity Kiltorcan-type aquifer of the Knockaderry GWB.	
	Main discharge mechanisms	In the west of the GWB (i.e., High or Moderate vulnerability areas), groundwater will discharge to the streams and rivers crossing the aquifer and to springs.	
	Hydrochemical Signature	There are no data available to assess this GWB. Groundwaters sampled in the same rock unit group in the adjacent Hospital GWB are Hard to Very Hard (310-425 mg/l as CaCO <sub>3</sub> ), with corresponding high alkalinities (295-355 mg/l as CaCO <sub>3</sub> ) and electrical conductivities (680-860 µS/cm). The pHs are neutral. Groundwaters have a calcium-bicarbonate signature. In the Lower Impure Limestones, iron and manganese concentrations frequently fluctuate between zero and more than the EU Drinking Water Directive maximum admissible concentrations (MACs). Hydrogen sulphide can often reach unacceptable levels (E.P. Daly, 1982). These components come from the muddy parts of these rock units and reflect both the characteristics of the rock-forming materials and the relatively slow speed of groundwater movement through the fractures in the rock allowing low dissolved oxygen conditions to develop. Background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.	

<b>Groundwater Flow Paths</b>	These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. Generally, flows in the aquifer are concentrated in a thin zone at the top of the rock; the weathered zone may be up to 3 m thick, with a connected fractured zone a further 10 or so metres, below which is a generally poorly fractured zone. Groundwater is confined by thick, low permeability subsoils in the west of the GWB. These subsoils restrict recharge and local discharge. Small volumes of groundwater probably cross-flow westwards into this GWB from the adjacent Knockaderry and Kilmeedy GWBs. In the west of the GWB, thinner and more permeable subsoils will allow groundwater to discharge to the surface as baseflow to rivers and streams or to springs. The “till with gravel” and alluvial deposits will contribute storage to the bedrock aquifer. Groundwater flow paths in the unconfined portions of this aquifer are short (30-300 m), with groundwater discharging locally to the streams, rivers and springs. In the confined parts, flow path lengths may be longer. Where groundwater is unconfined, groundwater levels are close to ground level. At a monitoring point in the south of the GWB near to a stream (Figure 1), seasonal groundwater level variation is about 1 m, ranging from 0.6-1.6 mbgl.
<b>Groundwater &amp; Surface water interactions</b>	Due to the thick, low permeability subsoils, groundwater–surface water interactions over the east of the GWB will be very low. However, in the west of the GWB, groundwater will discharge to the streams and rivers crossing the aquifer and to the springs. Although the rivers will be gaining, baseflow from the bedrock aquifer will be low due to its low storativity. The gravelly till and alluvium will enhance dry weather flows in the rivers.
<b>Conceptual model</b>	<ul style="list-style-type: none"> <li>• This GWB is bounded to the north, west and south by the contact with the karstic limestones of the Newcastle West GWB. The eastern boundary of this ‘ε’ –shaped GWB is formed partly by the contact with the high transmissivity Knockaderry and Kilmeedy GWBs, and partly by a surface water catchment divide that is an inferred groundwater high. The terrain is generally flat-lying and is poorly drained in the north and SE.</li> <li>• The GWB comprises low transmissivity and low storativity rocks, although localised zones of enhanced permeability do occur. Groundwater flows along fractures, joints and major faults. Where saturated alluvium or gravelly tills overlie the bedrock aquifers, these deposits will effectively contribute storage to the bedrock aquifer.</li> <li>• Recharge occurs diffusely through the subsoils. The amount of recharge is a function of subsoil thickness and permeability, and of topographic slope. Recharge will be limited over the east of the GWB. In the west of the GWB, where subsoils are higher permeability, recharge may be greater. However, where the water table is close to ground level, potential recharge may be rejected. Groundwater may recharge this GWB by cross-flowing from the adjacent Knockaderry and Kilmeedy GWBs.</li> <li>• Most groundwater flow occurs near the top of the bedrock in a narrow zone comprising a weathered zone of a few metres and a connected fractured zone below this. Deeper inflow levels will occur where isolated fractures or faults are intercepted. Some areas of the GWB are confined by thick, low permeability subsoils. In the west of the GWB, subsoils are higher permeability; here, groundwater is considered to be unconfined and in hydraulic connection with the streams and rivers. Recorded water levels are shallow (5 mbgl).</li> <li>• Unconfined flow path lengths are relatively short, and in general are between 30 and 300 m. Confined flow path lengths may be longer.</li> <li>• Groundwater discharges to the streams and rivers crossing the aquifer and to springs. Local flow directions are controlled by local topography.</li> <li>• The Lower Impure Limestones of this GWB confine the highly transmissive Devonian Kiltorcan-type rock units of the Knockaderry and Kilmeedy GWBs, which pass underneath, as well as lying next to, this GWB. The high transmissivity aquifers can be reached by drilling through the low transmissivity confining layer formed by this GWB, such as at Kilcolman and Clouncagh WSs.</li> <li>• A small part of the Knockaderry Gravel GWB overlies this GWB.</li> </ul>
<b>Attachments</b>	Figure 1 (Groundwater hydrograph).
<b>Instrumentation</b>	EPA Water Level Monitoring boreholes: Feenagh (LIM 141)
<b>Information Sources</b>	<p>Deakin, J., Daly, D. and Coxon, C. (1998) <i>County Limerick Groundwater Protection Scheme</i>. Geological Survey of Ireland Report to Limerick Co. Co., 72 pp.</p> <p>Deakin, J. (1995) <i>Bruff WS – Groundwater Source Protection Zones</i>. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp.</p> <p>Deakin, J. (1995) <i>Hospital WS – Groundwater Source Protection Zones</i>. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp.</p> <p>Aquifer chapters: Dinantian Lower Impure Limestones.</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: Groundwater hydrograph





**Rock units in GWB**

Rock unit name and code	Description	Rock unit group
Ballysteen Formation (BA),		Dinantian Lower Impure Limestones