

Hospital GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystem(s)	Area (km ²)
24 - Maigue Limerick and South Tipperary Co. Co.'s	Rivers: Maigue, Morningstar, Camoge, Loobagh, Bog, Mahore, Clonshire. Lough: Portanagort.	Glen Bog (001430).	260
Topography	This GWB occupies the lowlands in west Co. Limerick. It is elongated ENE-WSW, with a spur off to the northwest, and surrounds the hillier areas of Bruff and Ballingarry GWBs (which are situated in the western half of the GWB). The highest point, at 165 m, is Cromwell Hill in the northeast of the GWB. This hill is underlain by volcanic rocks. The lowest parts are in the northwest, along the course of the River Maigue. Most of the area is around 100 mAOD. Elevation increases slightly to 120 mAOD and 170 mAOD along the western and eastern margins, respectively, which are surface water catchment boundaries. Drainage density is high, with many small tributaries draining to the major rivers crossing the GWB.		
Geology and Aquifers	Aquifer categories	The majority of the GWB is an LI : Locally important aquifer which is moderately productive only in local zones. Relatively thin strips of aquifer in the eastern part of the GWB are PI : Poor aquifers which are generally unproductive except for local zones, as is a small blob of granite on the northern edge. A very small patch in the centre is Rk^d : Regionally important karstified aquifer dominated by diffuse flow. Small areas of volcanic rock in the northeast are classified as Lm : Locally important aquifers which are generally moderately productive.	
	Main aquifer lithologies	The GWB is mainly underlain by Dinantian Lower Impure Limestones. There are small areas of Devonian Old Red Sandstones and Dinantian (early) Sandstones, Limestones and Shales in the east of the GWB, and Dinantian Pure Unbedded Limestones in the centre of the GWB. A small area of Granitic rock occurs near the northern edge, whilst in the northeast of the GWB, there are small occurrences of Volcanic rocks.	
	Key structures	Major, relatively tight folds deform the rocks of this GWB. Overall, the zone along which the GWB occurs is coincident with the core of a large anticline that plunges to the WSW. The rock units within the GWB are the youngest in this structure. NNE-SSW and NNW-SSE trending faults cross-cut the fold axes. There are also some faults parallel to the fold axes. Compression 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 ² /d. However, at Hospital WS, a pumping test provided transmissivity estimates of approximately 75 m ² /d. At Bruff No 1 WS, aquifer transmissivity is approximately 40 m ² /d, showing that higher transmissivities can be achieved in local zones. Transmissivities are similar in the Old Red Sandstones, but may be higher at the top of the succession. Transmissivities will be low, towards the lower end of the range 2-10 m ² /d, in the Dinantian (early) Sandstones, Limestone and Shales which, in this area, comprises shaley strata. In the Pure Unbedded Limestones, transmissivity will be significantly higher, on the order of 200 m ² /d. Groundwater gradients will be approximately 0.005 to 0.03, depending upon local topography. <i>(data sources: Rock Unit Group Aquifer Chapters, Source Reports see references; estimation from maps)</i>	
	Thickness	In general, the effective thickness of this aquifer is likely to be ≤15 m, comprising a weathered zone of a few metres and a connected fractured zone below this. Although more isolated water-bearing fractures or faults can be intercepted at greater depths, this rock unit is a confining layer to the underlying Devonian Kiltorcan-type Sandstones.	
Overlying Strata	Lithologies	<i>[Information to be added at a later date]</i>	
	Thickness	Depth to bedrock varies significantly over this large GWB. In the northeast, subsoils are approximately 3-7 m thick, and outcrops occur. In the centre of the GWB, rock outcrops occur, and subsoils are generally 1-12 m thick. In the west of the GWB, depths to bedrock are generally greater than 15 m, and often >25 m. Similarly, in the SE, subsoils are generally more than 15 m thick. Outcrops are scattered, and are mainly confined to the NE, far NW and centre of the GWB.	
	% area aquifer near surface	<i>[Information to be added at a later date]</i>	
	Vulnerability	<i>[Information to be added at a later date]</i>	
Recharge	Main recharge mechanisms	Diffuse recharge will occur over the entire groundwater body via rainfall soaking through the subsoil or directly into the aquifer where rock is at surface. If subsoil is thick and impermeable, potential recharge will runoff. Potential recharge may be rejected in some areas due to a high water table.	
	Est. recharge rates	<i>[Information to be added at a later date]</i>	
Discharge	Springs and large known abstractions (m ³ /d)	Knocklong West WS A (351 m ³ /d), Knocklong West WS B (44 m ³ /d), Hospital WS No 3 (Millfarm) (185 m ³ /d), Bruff WS No 2 (Sycamore Drive) (220 m ³ /d), Hospital WS No 1 (251 m ³ /d, decreases in summer), Hospital WS No 2 (Castlefarm) (366 m ³ /d, dries in summer), Knockainey GWS (50 m ³ /d), Bruff No 1 (Moloney's Field). <i>[More information to be added at a later date]</i>	

	<p>Main discharge mechanisms</p> <p>The main discharges are to the streams and rivers crossing the aquifer and to springs. There may be a small volume of cross-flow from this GWB to the karstic North Kilmallock and Fedamore GWBs to the south and north, respectively.</p>
	<p>Hydrochemical Signature</p> <p>Groundwaters sampled at Bruff and Hospital WSSs (in the impure limestones) are hard to very hard (310-425 mg/l as CaCO₃), with corresponding high alkalinities (295-355 mg/l as CaCO₃) 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. No data are available for the ORS rocks in this GWB. In other areas, groundwaters in ORS aquifers are moderately hard to hard (depending upon the subsoil) with corresponding alkalinities and conductivities, and have a calcium–bicarbonate signature. Iron can be a problem. In all aquifers in this GWB, background chloride concentrations will be higher than in the Midlands, due to proximity to the sea. The Lower Limestone Shale and Ballysteen Limestone rock units are calcareous. The bedrock strata of the Old Red Sandstone aquifer, and volcanic and granitic rock units are siliceous.</p>
	<p>Groundwater Flow Paths</p> <p>These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. In the very small areas of karstified pure limestones, fractures and joints are solutionally-enlarged. The water table is 1–18 m below ground level, and in general follows the topography. The deeper water levels reported generally relate to the non-recharge season. Groundwater is unconfined over most of the GWB, although in some areas will be overlain by gravely till in which the water table lies. These gravely deposits will contribute storage to the bedrock aquifer and attenuate groundwater level variation (e.g., Athlacca). 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. The numerous dug wells in the area tap groundwater in the weathered and fractured more permeable zone at the top of the aquifer. Bored well depths range between 15 – 125 m, with most between 15 m and 40 m deep. Groundwater flow paths in this aquifer are short (30-300 m), with groundwater discharging locally to the streams, rivers and springs. Overall, the general groundwater flow directions are eastwards and westwards to the Rivers Maigue, Morningstar, Camoge and Mahore.</p>
	<p>Groundwater & Surface water interactions</p> <p>Due to the shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. The streams and rivers crossing the aquifer are gaining, although specific dry weather flows of 0.1 and 0.23 l/s/km² show that the aquifers are incapable of sustaining significant summer baseflow. Groundwater also discharges to springs. In the north of the GWB, Glen Bog (NHA 001430) is not actually a bog, but a wet woodland (carr) occupying the site of a former lake. The woodland floor is wet and in places quaking. The vegetation is sensitive to nutrient enrichment and drainage.</p>
<p>Conceptual model</p>	<ul style="list-style-type: none"> • This groundwater body is bounded to the east and along part of the western boundary by surface water catchment divides. Along most of the west boundary the contact with the Lower Limestone Shales of the Ballingarry GWB delimits this GWB. It is bounded to the north and south by the contact with the karstic Waulsortian Limestones of the Fedamore GWB and Kilmallock GWB respectively. There are also internal boundaries, where this GWB surrounds the Bruree GWB and part of the Ballingarry GWB. The area is low-lying or gently hilly and is generally poorly drained. • The GWB comprises low transmissivity and low storativity rocks, although localised zones of enhanced permeability do occur. The Dinantian (early) shaley rocks will have significantly lower permeabilities than the other rock units. The small areas of karstic limestones have higher transmissivities. Groundwater flows along fractures, joints and major faults. • Recharge occurs diffusely through the subsoils. Potential recharge may be rejected where the water table is high. Where saturated gravely tills overlie the bedrock aquifers, pumping will induce flow from the subsoils to the bedrock aquifer. • The aquifers are unconfined. The water table is from 0-18 m below ground level and follows topography. Most groundwater flow occurs near the surface 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. Flow path lengths are relatively short, and in general are between 30 and 300 m. Low DWFs and high water level variations at Hospital WS indicate that aquifer storage is low. • The Lower Impure Limestones of this GWB confine the highly transmissive Devonian Kiltorcan-type rock units of the Bruree and Ballingarry GWBs, which pass underneath this GWB as well as lying next to this GWB. The high transmissivity aquifers can be reached by drilling through the low transmissivity confining layer. • The spur of Lower Impure Limestones in the NW of the GWB that sticks into the karstic Fedamore GWB will either deflect northwards-flowing groundwater within the karstic aquifer, or cause it to discharge to surface at springs. • Recharge occurs diffusely through the subsoils. Groundwater discharges to the numerous small streams crossing the aquifer. Seepage zones may exist on the cliff faces. • Groundwater discharges to the streams and rivers crossing the aquifer and to springs. Local flow directions are controlled by local topography. Overall, flow directions are east- and westwards to the major rivers. Along parts of the southern and northern boundaries there may be some cross-flow from this GWB to the adjacent karstic GWBs. • Due to the shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. This interaction is rapid and seasonal; due to low storage and the local nature of the flow paths, summer baseflows to the rivers are low. • The Killacolla Gravel GWB overlies a small area of this bedrock GWB in the southwest.

Attachments	Groundwater hydrograph. (Figures 1 and 2), Hydrochemical signature (Figure 3)
Instrumentation	Stream gauges: 24006*, 24022*, 24023, 24025, 24082, 24083. (Stations marked with * have specific dry weather flows calculated.) EPA Water Level Monitoring boreholes: Hospital (LIM129), Castletown (LIM133), Ballynagreenagh (LIM173), Athlacca No 2 (LIM232), Athlacca No 3 (LIM233), Ballynagreenagh No 2 (LIM234), Ballynagreenagh No 3 (LIM243). EPA Representative Monitoring boreholes: Hospital WS (LIM56, LIM57).
Information Sources	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. Deakin, J. (1995) <i>Bruff WS – Groundwater Source Protection Zones</i> . Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J. (1995) <i>Hospital WS – Groundwater Source Protection Zones</i> . Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Aquifer chapters: Dinantian Lower Impure Limestones; Devonian Old Red Sandstones; Dinantian (early) Sandstones, Limestones and Shales; Dinantian Pure Unbedded Limestones.
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: Groundwater hydrograph

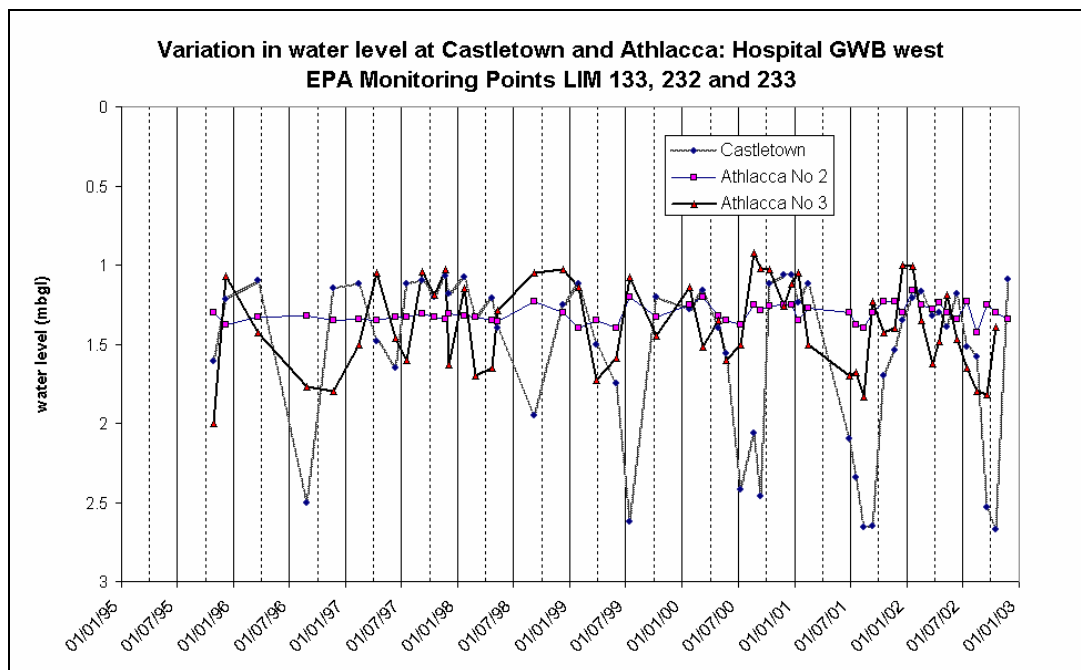


Figure 2: Groundwater hydrograph

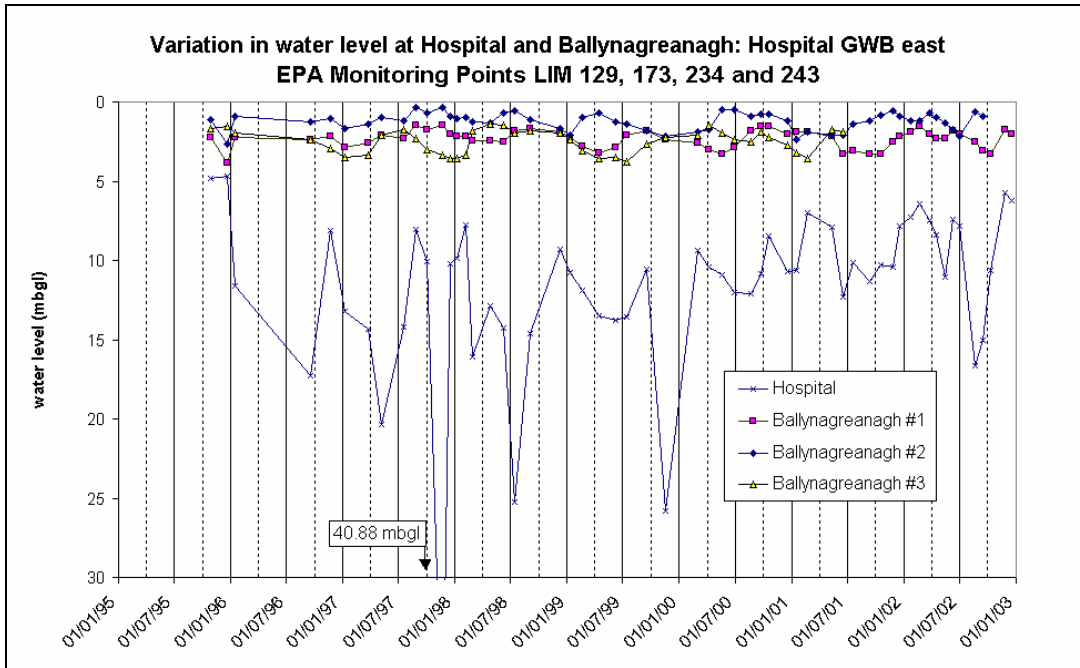
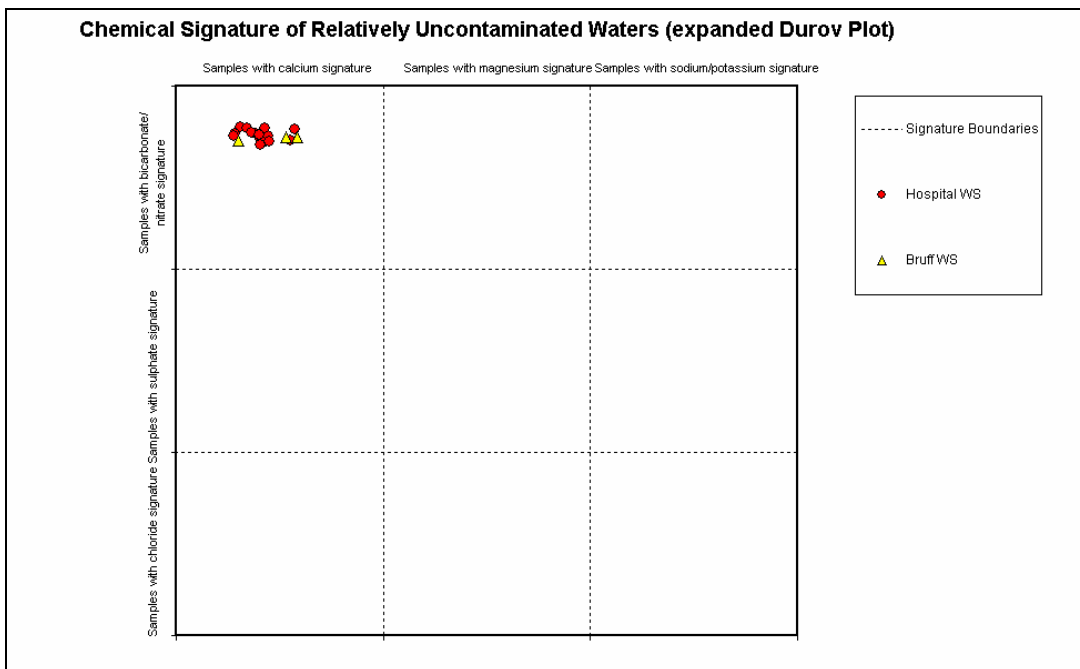
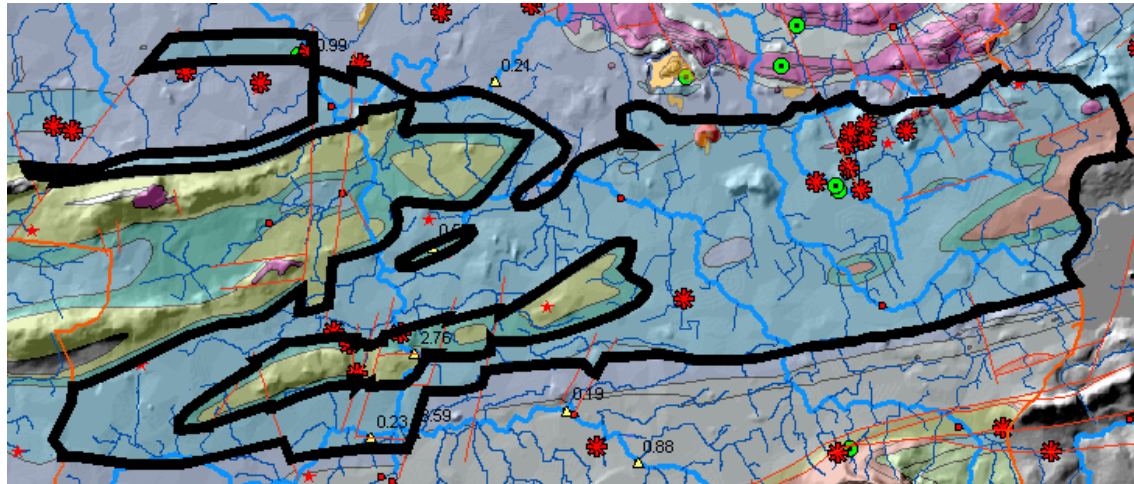


Figure 3: Hydrochemical signature





Rock units in GWB

Rock unit name and code	Description	Rock unit group
Ballysteen Formation (BA), Ringmoylan Shales (RM), Ballymartin Formation (BM)		Dinantian Lower Impure Limestones
Waulsortian Limestones (WA)		Dinantian Pure Unbedded Limestones
Old Red Sandstone (ORS)		Devonian Old Red Sandstones
Syenite (S)		Granitic and other Igneous Intrusive rocks
Trachyte (T)		Volcanic and other Igneous Extrusive rocks