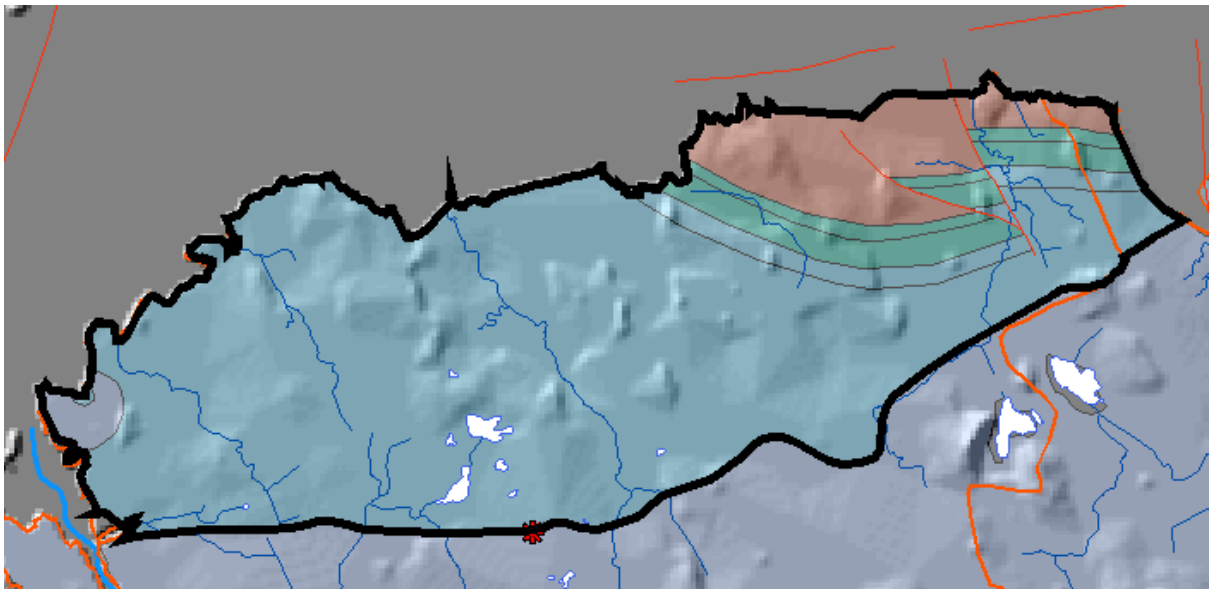
Ballysteen GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
24 - Deel/ Shannon Estuary South Limerick Co. Co.	Gortnagranagher Lough; Milltown Lake; Deel and Shannon Estuaries	Inner Shannon Estuary (000435)	42

Topography	This body is elongated E-W, and is very low-lying; the maximum elevation is approximately 35 mAOD, whilst the lowest points are at sea level. The Old Red Sandstone does not create higher relief than the impure limestones, in contrast to other areas (e.g. Kerry Head). Streams drain northwards off the adjacent karstic GWB (Askeaton) onto this GWB, although some streams flow south from this GWB onto the Askeaton GWB. Nearly all the GWB is within the Deel catchment; only in the very east does surface water drain to the Maigue estuary.	
Geology and Aquifers	Aquifer categories	The majority of the GWB is an **Ll:** Locally important aquifer which is moderately productive only in local zones. Relatively thin strips of aquifer in the eastern part of the GWB are **Pl:** Poor aquifer which is generally unproductive except for local zones. A very small area in the west is **Rk^c**: Regionally important karstified aquifer dominated by conduit flow.
	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 very west of the GWB.
	Key structures	The rocks are on the southern limb of a tight WSW-plunging major anticline. Bedding dip directions indicate associated minor folds, with dip angles of approximately 10^o to 40^o. NW-SE and N-S trending faults that are downthrown to the east cross-cut the fold. Compression during the folding would also have caused some fracturing and jointing of the rocks.
	Key properties	Transmissivity in the Lower Impure Limestones and Old Red Sandstones will be in the range 2-20 m^2/d. Transmissivities in the shaley strata of the Dinantian (early) Sandstones, Limestone and Shales will be lower, towards the lower end of the range 2-10 m^2/d. In the Pure Unbedded Limestones, transmissivity will be significantly higher, on the order of 200 m^2/d. Although the aquifers are generally low transmissivity, the very low relief of the ground means that groundwater gradients will be approximately 0.005 to 0.02. *(data sources: Rock Unit Group Aquifer Chapters, see references; estimation from maps)*
	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. However, more isolated water-bearing fractures or faults can be intercepted at greater depths.
Overlying Strata	Lithologies	*[Information to be added at a later date]*
	Thickness	The subsoil is shallow, with an average thickness of 2.5 m, and a range of 0–8 m. Areas of outcropping rock are small, scattered, and do not cover a large area.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	*[Information to be added at a later date]*
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. Potential recharge may be rejected in some areas due to the high water table.
	Est. recharge rates	*[Information will be added at a later date]*
Discharge	Springs and large known abstractions (m^3/d)	Ballysteen GWS (131 m^3/d), Ballynacourty GWS (79 m^3/d). *[More information to be added at a later date]*
	Main discharge mechanisms	The main discharges are to the streams crossing the aquifer and to the Shannon Estuary. There may be a small volume of cross-flow from this GWB to the Askeaton GWB to the south.
	Hydrochemical Signature	There are no hydrochemical data for this GWB. By analogy with similar GWBs, groundwater in the limestones is hard to very hard (300–450 mg/l as $CaCO_3$), with corresponding high alkalinity (250–340 mg/l as $CaCO_3$) and high electrical conductivity (> 600 µS/cm). Hardness and alkalinity will be lower in the Old Red Sandstone aquifer. In all groundwaters, the pHs will be neutral, background chloride concentrations will be higher than in the Midlands, due to proximity to the sea, and groundwaters will 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. Iron can be a problem in the ORS aquifers. The bedrock strata of the Old Red Sandstone aquifer are **siliceous**. The Lower Impure Limestones, mixed early Dinantian strata, and the Pure Unbedded Limestone rock unit groups are **calcareous**.

Groundwater Flow Paths	These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. In the small area of karstified pure limestones adjacent to the Deel estuary, conduit flow may dominate. Groundwater is unconfined; the water table is 1–10 m below ground level, and follows the topography. Flows in the aquifer are likely to be 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 m, 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 wells range between 40 – 110 m, with most approximately 70 m deep. Groundwater flow paths are short (30-300 m), with groundwater discharging locally to the streams. The general groundwater flow direction is northwards to the Shannon Estuary, excepting areas in the east and west where flow is to the Maigue or Deel Rivers, or along part of the southern boundary where the groundwater gradient is southwards.
Groundwater & Surface water interactions	The water table is close to ground level over much of the GWB, but is below or close to the base of the subsoils. The streams crossing the aquifer will be gaining, but the aquifer will not sustain high summer baseflows. Due to the shallow groundwater flow in this aquifer, the groundwater and surface waters are closely linked. Groundwater discharges to the Shannon Estuary.
Conceptual model	• The groundwater body is elongated E-W. It is bounded to north by the Shannon Estuary, to the west and east by the Deel and Maigue estuaries, and to the south by the contact with the Waulsortian Limestones of the Askeaton GWB, under which the Ballysteen Formation passes. The area is very low-lying, with gently undulating topography. • The GWB comprises low transmissivity rocks, although localised zones of enhanced permeability do occur. The Dinantian (early) shaley rocks will have significantly lower permeabilities than the other rock units. In the west, the small area of karstic limestones has high transmissivity. In most of the GWB, groundwater flows along fractures, joints and major faults. In the karstic limestone, conduit flow will dominate. • Recharge occurs diffusely through the subsoils. Potential recharge may be rejected where the water table is high. • The aquifers are unconfined. The water table is from 0-10 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 indicate that aquifer storage is low. • Groundwater discharges to the streams crossing the aquifer and to the Shannon Estuary. Unconfined flow directions are controlled by local topography. Overall, flow directions are northwards to the Shannon Estuary; along part of the southern boundary there may be some cross-flow from this GWB to the karstic Askeaton GWB. • 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.
Attachments	None.
Instrumentation	None.
Information Sources	Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme*. Geological Survey of Ireland Report to Limerick Co. Co., 72 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 calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Ballysteen Formation (BA),		Dinantian Lower Impure Limestones
Ringmoylan Shales (RM), Ballymartin Formation (BM)		Dinantian (early) Sandstones, Limestones and Shales
Waulsortian Limestones (WA)		Dinantian Pure Unbedded Limestones
Old Red Sandstone (ORS)		Devonian Old Red Sandstones