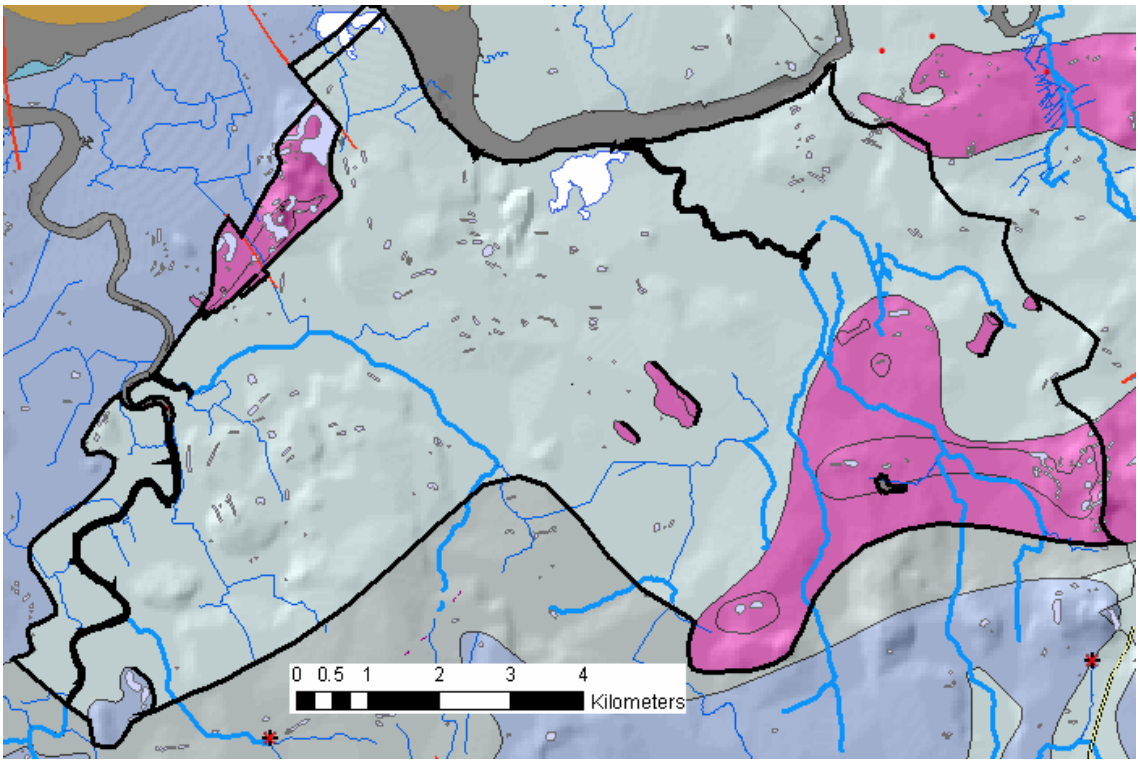
Limerick City South West GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
24 - Shannon Estuary Limerick Co. Co.	Rivers: Shannon, Maigue,Barnakyle, Ballynaclough, Ahanload. Creeks: Ballincurra, Ballindray.	Inner Shannon Estuary (000435), Loughmore Common Turlough (000438)	83

Topography	Much of the GWB is low-lying, with an average elevation of 20–30 mAOD. Higher ground is found in the west and southeast, in the areas underlain by volcanic rocks. Elevations in these areas reach 50 mAOD in general, with the highest ground reaching 90 mAOD. In the valleys of the larger rivers (e.g, Barnaklye, Maigue), elevations are around 10–15 mAOD. The land is poorly drained in the low-lying ground next to the River Shannon, and in the areas east and northeast of Dooradoyle (Sluggary and Rossbrier respectively).	
Geology and Aquifers	Aquifer categories	The majority of the GWB comprises an **Lm:** Locally important aquifer which is generally moderately productive. The Basalts and other Volcanic rocks rock unit group is currently classified as **Lm**. There is a small area (0.5 km^2) of **Rk^d**: Regionally important karstified aquifer dominated by diffuse flow.
	Main aquifer lithologies	Dinantian Pure Unbedded Limestone is the major rock unit group in the GWB. There is a smaller but significant area of Basalts and other Volcanic rocks. In the very SW of the GWB, there is a very small area (0.5 km^2) of Dinantian Pure Unbedded Limestone.
	Key structures	The rocks form part of the core of a large syncline, whose axis is oriented NE-SW. Dip angles range between 10^o to 40^o. NW-SE trending faults occur in the volcanic rocks in the west of the GWB. No faults or minor folds are mapped in the centre of this area, but are likely to be present.
	Key properties	Transmissivities are likely to be in the range 5-150 m^2/d, with the median value towards the lower-middle end of the range. Transmissivity in the limestone aquifer of the Pallas Grean GWB was estimated as 26 m^2/d. In the Volcanic rocks, transmissivities will be similar, with median values towards the lower end of the range. Transmissivity in the Volcanic rocks in this area may be variable: in some zones, columnar cooling joints provide a connected pathway for groundwater flow. In other parts, alteration of the rocks during their emplacement in shallow seas, or subsequent weathering during subaerial exposure in a tropical environment may have clogged potential flow pathways (both cooling joints and tectonic fractures) with clays. At Herbertstown WS in the nearby Knockroe SW GWB, transmissivity is about 100 m^2/d. However, there are failed wells known in this rock unit group. Because much of the ground is flat-lying, groundwater gradients will be low (~0.005-0.01) over most of the GWB, ranging up to 0.015 in the steeper areas. *(data sources: Rock Unit Group Aquifer Chapters, GWPS Reports, Source Reports, see references; estimation from maps)*
	Thickness	The Dinantian Pure Bedded Limestones vary laterally in maximum thicknesses from 150 m to up to 500 m. However, most groundwater flow is likely to take place in the top ~30 m, in the zone that comprises a weathered layer of a few metres (epikarst) and a connected fractured layer below this. Deeper groundwater flow occurs along fault zones and large fractures. In the volcanics, most groundwater flux is likely to be in the top ≤ 20-30 m, in the zone comprising a weathered layer of a few metres and a connected fractured zone below this. However, more isolated water-bearing joints or faults can be intercepted at greater depths.
Overlying Strata	Lithologies	The GWB is mainly covered by Limestone Till subsoils. There are a few small pods of gravel within the Till that are separately mapped. Undifferentiated Alluvium occurs along some of the rivers crossing the GWB. Small areas of Peat deposits are mapped. A proportion of the GWB is covered by urban made ground of Limerick City and satellite towns and villages.
	Thickness	Typically, subsoil thicknesses are in the range 0–6 m, with occasional measurement of up to 18 m. There is outcropping rock across the GWB, particularly in the elevated areas and on local high points.
	% area aquifer near surface	*[Information will be added at a later date]*
	Vulnerability	Groundwater vulnerability is Extreme and High. Extreme vulnerability predominates in the western half, whilst High vulnerability predominates in the eastern half.
Recharge	Main recharge mechanisms	Diffuse recharge will occur over the entire groundwater body via rainfall soaking through the subsoil and directly to the aquifer via outcrop. The turlough will accept point recharge in low water table conditions.
	Est. recharge rates	*[Information will be added at a later date]*
Discharge	Important springs and high yielding wells (m^3/d)	Knockea Group Water Scheme, which abstracts from the Volcanics, has an Excellent (> 400 m^3/d) yield, of 909 m^3/d. There are two known Good yielding (100 m^3/d < yield < 400 m^3/d) boreholes – at Patrickswell GWS in the pure bedded limestones and Greenhills GWS in the Volcanics.
	Main discharge mechanisms	The main discharges are to the streams and rivers crossing the GWB, and to the River Shannon that forms the northern boundary of the GWB. Regions in which groundwater is discharging are indicated by higher stream densities, i.e. next to the River Shannon, and the areas around Sluggary and Rossbrier.
	Hydrochemical Signature	No relevant hydrochemical data are available for the limestone aquifer in this GWB for assessment. By analogy with other pure limestone aquifers, the groundwater is likely to be hard to very hard, with corresponding high alkalinity and conductivity, and a neutral pH. It is likely to have a calcium–bicarbonate signature. Water quality data from the volcaniclastic aquifer indicate conductivities of between 470–700 µS/cm. In general, background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.

Groundwater Flow Paths	These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. Groundwater flows through an epikarstic layer and a zone in which fractures are more dense and open. The epikarst is thought to be relatively modern, being formed after the last ice age. The groundwater flow regimes in the epikarst and fractured zones will be hydraulically connected, with the degree of interconnection depending on the faults and joints associated with the structural deformation. Groundwater flux is thought to be concentrated in the top 30 m or so of the aquifer. The GWB is unconfined. It is considered that the rivers and streams are in hydraulic continuity with the aquifer and they therefore represent the water table elevation. Groundwater levels are variable: near streams and rivers, water levels measured in dug wells are generally within 2 m of ground level, but may be slightly deeper in bored wells. Away from surface water bodies, the depth to the water table generally ranges between about 6 m and 16 m. The water table is likely to generally follow the topography. Stream separations indicate that groundwater flow paths are on the order of 500–2000 m over the bulk of the GWB. In discharge zones, flow paths will be much shorter, at around 100–300 m. The areas underlain by volcanic rocks are less well-drained than those underlain by pure limestones. This may only be due to the epikarstic layer in the limestones redistributing recharge in the subsurface, or may indicate that the volcanics are lower transmissivity than the limestones. Local groundwater flow will be from the higher ground between surface water bodies to the rivers and streams. The regional groundwater flow direction is northwards to the Shannon in most of the GWB, but westwards towards the River Maigue in the western part of the GWB.
Groundwater & Surface water interactions	Existing data indicates that, over much of the GWB, the water table is below the base of the subsoils. In the vicinity of the streams crossing the aquifer, water levels are above the base of the subsoil and close to the surface. Rivers and streams are gaining. The turlough at Loughmore Common will be a groundwater source or sink, depending upon seasonal water levels within the aquifer. Groundwater will flow into the NHA Inner River Shannon as direct baseflow, and via baseflow to the River Maigue which flows into the Shannon.
Conceptual model	• The groundwater body is bounded to the north by the River Shannon, to the west by the contact with the karstified Pure Unbedded Limestones of Askeaton GWB, to the south by the impure limestones of Ballylongford GWB, and to the east by a surface water catchment boundary which is an implied groundwater divide. The terrain is gently undulating over much of the GWB, with small hills occurring in the SE. • Groundwater flow occurs along fractures, joints and faults in the limestones and volcanic rocks. There is likely to be an epikarstic layer at the top of the limestones, which acts to redistribute recharge in the subsurface and, in high water table conditions, is a very high transmissivity layer. The aquifers have low storativity. • Recharge occurs diffusely through the subsoils and at outcrop. Potential recharge may be rejected in areas where the water table is very close to the surface. • Groundwater flux in the limestone aquifer will be concentrated in an approximately 30 m zone at the top of the bedrock. This zone comprises an epikarstic layer of a few metres, below which is a network of joints, fractures and faults. Deeper groundwater flow can occur along permeable fault zones or deeper fractures. The flow regime in the volcanic aquifer is similar, excepting the epikarstic layer. • It is possible that, as the focus of drainage, the areas near to the Rivers Shannon and Mulkear are more karstified than other parts of this GWB, thus affecting the distribution of transmissivity in the subsurface. • Most of the aquifers in the GWB are unconfined. Near rivers and streams, the water table is close to the surface. Beneath higher ground, significant unsaturated zones may exist. Depending upon topography, the water table can vary between 2 metres up to ~15 m below ground surface. Water table fluctuations in discharge areas will be relatively low (on the order of 1-2 m) whereas, in the high ground underlain by volcanic rocks or local topographic highs in the limestones, the water table elevation may vary considerably. • Flow path lengths are generally long (up to several km's). In discharge zones, flow paths will be much shorter, at around 100–300 m. Regional groundwater flow in most of the GWB is from south to north, to the Shannon; in the west of the GWB, groundwater flows westwards to the Maigue River. However, on a local scale, groundwater discharges to the streams and smaller rivers crossing the aquifer, especially near Dooradoyle and the Shannon River. Local groundwater flow directions are determined by topography and local drainage patterns. • Groundwater discharges to the gaining rivers crossing the GWB, and the Shannon at the NW of the GWB.
Attachments	None.
Instrumentation	None.
Information Sources	Deakin, J. (1995) *Herbertstown Public Supply, Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme*. Geological Survey of Ireland Report to Limerick Co. Co., 72 pp. Deakin, J. and Daly, D. (2000) *County Clare Groundwater Protection Scheme.* Geological Survey of Ireland Report to Clare Co. Co., 67 pp. Aquifer Chapters: Pure Bedded Limestones, Basalts and other Volcanic rocks, 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
Visean Limestones (Undifferentiated)		Dinantian Pure Bedded Limestones
Volcaniclastic Rocks (V)		Basalts and other Volcanic rocks
Basalt (B)		Basalts and other Volcanic rocks
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones