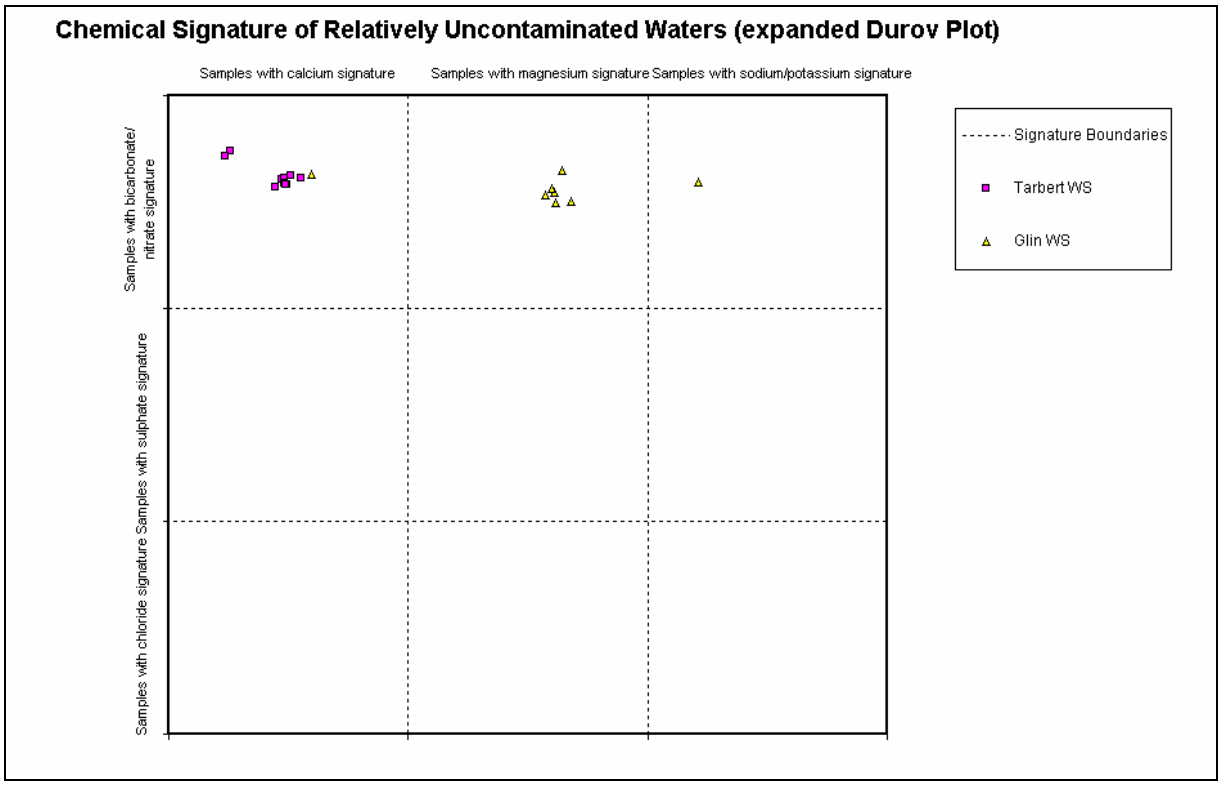
Spa GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystems	Area (km^2)
23 - North Kerry/ Tralee Bay catchment Kerry and Limerick Co. Co.'s	Rivers: Lee, Big, Tyshe.	Tralee Bay and Magharees Peninsula, West to Cloghane (00270).	62

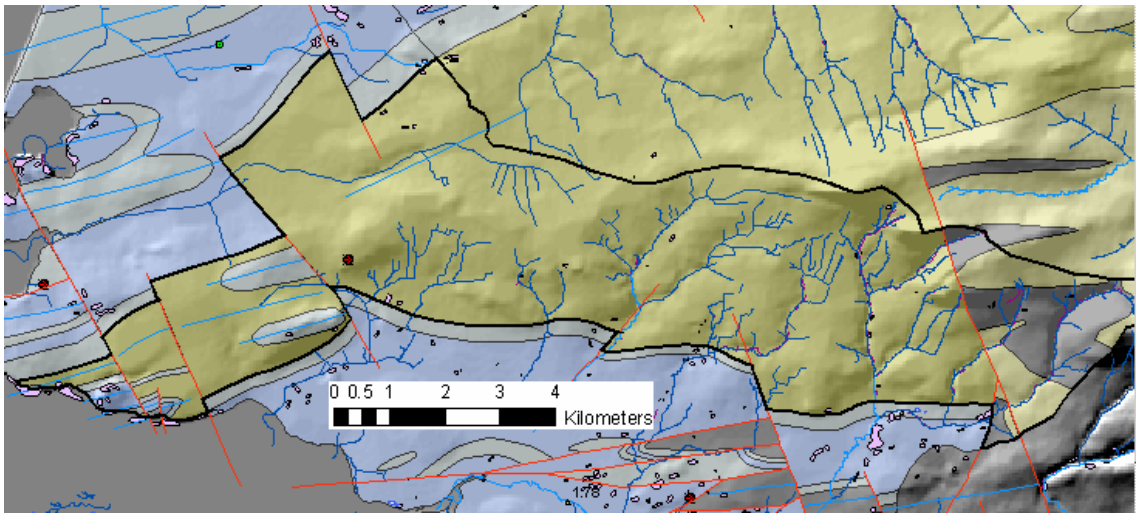
Topography	The groundwater body is elongated E-W, with a spur running SW towards the coast at Spa. Ground elevation ranges from 0 mAOD along the coast, to more than 350 mAOD in Stack's Mountains, along the NE of the GWB. The uplands are dissected by numerous streams and rivers which generally flow in a southerly direction onto the karstic Tralee GWB, although in the west of the GWB, rivers flow westwards onto the karstic Ardfert GWB. Drainage appears to be generally poor.	
Geology and Aquifers	Aquifer category(ies)	The vast majority of the GWB comprises an **Ll:** Locally important aquifer which is moderately productive only in local zones. There is a very small area of Clare Shales on the eastern boundary which is a **Pu**: Poor aquifer which is generally unproductive. There is less than 1 km^2 of karstified limestone on the coast just north of Spa. Although karstified, it is not classified as an **Rk** aquifer, since it is not large enough to sustain regional flow.
	Main aquifer lithologies	The main rock unit groups within the GWB are Namurian Undifferentiated and Namurian Sandstones. There are small areas of Namurian Shales, Dinantian Upper Impure Limestones and Dinantian Pure Unbedded Limestones.
	Key structures	The rocks are the youngest strata in an area that is strongly folded. Bedding dips are between 10-55^o in both N/NE and S/SE directions due to small folds. There are two sets of faults cross-cutting the fold axes: NNW-SSE and NE-SW. Fractures may be more open on the fold axes and near the major faults.
	Key properties	Transmissivity is in the range 2–20 m^2/d. At Glin WS in the nearby Ballylongford GWB, a pumping test gave transmissivity of 14 m^2/d [7-27 m^2/d], but this may have been affected by faulting. Transmissivities in Dinantian Upper Impure Limestones will be similar, but in the Namurian Shales will be significantly lower. Groundwater travel times in the karstified Pure Unbedded Limestones will be fast due to flow being concentrated in conduits. Aquifer storativities in all rock units are low. At Glin WS, estimated groundwater gradients are 0.04 - 0.05. Over this GWB, they are likely to be in the range 0.01 – 0.05. *(data sources: Rock Unit Group Aquifer Chapters, Source Reports, see references)*
	Thickness	In general, most groundwater flow occurs within the top 15 m of the aquifer, in the layer that comprises a weathered zone of a few metres and a connected fractured zone below this. However, deep water strikes (30-90 m) are noted in this aquifer, and are associated with slightly better yields (moderate to good, rather than poor) and better productivities (III and IV, rather than IV and V). Permeable zones are met at deeper levels than in other rocks. In a 3 km deep exploration borehole drilled by Ambassador Oil near Doonbeg (on the north side of the Shannon Estuary), for example, water was struck at 107 m and then intermittently until a depth of 610 m.
Overlying Strata	Lithologies	The majority of the GWB is overlain by Namurian Shale and Sandstone Tills. There is a small area of Limestone Till in the south, and small areas of Blanket Peat and Cutover Peat in the NE. Narrow zones of Undifferentiated Alluvium occur along some of the river courses. Karstified limestone outcrops 2 km west of Spa.
	Thickness	Depth to bedrock data are sparse in this GWB. Available data indicate that subsoil thickness ranges from 1 m to about 10 m. Most data indicate depths to rock of 4 m or less. Outcrop is mainly confined to the incised river and stream valleys in the east of the GWB, which may indicate that depth to bedrock generally increases westwards, towards lower ground.
	% 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 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. Due to the generally low permeability of the aquifers within this GWB, a high proportion of the recharge will then discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater resource in the aquifer.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	Important springs and high yielding wells (m^3/d)	None known.
	Main discharge mechanisms	The main discharges are to the streams crossing and incising into the sandstone and shale rock units. Small springs and seeps are issue at the stream heads or along their course. Groundwater from this GWB may cross-flow into the downstream karstic limestone Tralee GWB.

Discharge	Hydrochemical Signature	No data are currently available for this GWB. Groundwaters sampled in the nearby Ballylongford GWB are Moderately Hard (120-270 mg/l $CaCO_3$) and have moderate alkalinities (170-240 mg/l $CaCO_3$). Measured electrical conductivity ranges from ~440-560 µS/cm. Spring waters (Tarbert WS) have a calcium bicarbonate signature. Groundwater sampled from a borehole (Glin WS) has a signature varying from Ca-HCO_3 to Na/K-HCO_3 and alkalinities greater than total hardness. This is typical of confined waters where ion exchange has occurred. Reducing conditions may also occur. Both iron and manganese can exceed allowable concentrations, these components coming from the shales. Background chloride concentrations will be higher than in the Midlands, due to the proximity to the sea. The limestone bedrock aquifers will have Hard to Very Hard groundwaters with calcium-bicarbonate signatures. Iron and manganese may be a problem in the impure limestones.
Groundwater Flow Paths		These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. Generally, groundwater levels are 1-7 m below ground level, and follow the topography. Deeper water levels, from 12-25 m are observed, however, which may indicate that there are zones that are hydraulically isolated from the rest of the aquifer. Unconfined flows in the aquifer will 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. Unconfined groundwater flow paths are short (30-300 m), with groundwater discharging to the streams and small springs and seeps. Artesian conditions and deep inflow levels in the adjacent Abbeyfeale GWB indicate that some of the aquifer is confined. Confined flow path lengths may be considerable. Overall, groundwater flow is to the south and west.
Groundwater & Surface water interactions		Due to the component of shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. The streams crossing the aquifer are gaining. Dry weather flows in the adjacent Abbeyfeale GWB are low (0.1 to 0.5 l/s/km^2 at 5 stations), indicating that the aquifers have low storage are therefore incapable of sustaining summer river flows. Small springs and seeps will contribute to river flows. Water from the rivers flowing onto the adjacent Tralee GWB will recharge the karstic aquifer.
Conceptual model		• The groundwater body is bounded to the north and east by surface water catchments, thereby implied groundwater divides. The western and southern boundaries are formed by the contacts with the karstified Ardfert and Tralee GWBs respectively. Part of the southern boundary is formed by the coastline. The terrain is hilly and dissected by rivers. • The groundwater body is composed primarily of low permeability rocks, although localized zones of enhanced permeability do occur along faults. Groundwater flows along fractures, joints and major faults. • Recharge occurs diffusely through the subsoils and via outcrops. It occurs especially in upland areas where the subsoil is thinner and rainfall higher. • The aquifers within this GWB are both unconfined and confined. Most flow in this aquifer will occur near the surface; most groundwater flow is likely to take place in the top 15 m or so, in the layer that comprises a weathered zone of a few metres and a connected fractured zone below this. The water table is generally from 1-7 m below ground level and follows topography. Deep inflow levels, artesian wells and hydrochemistry indicate confined conditions in higher permeability strata from which better yields can be obtained. Unconfined flow path lengths are relatively short, and in general are between 30 and 300 m. Confined flow paths may be significantly longer. Low dry weather flows indicate that aquifer storativity is low. • Groundwater discharges to the numerous small streams crossing the aquifer, and to springs and seeps. Local groundwater flow directions are oblique to the surface channels. There may be some cross-flow of groundwater into the lower-lying karstic Tralee GWB to the south. Overall, the flow direction is to the south and to the west. • Due to the component of 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		Hydrochemical signature (Figure 1).
Instrumentation		None.
Information Sources		Conlon, V. and Wright, G. (1998) *County Kerry Aquifer Classification (draft).* Geological Survey of Ireland Report to Kerry Co. Co., 18 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. Hudson, M. (1995) *Glin WS: Groundwater Source Protection Zones.* Geological Survey of Ireland Report to Limerick Co. Co., 8 pp. Aquifer Chapters: Namurian Undifferentiated; Namurian Sandstones; Namurian Shales; Dinantian Upper Impure Limestones; Dinantian Pure Bedded 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

Figure 1: Hydrochemical signature



NB: these data are from similar rock units in the Ballylongford GWB, which is 34 km to the north of this GWB. Tarbert WS is a spring source, wheras Glin WS is a borehole.



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Namurian Undifferentiated (NAM)		Namurian Undifferentiated
Feale Sandstone Formation (FS)		Namurian Sandstones
Cloone Sandstone Formation (CF)		Namurian Sandstones
Glenoween Shale Formation (GN)		Namurian Shales
Clare Shale Formation (CS)		Namurian Shales
Dirtoge Limestone Formation (DI)		Dinantian Upper Impure Limestones
Cloonagh Limestone Formation (CL)		Dinantian Pure Unbedded Limestones