

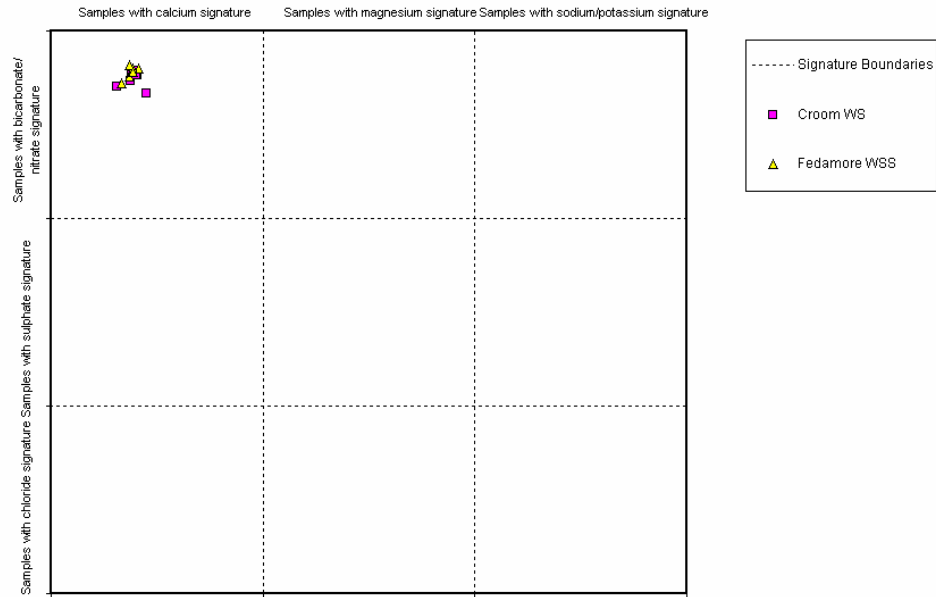
North Kilmallock GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authorities		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
24 - Maigue catchment Limerick, Cork and South Tipperary Co. Co.'s		Rivers: Maigue, Loobagh, Morningstar; Streams: Charleville.	-	44
Topography	The GWB is elongate and oriented ENE-WSW, in line with the structural grain of the region. The GWB is not continuous, but is compartmentalised by faults. The topography is fairly subdued, ranging from around 60 mAOD to 130 mAOD. Elevation is lowest where the Loobagh and Maigue Rivers join, near the centre of the GWB, and greatest at the western and eastern edges of the GWB, which are defined by surface water catchment boundaries. There is no distinct change in topography between this GWB and the ones to the north and south of it (Hospital and Charleville GWBs).			
Geology and Aquifers	Aquifer categories	RK^d : Regionally important karstified aquifer dominated by diffuse flow.		
	Main aquifer lithologies	Most of the GWB comprises Dinantian Pure Unbedded Limestones. There is a very small area of Dinantian Pure Bedded Limestones in the SE corner of the GWB.		
	Key structures	The rocks are on the southern limb of a major WSW-plunging anticline. Here, strata are tilted at about 35-45°, to the southeast. There are likely to be smaller, parasitic folds on the larger structures. NW-SE and NE-SW trending faults cross-cut the GWB along its length and, towards the west of the GWB, compartmentalise the aquifer. According to Brück <i>et al.</i> (1986), the rocks are 'well jointed'.		
	Key properties	Transmissivity in the diffusely karstified aquifers is in the range 20–2000 m ² /d. In this area of the country, the median value will be towards the lower end of the range. At Croom and Fedamore WSS (in the Fedamore GWB, north of this GWB), transmissivities are 120 m ² /d [estimate range 95–145 m ² /d] and 34 m ² /d [estimate range 23–41 m ² /d], respectively. Specific yield will be low, on the order of a few percent. Groundwater gradients within the karstic aquifer are low, ranging from 0.001 to 0.02. <i>(data sources: Rock Unit Group Aquifer Chapters, Limerick GWPS Report, Source Reports, see references; estimation from maps)</i>		
	Thickness	The Dinantian Pure Unbedded Limestones attain maximum thicknesses of more than 1200 m. However, the effective flowing thickness is likely to be about 30 m. An epikarstic layer of a couple of metres is likely to exist at the top of the bedrock.		
Overlying Strata	Lithologies	GSI mapping indicates that much of the GWB is covered by Limestone Till, with 'Till with Gravel' pods occurring also. Along the courses of the Rivers Maigue and Loobagh, there are extensive areas of Undifferentiated Alluvium which, according to Brück <i>et al.</i> (1986), is fine-grained and homogenous.		
	Thickness	Typically, subsoil thicknesses are in the range 6–15 m. However, significantly greater thicknesses are recorded over the GWB, ranging from 18 m up to 45 m. There are a few, widely-scattered, small outcrops.		
	% 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 via rainfall soaking through the subsoil only where subsoil thickness and permeability permit this, and directly to the aquifer via the limited outcrop area. Cross-flow from the upstream aquifers within the Charleville GWB may occur; this volume may include deep circulating warm groundwaters.		
	Est. recharge rates	<i>[Information to be added at a later date]</i>		
Discharge	Springs and large known abstractions (m ³ /d)	Bulgaden GWS (327 m ³ /d; 100 m ³ /d – EPA database); Knocklong WS (246 m ³ /d – EPA database). The large spring system west of Kilmallock, the Knocksouna Group (NGR 15630, 12770), has been studied in detail as part of the Irish Geothermal Project (Brück <i>et al.</i> , 1986). The system comprises a group of 12 warm springs (mean temperature 15.6 °C) spanning approximately 700 m on an east-west trending line. The total output for the springs is in the region of 28,800 m ³ /d and there is additional spring water bubbling up into the nearby stream. <i>[More information may be added at a later date]</i>		
	Main discharge mechanisms	Groundwater is likely to discharge to the streams and rivers crossing the GWB, and to seeps at the heads of streams. The subsoils are relatively thick over most of this GWB and may prevent rivers gaining baseflow from the groundwater along some of their lengths.		
	Hydrochemical Signature	No EPA or GSI hydrochemical data are available for this GWB. The hydrochemistry of the Waulsortian limestone aquifer in the Fedamore GWB (north of this GWB) shows a very hard (370–430 mg/l as CaCO ₃), calcium-bicarbonate type water with high alkalinities (330–380 mg/l as CaCO ₃) and electrical conductivities, and neutral pHs. Brück <i>et al.</i> (1986) measured hydrochemical parameters in the warm springs west of Kilmallock and found that they had an Mg-Ca-HCO ₃ signature, low NO ₃ , and isotopic evidence of a long residence time.		

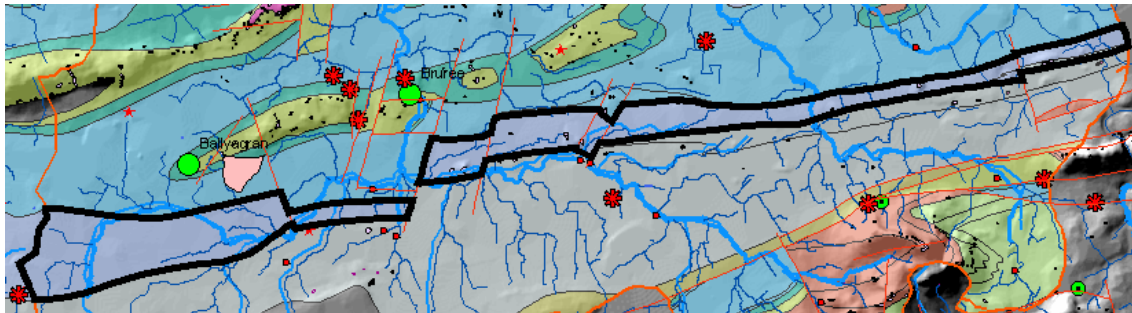
Groundwater Flow Paths	<p>These rocks are generally devoid of intergranular permeability, with groundwater flowing through a diffuse network of solutionally-enlarged joints, fissures and small conduits, and along faults. One cave is mapped in the area of this GWB. However, dolomitisation is noted by Brück <i>et al.</i> (1986), which would create intergranular spaces for groundwater to flow through. Groundwater levels are variable: near streams and rivers, water levels are generally within 2-4 m of ground level. Away from surface water bodies, the depth to the water table generally ranges between about 9 m and 25 m. The deeper water levels are recorded on or near local topographic highs. Groundwater is probably confined over much of the GWB by the thick subsoils. In areas near outcropping rock, groundwater is likely to be unconfined. The piezometric surface/ water table is likely to generally follow the topography. Local groundwater flow will be from the higher ground to the rivers and streams. Ground elevation decreases from south to north. However, due to the E-W elongation of the GWB, groundwater flow directions are likely to be more E-W than N-S. The E-W flow direction is supported by work by Brück <i>et al.</i> (1986), who carried out a geophysical survey in the area. They surmise that an E-W feature is responsible for conducting warm (14-15 °C), deep circulating groundwaters to the surface between Knocksouna Hill and the River Loobagh. Groundwater flow paths in regionally important aquifers are generally long (several km's). However, groundwater can also discharge locally to surface water features or springs if the topography is variable, or low permeability subsoil induces discharge of the groundwater where it begins to become confined. In discharge zones, flow paths will be much shorter, at around 100–300 m.</p>
Groundwater & Surface water interactions	<p>Due to the thick subsoils, groundwater-surface water interaction will be limited. However, the rivers crossing the aquifer are likely to be receiving baseflow from the aquifer. Existing data indicates that, over much of the GWB, groundwater levels are above 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. Where subsoils are thin or absent, the nature of the karstic system can lead to rapid interchanges of water between surface and underground. The seeps and small springs on the local topographic highs that form the heads of small streams are likely to be groundwater fed (rather than from perched groundwater in subsoils).</p>
Conceptual model	<ul style="list-style-type: none"> • The groundwater body is long and thin, and orientated ENE-WSW. It is bounded to the east and west by surface water catchment divides; in the east, this divide coincides with the Shannon RBD boundary. To the north and south, the limits of this GWB are created by the contact with the low transmissivity rocks of the Hospital and Charleville GWBs, respectively. The topography is subdued, with only small local highs. The ground surface generally slopes northwards. • The GWB is comprised of diffusely karstified limestone aquifers. These are highly transmissive limestones, with low storativity. • Recharge occurs only where subsoil thickness and permeability permit this, and directly to the aquifer via outcrop. Cross-flow from the upstream aquifers within the Charleville GWB may occur. • Groundwater flow in this aquifer will be concentrated in an approximately 30 m zone at the top of the bedrock. This zone is likely to comprise an epikarstic layer of a few metres, below which is a network of diffuse solutionally-enlarged joints and small conduits, fractures and faults. • The faulting across the groundwater body has compartmentalised it fully in the western part. In other areas, faulting may have enhanced permeability in the fault zone, or reduced it. • The aquifer is mainly confined or semi-confined. Unconfined groundwater is limited to small areas where the subsoils are thin or absent. Depending upon topography and local ground elevation, groundwater levels can vary between 2 metres up to 25 m below ground surface. • Flow path lengths are generally 500-2000 m. Groundwater can also discharge locally to surface water features or springs if the topography is variable, or low permeability subsoil induces discharge of the groundwater where it begins to become confined. In discharge zones, flow paths will be much shorter, at around 100–300 m. • Shallow groundwater discharges to the streams and rivers crossing the GWB, and to seeps at the heads of streams. The subsoils are relatively thick over most of this GWB and may prevent rivers gaining baseflow from the groundwater along some of their lengths. • Deep circulating warm groundwater comes to the surface at the group of springs between Knocksouna Hill and the River Loobagh, west of Kilmallock.
Attachments	Hydrochemical signature (Figure 1)
Instrumentation	None recorded.
Information Sources	<p>Brück, P.M., Cooper, C.E., Duggan, K., Goold, L. and Wright, D.J. (1986) The Geology and Geochemistry of the Warm Springs of Munster. <i>Ir. J. Earth Sci.</i>, Vol. 7, pp. 169-194.</p> <p>Daly, D., Keegan, M. and Wright, G.R. (2001) <i>County Tipperary (South Riding) Groundwater Protection Scheme</i>. Geological Survey of Ireland updated and revised Report to Tipperary (South Riding) County Council, 54 pp.</p> <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>Croom Public Supply – Groundwater Source Protection Zones</i>. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp.</p> <p>Deakin, J. (1995) <i>Fedamore Public Supply – Groundwater Source Protection Zones</i>. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp.</p> <p>Aquifer chapters: Dinanatian Pure Unbedded Limestones; Dinanatian Pure Bedded Limestones.</p>
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

Chemical Signature of Relatively Uncontaminated Waters (expanded Durov Plot)



NB: these samples were taken from public water supply schemes (WSs) abstracting groundwater from Dinantian Pure Unbedded Limestone aquifers in the Fedamore GWB.



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones
Knockordan Limestone Formation (KD)	Pale cherty crinoidal limestones	Dinantian Pure Bedded Limestones