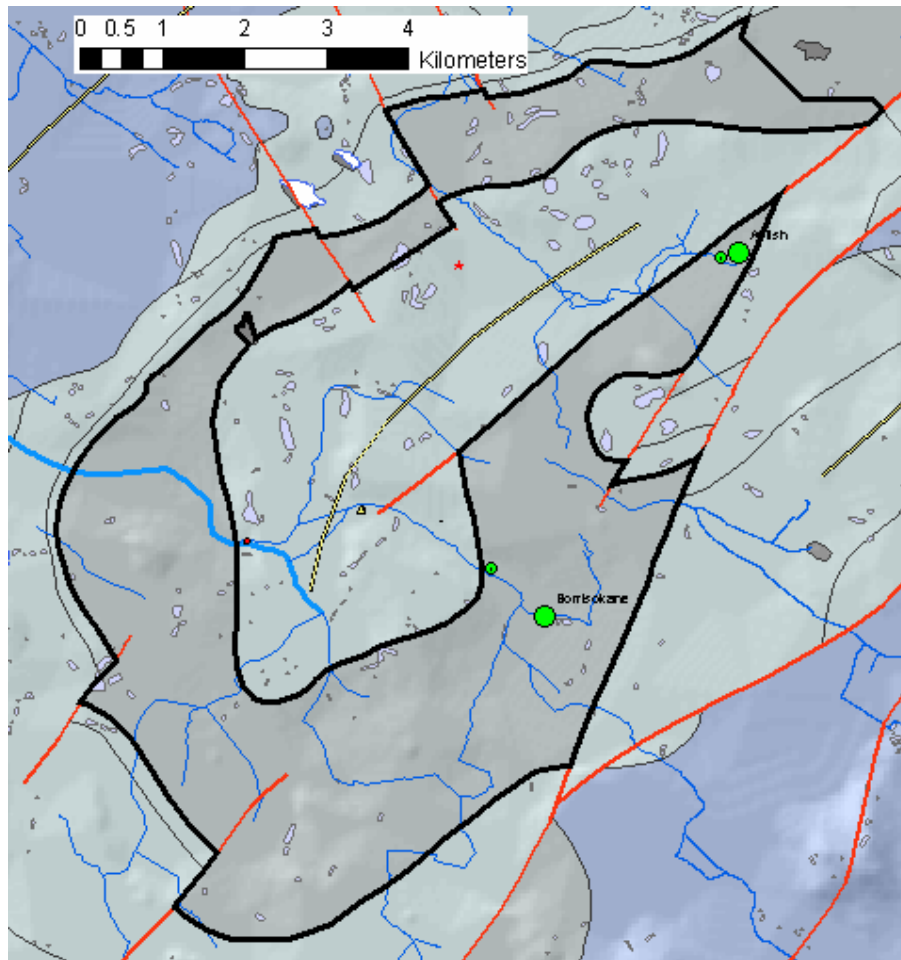


Ballinderry GWB (Area 25): Summary of Initial Characterisation.

Hydrometric Area Local Authority		Associated surface water features	Associated terrestrial ecosystem(s)	Area (km ²)
25 - Lough Derg catchment North Tipperary Co. Co.		Rivers: Ballyfinboy, Carrigahorrig. Streams: Ardrony.	Fiagh Bog (000932).	38
Topography	The GWB is arcuate in shape, with the open ends pointing to the NE. Much of the GWB is flat-lying to gently undulating, with elevations typically in the range 50-70 mAOD. Elevations reach just over 80 m in the south and SE of the GWB. The area is not well-drained, particularly in the south and SW. Surface drainage is generally SE to NW, with streams and rivers very gently incising into the substrate.			
Geology and Aquifers	Aquifer category	LI: Locally important aquifer which is moderately productive only in local zones.		
	Main aquifer lithologies	Dinantian Upper Impure Limestones.		
	Key structures	The rocks occur in the limbs of a large syncline ('Borrisokane syncline'), whose axis plunges to the WSW. Strata dip towards the centre of the syncline (i.e., to the NW, E and SE) at angles ranging between 5° and 50°. Minor folds associated with the major structure are present. Significant faults cross-cut the limbs of the fold, and are orientated NW-SE and SW-NE. A major SE-NW fault that extends from east Co. Clare to West Co. Offaly (the Knockshigowna Fault) forms the SE boundary of the GWB. Deformation associated with the folding will have caused fracturing, in addition to the deformation caused by the faulting. Joints and fractures may be more open on the axes of the minor anticlines. A large fold axis-parallel fault forms part of the inner margin of the GWB.		
	Key properties	Yields and productivities of boreholes drilled in the Upper Impure Limestones are often low. Transmissivity is generally in the range 2-20 m ² /d. However, high permeabilities in the vicinities of Aglish and Borrisokane WS springs have been estimated: 10 m/d and 18 m/d. These values are much higher than is general for this rock unit group type, and pertain only to the top few metres or so of very weathered rock or narrow fault zones. Low transmissivities are more characteristic of the bulk of the aquifer. Storativity is low, on the order of 0.015-0.03. In this generally flat-lying area, groundwater gradients on the order of 0.005 to 0.02. <i>(data sources: Rock Unit Group Aquifer Chapters, GWPS Reports, Source reports, see references)</i>		
	Thickness	The Dinantian Upper Impure Limestones are about 250 m thick in this vicinity. However, permeability tends to decrease rapidly with depth. Most groundwater flow occurs in the upper ≤ 15 m or so, in the zone that comprises a weathered layer and a connected fracture zone below this. Deeper flows may occur along faults or significant fractures. There are some purer limestone beds within this succession – these may display greater dissolution than the impure limestones, and may even have some epikarst developed.		
Overlying Strata	Lithologies	<i>[Information to be added at a later date]</i>		
	Thickness	Subsoil thickness data are sparse. Data for the GWB and surrounding area indicate thicknesses in the range 1-5 m. There is outcropping rock and probably 'rock close' across parts of the GWB, particularly in the north.		
	% area aquifer near surface	<i>[Information to be added at a later date]</i>		
	Vulnerability	The majority of the GWB has 'High-Low' groundwater vulnerability. Extreme vulnerability zones occur over the remainder of the GWB, particularly in the north.		
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. In general, due to the generally low permeability of the aquifers within this GWB, a proportion of the recharge will 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	<i>[Information to be added at a later date]</i>		
Discharge	Important springs and high yielding wells (m ³ /d)	There are two Intermediate yielding springs (430 m ³ /d < yield < 2,160 m ³ /d) within this GWB at Borrisokane (1186 m ³ /d) and Aglish (520 m ³ /d). The source areas of these springs extend outside this GWB into the higher transmissivity Lismaline and Borrisokane GWBs, respectively. There are no known Excellent (>400 m ³ /d) or Good (100 m ³ /d < yield < 400 m ³ /d) yielding boreholes.		
	Main discharge mechanisms	Groundwater discharges to gaining streams and rivers crossing the GWB, to two known Intermediate yield springs, and numerous small springs and seeps.		
	Hydrochemical Signature	Groundwaters from all aquifers within this groundwater body have a calcium-bicarbonate signature. At Aglish WS spring, groundwater hardness ranges between 'Hard' and 'Very Hard' (total hardness 335–385 mg/l as CaCO ₃), with corresponding high alkalinities, and electrical conductivity values of 670-750 µS/cm. At Borrisokane WS spring, groundwater is consistently Very Hard (354–407 mg/l as CaCO ₃). Alkalinity is high (310–350 mg/l as CaCO ₃), with electrical conductivity in the range 740-770 µS/cm. As would be expected, pH is neutral. Within the Impure Limestones, iron and manganese concentrations frequently fluctuate between zero and more than the EU Drinking Water Directive maximum admissible concentrations (MACs). These components come from the muddy parts of these rock units and reflect both the characteristics of the rock-forming materials and the development of low dissolved oxygen conditions.		

Groundwater Flow Paths	<p>These rocks are devoid of intergranular permeability; groundwater flow occurs in fractures and faults. In the main, the rocks are dependent on fracturing and fissuring to enhance their permeability. Zones of high permeability can be encountered near fault zones and in areas of intensive fracturing. Limited karstification may occur in the slightly more pure limestone zones in the Upper Impure Limestones. Permeabilities in the upper few metres of the bedrock aquifer are often high although they decrease rapidly with depth. In general, groundwater flow is concentrated in the upper 15 m of the aquifer, this zone comprising a weathered layer of a couple of metres and an open fractured and jointed zone beneath this. Improved yields can be encountered where fault zones are intercepted by boreholes. Often, these flowing intervals behave in a confined way and, when the water level falls beneath the inflow level, yields decrease and drawdowns increase rapidly. The locations of the two known Intermediate yield springs is influenced by faulting.</p> <p>Generally speaking, these rocks are unconfined. Groundwater levels are shallow, less than 10 m below surface, and commonly less than 3 mbgl. Next to the rivers, water levels will be closer to ground level. Groundwater may be locally confined where it flows beneath the low permeability bases of the bogs. Groundwater flow paths are generally shallow and short, on the order of 30-300 m long, with groundwater discharging to the streams and rivers that traverse the aquifer. Local groundwater flows are determined by the local topography. There is no regional flow system.</p>
Groundwater & Surface water interactions	<p>The streams and rivers crossing the aquifer are generally gaining. Due to the shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. Fiagh Bog is a calcium-rich fen and therefore dependent on groundwater.</p>
Conceptual model	<ul style="list-style-type: none"> • The GWB is arcuate, with the open ends pointing NE. It is bounded on the outer edge by the contact with the higher transmissivity Lismaline GWB, and on the inner edge by the contact with the karstified limestones of the Borrisokane GWB. In the NE of the GWB, a surface water catchment divide, which is an implied groundwater divide, bounds the GWB along a short part of its perimeter. The terrain is generally flat-lying to gently undulating. • The GWB is comprised of generally low transmissivity and storativity rocks. • Flow occurs along fractures, joints and major faults. Flows in the aquifer are typically concentrated in a thin zone at the top of the rock that comprises a weathered layer of a few metres below which is an open fractured zone. However, deeper groundwater flow in fault zones can occur. Limited karstification and epikarst development may have taken place in the Upper Impure Limestones in areas where purer limestone beds occur. • Diffuse recharge occurs across the entire GWB, but particularly where rock outcrops or where subsoils are thin. Due to the generally low permeability of the aquifer within this GWB, a proportion of the recharge will discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively limiting the available groundwater resource in the aquifer. • The aquifers within the GWB are generally unconfined. Areas where confined conditions occur include beneath the raised bogs and in the deeper, isolated fault zones. Depending upon the local topography, the water table can vary between a few metres up to about 10 m below ground surface. Flow path lengths are short (≤ 30-300 m). Groundwater flows to the surface water bodies, with local flow directions controlled by local topography. There is no regional flow system. • Groundwater discharges to the streams and rivers crossing the aquifer and to a few springs. Fault zones influence the locations of the larger (Intermediate yield) springs within the GWB. • Due to the shallow groundwater flow in this aquifer the groundwater and surface waters are closely linked. An NHA-designated ecosystem in the GWB – a calcium-rich fen – is dependent on groundwater. Groundwater and surface water interactions require special attention where terrestrial ecosystems are dependant on a sustainable balance between the two.
Attachments	None.
Instrumentation	EPA Representative Monitoring points: Borrisokane borehole (TIN 14), Eglisk bore (TIN 83)
Information Sources	<p>Hunter Williams, N., Motherway, K. and Wright, G. (2002) <i>North County Tipperary Groundwater Protection Scheme (draft)</i>. Geological Survey of Ireland Report to North Tipperary Co. Co., 58 pp.</p> <p>Hunter Williams, N., Motherway, K. and Wright, G. (2002) <i>Aglisk WS, Groundwater Source Protection Zones</i>. Geological Survey of Ireland, 15 pp.</p> <p>Hunter Williams, N., Motherway, K. and Wright, G. (2002) <i>Borrisokane WS, Groundwater Source Protection Zones</i>. Geological Survey of Ireland, 14 pp.</p> <p>Hunter Williams, N., Motherway, K. and Wright, G. (2002) <i>North County Tipperary Groundwater Protection Scheme (draft)</i>. Geological Survey of Ireland Report to North Tipperary Co. Co., 58 pp.</p> <p>Aquifer chapters: Dinantian Upper Impure 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



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Slevoir Formation (SV)	Muddy limestone and calcareous shale	Dinantian Upper Impure Limestone