Wicklow GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystems	Area (km^2)
Hydrometric Area 10 Wicklow Co. Co. Wexford Co. Co. Dublin Co. Co.	Avoca, Aughrim, Avonbeg, Avonmore, Ballyduff stream, Cloghoge Brook Derry Water, Ow, Glenealy, Glendasan, Templerainy Stream, Redcross, Potters, Three Mile Water, Vartry, Newcastle, Newtownmountkennedy, Dargle, Glencullen, Glencree, Shanganagh, Kill-o-the Grange Stream.	Vartry Reservoir (1771); Avoca River Valley (1748); Avoca Town Marsh (1931); Buckroney - Brittas Dunes and Fen (SAC 729); Magherabeg Dunes (SAC 1766); Dalkey Coastal Zone and Killiney Hill (1206); Ballybetagh Bog (1202); Knocksink Wood (SAC 725); Kilmacanoge Marsh (724); Carriggower Bog (716); Powerscourt Waterfall (1767); Dargle River Valley (1754); The Murrough (730).	1396

Topography		This GWB is a large area within Co. Wicklow and a smaller area of Co. Dublin. The topography is mountainous, comprising the Wicklow and Dublin Mountains. Elevations range from sea level along the coast to high elevations along the western boundary between the Eastern and Southeastern RBDs with the highest peak of 840 m OD at Mullaghcleevaun.
Geology and Aquifers	Aquifer type(s)	**Ll:** Locally important aquifer, moderately productive only in local zones **Pl:** Poor aquifer, generally unproductive except for local zones **Pu:** Poor aquifer, generally unproductive
	Main aquifer lithologies	The Leinster Granites Ordovician Metasediments Cambrian Metasediments *Small amounts of* Ordovician Volcanics (0.7 %)
	Key structures.	The Lower Paleozoic rocks have a complex geological history and comprise a large range of rock types including greywackes (turbidites), volcaniclastic sediments, lavas, shales, mudstones, quartzites and cherts. During the Ordovician the Iapetus Ocean began to close and volcanoes formed adjacent to the continental margins, giving rise to a complex suite of volcanic and deep-water sediments. As two continents collided, the accumulated sediments were squeezed up to form a chain of mountains (Caledonian Orogeny). These rocks are thus highly folded and faulted with several phases of deformation. Large granite plutons were intruded and the surrounding rocks have been metamorphosed on a regional scale, transforming the original shales and sandstones and giving the rocks their pervasive fabric or cleavage. There are varying degrees of rock deformation, which has influenced the bedrock permeability. Rocks deform mainly by folding and faulting; both of which are associated with fracturing and permeability development.
	Key properties	The area includes varied hydrogeological settings. In general there are three main areas of consideration: the Granites are considered to be a Pl aquifer, the majority of the Ordovician metasediments are Ll, and the other Lower Paleozoic rocks are classified as Pl and Pu aquifers. In addition to the variety in these rock types, the topography is very varied, with mountainous granite areas in the west and areas of low-lying land towards the coast. The topographic slope will influence the hydraulic gradient in the aquifer, which in turn will influence the velocity and volume of groundwater flow. The Ordovician Metasediments are one of the better aquifers within this GWB and a number of small public supplies are abstracted from these rocks. GSI source protection reports have been written for the following two examples: The Roundwood public water supply is located in the Maulin Formation (Ordovician Metasediments). Pumping Tests from PW1 and 2 suggest a transmissivity of about 30 m^2/d. (Woods 2003) The underlying aquifer at Redcross, the Kilmacrea Formation (Ordovician Metasediments) is composed of fractured and weathered shales. Analysis of the 12 hour pumping test provided an apparent transmissivity of about 32 m^2/d. There is a probable zone of higher permeability close to the surface, and the permeability decreases with increasing depth below ground level. (Woods 2003)
	Thickness	The majority of groundwater flow will occur in the top few metres. This flow is mostly in along a weathered zone in a lateral direction towards rivers and springs. In some instances a greater degree of structural deformation may provide a fracture network which will allow groundwater movement at greater depths. Only flow in isolated fractures is expected below 30m.
Overlying Strata	Lithologies	Till ('boulder clay') is the most widespread subsoil in the groundwater body. Several types of till occur. South of Wicklow town the dominant type is Till derived from Lower Paleozoic rocks. There are some smaller areas of till derived from granites in the Western areas of the body and some gravel deposits along river channels. North of Wicklow there is a greater variety of till types, although the Lower Paleozoic and Granite till are still found along the central and western areas of the body respectively. There is greater variety in sediment deposition in the east of the body where there are areas of gravel deposits, tills derived from limestones and Irish Sea Till.
	Thickness	The tills are very thin in mountainous areas. Thickness increases further down slope and also towards the southeast.
	% Area aquifer near surface	High - there are large areas of outcrop present in the higher altitudes of the Wicklow Mts.
	Groundwater Vulnerability	Mostly Extreme above 200mOD. Below this the vulnerability is mainly High with some smaller areas of Moderate and Low in places along the coast and southeast.

Recharge	Main recharge mechanisms	The dominant recharge process will be diffuse recharge from water percolating through the overlying tills and into the aquifer. High rates of potential recharge are expected in the hilly areas where there are very thin subsoils and high rainfall. A large portion of this potential recharge will be rejected because the rocks in this area are considered to be poor aquifers with low storativity. In addition, the steep slopes in the area will increase surface runoff. Therefore the rapid runoff component to streams will be higher, which must be taken into account in recharge calculations. The very high drainage density in the area gives an indication of this. The drainage density is lower in the Lower Paleozoic rocks (0.687km/km^2) than in the Granites (1.021km/km^2).
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	Springs and large known abstractions	GSI Source Reports – Redcross (220), Roundwood (185) EPA Sources Register – Location (Abstraction (m^3/d)) Glencullen (Bore No. 3) (250), Glencullen (Bore No. 4) (100), Bulford Farm (70), Windgates/Templecarrig (70), Barndarrig (34), Ballycoogue (27), Johnstown/Thomastown (18), Kirikee (13), Thomastown, Ballycoogue, Brittas Bay (North), Laragh/Annamore PWS (@ Raheen) (374), Rathdrum (560), Knockananna (39), Aughrim/Annacurra (375),
	Main discharge mechanisms	Groundwater will discharge directly to the sea along the coast. The GWB will also discharge to the over lying streams and rivers as baseflow. The proportion of river flow that is baseflow will vary through out the area. Mountainous rivers have a "flashy" profile and rivers on slopes lower down have a flatter profile. The geomorphology also plays a role in defining the flow characteristics of the rivers. There are a large number of small springs in the area. These are located at the foot of hills at the break in slope, where the water table comes to the surface.
	Hydrochemical Signature	Five County Council sources located in the granite show that the groundwater is a calcium bicarbonate type and is **soft** to **moderately hard** (50–250 mg/l $CaCO_3$). Six Council sources sampled for the Ordovician Rocks (data also available for several other areas) show the groundwaters are generally of calcium bicarbonate type, and **soft** to **moderately soft** (20–80 mg/l $CaCO_3$). Some areas in east Wicklow, around Enniskerry and Ashford, show slightly higher hardness and alkalinity, probably because the overlying tills, sands and gravels include limestone clasts, which chemically alter the recharge. Low conductivity values 130 - 220
Groundwater Flow Paths		The majority of groundwater flow in this aquifer will take place in the upper 3m of the rocks. This will be lateral flow towards discharge point such rivers and streams. Deeper groundwater flow is possible and deep-water strikes are often encountered (between 10 and 40 m.b.g.l.) but they are more isolated features located along open fractures, which allow groundwater flow. Regional groundwater flow paths are not considered to develop, as the rocks do not have sufficient transmissivity to transport water over long distances. Typical groundwater flow paths will be in the order of a couple of hundred metres, with discharge occurring to the closest surface water feature.
Groundwater & surface water interactions		There will be highly varied groundwater and surface water interaction processes occurring within the large area of this groundwater body. The nature of these interactions will be determined by local factors and it is therefore impossible to generalize over such a large area. Such local influences could include the depths and permeability of subsoil, slope, local permeability of the rock, overlying surface water bodies and human alterations to the environment. Such interactions should be considered on a local scale where the importance of them is most critical e.g. at protected areas.
Conceptual model	This GWB is a large area within Co. Wicklow and a smaller area of Co. Dublin. The topography of the area is mountainous, comprising the Wicklow and Dublin Mountains. The GWB is composed primarily of low permeability rocks, although localised zones of enhanced permeability do occur. The boundaries of the GWB are defined by the extent of Hydrometric Area 10. Groundwater flow occurs mostly in a shallow upper weathered zone; deeper groundwater flow is possible along fractures, joints and major faults. Recharge occurs diffusely through the subsoils and via outcrops. There are large areas where the rock is close to surface, which would suggest high potential recharge values, but calculations must consider the effect of rejected recharge from the lower permeability rocks. The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and/or of lower permeability. Groundwater flow is considered to recharge and discharge on a local scale. Drainage density values suggest shorter flow paths in the granites than on the flatter Lower Paleozoics. Groundwater discharges to the numerous small streams crossing the aquifer, to springs and seeps and also directly to the Irish Sea.	
Attachments		
Instrumentation	Stream gauge: 10001, 10002, 10003, 10004, 10005, 10006, 10007, 10008, 10009, 10010, 10012, 10013, 10014, 10015, 10016, 10017, 10018, 10019, 10020, 10021, 10022, 10023, 10024, 10025, 10026, 10027, 10028, 10029, 10030, 10031, 10032, 10033, 10034, 10035, 10036, 10037, 10070, 10071 Borehole Hydrograph: Some are present within the area of the GWB but they measure the Groundwater Levels in Gravel Aquifers. EPA Representative Monitoring boreholes: Roundwood (WIC027), Redcross (WIC026)	

Information Sources	McConnell B, Philcox M, Sleeman A G, Stanley G, Flegg A M, Daly E P & Warren W P. 1994. *A Geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 16, Kildare-Wicklow*. Geological Survey of Ireland, 70 pp. Tietzsch-Tyler D & Sleeman A G. (1994) Geology of Carlow - Wexford. A geological description to accompany the Bedrock Geology 1:100,000 map series, Sheet 19, Carlow - Wexford. Geological Survey of Ireland. Woods L & Wright G R (2003) Redcross Water Supply. Groundwater Source Protection Report. Wicklow Groundwater Protection Scheme. GSI report to Wicklow Co. Co. Woods L & Wright G R (2003) Roundwood Water Supply. Groundwater Source Protection Report. Wicklow Groundwater Protection Scheme. GSI report to Wicklow Co. Co. Wright G R & Woods L (2003) *County Wicklow Groundwater Protection Scheme.* Report to Wicklow County Council. Geological Survey of Ireland
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Formation Name	Code	Description	Rock Unit Group	Aquifer Classification
Aplite	apl		Granites & other Igneous Intrusive rocks	Pl
Appinite	app		Granites & other Igneous Intrusive rocks	Pl
Arklow Head Formation	AH	Black slates overlain by rhyolitic tuffs	Ordovician Metasediments	Pu
Arklow Head Formation & Felsic volcanics	fvAH	Black slates overlain by rhyolitic tuffs	Ordovician Metasediments	Pu
Avoca Formation	AV	Rhyolitic volcanics, dark grey slate	Ordovician Metasediments	Pu
Avoca Formation & Felsic volcanics	fvAV	Rhyolitic volcanics, dark grey slate	Ordovician Metasediments	Pu
Avoca Formation & Intermediate volcanics	ivAV	Rhyolitic volcanics, dark grey slate	Ordovician Metasediments	Pu
Ballybeg Member	MNbb	Dark grey semi-pelitic, psammitic schist	Ordovician Metasediments	Ll
Ballylane Formation	BY	Green & grey slate with thin siltstone	Ordovician Metasediments	Pl
Ballymoyle Formation	BL	Rhyolitic volcanics, grey & black slate	Ordovician Volcanics	Pl
Ballymoyle Formation & Felsic volcanics	fvBL	Rhyolitic volcanics, grey & black slate	Ordovician Metasediments	Pl
Ballymoyle Formation & Quartzite	qzBL	Rhyolitic volcanics, grey & black slate	Ordovician Volcanics	Pl
Barravore Aplogranite	LqBv	Fine-grained, muscovite-rich aplogranite	Granites & other Igneous Intrusive rocks	Pl
Bray Head Formation	BR	Greywacke & quartzite	Cambrian Metasediments	Pl
Bray Head Formation & Quartzite	qzBR	Greywacke & quartzite	Cambrian Metasediments	Pl
Butter Mountain Formation	BZ	Dark slate-schist, quartzite & coticule	Ordovician Metasediments	Ll
Carrawaystick Aplite	LqCw	White, saccharoidal garnetiferous aplite	Granites & other Igneous Intrusive rocks	Pl
Croghan Kinshelagh Granite	Ck	Grey to pink even-grained granite	Granites & other Igneous Intrusive rocks	Pl
Devils Glen Formation	DG	Greywacke & shale	Cambrian Metasediments	Pl
Devils Glen Formation & Mafic volcanics	mvDG	Greywacke & shale	Cambrian Metasediments	Pl
Diorite	Di		Granites & other Igneous Intrusive rocks	Pl
Dolerite	D		Granites & other Igneous Intrusive rocks	Pl
Glencullen River Formation	GL	Buff-coloured tuff & greywacke	Ordovician Metasediments	Pl
Glendalough Adamellite	LqGd	Adamellite with microcline phenocrysts	Granites & other Igneous Intrusive rocks	Pl
Granite (undifferentiated)	Gr		Granites & other Igneous Intrusive rocks	Pl
Kilmacrea Formation	KA	Dark grey slate, minor pale sandstone	Ordovician Metasediments	Ll
Kilmacrea Formation & Felsic volcanics	fvKA	Dark grey slate, minor pale sandstone	Ordovician Metasediments	Pl
Knockree Member	MNkr	Quartzite	Ordovician Metasediments	Ll
Maulin Formation	MN	Dark blue-grey slate, phyllite & schist	Ordovician Metasediments	Ll
Maulin Formation & Intermediate volcanics	ivMN	Dark blue-grey slate, phyllite & schist	Ordovician Metasediments	Ll
Maulin Formation & Mafic volcanics	mvMN	Dark blue-grey slate, phyllite & schist	Ordovician Metasediments	Ll
Maulin Formation & Quartzite	qzMN	Dark blue-grey slate, phyllite & schist	Ordovician Metasediments	Ll
Microgranite	mGr		Granites & other Igneous Intrusive rocks	Pl
Moneyteige Member	BYmt	Metagreywackes, slates & metadolerites	Ordovician Metasediments	Pl

Oaklands Formation	OA	Green, red-purple, buff slate, siltstone	Ordovician Metasediments	Ll
Percys Table Granodiorite	LqPt	Aphyric granodiorite	Granites & other Igneous Intrusive rocks	Pl
Roundwood Member	MNrw	Basalt breccia	Ordovician Metasediments	Ll
Serpentinite	S		Granites & other Igneous Intrusive rocks	Pl
Tober Colleen Formation	TC	Calcareous shale, limestone conglomerate	Dinantian Upper Impure Limestones	Pl
Type 1 Granodiorite	Nt1	Fine-grained granodiorite to granite	Granites & other Igneous Intrusive rocks	Pl
Type 2 Equigranular Granite	Tw2e	Pale, fine to coarse-grained granite	Granites & other Igneous Intrusive rocks	Ll
Type 2 Microcline Porphyritic Granite	Tw2m	Granite with microcline phenocrysts	Granites & other Igneous Intrusive rocks	Pl
Type 2 Sparsely Porphyritic Granite	Tw2i	Granite, some microcline phenocrysts	Granites & other Igneous Intrusive rocks	Pl
Type 2e equigranular Granite	Nt2e	Pale grey fine to coarse-grained granite	Granites & other Igneous Intrusive rocks	Pl
Type 2p microcline porphyritic Granite	Nt2p	Granite with microcline phenocrysts	Granites & other Igneous Intrusive rocks	Pl
Type 3 muscovite porphyritic Granite	Nt3	Granite with muscovite phenocrysts	Granites & other Igneous Intrusive rocks	Pl
Type 4 muscovite/microcline porphyritic Granite	Nt4	Muscovite-microcline porphyritic granite	Granites & other Igneous Intrusive rocks	Pl
Wicklow Head Formation	WH	Silver-grey mica-schist	Ordovician Metasediments	Pl