

Dublin GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystems	Area (km ²)
Dublin Co. Co. Kildare Co. Co. Meath Co. Co. Hydrometric Area 9	Rivers - Ballough Stream, Broadmeadow, Clonshanbo, Dodder, Fairyhouse Stream, Liffey, Lyreen, Mayne, Rye Water, Santry, Tolka, Ward	Dodder Valley (991), Sluice River Marsh (1763), Santry Demesne (178), Liffey Valley (128), Booterstown Marsh (1205) Donadea Wood (1391), Hodgestown Bog (1393), Liffey Bank Above Athgarvan (1396), Mouds Bog (SAC 395), Rye Water Valley (1398)	837
Topography	This GWB is located in the Greater Dublin City area and extends southwest towards Kildare. The area is generally low-lying, with areas of higher elevation surrounding to the south and to a lesser extent to the north. Elevations decrease towards the various river estuaries around Dublin city. At the boundaries of the GWB the highest elevations are to the south at the foothills of the Dublin Mountains and to the northwest where the Namurian rocks form an area of higher elevation to the southwest of Dunshaughlin.		
Geology and Aquifers	Aquifer type(s)	LI: Locally important aquifer, moderately productive only in local zones PI: Poor aquifer, generally unproductive except for local zones	
	Main aquifer lithologies	Dinantian Upper Impure Limestones Dinantian Lower Impure Limestones Dinantian Pure Unbedded Limestones Dinantian Mixed Sandstones, Shales and Limestones. Namurian Undifferentiated rock.	
	Key structures.	In the Dublin Basin minor open NE/SW folds cause strike swings in otherwise predominantly E-W striking moderate to shallow dipping strata. A parallel anticline is present to the south in the core of which the Portrairie and Lambay inliers are exposed and which continues SW towards Hermitage, exposing the Boston Hill formation along its axis. At the southern margin of the basin the Donnybrook-Tallaght syncline is present. The structure of the area south of Portmarnock is uncertain owing to the drift cover, but a further pair of major folds may occur, with the reef limestone plunging and or being faulted out west of the Balgriffin-Raheny area (Creighton <i>et al</i> 1979).	
	Key properties	In general permeability in these rock units are likely to be low (1-10m ² /d) (Creighton <i>et al</i>). Secondary dolomitisation along faults in the Dublin area suggests that they have been, and may still be, open to allow fluid migration. (ERA 1991). Pumping test analysis at the public supply boreholes at Dunboyne, Co. Meath provided transmissivity values between 10 and 150 m ² /d. (Woods 1996) A series of hydrogeological tests were carried out in the Barrockstown area around 4.5km north of Maynooth. Double Packer tests carried out on two boreholes in the area gave permeabilities ranging from 1.4 x 10 ⁻⁶ to 6.1 x 10 ⁻⁷ m/s. In situ Rising/Falling Head tests in eight of the bedrock wells gave similar results but more diverse than the packer test results, varying from 5.04 x 10 ⁻⁵ to 7.39 x 10 ⁻⁹ m/s (Cullen 1998).	
	Thickness	There is a distinct reduction in the permeabilities of these rocks with depth. Packer tests show permeabilities reduce an order of magnitude for each five metres of depth in the limestone (Aspinwall & Company, 1979). Most groundwater flow will take place close to the surface with additional isolated flow along fractures and fissures located at depths up to 50 m.b.g.l.	
Overlying Strata	Lithologies	There are a number of subsoil types. Their distribution is related to ice flow directions during the last ice age. To the south we find till derived from Granite and Lower Paleozoic rocks in the Dublin Mountains. Along the coast and some distance inshore there are deposits of Irish Sea Till, which is the least permeable of the subsoils. The majority of the aquifer is overlain by limestone-derived till which came from the limestone expanses around Dublin. There are smaller gravel deposits in the area, which will be the most permeable of the subsoils, including glacial deposits and alluvial gravels. To the very southwest of the GWB, in Kildare, there are major gravel deposits, including the Mid-Kildare Gravel Aquifer (The Curragh).	
	Thickness	The thickness of the subsoil, as in all Ireland, is highly variable. There are thick deposits of till along the coast, over 10m thick in places. The thickness reduces further inland. West of Lucan the till deposits are mostly quite thin (<3m), with some exceptions e.g. along the river channels of the Liffey and other streams. The thickness of the overlying till increases west of a line connecting Dunboyne, Co. Meath to Maynooth to Newcastle, Co Kildare.	
	% Area aquifer near surface	The area of aquifer close to surface may be quite significant. Thin subsoil areas are located towards the center of the GWB where.	
	Vulnerability	The vulnerability of the groundwater is generally Extreme between Maynooth and Phoenix Park in Dublin, to the east and west of this area the general vulnerability is Moderate. It must be remembered that the vulnerability, as with subsoil thickness, is highly variable at all scales.	

Recharge	Main recharge mechanisms	<p>The area of the GWB beneath Dublin City will have completely different recharge processes than the rest of the GWB in rural areas. Dublin City is essentially a cement cap on the limestone, which prevents the area from receiving recharge. The only open areas where recharge may occur are at parks, squares and gardens. Conservatively it is estimated that 10% of the city area is available for recharge. Some recharge occurs from leaking sewers, mains and storm drains. To optimize recharge calculations an estimate of the leakage from mains and other water works would be of use.</p> <p>Elsewhere 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.</p>
	Est. recharge rates	<i>[Information to be added at a later date]</i>
Discharge	Springs and large known abstractions	<p>GSI Source Reports – Dunboyne (Abstraction is 1160m³/d from four wells).</p> <p>A number of warm springs are situated in the Lucan and Celbridge areas. Typical spring temperatures range from 12.5-25°C, which is significantly above temperatures normally expected for Irish groundwater. It is thought that the groundwater issuing from these springs comes from a much deeper source than most groundwater in Ireland (Burdon, 1983). The presence of warm springs has been associated with deep faults, which would allow deeper, warmer waters to the surface rapidly, and it may be that they are more noticeable in poorer aquifers where the dilution effect of colder, shallower, younger waters is reduced.</p>
	Main discharge mechanisms	<p>The GWB will discharge directly to the Irish Sea along the coast. There will be discharge to the overlying gravel aquifers in places (ERA 1991) and there will also be discharge to the overlying rivers, if they are in hydraulic continuity with the aquifer. Dry Weather Flows vary (0.01 to 3 l/s/km²) but typical values are quite low (<1 l/s/km²). This implies the aquifer does not support large baseflows to the rivers during summer time.</p>
	Hydrochemical Signature	<p>The hydrochemical analyses of groundwater from the area indicate a very hard water (350-480 mg/l (CaCO₃)), with a high alkalinity (300 - 350 mg/l (CaCO₃)). Conductivities are also very high, ranging 550-900 µS/cm. This groundwater is a calcium bicarbonate water, as can be seen from the accompanying Durov Diagram.</p>
Groundwater Flow Paths		<p>The general groundwater flow direction in this aquifer is towards the coast and also towards the River Liffey and Dublin City. This aquifer is not expected to maintain regional groundwater flow paths. Groundwater circulation from recharge to discharge points will more commonly take place over a distance of less than a kilometre. The majority of groundwater flow will be a rapid flow in to upper weathered zone but flow in conduits is commonly recorded at depths of 30 to 50 m b.g.l. . The aquifer is not considered to have any primary porosity and flow will be through fractures, some of which will have been enlarged by karstification and dolomitisation. The fissured nature and the moderate permeability of the bedrock close to the surface imply that water will move at high velocities.</p>
Groundwater & surface water interactions		<p>The will by 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.</p>
Conceptual model	<p>This GWB occupies a large area extending across the County Dublin from Malahide to Blackrock west across the whole county and extending into Kildare and Meath as far as Kilcock. The area is mostly low-lying with very little surface topography. The GWB is composed of moderate permeability karstified limestone. Very small areas of low permeability impure limestones are incorporated with this GWB, since they are isolated and do not alter significantly the flow system. The boundaries of this GWB are defined to the south by the contact with the Granites and Lower Paleozoic rocks, to the west and north by the extent of the Liffey catchment to the east by the coast. Groundwater flow occurs along fractures, joints and major faults. There are a number of warm springs located within this GWB, which suggest deep groundwater circulation is possible. Recharge occurs diffusely through the subsoils and via outcrops. Special attention must be paid to recharge assessments for the urban areas, which account for almost a quarter of the area of this GWB. The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and/or lower permeability. Most flow in this aquifer will occur near the surface. In general, the effective thickness of this aquifer is likely to be about 10 m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, deep-water strikes are commonly found in more isolated faults/ fractures at depths of 30 – 50 m.b.g.l. Flow path lengths are not considered to be on a regional scale, and are typically less than 1km in length. Groundwater discharges to the numerous streams and rivers crossing the aquifer, and to the springs and seeps towards the coast.</p>	
Attachments		
Instrumentation	<p>Stream gauge: 08001, 08003, 08004, 08005, 08006, 08007, 08008, 08009, 08012, 08013, 09002, 09003, 09004, 09005, 09006, 09009, 09011, 09012, 09015, 09018, 09019, 09022, 09024, 09030, 09035, 09036, 09037, 09041, 09043, 09044, 09048, 09049, 09055, 09101, 09102, 10038</p> <p>Borehole Hydrograph: Dundrum CMH (DLR 030), B.N.M. Allen (KID063),</p> <p>EPA Representative Monitoring boreholes: Batterstown (MEA118)</p>	

Information Sources	<p>Aspinwall and Company (1979) <i>Hydrogeological survey of proposed waste disposal site at Gollierstown, Co. Dublin</i>. Report prepared for Dublin Co. Co.</p> <p>Burdon D J (1983) <i>Irish Groundwater Resources in Relation to Geothermal Energy Investigations</i>. Unpublished Report to GSI. 275pp.</p> <p>Creighton J R, Daly D & Reilly T A (1979) <i>The Geology and Hydrogeology of County Dublin with Particular Reference to the location of Waste Disposal Sites</i>. Unpublished GSI Report. pp 48</p> <p>Cullen K T (1998) <i>Proposed Barrockstown Waste Management Facility</i>.</p> <p>Kelly C & Fitzsimons V. (2002) <i>County Kildare Groundwater Protection Scheme</i>. Main Report. Final report to Kildare County Council. Geological Survey of Ireland 55pp.</p> <p>McConnell B, Philcox M & Geraghty M, 2001. <i>Geology of Meath: A geological description to accompany the bedrock geology 1:100,000 scale map series, Sheet 13, Meath</i>. Geological Survey of Ireland. 77 p.</p> <p>McConnell B, Philcox M, Sleeman A G, Stanley G, Flegg A M, Daly E P & Warren W P 1994. <i>A Geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 16, Kildare-Wicklow</i>. Geological Survey of Ireland, 70 pp.</p> <p>Woods L (1998) <i>Dunboyne Public Supply, Groundwater Source protection Zones</i>. Report to Meath County Council. Geological Survey of Ireland. 54 p.</p> <p>Woods L, Meehan R & Wright G R, 1998. <i>County Meath Groundwater Protection Scheme</i>. Report to Meath County Council. Geological Survey of Ireland. 54 p</p> <p>Wright G R & Woods L (2003) <i>County Wicklow Groundwater Protection Scheme</i> Report to Wicklow County Council. Geological Survey of Ireland</p>
Disclaimer	<p>Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae</p>

Table 1 Bedrock formations contained within the Dublin GWB

Unit Name	Code	Description
Ballysteen Formation	BA	Fossiliferous dark-gray muddy limestone
Boston Hill Formation	BN	Nodular & muddy limestone & shale
Feighcullen Formation	FE	Skeletal, oolitic & micritic limestone
Lucan Formation	LU	Dark limestone & shale (' Calp)
Namurian (undifferentiated)	NAM	Shale & sandstone
Old Red Sandstone (undifferentiated)	ORS	Red conglomerate, sandstone & mudstone
Rush Conglomerate Formation	RU	Conglomerate, shale, limestone
Tober Colleen Formation	TC	Calcareous shale, limestone conglomerate
Waulsortian Limestones	WA	Massive unbedded fine-grained limestone





