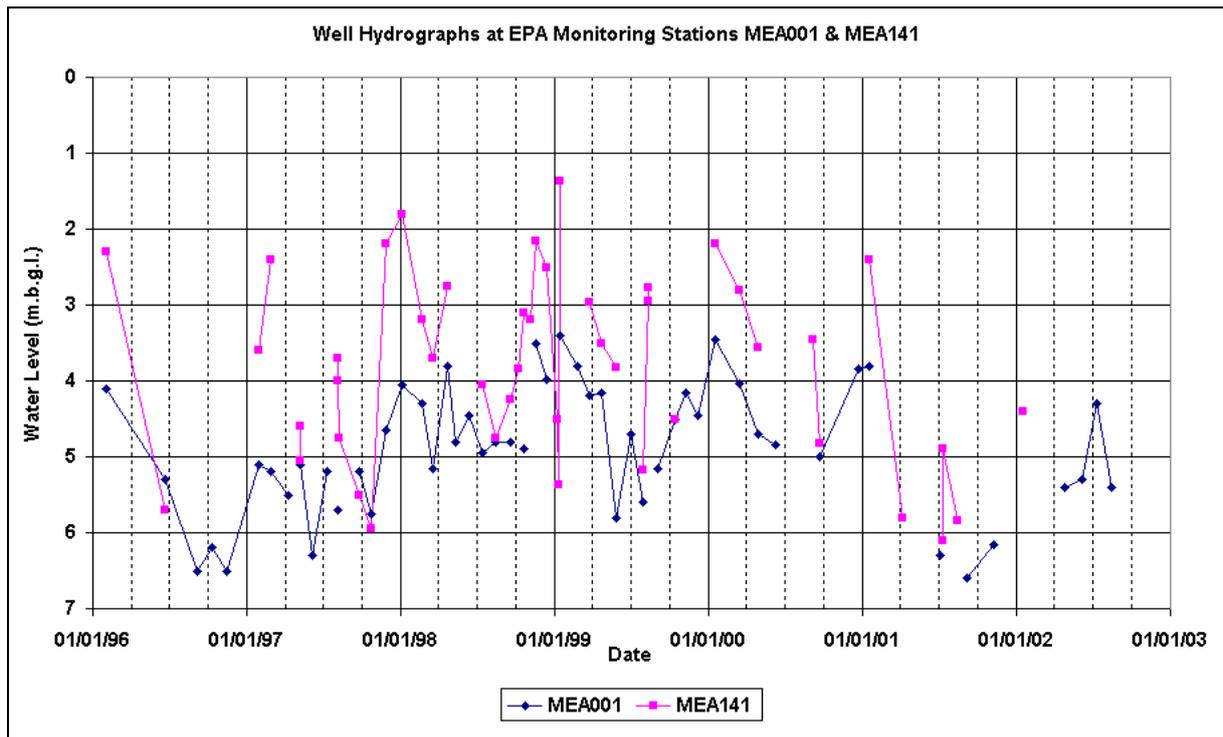


### Bettystown GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water bodies	Associated terrestrial ecosystems	Area (km <sup>2</sup> )
Meath Co. Co. Hydrometric Area 08	Nanny & Hurley	Thomastown Bog (1593), Balrath Woods (1579), Laytown Dunes and Nanny Estuary (554).	77
<b>Topography</b>		This GWB is located to the south of the Boyne Estuary. The elevation ranges from sea level along the coast to 80 m OD along the eastern boundary. In general there is a fall in elevations from the southwest and west towards the east or southeast. There are hills located to the southeast and northwest of the GWB in the Namurian and Ordovician rocks respectively. In the northwest there are some isolated hills and large enclosed depressions. This type of topography, in association with a very low drainage density, is typical of karstic regions.	
<b>Geology and Aquifers</b>	Aquifer type(s)	<b>Rk<sup>d</sup></b> : Regionally important karstified aquifer dominated by diffuse flow <b>Lm</b> : Locally important aquifer, generally moderately productive	
	Main aquifer lithologies	Dinantian Pure Bedded Limestone These limestones are pale grey, thickly bedded, fine to coarse-grained limestones with abundant fragments of crinoids and coral fossils. The lower part of the rock succession is often dolomitised and karstified, which can be seen where drift cover is absent.	
	Key structures.	The GWB is located in an area that has experienced intense structural deformation. To the south the Ordovician and Silurian rocks have been faulted up against the pure limestones along the Nanny Fault. In the south the Boulders fault has displaced the rocks to the east.	
	Key properties	These limestones have a moderate to good secondary permeability and the development of joints and fissures by solutional processes and the dolomitisation and decalcification have increased their storativity. The permeability of the resulting solution features may have been reduced by later (Quaternary) infilling with sands, silts and clays. The porosity is estimated at 5% at Mell Quarries and 10% at Platin Quarry. Evidence from pumping tests at Platin Quarry indicate that the transmissivity of the bedrock in this area is between 78 to 144m <sup>2</sup> /d, which is considered to be indicative of the regionally important aquifer. The drilling also showed there was a significant sand filled fracture at around 42m below ground.	
	Thickness	These platform pure limestones are over 850 m thick in this area. Some thinner units include the Crufty Formation (maximum 60m thick) and the Mullaghfin Formation (maximum 80m thick). The majority of groundwater flow occurs in the upper 30m. Data from water strikes in the area show a large variety the depth of groundwater flow but it is possible to strike water at depths of 40m.	
<b>Overlying Strata</b>	Lithologies	The lithology of the subsoils overlying this area varied. From the coast to Dunleek the main till present is the Irish Sea Till. This till is very clayey and its colour varies across the area. Northwest of Dunleek the subsoil type is dominated by till derived from Namurian Sediments. This till is generally dark brown in colour, matrix-dominated and clayey, with quite poor drainage characteristics. To the south of Dunleek there is Till derived from Limestone sediments. Generally the deposit has a brown colour, and allows better drainage than the till derived from other rocks in the area. There are a number of gravel deposits in the area, which are generally located along river courses.	
	Thickness	Thickness of the subsoil is variable of the area of the aquifer. There are some areas where the rock is at the surface, in the west at the foot of Redmountain. There is also borehole evidence of deep subsoils e.g. ~30m. Subsoil is thickest in the lower areas and thins towards the uplands and also along the course of the River Nanny. There are quarries located within this aquifer and it should be noted that these would be localities where the aquifer will be directly exposed to the elements.	
	% area aquifer near surface	10%	
	Vulnerability	The vulnerability of this GWB is highly variable. In general the GWB is either Low or Moderate but there are many isolated areas of High and Extreme located along rivers and in areas of higher elevation.	
<b>Recharge</b>	Main recharge mechanisms	Water will enter this aquifer by point and diffuse recharge. In karstic limestone it is possible for large amounts of water to enter the aquifer by point recharge. This occurs where dissolution of the limestone has opened up fractures in the rock. It is possible for rainwater to enter the aquifer directly at enclosed depressions or if the water table is below a river for water to seep through the riverbed into the aquifer. Diffuse recharge is more widespread across the areas but subsoils overlying the aquifer will hamper the percolation of water. Therefore the highest amounts of disuse recharge will occur where subsoils are thinnest and most permeable. In this instance the tills derived from limestone are considered to be most permeable.	
	Est. recharge rates	<i>[Information will be added at a later date]</i>	
<b>Discharge</b>	Springs and large known abstractions	Julianstown (Spring), Gaskinstown, Garballagh	
	Main discharge mechanisms	Water will discharge from the aquifer directly to the coast and also, where the water table is above riverbed elevations, to the overlying rivers in the area. This discharge to rivers may occur as baseflow or as springs located in the vicinity of rivers.	

Hydrochemical Signature	The hydrochemical data collected in this area display a Calcium-Bicarbonate signature. Typical Electrical Conductivity values are between 600-700 $\mu\text{S}/\text{cm}$ . The Total Hardness values in the aquifer are between 250-350mg/l $\text{CaCO}_3$ , which are considered to indicate "Hard" water. Alkalinity values range from 200 to 350 mg/l with most values around 250mg/l. These values are typical of an unconfined limestone aquifer. This GWB is considered to be <b>Calcareous</b> .
<b>Groundwater Flow Paths</b>	<p>Groundwater flow in the aquifer will be from the main recharges areas, i.e. the areas of thin subsoil, in the northwest and south to the River Nanny, which runs along the southeastern boundary of the body. Groundwater flow paths of up to a couple of kilometres can be expected. This is supported by the absence of surface water features in the north and northwest of the area. In these regions the surface water percolates underground and the transmissivity and storativity in the aquifer area sufficient to transmit large quantities of water over long distances.</p> <p>The nature of groundwater flow will depend on the degree of karstification of the limestone. Where the aquifer is heavily karstified groundwater flow will be concentrated along a few enlarged conduits. Elsewhere groundwater flow will be through a series of connected fractures. The presence of fissuring within these limestones at Drogheda is shown in boreholes at Drybridge, Co. Louth, (drilled as part of the investigation by the North East Regional Development Organisation (NERDO) in 1981), where 8m out of the 16m of borehole which was calliper logged had a diameter greater than the drill bit size. Trial wells at Mell, County Louth, also showed cavities up to 10% of the total rock penetrated. Recent borehole records from the site investigation for the Northern Motorway in these limestones have recorded cavities/fissures with a vertical depth up to 3m (BMA 1995). Evidence from the Platin Quarries in Co. Meath also suggests karstic solution of fissures has developed within this limestone.</p> <p>From studying the Hydrographs at the EPA monitoring stations MEA001 &amp; MEA141 it is clear that there is a significant annual fluctuation in groundwater levels (~4m) and it the appearance of the hydrographs also suggest a rapid response to recharge. Both of these characteristics are typical in karstified areas where there is minimal storage in the conduit dominant groundwater system.</p> <p>The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and/or lower permeability e.g. in the east where there are thick deposits of Irish Sea Till.</p>
<b>Groundwater &amp; surface water interactions</b>	<p>A vital link between surface water and groundwater can be seen in two protected areas of this GWB. Firstly, about 1km northwest of Duleek, Duleek Commons Natural Heritage Area (NHA) occupies a level, drained marsh area that was associated with the floodplain of a tributary running from Thomastown Marsh, through the undulating drift landscape to the River Nanny. Many wetlands in the area have completely disappeared due to drainage. Duleek commons is in relatively good condition. Thus this rather degraded wetland is of importance. Further drainage work here or the lowering of the water table would be inappropriate. Secondly, Thomastown Bog situated 3 km west of Duleek, Co. Meath. The site consists of a raised bog surrounded by wet woodland and wet grassland. This site lies on the boundary between the Limestones and Namurian rocks to the northwest. The southeast section of the woodland has Willow and large Alder (<i>Alnus glutinosa</i>) as the dominant tree species. These wet woodlands also have a rich ground flora.</p> <p>It is also important that in a karst aquifer surface water and groundwater are more closely linked than in other aquifer types. Springs and swallow holes represent direct links between the two.</p>
<b>Conceptual model</b>	<p>This GWB is located south of Drogheda in Co. Meath. The body is bounded on the east by the Irish Sea and to the north by the boundary between the River Boyne and Nanny catchments. Elsewhere the area of the GWB is defined by the extent of the Pure Bedded Limestones in that area. The area is low-lying with elevations decreasing towards the Irish Sea and the Nanny river to the southeast. The GWB is composed of high permeability karstified limestone. Groundwater flow occurs along fractures, joints and major faults. Recharge occurs diffusely through the more permeable subsoils in the southwest and also the thinner subsoils in the northwest. It is also possible that there may be locations of point recharge via swallow holes. 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 in a zone near the surface. In general, the majority of groundwater flow occurs in the upper 30 m, comprising a weathered zone of a few metres and a connected fractured zone below this. However, deep water strikes in more isolated faults/ fractures can be encountered to 50 mbgl. Regional groundwater flow will be towards the River Nanny and also, in the northeast to the Coast, but on a local scale, groundwater discharges to the streams and rivers crossing the aquifer. Flow path lengths are generally 500-2000 m. The main discharge areas for the aquifer are the coast and the River Nanny.</p>
<b>Attachments</b>	<p>Durov Plot for EPA Monitoring Station MEA115 Well Hydrograph at EPA Monitoring Stations MEA001 &amp; MEA141 List of Geological formations present in the GWB.</p>
<b>Instrumentation</b>	<p>Stream gauge: 08018, 08019 Borehole Hydrograph: Garballagh (MEA001), Gaskinstown (MEA141) EPA Representative Monitoring boreholes: Garballagh (MEA115), Comiskey (MEA112)</p>
<b>Information Sources</b>	<p>Bernard Murphy &amp; Associates, 1996. Drilling logs for the proposed Northern Motorway. <i>E.I.S., Northern Motorway</i>. McConnell B, Philcox M &amp; 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. N.E.R.D.O. 1981. Groundwater Resources in the N.E.R.D.O. Region. <i>An Foras Forbartha &amp; Geological Survey of Ireland</i>. Woods L, Meehan R &amp; Wright G R, 1998. <i>County Meath Groundwater Protection Scheme</i>. Report to Meath County Council. Geological Survey of Ireland. 54 p.</p>
<b>Disclaimer</b>	<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>





Formation Name	Code	Description	Rock Unit Group	Aquifer Classification
Clonlusk Formation	CJ	Pale crinoidal peloidal grain-rudstone	Dinantian Pure Bedded Limestones	Rkd
Crufty Formation	CU	Peloidal wackestone-grainstone, shale	Dinantian Pure Bedded Limestones	Rkd
Mornington Formation	MT	Dark limestone & calcareous shale	Dinantian Upper Impure Limestones	Lm
Mullaghfin Formation	MF	Pale peloidal calcarenite	Dinantian Pure Bedded Limestones	Rkd
Platin Formation	PT	Crinoidal peloidal grainstone-packstone	Dinantian Pure Bedded Limestones	Rkd
Tullyallen Formation	TA	Pale micritised grainstone-wackestone	Dinantian Pure Bedded Limestones	Rkd