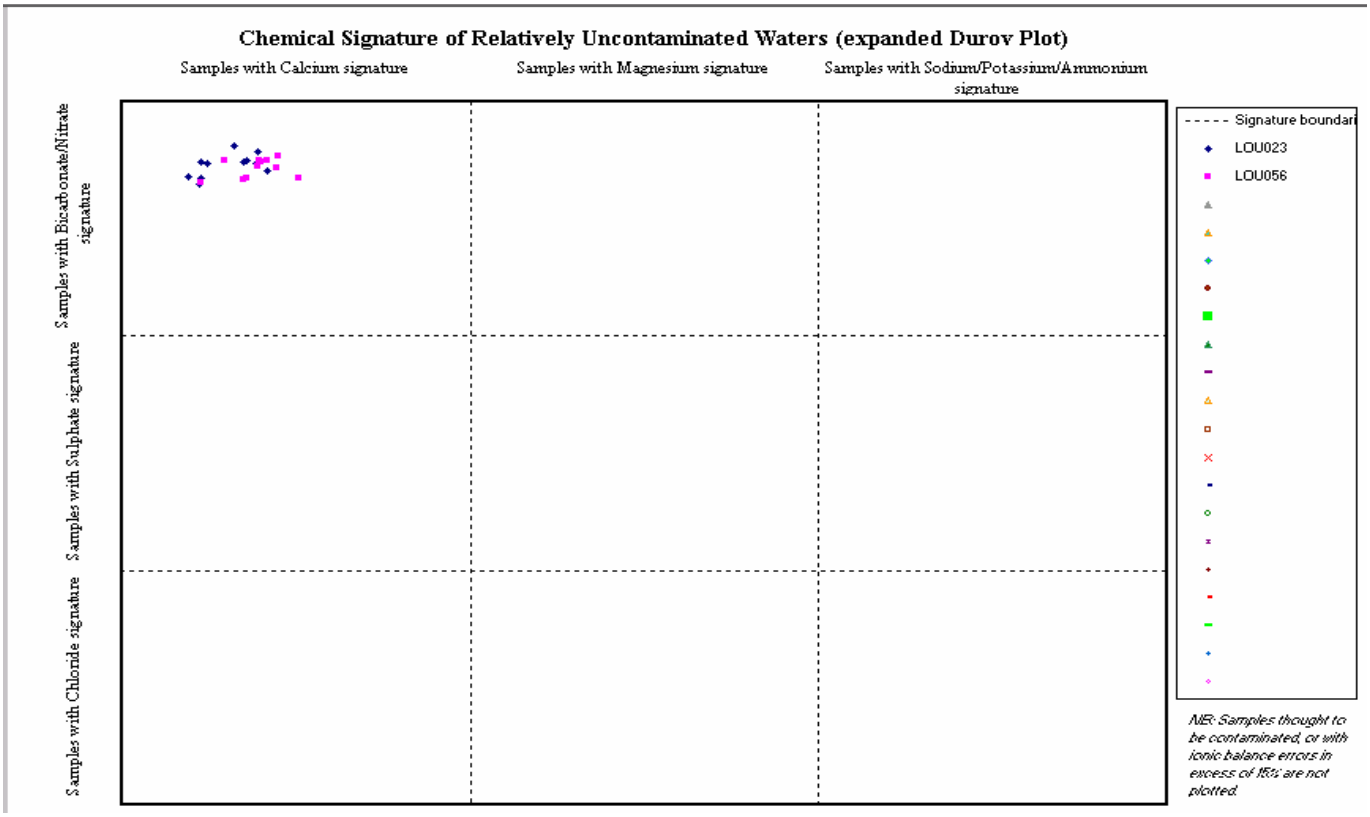
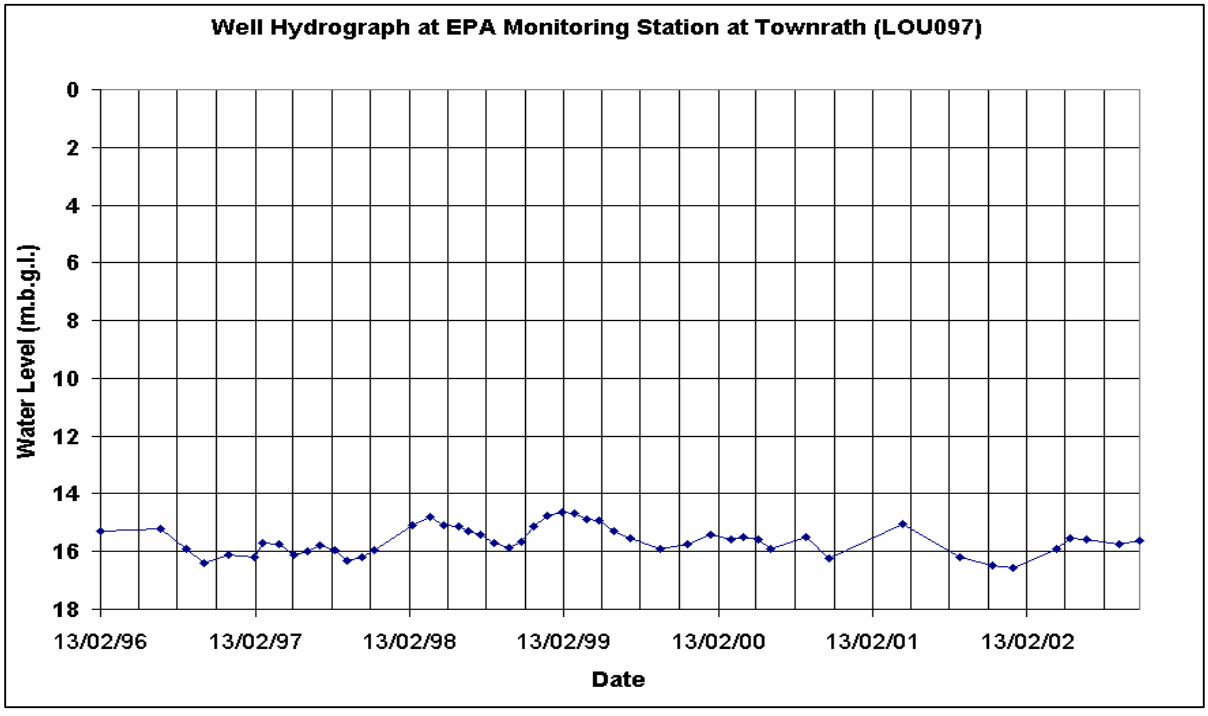
Drogheda GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority		Associated surface water bodies	Associated terrestrial ecosystems	Area (km^2)
Louth Co. Co. Meath Co. Co. Hydrometric Area 07		Boyne, Mattock	Boyne River Island (1862), Boyne Coast & Estuary (SAC) (1957)	49
Topography		A low-lying flood plain type area of the River Boyne. In general elevations are higher to the north and southeast and fall off towards the river and the coast. There are some large areas of enclosed depressions evident on the map to the north of the Boyne, northeast of Drogheda town, and also south of the Boyne at Donore.		
Geology and Aquifers	Aquifer type(s)	**Rk^d**: Regionally important karstified aquifer dominated by diffuse flow **Lm:** Locally important aquifer which is generally moderately productive		
	Main aquifer lithologies	The area is mainly underlain by Dinantian Pure Bedded limestones, but an area of Dinantian Upper Impure limestones located to the southeast and along the coast has also been included in this GWB.		
	Key structures.	The limestones in this area are adjacent to Lower Palaeozoic rocks to the north and south, which have been faulted up against them. The limestones have been deformed into a syncline that dips towards the River Boyne.		
	Key properties	The limestones have a moderate to good secondary permeability and joints and fissures have been enlarged by solution of the limestone. The dolomitisation and decalcification have increased the available storativity of the limestones. 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. During drilling at Mell the limestone was massive and crystalline with strong vertical jointing and karstification. Three fissures were intersected during drilling but all were filled with unconsolidated material. An optimum borehole yield of 1600 m^3/d was estimated for a large drawdown of 36 m and a transmissivity of 140 m^2/d was calculated. (Minerex 1983) There are some gravel deposits mapped in this area that may augment the storage in the underlying bedrock aquifer if they are in hydraulic connection.		
	Thickness	The pure limestones are over 850 m thick in this area. Some thinner units include the Crufty Formation (maximum 60 m thick) and the Mullaghfin Formation (maximum 80 m thick). In a regionally important aquifer such as this it is considered that the majority of groundwater flow occurs in the upper ?30 m of the aquifer in a network of connected fractures and fissures. Drilling evidence in the area show a large variety in the depths of major water inflows, it is possible to strike water in cavities at depths below 40m.		
Overlying Strata	Lithologies	The subsoils vary from limestone-derived till in the west to Irish Sea Till east of Drogheda. The limestone-derived till is considered to be more permeable than the Irish Sea Till. There are also some isolated areas of gravel deposits along the River Boyne.		
	Thickness	There are large areas of rock outcrop in the western area of the GWB where the elevation rises towards the Namurian hills. The thickness of the subsoil increases to over 10 m in places in the east, although isolated areas of outcrop are still present. Bedrock will be exposed at the quarries (Platin, Mell & Donore).		
	% area aquifer near surface	10%		
	Vulnerability	The groundwater vulnerability area is highly variable. The general trend is increasing vulnerability to the west as the subsoil thins and is also more permeable. At present GSI vulnerability maps are not available for Co. Louth.		
Recharge	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 where dissolution of the limestone has opened up fractures in the rock. Rainwater can enter the aquifer directly at enclosed depressions or at swallow holes. There is a swallow hole recorded in the north of the GWB at Mell, Co. Louth. Diffuse recharge is more widespread across the area, but thick, poorly permeable subsoils overlying the aquifer will reduce the amount of water reaching the water table. Therefore the highest amounts of diffuse recharge will occur where subsoils are thinnest and most permeable. In this instance the limestone-derived till and gravel deposits are considered the most permeable and will allow the most recharge. Water from the Wilkinstown GWB is abstracted at Lynch's Cross to supply the Tullyallen WS which is located within this GWB, hence recharging this GWB.		
	Est. recharge rates	*[Information will be added at a later date]*		
Discharge	Springs and large known abstractions	Collon PWS (1100 m^3/d) is located in the Wilkinstown GWB but one of the wells is located in this GWB. Tullyallen WS (176 m^3/d) is located in this GWB but one of the wells plots in the Wilkinstown GWB. Yellowbatter (900 m^3/d) (2 Wells); Boyne Valley Honey (15 m^3/d); Toberboice (spring).		
	Main discharge mechanisms	Water will discharge from the aquifer directly to the coast and also, where the water table is above river stage, to rivers in the area, as baseflow or as springs in the vicinity of rivers.		
	Hydrochemical Signature	The Durov Plot for this GWB shows that monitored sources consistently show a calcium bicarbonate hydrochemical signature. The typical electrical conductivity values range from 550 to 650 µS/cm, with Moderately Hard to Very Hard waters and Alkalinity values of 150 to 350 mg/l.		

Groundwater Flow Paths	Groundwater flow in the aquifer will be from the main recharges areas, i.e. the areas of thin subsoil, in the west and north towards the discharge areas i.e. River Boyne and the coast. 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 are sufficient to transmit large quantities of water over long distances. 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. Where the rock is less karstified nature groundwater flow will be though a series of connected fractures and joints. The presence of fissuring within these limestones at Drogheda is shown in boreholes at Drybridge, Co. Louth, (drilled as part of the NERDO investigation, 1981), where 8 m out of the 16 m of borehole which was caliper logged had a diameter greater than the drill bit size. Trial wells at Mell, Co. Louth also showed cavities up to 10% of the total rock penetrated. Recent borehole records from the site investigation for the Northern Motorway recorded cavities/fissures with a vertical depth up to 3 m (BMA 1995). Evidence from the Platin Quarries in Co. Meath also confirms karstic solution of fissures has developed within this limestone.
Groundwater & surface water interactions	Groundwater and surface water are more directly linked at certain karst features such as springs and swallow holes. Evidence of such features is present at Mell where a swallow hole is recorded in the GSI Karst Database. Consideration should also be given to groundwater and surface water interactions in the River Boyne Islands, formed by the build-up of alluvial sediment in this part of the river where water movement is sluggish. In such islands surface water enters the sediments on the upstream side of the island, travelling through the sediments of the islands as groundwater and discharging on the downstream side, to become surface water again. This dynamic conversion between the two systems is important to the fauna of the island.
Conceptual model	This GWB straddles the boundary of Co. Meath and Co. Louth in the area of Drogheda. The GWB consists of Dinantian Limestones, bounded to the north and south by Lower Paleozoic rocks, to the west by Namurian rocks and to the east by the Irish Sea. The area is a low lying river basin, the land surface slopes down from higher elevations in the Namurian and Lower Paleozoic rocks towards the River Boyne and the coast. The GWB is mostly composed of highly permeable karstified limestone. The area of impure limestones is not expected to impede groundwater flow, since structural deformation in this area has caused these rocks to be more permeable than in other localities where they occur. Groundwater flow occurs along fractures, joints and major faults from the recharge areas in the east and north to the discharge areas along the River Boyne and at the coast. The aquifers within the GWB are generally unconfined, but may become locally confined where the subsoil is thicker and of lower permeability e.g. thick sequences of Irish Sea Till. Most flow in this aquifer will occur in a zone near the surface. In general, most groundwater flow is likely to occur 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 down to at least 50 mbgl. Flow path lengths can be between 500 and 2000 m.
Attachments	Durov Diagram Hydrograph at EPA Monitoring Station LOU097
Instrumentation	Stream gauge:07061 Borehole Hydrograph: LOU097 EPA Representative Monitoring boreholes: LOU023, LOU056 & LOU40
Information Sources	Bernard Murphy & Associates, 1996. Drilling logs for the proposed Northern Motorway. *E.I.S., Northern Motorway*. McConnell B, Philcox M & Geraghty M, 2001. *Geology of Meath: A geological description to accompany the bedrock geology 1:100,000 scale map series, Sheet 13, Meath*. Geological Survey of Ireland. 77 p. Minerex (1983) *The hydrogeology of Co. Meath. A Preliminary Assessment of Groundwater Potential.* Report to Meath Co. Co. N.E.R.D.O. 1981. Groundwater Resources in the N.E.R.D.O. Region. *An Foras Forbartha & Geological Survey of Ireland.* Woods L, Meehan R & Wright G R 1998. *County Meath Groundwater Protection Scheme*. Final report to Meath County Council. Geological Survey of Ireland. 54 p.
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
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
Drogheda Granite	Dr	Quartz monzonite	Granites & other Igneous Intrusive rocks	Pl
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


Chemical Signature of Relatively Uncontaminated Waters (expanded Durov Plot)
Samples with Calcium signature
Samples with Magnesium signature
Samples with Sodium/Potassium/Ammonium signature
Samples with Bicarbonate/Nitrate signature
Samples with Sulphate signature
Samples with Chloride signature
Signature boundari
LOU023
LOU056
NB: Samples thought to be contaminated, or with ionic balance errors in excess of 8%, are not plotted


Well Hydrograph at EPA Monitoring Station at Townrath (LOU097)
Water Level (m.b.g.l.)
0
2
4
6
8
10
12
14
16
18
13/02/96
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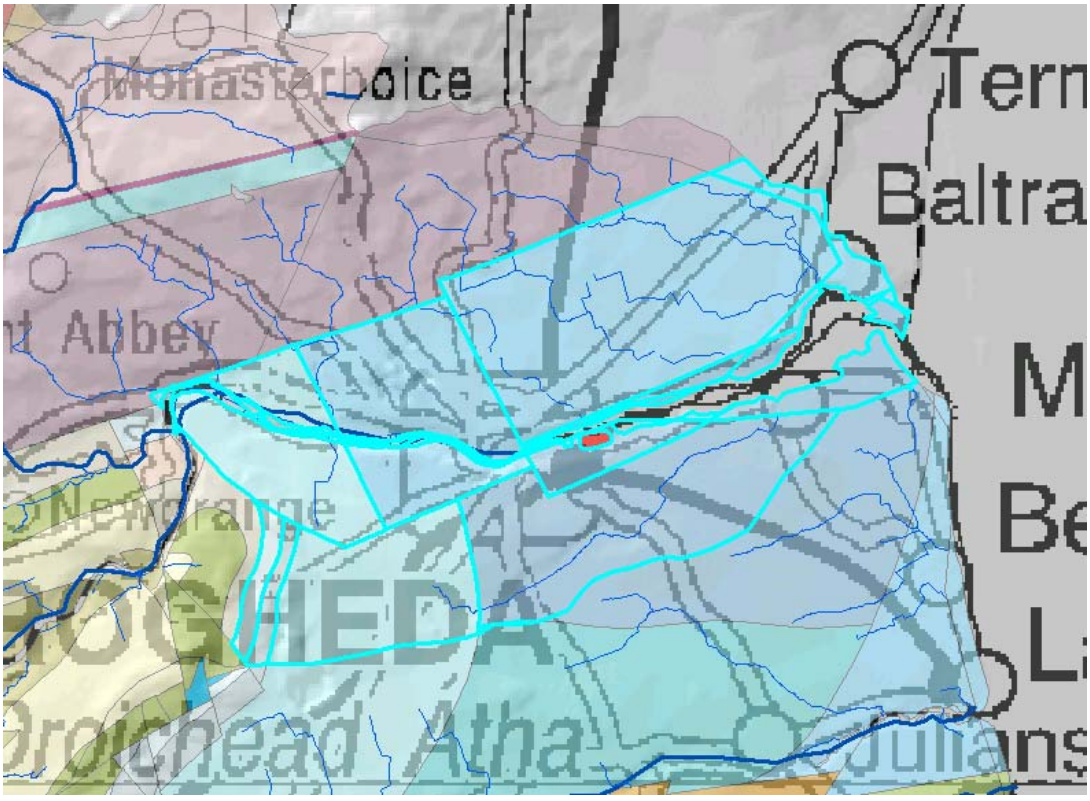
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