Cavan GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority		Associated surface water bodies	Associated terrestrial ecosystems	Area (km^2)
Hydrometric Area 36 Cavan Co. Co. Monaghan Co. Co. Longford Co. Co. Leitrim Co. Co.		***Rivers:*** Annalee, Bunnoe, Cavan, Cullies, Dromore, Finn, Knappagh, Erne, Stradone, Laragh, Magheramey. ***Streams:*** Aghnacliffe, Avaghon Lake Stream, Laheen, Legga, Madabawn, 1100 unnamed. ***Lakes:*** see list below *	Lough Oughter and associated lakes (O'Riain, 2004)	1410
Topography		This large, SW-NE aligned GWB is bounded to the south, east and west by the topographic divide (Hydrometric Area 36). The northern boundary comprises more productive aquifers. The entire GWB is characterised by drumlin topography. Inter-drumlin elevations generally range from 5 mAOD around Lough Oughter (Killashandra GWB), to c.250 mAOD in the southeast. The drumlin peaks are generally an additional 40-60 m. There are also three higher areas in western and central region of the GWB, the highest of which rises to c.300 mAOD. Surface water generally feeds from the periphery of the GWB towards Lough Oughter, which then flows northwards towards Lough Erne.		
Geology and Aquifers	**Aquifer type(s)**	The vast majority of the GWB (c.98%) comprises **Pl:** Poor aquifer, generally unproductive except for local zones. In the southwest, there is a small area of **Ll:** Locally important aquifer, moderately productive only in local zones, and there is also a small outlier of **Lm:** Locally important aquifer, generally moderately productive, in the centre of the GWB.		
	Main aquifer lithologies	Essentially split by a SW-NE line across this GWB, the northern area is dominated by Ordovician Metasediments (54.22% of GWB) and the south by Silurian Metasediments and Volcanics (41.97%). Other rocks of note are two areas of Granites & other Igneous Intrusive Rocks (1.34%) and thin bands of Ordovician Volcanics (<0.5%) in the southern area. There are also Dinantian age rocks (2.17%) in the southwest and as the central outlier. Refer to Table 1 for details.		
	Key structures.	Being part of the Longford-Down Inlier, the rocks in this part of the country have been significantly deformed, resulting in a large number of approximately SW-NE faults with associated perpendicular faults e.g. Carrickateane, Orlock Bridge, Kehernagilly and Laragh Faults. Dips in the rock succession are variable but overall, appear to be to the SE by up to 80°.		
	Key properties	Yields in this GWB are available for 65 wells and range from 4.4-1091 m^3/d, averaging 143 m^3/d. Of these, 3 have 'excellent' yields – 2 of which are located on a mapped fault – and 39 have 'good' yields, approximately half of which are in faulted zones. Only 3 specific capacity values are available for the higher yields, all of which are quite low: 6, 7 and 12 $m^3/d/m$. These low specific capacities result in low productivity values for these wells (III; IV and IV). For the remaining poorer yielding wells, specific capacity values range from 0.1-19.9 $m^3/d/m$, averaging 4.3 $m^3/d/m$ over are 23 values. Only one transmissivity value is available for this GWB: 0.23 m^2/d for a low yielding well. The national transmissivity data for these rocks are also low (<20 m^2/d in most rocks) or possibly moderate in the Silurian rocks (20-80 m^2/d). However, higher values may be achieved in faulted zones, especially in the coarser-grained rocks, which may be exemplified by the 'excellent' and 'good' yields. The available specific dry weather flows are low, ranging from 0.01-0.55 $l/s/km^2$ (6 stations), suggesting that these aquifers do not make a significant baseflow contribution to streamflow. Storativity is also expected to be low. Of the c.320 available groundwater levels, 60% are 0-3 m below ground level and just over 12% area greater than 10 m bgl, indicating that flow is predominantly shallow. Groundwater gradients have not been calculated by are expected to be relatively steep. *(Ordovician Aquifer Chapter; Silurian Aquifer Chapter*)		
	Thickness	Most groundwater flux will be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3 m thick, as indicated by the predominantly shallow water levels, a zone of interconnected fissuring around 10 m thick, and a zone of isolated poorly connected fissuring typically less than 150 m. Water strikes of between 30-40 m bgl are noted 5 boreholes and an additional borehole ('good' yield) has strikes recorded at 43 and 82 m bgl. This suggests some deeper flow component, although it is likely to be very limited.		
Overlying Strata	**Lithologies**	The GWB is predominantly covered by till subsoil (71%), with a smaller proportion of peat (9%). Approximately 10% of the body is mapped as rock outcrop/shallow subsoil. There are no data for the western end of the GWB (c.4% of the area).		
	Thickness	Across the GWB, outcrop and borehole data suggest that the drumlins appear to represent a thicker deposit, frequently >10 m thick, with rock nearer the surface of the inter-drumlin areas. Generally, the southern half of the GWB has shallower subsoil.		
	% area aquifer near surface	*[Information will be added at a later date]*		
	Vulnerability	From the Monaghan GWPS, the vulnerability is predominantly classed as Extreme in the southeast of the GWB, and Low in the northeast, where deposits are less permeable and thicker. No data are available for Cavan or Leitrim however, the similar topography and outcrop distribution may suggest a similar pattern of vulnerability.		

Recharge	**Main recharge mechanisms**	Diffuse recharge occurs via rainfall percolating through the thinner/more permeable subsoil and via outcrops. Due to the low permeability of some of the subsoil (thicker till and peat) and the aquifers in the GWB, a high proportion of the available recharge will discharge to the streams in the GWB. In addition, the steep drumlin slopes will promote surface runoff. The high stream density is likely to be influenced by the lower permeability rocks as well as the subsoil.
	Est. recharge rates	*[Information will be added at a later date]*
Discharge	**Important springs and high yielding wells**	***Sources:*** None identified. ***Springs:*** None identified. ***Excellent Wells:*** Cooltrimegish (1091 m^3/d), Sallaghan (523 m^3/d), Corrachulter (436 m^3/d). ***Good Wells:*** Drumloo (327 m^3/d), Milltown (273 m^3/d), Dromod (262 m^3/d), Tirquin (259 m^3/d), Poles (245 m^3/d), Corglass (218 m^3/d), Dernaroy (218 m^3/d, 196 m^3/d), Drumaveale (218 m^3/d), Drumgola (218 m^3/d), Garrybane (218 m^3/d), Drumauna (218 m^3/d), Ardlougher (196 m^3/d), Drollagh (190 m^3/d), Fastry (173 m^3/d), Killycannan (153 m^3/d), Killgary (153 m^3/d), Tullyvin (149 m^3/d, 120 m^3/d), Annagelliff (131 m^3/d), Bruse (131 m^3/d), Brusky (131 m^3/d), Carrickboy (131 m^3/d), Cootehill (131 m^3/d), Lismagratty (131 m^3/d), Tievenanass (131 m^3/d), Tullnahinnera (131 m^3/d, 118 m^3/d), Unshinagh (131 m^3/d), Corduff (126 m^3/d), Turfad (120 m^3/d), Ardvarny (112 m^3/d), Clonoose (109 m^3/d), Derrycassan (109 m^3/d), Lisnacark (109 m^3/d), Moyne (109 m^3/d), Mullaghoran (109 m^3/d), Tullnanegish (109 m^3/d), Carrickallen (103 m^3/d).
	Main discharge mechanisms	The main groundwater discharges are to the lakes and rivers and streams crossing the GWB, reflecting short groundwater flow paths. Small springs (of which a number are recorded) and seeps are likely to issue at the stream heads and along their course. Groundwater may also flow into the adjacent, higher permeability (Lm) GWB.
	Hydrochemical Signature	***National classification:*** Ordovician/Silurian Metasediments Non-calcareous. Ca-Mg-HCO_3 signature. However, Cavan and Monaghan also have Ca-Mg-SO_4 recorded. Alkalinity (mg/l as $CaCO_3$): range of 9-470; mean of 172 (445 'non limestone subsoils' data points) Total Hardness (mg/l): range of 5-481; mean of 222 (389 'non limestone subsoils' data points) Conductivity (μS/cm): range of 80-477; mean of 490 (477 'non limestone subsoils' data points) *(Calcareous/Non calcareous classification of bedrock in the Republic of Ireland report)*
Groundwater Flow Paths		In the absence of inter-granular permeability, groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. Available groundwater levels are mainly 0-10 m below ground level (60% <3 mbgl). Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to nearby lakes, streams and small springs. There are observed deeper water strikes, indicating that there is a component of deep groundwater flow, however shallow groundwater flow is thought to dominant. Groundwater flow directions are expected to follow topography – overall in a northerly direction.
Groundwater & surface water interactions		Groundwater will discharge locally to streams and rivers crossing the aquifer and also to small springs and seeps. Owing to the poor productivity of the aquifers in this body it is unlikely that any major groundwater - surface water interactions occur. Baseflow to rivers and streams is relatively low.
Conceptual model		• This large, SW-NE aligned GWB is bounded to the south, east and west by the topographic divides (Hydrometric Area 36). The northern boundary comprises more productive aquifers. The entire GWB is characterised by drumlin topography. Inter-drumlin elevations generally range from 5 mAOD to c.250 mAOD. There are also three higher areas in western and central region of the GWB, the highest of which rises to c.300 mAOD. • The GWB is composed primarily of low transmissivity rocks. Most of the groundwater flux is in the uppermost part of the aquifer: comprising a broken and weathered zone typically less than 3m thick; a zone of interconnected fissuring typically less than 10m; and a zone of isolated fissuring typically less than 150m. • Recharge occurs diffusely through the thin/permeable subsoil and via outcrops, although is limited by ay thicker low permeability subsoil and the low permeability bedrock itself. Therefore, most of the effective rainfall is not expected to recharge the aquifer. • Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to the lakes and streams crossing the aquifer, and to small springs and seeps. Overall, the flow direction is expected to be to the north and east, as determined by the topography.
Attachments		Figure 1. Figure 2. Table 1.
Instrumentation		**Stream gauges:** 36010*, 36011*, 36012 *, 36015* (Present but not representative of flow in this GWB), 36016*, 36017*, 36018*, 36024, 36030, 36031, 36037, 36038, 36039, 36044, 36070, 36072, 36074, 36075, 36076, 36077, 36078, 36079, 36080, 36081, 36082, 36085, 36120, 36121, 36122, 36123, 36124, 36125, 36126, 36127, 36130, 36135, 36136, 36137, 36138, 36139, 36141, 36143, 36145, 36146, 36147, 36149, 36150, 36151, 36152, 36153, 36155, 36157, 36172, 36173, 36174, 36182, 36183, 36184, 36190, 36192, 36193, 36194, 36195, 36196, 36197, 36198. *Adjusted dry water flow data available for these **EPA Water Level Monitoring boreholes:** CAV141 (on boundary with Killashandra GWB), CAV161 **EPA Representative Monitoring points:** CAV26, LEI67, MON14, MON17, MON18, MON19, MON23, MON28, MON29, MON31, MON44, MON46, MON53, MON55.

Information Sources	An Foras Forbartha and Geological Survey of Ireland (1981). *Groundwater Resources in the N.E. (R.D.O.) Region;* Main Report and Technical Appendices, Volumes 2, 3. 170pp. Geraghty, M., Farrelly, I., Claringbold, K., Jordan, C., Meehan, R., and Hudson, M., 1997. *Geology of Monaghan-Carlingford. A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 8/9, Monaghan-Carlingford*. Geraghty, M. (ed.). Geological Survey of Ireland. 60 p. McConnell, B., Philcox, M. and Geraghty, M., 2001. *Geology of Meath: A geological description to accompany the bedrock geology 1:100,000 scale map series, Sheet 13, Meath*. With contributions from J. Morris, W. Cox, G. Wright, and R. Meehan. Geological Survey of Ireland. 77 p. Morris J.H., Somerville I.D. and MacDermot C.V. (2002). *Geology of Longford-Roscommon.* A Geological Description to Accompany the Bedrock Geology 1:100,000 Bedrock Series Sheet 12. With contributions by D.G. Smith, M. Geraghty, B. McConnell, K. Carlingbold, W. Cox and M. Lee. Geological Survey of Ireland, 121pp. Swartz, M and Daly, D. (2002) *County Monaghan Groundwater Protection Scheme Report*. Main Report. Final Report to Monaghan County Council. Geological Survey of Ireland O' Riain, G. 2004. *Water Dependent Ecosystems and Subtypes (Draft)*. Compass Informatics in association with National Parks and Wildlife (DEHLG). WFD support projects.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

***Lakes:**

Aghnacor Lough,	Cordoo Lough,	Drumellis Lough,	Kilycloughan Lough,	Lower Lough,
Anagose Lake,	Corfad Lough,	Drumgill Lough,	Knockbride Lough,	Lurgacham Lough,
Annagh Lough,	Corfeehone Lough,	Drumgola Lough,	Lagan Lough,	Mill Lough,
Annaghard Lough,	Corgarve Lough,	Drumgole Lough,	Laurel Lough,	Mill Pond,
Annagheane Lough,	Corglass Lough	Drumhay Lough,	Lavey Lough,	Milltown Lough.
Annaghierin Lough,	Corkeeran Lough,	Drumherriff Lough,	Leamgeltan Lough,	Mosy's Lough,
Annaghkilly Lough,	Corlisbrattan Lough,	Druminnick Lough,	Leebeen Lough,	Moyduff Lough,
Annaghmakerig Lough,	Corlougharoe Lough,	Drumkilroosk Lough	Lisabuck Lough,	Muddy Lough,
Annaghoash Lough,	Cormeen Lough,	Drumlane Lake.	Lisakillewbane Lough,	Mullaghard Lough,
Annies Lough,	Cornafean Lough,	Drumlona Lough,	Lisclogher Lough,	Mullananry Lough,
Ardra Lough,	Cornagall Lough,	Drumlorn Lough,	Lisdoagh Lough,	Mullinroe Lough,
Baraghy Lough,	Cornalara Lough,	Drummany Lough,	Lismagonway Lough,	Oghill Lough,
Barragh Lough,	Corndvody Lough,	Drumsaul	Lisnakillewduff Lough,	Omard Lough,
Barrnagrow Lough,	Corr Lough,	Drumsheil Lough,	Lisnananagh Lough.	Peartree Lough,
Bawndoora Lough,	Corragarry Lough,	Dumb Lough,	Little Lough,	Pleasure Lough,
Beaghmore Lough,	Corraghy Lough,	Dunrora Lough,	Long Lough,	Portlongfield Lough,
Beaghy Lough,	Corrakane Lough.	Dunsrim Lough,	Lough Acanon,	Pound Lough,
Bellatrain Lough,	Corraneary Lough,	Durracaun Lough,	Lough Aconnick, Lough	Quarry Lough,
Black Lough,	Corravohy Lough,	Enaghan Lough,	Asturral,	Radeerpark,
Bocks Lough,	Corravon Lough,	Fartagh Lough,	Lough Avattan,	Rectory Lake,
Bog Lough,	Corrinshingo,	Feagh Lough,	Lough Bane,	Rockfield Lough,
Boraghy Lake,	Lough Corryloon or Oghill	Gangin Lough,	Lough Bawn,	Roosky Lough,
Bunchy Lough,	Cosekemduff Lough,	Gartinadress Lough,	Lough Beg,	Sallaghan Lough,
Calloughs Lough,	Counternan Lough,	Garty Lough,	Lough Carnaman,	Sarranseer Lough,
Carlin Lough,	Creeve Lake,	Glasdrumman Lough,	Lough Clegg,	Shankill Lough,
Carrickmore Lough,	Creeve Lake Upper,	Gorknakillew Lough,	Lough Dermot,	Shantonagh Lough,
Carrigallen Lough,	Crossduff Lough,	Gortermone Lough,	Lough Egish,	Shatemon Lough,
Carrs Lough,	Cullies Lough,	Graddum Lough,	Lough Gail,	Shinan Lough,
Carvagh Lough,	Dernaweel Lough,	Greaghlone Lough,	Lough Gowna,	Skerrig Lough,
Caseys Lough,	Derry Lough,	Green Lough,	Lough Islan,	Steepletons Lough,
Cashlan Lough,	Derrygoany Lough,	Guinikin Lough,	Lough Magon,	Swan Lough,
Castlecosby Lough.	Derrylane Lough,	Gulladoo Lough,	Lough Major,	Taghart Lough,
Claragh Lough,	Doogary Lough,	Inner Lough,	Lough Mentes,	Tattincake Lough,
Clifferna Lough,	Doohal Lough,	Island Lough,	Lough Mino,	Tawlaght Lough,
Cloorcorick Lough,	Dromore Lough,	Keeny Lough,	Lough Morne,	Tievaleny Lough,
Closeagh Lough,	Drum Lough,	Kehernaghkilly Lough,	Lough Mushlin,	Tonyduff Lough,
Cloverhill Lough,	Drumand Lough,	Kill Lough,	Lough Naback,	Tonyscallan Lough,
Coaghen Lough,	Drumart Lough,	Killaliss Lough,	Lough Nabelwy,	Toome Or Crinkill Lo
Coalkill Lough,	Drumate Lough,	Killfargy Lough,	Lough Nadarragh,	Town Lough,
Comertagh Lough,	Drumbess Lough,	Killybandrick Lough	Lough Naglare,	Tully South Lough,
Cool trim Lough,	Drumcalpin Lough,	Killydream Lough.	Lough Namachree,	Tullyroan Lough,
Cooney Lough,	Drumcor Lough,	Killymooney Lough,	Lough Shawn,	Urney Lough,
Coppony Lough,	Drumcrow Lough,	Killynenagh Lough,	Lough Sillan,	White Lough,
Coragh Lough,	Drumeague Lough Lr,	Killyrue Lough,	Lough Skuddal,	Wood Lough.
Corconnelly Lough,	Drumeena Lough,	Killyvaghan Lough,	Lough Tacker,	
Cordonaghy Lough,		Kilnaleck Lough,	Loughapharton,	

Figure 1. Location and boundaries of Cavan GWB.

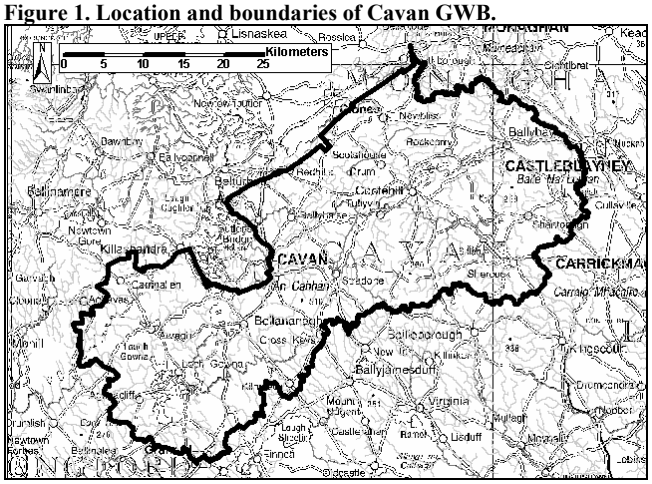

Table 1. List of Rock units in Cavan GWB

Rock Unit Name	Code	Description	Rock Unit Group	Aquifer Class.	% Area
Red Island Formation	RI	Greywacke, microconglomerate & argillite	Ordovician Metasediments	Pl	25.15
Lough Avaghon Formation	LA	Massive sandstone & microconglomerate	Silurian Metasediments and Volcanics	Pl	20.71
Coronea Formation	CA	Turbidite, red shale, minor volcanic	Ordovician Metasediments	Pl	17.82
Shercock Formation	SK	Fine to coarse grained turbidite	Silurian Metasediments and Volcanics	Pl	8.25
Slieve Glah Formation	SG	Siltstone, mudstone & thin turbidite	Silurian Metasediments and Volcanics	Pl	7.12
Finnalaghta Formation	FA	Blue-grey greywacke & black argillite	Ordovician Metasediments	Pl	5.06
Cootehill Member	LAcl	Thin turbidite & turbiditic pelite	Silurian Metasediments and Volcanics	Pl	3.07
Carrickateane Formation	CT	Greywacke with argillite & black shale	Ordovician Metasediments	Pl	2.69
Crossdoney Granite	Cg	Hornblende-biotite granite	Granites & other Igneous Intrusive rocks	Pl	1.05
Carrickatee Formation	CK	Black shale, mafic volcanics & tuffs	Ordovician Metasediments	Pl	1.04
Red Island Formation	RI	Greywacke, conglomerate & argillite	Ordovician Metasediments	Pl	0.91
Taghart Mountain Formation	TM	Turbidite, massive sandstone & siltstone	Silurian Metasediments and Volcanics	Pl	0.83
Kehernaghkilly Formation	KY	Black shale & minor rhyolitic tuff	Ordovician Metasediments	Pl	0.77
Dinantian Limestones (undiff.)	DIN	Limestone	Din. Mixed S'dstones, Shales and L'stones	Lm	0.61
Lough Avaghon Formation	LA	Massive sandstone & conglomerate	Silurian Metasediments and Volcanics	Pl	0.58
Mullanalt Member	LAmt	Siltstone, mudstone & fine greywacke	Silurian Metasediments and Volcanics	Pl	0.51
Ballysteen Formation	BA	Dark muddy limestone, shale	Dinantian Lower Impure Limestones	Ll	0.40
Lucan Formation	LU	Dark limestone & shale (calp)	Dinantian Upper Impure Limestones	Ll	0.36
Meath Formation	ME	Limestone, calcareous sandstone	Din.(early) S'dstones, Shales and L'stones	Ll	0.35
Pollareagh Member	SGph	Conglomerate	Silurian Metasediments and Volcanics	Pl	0.35
Castlerahan Formation	RA	Dark quartz greywacke, microconglomerate	Silurian Metasediments and Volcanics	Pl	0.30
Volcanics	mv	Mafic & felsic volcanic tuff	Ordovician Volcanics	Pl	0.29
Corn Hill Formation	CH	Shale, greywacke & volcaniclastics	Ordovician Metasediments	Pl	0.28
Laragh Formation	LH	Pyritic, graptolitic, black shale	Ordovician Metasediments	Pl	0.27
Diorite	Di	Diorite	Granites & other Igneous Intrusive rocks	Pl	0.25
Glen Lodge Formation	GE	Shale, minor sandstone & lava	Ordovician Metasediments	Pl	0.24
Moathill Formation	MH	Limestone, calcareous sandstone, shale	Din.(early) S'dstones, Shales and L'stone	Ll	0.22
Fearnaght Formation	FT	Pale conglomerate & red sandstone	Dinantian Sandstones	Lm	0.22
Aghnamullen Member	LAan	Thin turbidite & silt/mudstone	Silurian Metasediments and Volcanics	Pl	0.18
Kilnaleck Shale Formation	KK	Dark grey laminated shale and mudrock	Silurian Metasediments and Volcanics	Pl	0.08
Monzogranite	Ad	Monzogranite	Granites & other Igneous Intrusive rocks	Pl	0.03
Laragh Formation	LH	Pyritic, graptolitic, black shale	Ordovician Metasediments	Pl	0.01
Croghan Limestone Formation	CL	Dark cherty limestone, shale	Dinantian Pure Bedded Limestones	Pending	0.01
Arva Granodiorite	Av	Porphyritic granodiorite	Granites & other Igneous Intrusive rocks	Pl	0.01

Figure 2. Groundwater hydrographs (EPA Groundwater Level Monitoring)