Ballymote GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
35 Sligo/Mayo/Leitrim Co. Co.	**Rivers**: Arrow Or Unshin, Ballysadare, Cloneen, Douglas, Owenmore, Drumfin. **Streams**: Bunnanaddan, Ballymote. **Lakes**: Aghalenane, Ardaboy, Ardloy, Black, Boathole, Cleavry, Cloonacleigha, Corradoo, Dernaskeagh, Doogloon, Killawee, Agh, Lough Arkedy, Arrow, Availe, Gowra, Labe, Meharth, Loughmeenaghan, Templehouse, Templevanny, Tunnagh, White.	Unshin River (001898), Meharth Lough (001900), Templehouse and Cloonacleigha loughs (00636), Lough Arrow (001673), Turloughmore (000637), Quarryfield West Turlough (001901)	290

Topography		The GWB occupies an area centred on Ballymote. The land surface is low-lying in the western part of the GWB, with elevations at approximately 50 mAOD. The eastern and southern areas have higher relief, with elevations ranging from 70-350 mAOD. Bricklieve Mountain (upland karst) occupies the area around Ballinafad. Drumlin fields occupy the eastern and southwestern areas, which are orientated along a NW axis. The western and eastern boundaries are topographic divides which includes the boundary with the adjoining Tobercurry GWB and the divide between the Shannon and the Western RBD areas. The northern and southern boundaries comprise the poor aquifers of the Gorteen GWB to the south and the Lavagh-Ballygawley GWB to the north. The main drainage is to the north. The location and boundaries are given in Figure 1.
Geology and Aquifers	**Aquifer categories**	**Rk^c:** Regionally important karstified aquifer dominated by conduit flow. The 'c' signifies conduit flow.
	Main aquifer lithologies	Dinantian Pure Bedded Limestones dominate the GWB. Table 1 gives the rock units for the GWB.
	Key structures	The GWB is located within the Ballymote synclinal basin. Within the synclinal basin are two noted synclines: the runs through Ballymote and the second through Gorteen. Both trend NE-SW. A major NE-SW trending fault (Killavil-Belhavel Fault) crosses the GWB north of L. Arrow, truncating the syncline running through Ballymote. On either side of L. Arrow there are several NNW-SSE trending faults.
	Key properties	Karstification is widespread throughout, and recorded features include turloughs, enclosed depressions, dry valleys, swallow holes, caves and springs. Yield data are sparse, there are 2 "good" (100-400 m^3/d) wells present. Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Discharge measured from 2 springs in the Bricklieve area ranges from 518-11,000 m^3/d and 1600-18,000 m^3/d. The yield from the spring for Riverstown WS drops during dry weather periods. Storativity is likely to be low - approximately 0.01-0.02. Annual water fluctuations are variable as can be seen in the hydrographs present in Figures 2, 3 and 4. Note, that the locations of the wells are beside rivers. Tracer tests were carried out in the Bricklieve upland karst area, and groundwater velocities of 25-51 m/hr were recorded (Thorn *et al*, 1990). Groundwater gradients in the Bricklieve upland karst area range from 0.019 to 0.075. General flow directions are likely to be from south to north (with the exception of the southern flanks of Bricklieve where flow directions are locally to the south) under hydraulic gradients that are expected to be greater than 0.0005 on the low lying areas.
	Thickness	Most groundwater flow is likely to be in an epikarstic layer a couple of metres thick and in a zone of interconnected solutionally-enlarged fissures and conduits that extends approximately 30 m below this. Deeper inflows can occur in areas associated with faults or dolomitisation.
Overlying Strata	**Lithologies**	Till is the dominant subsoil type, with drumlins occupying the eastern and southwestern parts of the GWB. Cutover peat occupies the areas between the drumlins. The presence of blanket peat/cutover peat is unexpected over the karstified limestone. It may be due to the presence of low permeability till..
	Thickness	Data are sparse (n=3), with thickness between 0-6 m. Outcrops are extensive in the Bricklieve area.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	*[Information to be added at a later date]*
Recharge	**Main recharge mechanisms**	Both point and diffuse recharge occur. Diffuse recharge occurs via rainfall percolating through permeable subsoil and rock outcrops. Point recharge to the underlying aquifer occurs by means of swallow holes, which are located on the eastern side of the GWB and on the upland area of Bricklieve.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	**Large springs and high yielding wells (m^3/d)**	Good wells: Rathmullen – 109 m^3/d, Riverstown – 218 m^3/d. Springs: Toberacoll – mean flow from 26 observations - 5800 m^3/d. Tobermania – mean flow from 25 observations – 3000 m^3/d (Thorn *et al*, 1990).

	Main discharge mechanisms	The main discharges are to springs, streams, rivers and lakes.
	Hydrochemical Signature	The groundwater has a $CaHCO_3$ signature as illustrated by an expanded Durov Plot, given in Figure 5. Alkalinity, electrical conductivity and hardness are high. The range and median values are given below for two sources. carrowagark (n=14) / achonry (n=7) Alkalinity (mg/l CaCO3): 238-428, 360 / 404-416, 412 Hardness (mg/l CaCO3): 364-436, 388 / 404-456, 440 Conductivity (microsiemens/cm): 684-827, 731 / 837-889, 863
Groundwater Flow Paths		These rocks are generally devoid of intergranular permeability. Groundwater flows through fissures, faults, joints and bedding planes. In pure bedded limestones these openings are enlarged by karstification which significantly enhances the permeability of the rock. Karstification can be accentuated along structural features such as fold axes and faults. Groundwater flow through karst areas is extremely complex and difficult to predict. As flow pathways are often determined by discrete conduits, actual flow directions will not necessarily be perpendicular to the assumed water table contours. Groundwater can flow across surface water catchment divides and beneath surface water channels. Flow velocities can be rapid and variable, both spatially and temporally. Rapid groundwater flow velocities indicate that a large proportion of groundwater flow takes place in enlarged conduit systems. Flow path lengths can be up to a several kilometres in length. Overall groundwater flow will be towards the rivers and lakes, generally to the north, but the karstified nature of the bedrock means that locally, groundwater flow directions can be highly variable. Groundwater may be confined locally.
Groundwater & Surface water interactions		Generally, there is a high degree of interconnection between groundwater and surface water in karstified limestone areas. The karst features represent the close interaction between surface water and groundwater. The stream density is relatively high, which is due to the relatively low permeability subsoils. Any contamination of surface water is rapidly transported into the groundwater system, and vice versa.

Conceptual model	• The GWB occupies an area centred on Ballymote. The land surface is low-lying in the western part of the GWB, with elevations at approximately 50 mAOD. The eastern and southern areas have higher relief, with elevations ranging from 70-350 mAOD. Bricklieve Mountains occupy the area around Ballinafad. Drumlin fields occupy the eastern and southwestern areas, which are orientated along a NW axis. • The western and eastern boundaries are topographic divides which includes the boundary with the Tobercurry GWB and the divide between the Shannon and the Western RBD areas. The northern and southern boundaries comprise the poor aquifers of the Gorteen and the Lavagh-Ballygawley GWB's. The main drainage is to the north. • The aquifer is a Regionally important karstified aquifer (**Rk^c**). • Several karst features are recorded, and these include turloughs, caves and swallow holes but this is thought to only represent a fraction of the existing karst features. • Transmissivities are expected to be variable, ranging from 1 to greater than 2000 m^2/d. Storativity is expected to be in the range of 1-2%. • Most groundwater flux is likely to be in the upper part of the aquifer. • Till is the dominant subsoil type. • Recharge occurs via point and diffuse mechanisms. Point recharge to the underlying aquifer occurs by means of swallow holes. • The main discharges are to springs, streams, rivers and lakes. • The groundwater has a calcium bicarbonate signature. • There is a high degree of interconnection between groundwater and surface water.
Attachments	Table 1, Figure 1, 2, 3, 4.
Instrumentation	**Stream gauges:** 35008, 35010, 35014, 35017, 35030, 35031, 35033, 35034, 35035, 35036, 35037, 35038, 35074, 35075, 35086, 35087. **EPA Water Level Monitoring boreholes:** (SLI025), (SLI031), (SLI033). **EPA Representative Monitoring points:** (SLI008), (SLI013), (SLI015), (SLI022), (SLI027), (SLI028).

Information Sources	MacDermot, C.V. Long C.B. and Harney S.J (1996) *Geology of Sligo-Leitrim: A geological description of Sligo, Leitrim and adjoining parts of Cavan, Fermanagh, Mayo and Roscommon, to accompany bedrock geology 1:100,000 scale map, Sheet 7, Sligo - Leitrim*. With contributions from K. Carlingbold, G. Stanley, D. Daly and R. Meehan. Geological Survey of Ireland, 100pp. Thorn, R., Drew, D. and Coxon, C. (1990). *The Hydrology and Caves of the Geevagh and Bricklieve Karsts, Co. Sligo. Irish Geography* 23(2) (1990) 120-135. Geographical Society of Ireland, Dublin. Thorn, R. (1987). The Geevagh Karst. *Irish Speleology.* Journal of the Speleological Union of Ireland. Vol. 4 No. 1 1987. Thorn, R., Doyle, M., Henry, H. (1986). *The Groundwater Resources of South County Sligo – A Preliminary Appraisal.* Sligo Regional Techincal College. Report Number 86/1. ISBN 0 948870 01 X.
Disclaimer	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae.

Table 1. List of Rock units inGWB

Rock unit name and code	Description	Rock unit group	Aquifer Classification
Bricklieve Limestone Formation (upper) (BKU)	Bioclastic cherty limestone	Dinantian Pure Bedded Limestones	Rkc
Bricklieve Limestone Formation (lower) (BKL)	Bioclastic cherty limestone	Dinantian Pure Bedded Limestones	Rkc
Bricklieve Limestone Formation (BK)	Bioclastic cherty limestone	Dinantian Pure Bedded Limestones	Rkc

Figure 1. Location and Boundaries of GWB

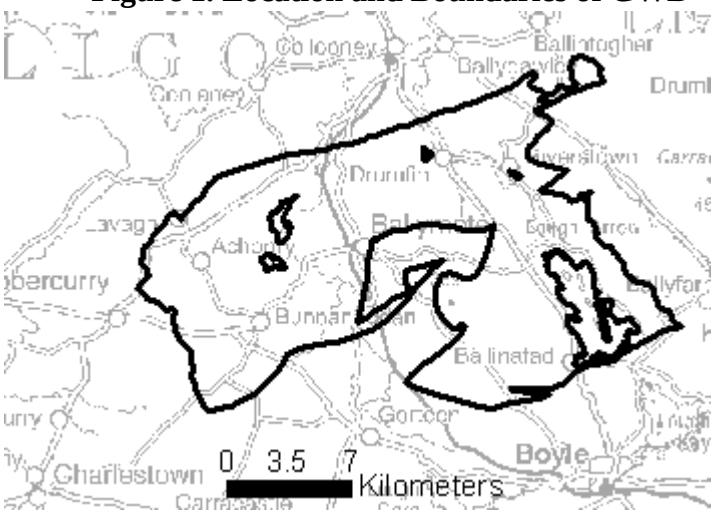

Figure 2

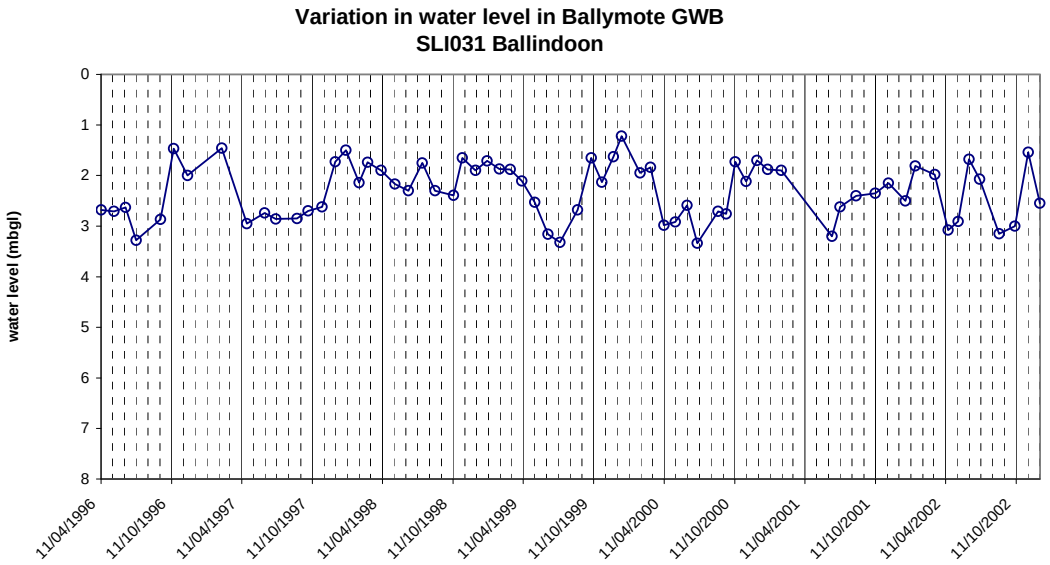

Figure 3

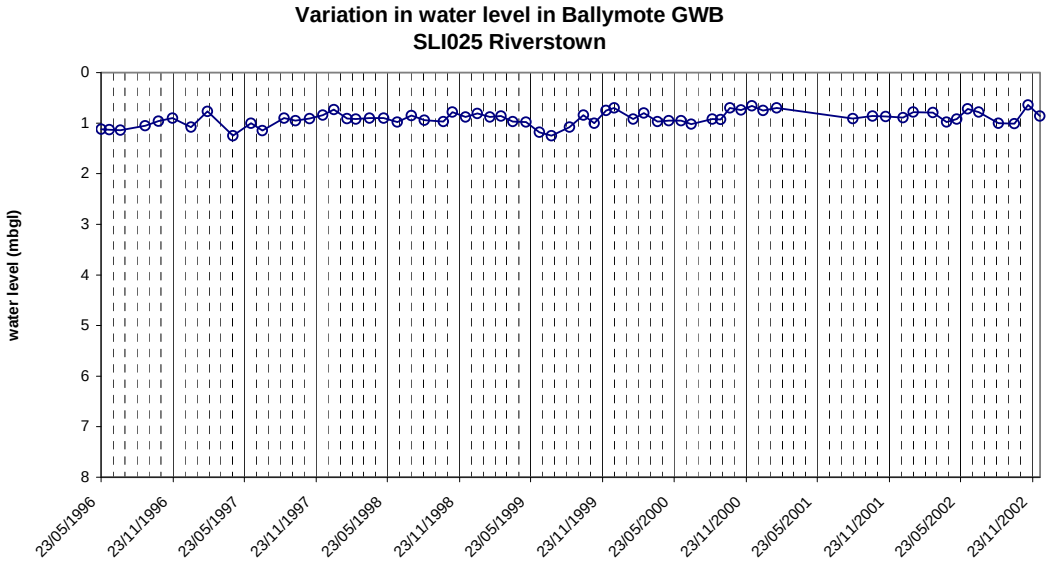

Figure 4

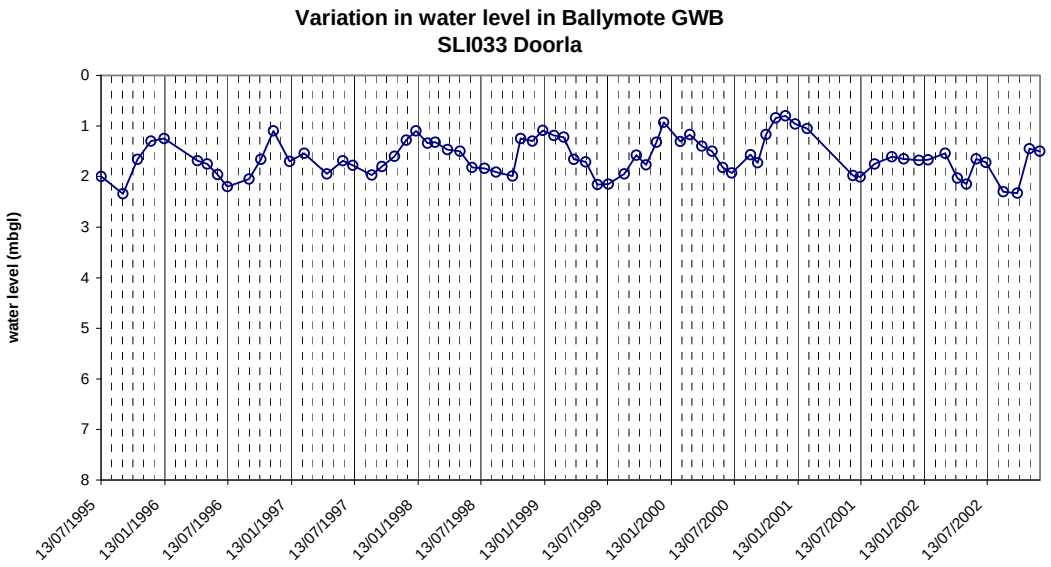
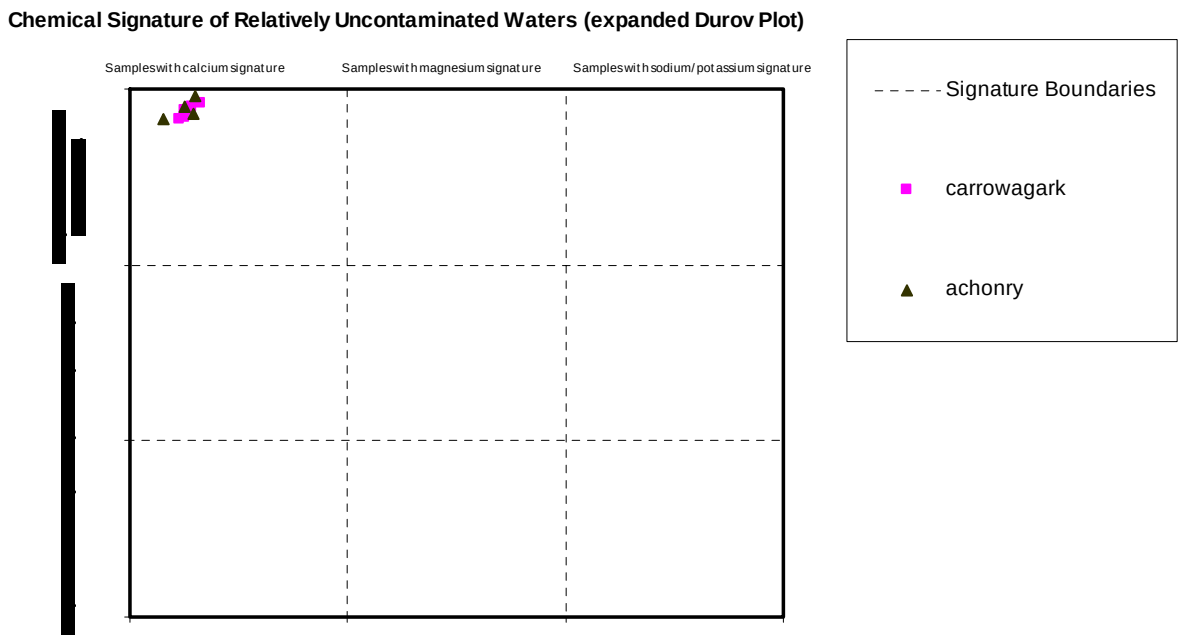
Figure 5