Clifden-Castlebar GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
32 Galway, Mayo Co Co's	There are numerous rivers, unnamed streams and lakes. See Table 1 for a full listing of the surface water features.	Connemara Bog Complex / The Twelve Pins - Garraun Complex / Mweelrea-Sheffry-Errif Complex (O'Riain, 2004).	898

Topog-raphy	The land surface is characterised by steep slopes and mountainous terrain, flattening in a westerly direction toward the coastline. Elevations range from 10-810 mAOD. The Twelve Pins, Sheffry Hills, Partry Mountains and the Maamturk Mountains are present in the GWB. The GWB stretches from Clifden in the south to Castlebar in the north.	
Geology and Aquifers	**Aquifer categories**	The main aquifer category in this GWB is: **Pl:** Poor aquifer which is generally unproductive except for local zones. It composes 98% of the GWB. Between Castlebar and Newport, there is a narrow area with an aquifer category of **Ll:** Locally important aquifer which is moderately productive only in local zones. East of Louisburgh, near Aghagower, East of Leenaun, in the Partry Mountains and just north of Toormakeady there are three small areas (5 km^2, 0.5 km^2, 6 km^2) of Moy Sandstone which is: **Lm:** Locally important aquifer which is generally moderately productive. Also just north of Toormakeady is an area (0.8 km^2) occupied by Visean Limestone which is: **Rk^c:** Regionally important karstified aquifer dominated by conduit flow
	Main aquifer lithologies	This GWB is composed primarily of Precambrian Quartzites, Gneisses & Schists, Ordovician Metasediments and Silurian Metasediments and Volcanics. Table 2 presents a full list of lithologies present. Precambrian Marbles cross cut the southern half of the GWB in two areas, at Clifden and Letterfrack and are part of the Letterfrack GWB.
	Key structures	The rocks in the GWB have undergone several episodes of deformation, comprising intense folding and faulting. The main structural trend is E-W. Major E-W trending folds include the Mweelrea Syncline and the Croagh Patrick Syncline. Parallel to these synclines are several major faults such as the Lough Nafooey, Derry Bay, Errif Valley and Doon Rock Fault. The Maam Valley Fault Zone is a major NW-SW trending fault structure. (Long *et al*, 2002). Bedrock strata tend to be steeply dipping.
	Key properties	Well data are sparse in the GWB. Three boreholes located in the schists north of Clifden, at Glenbricken and Coolacloy, have reported yields of 33, 26 and 15 m^3/d with specific capacities of 15, 1.3 and 0.6 $m^3/d/m$ respectively. The data indicate low transmissivities – in the range of 0.7-20 m^2/d. Two wells near Louisburgh also have similar yields and implied transmissivities. In the vicinity of faults, transmissivity may be higher. Storativity is expected to be low (<0.5%). The data are inadequate to calculate groundwater gradients, however, these are expected to be greater than 0.01.
	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; a zone of interconnected fissuring 10-15 m thick; and a zone of isolated poorly connected fissuring typically less than 150 m, in which strikes are noted between 40-50 m and 50-56 m below ground level in two boreholes near Louisburgh, but yields are from these isolated depths are low.
Overlying Strata	**Lithologies**	Approximately 32% of the subsoils are dominated by Blanket Peat. A full listing is given in Table 3.
	Thickness	Subsoil thickness data are sparse. Available data indicate the thickness of the subsoils is generally less than 3 m over the GWB. Subsoils are thicker in the low lying flatter areas of the GWB. The thickness of the blanket peat ranges from 0-6 m, depending on topography (Daly, 1985).
	% area aquifer near surface	*[Further Information to be added at a later date]*
	Vulnerability	*[Further Information to be added at a later date]*
Recharge	**Main recharge mechanisms**	Diffuse recharge occurs via rainfall percolating through the subsoil and rock outcrops. Due to the low permeability of much of the subsoil (blanket peat) and the aquifers, a high proportion of the available recharge will discharge to the streams. In addition, the steep slopes in the mountainous areas promote surface runoff. The stream density is approximately 1.5 km/km^2, indicating the high proportion of surface runoff.
	Est. recharge rates	*[Information to be added to and checked]*
Discharge	**Large springs and large known abstractions (m^3/d)**	There are no known large springs or large abstractions in the GWB.
	Main discharge mechanisms	Shallow groundwater is likely to discharge to streams and lakes, but the limited bedrock transmissivity means that the baseflow component of the total streamflow will be low. Small springs and seeps are likely to issue at the stream heads and along their course. Seepages will develop on the coastal cliff faces.

	Hydrochemical Signature	Wells north of Clifden have alkalinities in the range of 67-180 mg/l $CaCO_3$ and hardness in the range of 75-178 mg/l $CaCO_3$. The signature in the GWB is predominantly Ca-Mg-HCO_3.
Groundwater Flow Paths		Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. Generally, water levels are 0-8 m below ground level. Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to nearby streams and small springs. There are observed deep water strikes, indicating that there is a component of deep groundwater flow, however shallow groundwater flow is dominant. Groundwater flow directions are expected to follow topography – overall in a westerly 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 likely to be relatively low. Lakes comprise approximately 3% of the GWB.
Conceptual model		• The GWB is bounded to the west by the coast. The northern, southern and eastern boundaries are surface water catchment divides. The terrain is characterised by mountainous areas, flattening toward the coastline. • 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. • Groundwater flow is expected to be concentrated in fractured and weathered zones and in the vicinity of fault zones. • Recharge occurs diffusely through the subsoils and via outcrops. Recharge is limited by the peat and the low permeability bedrock, thus most of the available recharge discharges rapidly to nearby streams. • Flow paths are likely to be short (30-300 m) with groundwater discharging rapidly to nearby streams and small springs and flow directions are expected to follow topography. • Groundwater discharges rapidly to nearby small streams, lakes, small springs and seeps. Overall flow direction is westwards. • The rock units in GWB are generally of low permeability and baseflow to rivers and streams is likely to be relatively low.
Attachments		Table 1, 2, 3 and Figure 1.
Instrumentation		**Stream gauges:** 32004*, 32005, 32008, 32010, 32011*, 32013, 32014, 32015, 32016, 32017, 32018, 32019, 32020, 32023, 32060, 32072, 32073, 32074, 32078. * Adjusted Dry River Flow data available **EPA Water Level Monitoring boreholes:** (Mayo 84) **EPA Representative Monitoring points:** None
Information Sources		Daly, D. (1985) *Groundwater in County Galway with particular reference to its Protection from Pollution*. Geological Survey of Ireland report for Galway County Council. 98pp. Pracht, M., Lees, A., Leake, B., Feely, M., Long, B., Morris, J., McConnell, B., (2003*). A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 14, Galway Bay*. Unpublished Geological Survey of Ireland Map Series Report. Long, B., McConnell, B., Philcox, M.E. (2002). *A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 11, South Mayo.* Geological Survey of Ireland Map Series Report. Aquifer Chapters: The Granite, Ordovician, Precambrian and Ordovician Aquifers. O' Riain, G., (2004). *Water Dependent Ecosystems and Subtypes Draft Report.* WFD Support Projects. Compass Informatics in association with National Wildlife and Parks Service (DEHLG).
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 Associated surface water features

Rivers: Bellakip, Bunanakee, Bundorragh, Bunleemshough, Bunowen, Carrowbeg, Carrownisky, Cross, Culfin, Davros, Derrycraff, Erriff, Glaishwy, Glencullin, Glendavock, Glenlaur, Glenummera, Keeraun, Kylemore, Lugatoran, Moyour, Mweelin, Newport, Owenacunny, Owenadornaun, Owencloghagh, Owenduff, Owengarr, Owenglin, Owenmore, Owennabaunoge, Owennabrockagh, Owennaglogh, Owennasallagh, Owenwee, Polladirk, Shanaveagh, Traheen, Streamstown, Traheen, Erriff, Owenwee, Glenisland.
Streams: Owengarve
Lakes: Tonacrick Lough, Tawnyard Lough, Shanakeever Lough, Rusheenduff Lough, Rusheen Lough, Roonagh Lough, Prospect Lough, Moher Lough, Maw Lough, Lugaloughan, Lugaharry Lough, Lugacolliee Lake, Loughnakilky, Loughbaun, Loughauwnphaudeen, Loughaun's, Loughaunattin, Loughaunarow, Loughaunaroor, Loughaun, Loughaun, Loughaun, Loughanshee, Loughans, Loughanillaun, Loughanboy, Loughanaveeny, Loughan, Loughan, Loughan, Woongar, Usk, Tully, Touther, Tonagh, Tarriff, Tanny, Srahwee, Sillagh, Sallagher, Phreaghaun, Oughter, Nawarawaun, Natawny, Nasoodery, Namucka, Nambrackkeagh, Nambrackkeagh, Nambrackkagh, Nakilla, Nakilla, Nahoomin, Nahillion, Nahaltora, Naguroge, Nagap, Nacorrussaun, Nacorra, Nacarrigeen, Muingacurry, Muck, Maladrolaun, Lugaloughan, Louracheragh, Laraha, Laraha, Knockaunbaun, Greney, Glenawough, Gall, Fee, Fee, Fadda, Emlaghnacourty, Emilagh, Doo, Donoghmeave, Darrdun, Cunnel, Cunnel, Cashleen, Cahasy, Bunnaboghec, Breenbannia, Brawn, Benchoona, Ben, Bellawaum, Beg, Beg, Beg, Beg, Beflawaum, Awaniareen, Awaddy, Auna, Athola, Ascardaun, Apillaun, Animma, Alisheen, Agh, Adroma, Acreragh, Acrannereen, Loch an Gherarrain Bhain, Lettershask North, Lettereen Lough, Kylemore/Pollacappul Lough, Knappaghmore Lough, Knappagh Lough, Knappagh Lough, Killadangan Lough, Island Lough, Island Lough, Is_Inland, Glencullin Lough, Glenbrickeen Lough, Gibson's Lough, Fin Lough, Fiddaungil, Feenune Lough, Faul Lough, Emlaghbeg Lough, Drinagh Lough, Drimeen Lough, Drimeen Lough, Doonloughan Lough, Doonloughan Lough, Dooaghtry Lough, Doo Lough, Derrywaking Lough, Derryvraun Lough, Derrylea Lough, Derrygarvebeg, Derryaun Lough, Derryascorra Lough, Derrintin Lough, Derrarlan Lough, Cuilmore Lough, Cross Lough, Croft Lough, Creggan Lough, Cregg Lough, Creeggan Lough, CourhoorLough, Corragaun Lough, Cogaula Lough, Cashel Lough, Carrowevagh Lough, Carrickawaddy Lough, Boolagare Lough, Boheh Loughs, Boheh Loughs, Beltra Lough, Barnahallia Lough, Ballynakill Lough, Ballynacarrick Lough, Ballybwee Lough, Ballinaboy Lough, Aughrusbeg Lough, Anivan

Table 2. Rock units in Clifden GWB

RockUnit	category	aquifer type	%AREA o	Code	Unit name
Dinantian Pure Bedded Limestones	Rkc	Pending Classification	1%	VIS	Visean Limestones (undifferentiated)
Cambrian Metasediments	Pl	Poorly Productive Bedrock Aquifer	2%	WG	Westport Grit Formation
Devonian Old Red Sandstones	Pl	Poorly Productive Bedrock Aquifer	5%	GM	Graffa More Formation
Granites & other Igneous Intrusive rocks	Pl	Poorly Productive Bedrock Aquifer	12%	S	Serpentinite
Ordovician Metasediments	Pl	Poorly Productive Bedrock Aquifer	36%	SH	Slate Members
Ordovician Volcanics	Pl	Poorly Productive Bedrock Aquifer	2%	FN	Farnacht Formation
Precambrian Quartzites, Gneisses & Schists	Pl	Poorly Productive Bedrock Aquifer	22%	ST	Streamstown Schist Formation
Silurian Metasediments and Volcanics	Pl	Poorly Productive Bedrock Aquifer	19%	SK	Strake Banded Formation
Dinantian Sandstones	Lm	Productive Fractured Bedrock Aquifer	1%	MO	Moy Sandstone Formation

Table 3. List of Subsoils in Clifden GWB.

Parent Material	Code	%area of GWB
Alluvium	A	1.07%
Alluvium clayey	Ac	0.03%
Acidic esker sand/gravel	AcEsk	0.00%
Alluvium gravelly	Ag	0.00%
Alluvium silty	Asi	0.01%
Blanket peat	BktPt	32.09%
cutover	Cut	0.70%
Sandstone sand/gravel (devonian/carb)	GDCSs	0.00%
sandstone sand/gravel (lower palaeozoic)	GLPSs	0.68%
sandstone and shale sand/gravel (lower palaeozoic)	GLPSsS	0.03%
metamorphic sand/gravel	GMp	0.18%
Lake sediments undifferentiated	L	0.00%
Lakes	Lake	2.80%
islands	Lk_isle	0.02%
Madeground	Made	0.10%
Beach Sand	Mbs	0.49%
Estuarine Sediments	Mesc	0.08%
Rock at surface	Rck	41.61%
Scree	Scree	0.90%
Till sandstone devonian carboniferous	TDCSs	0.07%
Till sandstone devonian	TDSs	3.27%
Till Granitic	TGr	0.73%
Sandstone dominated Lower Palaeozoic Till	TLPSs	4.88%
Till sandstone and shaleSandstone and shale dominated till (Devonian/Carboniferous)	TLPSsS	5.42%
Limestone till	TLs	0.06%
Metamorphic Till	TMp	4.57%
Blown sand	Ws	0.19%

Figure 1. Clifden-Castlebar GWB [reference only]