Herbertstown GWB: Summary of Initial Characterisation.

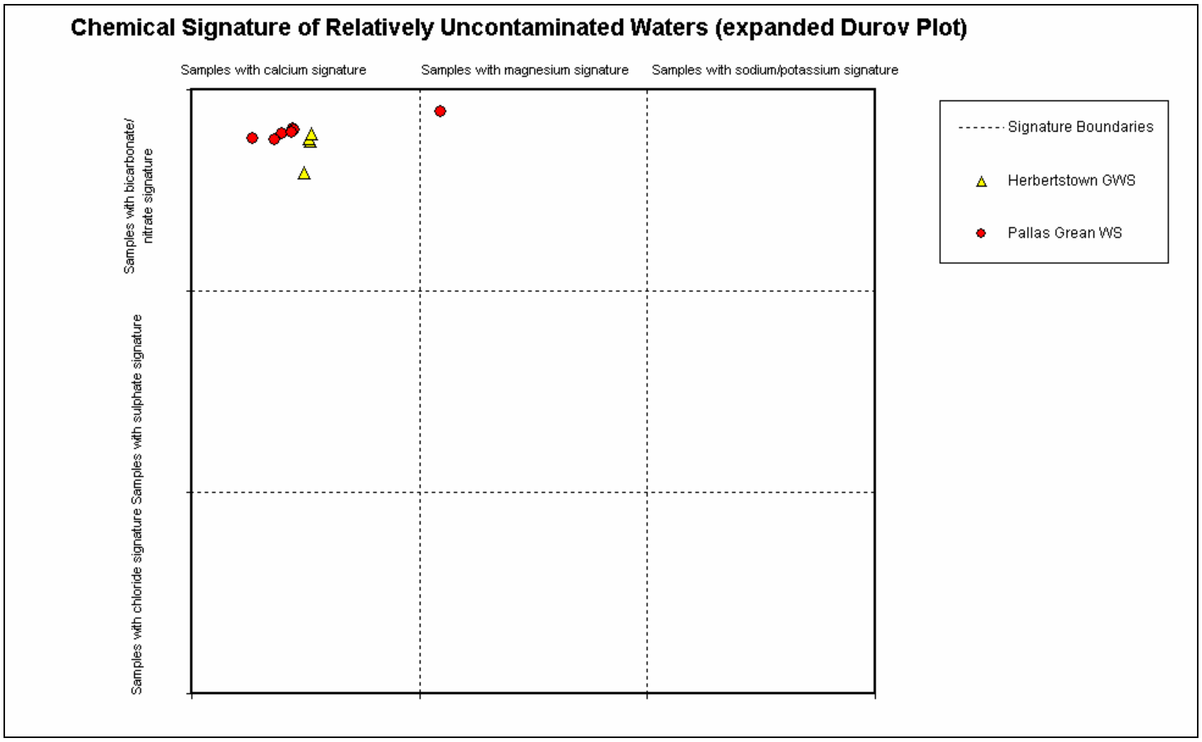
Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
24 - Maigue catchment Limerick Co. Co.	Rivers: Groody*, Camoge. ** note that the Groody River crosses the hydrometric boundary into Hydrometric Area 25.*	None groundwater-dependent.	38

Topography	The GWB has an irregular outline, but is very roughly 'C' shaped. The largest part of the GWB is in the west and north, with a narrower tail in the SE. Ground elevation ranges from just under 70 mAOD to just over 130 mAOD. The highest ground is found in the SE of the GWB, and along parts of the western and southern boundaries, where the more resistant adjacent volcanic rocks of the Knockroe SW GWB have created topographic highs. The lowest elevations occur in the west of the GWB, where the Camoge River flows off the GWB. Over most of the GWB, in the west, elevations are around 80 mAOD, and the terrain is almost flat. Drainage is poor, and many drainage channels have been excavated. Most of the drainage channels and small streams drain to the River Camoge. However, within this GWB, there are tributaries of the River Groody, which drains to the adjacent catchment. One of the channels drains to both Rivers.	
Geology and Aquifers	Aquifer categories	All aquifers within this GWB are classified as **Lm:** Locally important aquifers which are generally moderately productive.
	Main aquifer lithologies	The majority of the GWB comprises Dinantian Pure Bedded Limestones. There is a very small area at surface of Basalts and other Volcanic rocks.
	Key structures	The rocks are on the western limb of a large boat-shaped syncline whose axis is orientated ENE-WSW. Strata are tilted to the NE, E and SE at angles ranging between 10-45°. NNW-SSE trending major faults cross-cut the fold at about 2.5 km intervals. There are also ENE-WSW orientated faults. Movements during the folding would also have caused some fracturing and jointing of the rocks. Deakin (1995) considers that fracturing and jointing in the area may provide high transmissivity zones in a north-south direction.
	Key properties	Transmissivity in the limestone aquifer at Pallas Grean (in the adjacent Pallas Grean GWB) was estimated as 26 m^2/d. Transmissivities are likely to be in the range 5-150 m^2/d. The median value will be towards the lower-middle end of the range. In the Volcanic rocks, transmissivities will be similar, with median values towards the lower end of the range. Because the ground is flat-lying, groundwater gradients will be low (~0.01) over most of the GWB, ranging up to 0.02 in the steeper areas. *(data sources: Rock Unit Group Aquifer Chapters, Limerick GWPS Report, Source Reports, see references; estimation from maps)*
	Thickness	The Dinantian Pure Bedded Limestones vary laterally in maximum thicknesses from 150 m to up to 500 m. However, most groundwater flow is likely to take place in the top ~30 m, in the zone that comprises a weathered layer of a few metres and a connected fractured layer below this. Deeper groundwater flow occurs along fault zones and large fractures.
Overlying Strata	Lithologies	GSI mapping indicates that the subsoil is predominantly Limestone Till. There are small areas of Gravel, Till with Gravel. Alluvium occurs along the course of the Camoge River, and also along smaller rivers.
	Thickness	There are insufficient data to assess subsoil thicknesses across this GWB.
	% area aquifer near surface	*[Information to be added at a later date]*
	Vulnerability	Probable groundwater vulnerability ranges from Extreme to High over most of the GWB. There are some smaller areas of Moderate Vulnerability in the west of the GWB. Extreme vulnerability areas occur mainly around the margins of the GWB, although there are some Extreme areas in locally elevated areas in the west of the GWB. The remaining areas are predominantly High vulnerability.
Recharge	Main recharge mechanisms	Diffuse recharge will occur via rainfall percolating through the subsoil or areas of outcropping rock. The proportion of the effective rainfall that will recharge the aquifer is determined by the thickness and permeability of the subsoil, and by the slope. The drainage density indicates the water table is close to the ground surface over much of the GWB. In these areas, groundwater flow paths will be very short and potential recharge may be rejected. Point recharge of waters originating from outside the GWB may occur along the eastern edges of the groundwater body, where runoff from the low transmissivity Knockseefin-Longstone West GWB crosses onto this GWB and has caused karstification. Subsurface cross-flow from the adjacent Knockseefin-Longstone West GWB may also occur.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	Springs and large known abstractions (m^3/d)	Carnane GWS (208 m^3/d – EPA database), Drombanna Co-Op (Fedamore) (163 m^3/d – EPA database), Golden Vale Co-Op (Ballybricken) (32 m^3/d – EPA database), Knockea GWS (unknown abstraction – EPA database), Herbertstown GWS (new) (unknown abstraction – EPA database). Caherline Caherconlish GWS (163 m^3/d – EPA database) falls within Maigue catchment used as the eastern boundary of the GWB but, from topographic considerations, would appear to be on the east of the catchment divide and part of the Pallas Grean GWB. *[More information may be added at a later date]*
	Main discharge mechanisms	The rivers, streams and drainage ditches crossing the GWB are gaining. Groundwater also discharges to springs.

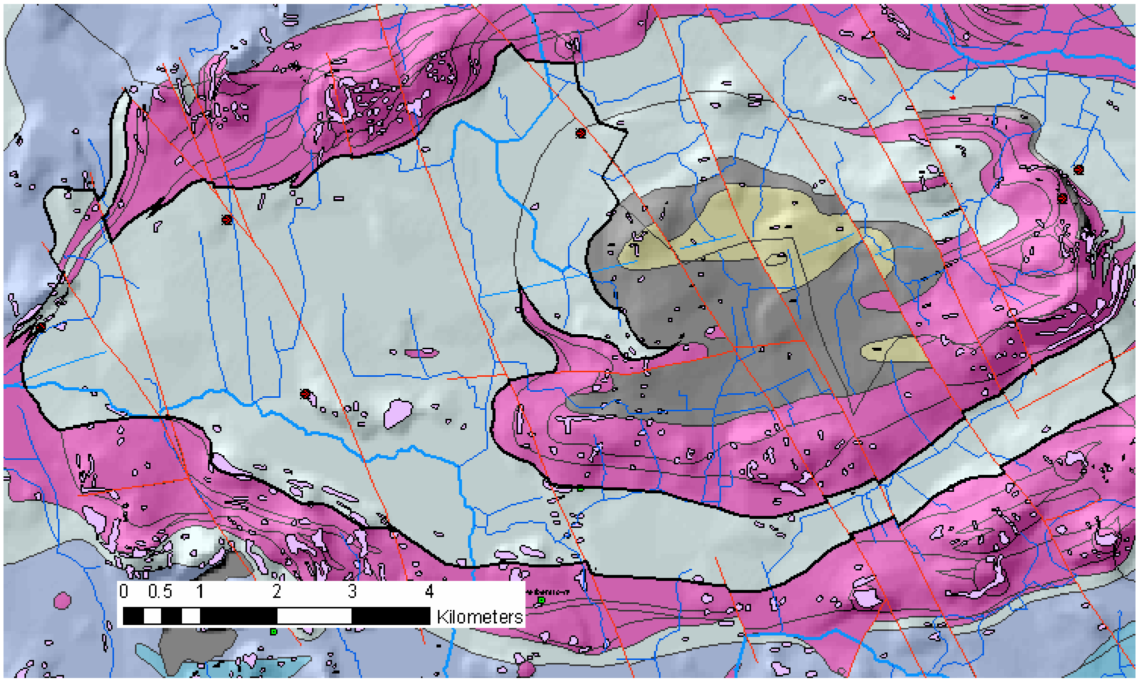
	Hydrochemical Signature	Groundwater generally has a calcium-bicarbonate signature, although in the adjacent Pallas Grean GWB, a Ca-Mg-HCO_3 signature indicates some influence of dolomitisation. Groundwater is typically Hard to Very Hard (240–370 mg/l as $CaCO_3$) with corresponding high alkalinities (230–315 mg/l as $CaCO_3$) and conductivities (530-670 µS/cm), and pHs in the range 7.2-7.85. One km to the north of the Namurian rocks of the Knockseefin-Longstone West GWB, there is a chalybeate (iron rich) spring that is reputed to sometimes be 'oily'. The spring is near a NNW trending fault, and the composition of the spring water indicates that the groundwater has originated in the Namurian rocks and travelled along the fault zone. Background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.
Groundwater Flow Paths		Groundwater flows through fractures and faults. A limited amount of dissolution along fractures and bedding planes may have further increased permeability in some areas. Dolomitisation may have further increased local permeability, although this is not known on this side of the syncline. Permeabilities in the upper few metres are often high although they decrease quite rapidly with depth. In general, groundwater flow is concentrated in the upper 30 m of the aquifer; this zone comprises a weathered layer of around 3 m thick, with a connected fractured zone a further 20-25 m, below which is a generally poorly fractured zone, although deeper inflows from along faults or connected fractures can be encountered. Karstification has occurred at the boundary between the non-carbonate rocks of the Knockseefin-Longstone West GWB and the limestones within this GWB (Strogen, 1988). Transmissivities will be enhanced in this area, and point recharge is likely to occur. Groundwater is predominantly unconfined and the water table is considered to be in hydraulic continuity with the rivers and streams. The drainage pattern and database records show that the water table is very close to the surface (0-3 mbgl) over much of the GWB, with dug wells the most common means of abstracting groundwater in this area. However, in the elevated areas at the southern edge of the GWB, deep wells intersect the water table at between 18-24 mbgl. Groundwater flow paths are typically relatively short in the low-lying waterlogged areas, with groundwater discharging locally to the streams, ditches and small springs. However, the chalybeate spring that is >1000 m from the Namurian outcrop demonstrates that longer flow paths occur along the NNW-SSE fault zones. Longer flow paths will also occur in more elevated areas where the water table is further below ground level. Local topographic variation and the locations of streams will determine the groundwater flow direction. In the north of the GWB, groundwater discharges to the Groody River, which flows NE into the adjacent Hydrometric Area.
Groundwater & Surface water interactions		The very shallow nature of the flow system (due to the generally high water table) leads to rapid interchanges of water between surface and underground. At the boundary between the non-carbonate Knockseefin-Longstone West GWB and this limestone aquifer, swallow holes and karstic features receive surface water. Groundwater is discharged to surface as springs or as baseflow to rivers and streams crossing the GWB.
Conceptual model		• The GWB is irregular in shape. It is roughly 'C' shaped. The northern, western and southern boundaries are formed by the contact with the lower transmissivity volcanic rocks of the Knockroe GWBs. Most of the eastern boundary is formed by the contact with the volcanic and Namurian rocks of the Knockseefin-Longstone West GWB; the NE and SE parts of the boundary are coincident with surface water catchment boundaries. The area is mostly very flat-lying, except around parts of the southern and western margin, and in the SE. • The GWB comprises moderately transmissive rocks that have low storativity. Localised zones of enhanced permeability occur along the NNW-SSE orientated fault zones and fracture system. The small areas of gravelly tills and alluvium may contribute storage to the bedrock aquifer. • Diffuse recharge occurs where subsoil thickness and permeability permit. The factor limiting diffuse recharge is the generally high water table, which will cause effective rainfall to be rejected or flow quickly to surface water features via very short flow paths. However, local internal drainage basins probably exist, ponding the potential recharge. Point recharge is likely to occur of runoff from the non-carbonate low transmissivity rocks of the Knockseefin-Longstone West GWB. • The aquifer is generally unconfined. The water table follows topography and is typically 0-3 m below ground level in the flat-lying areas, although in elevated areas, unsaturated zones of around 20 m exist. Groundwater flows along fractures, joints and major faults. Most groundwater flow occurs near the surface in a zone roughly 30 m thick comprising a weathered zone of a few metres and a connected fractured zone below this. Deeper inflow levels will occur where isolated fractures/faults or jointed zones are intercepted. Flow path lengths in general are relatively short, particularly in areas where the water table is near to the surface. However, the NNW-SSE fracturing and faulting is known to create high-permeability pathways where groundwater flows significant distances (>1000 m), and has probably caused transmissivity anisotropy. • Groundwater discharges to the streams crossing the aquifer and to small springs. Unconfined groundwater flow directions are controlled by local topography and drainage patterns. Overall, most groundwater flows westwards, down-slope, and southwards to the Camoge River. • In the NE of the GWB, groundwater flows to the Groody River and its tributaries, and, as the boundary between the two GWBs is currently drawn, probably cross-flows into the adjacent Pallas Grean GWB. The Groody River also crosses the catchment divide as it is mapped. • Because the water table is very close to the surface over much of the GWB, the very shallow nature of the flow system leads to rapid interchanges of water between surface and underground.
Attachments		Hydrochemical signature (Figure 1).
Instrumentation		Stream gauges: 24040. EPA Representative Monitoring boreholes: Herbertstown GWS (new) (LIM 245), Herbertstown (LIM 55A) (EPA database puts both monitoring points at same location).

Information Sources	Deakin, J. (1995) *Pallas Grean Public Supply, Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme*. Geological Survey of Ireland Report to Limerick Co. Co., 72 pp. Strogen, P. (1988). The Carboniferous lithostratigraphy of southeast Co. Limerick, Ireland, and the origin of the Shannon Trough. *Geol. J.,* Vol. 23, pp. 121–137. Aquifer chapters: Dinantian Pure Unbedded Limestones, Basalts and other Volcanic rocks.
Disclaimer	Note that all calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Figure 1: Hydrochemical signature



NB: this plot also contains data from the adjacent Pallas Grean WS.



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Herbertstown Limestone Formation (HE)	Blue-grey limestone and interbedded ash	Dinantian Pure Bedded Limestone
Dromkeen Limestone Formation (DR)	Pale thick-bedded bioclastic limestone	Dinantian Pure Bedded Limestone
Trachyte (T)		Basalts and other Volcanic rocks