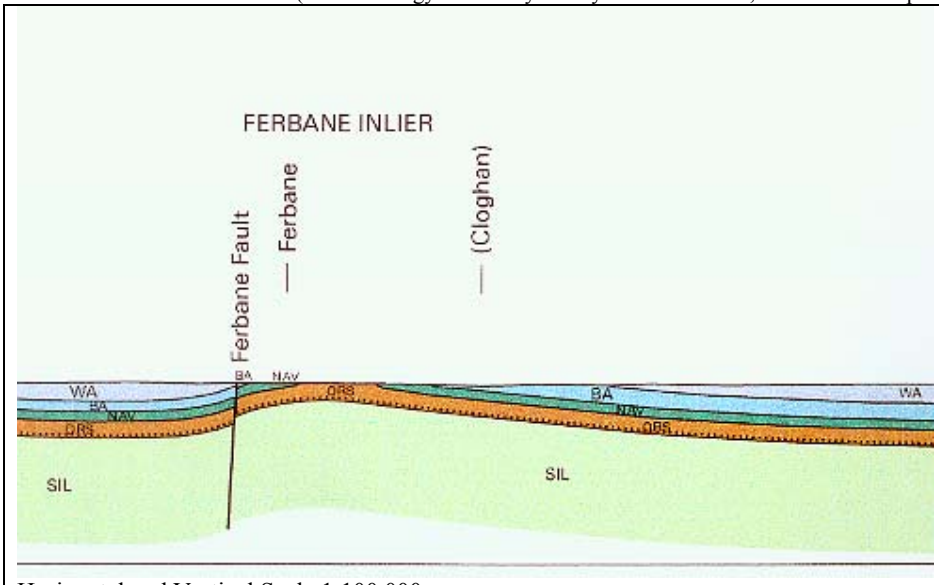
Ferbane GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authority		Associated surface water bodies	Associated terrestrial ecosystem(s)	Area (km^2)
25 - Brosna Catchment Offaly Co. Co.		Rivers: Brosna.	None groundwater-dependent.	14 (at surface)
Topography	The GWB is narrow, and elongated in a NE-SW direction, in line with the structural 'grain' of the area. The area is extremely flat-lying, with elevations ranging from 40-60 mAOD across the GWB. Four streams flow off this GWB and drain to the Brosna and Little Rivers, but only the River Brosna crosses the GWB.			
Geology and Aquifers	Aquifer categories	**Rf:** Regionally important fissured aquifer.		
	Main aquifer lithologies	Devonian Kiltorcan-type Sandstones. *(Described as Cadamstown Sandstone in the Offaly Groundwater Protection Scheme)*		
	Key structures	The Devonian Kiltorcan-type Sandstones of this body form the core of a major northeast southwest trending anticlinal structure known as the Ferbane Inlier. The sandstones are overlain to the northwest and southeast by Dinantian Sandstones, Shales & Limestones which are in turn overlain by Dinantian Lower Impure Limestones (Figure 1). A major fault, the Ferbane Fault, runs along the northwestern side of the inlier (trending northeast to southwest) downthrowing the succession to the northwest of the fault. The rock layers dip to the northwest and southeast at 5-15^{o}, unless the strata are further deformed by faulting. The fold axis is heavily dissected by northwest to southeast normal faults that are spaced at 1-3 km. Rocks of a similar type, approx. 17 km southeast of this GWB in the Clonaslee West GWB, are well jointed (two sets of major vertical joints NW-SE and NE to SW) and horizontal fractures can recognised in most exposures as well as microfractures which are frequently closely spaced (≤0.2m).		
	Key properties	Transmissivity is in the range 20 to 90 m^2/d. Specific yield = 0.01-0.02, and Storativity = 8.4 x 10^{-4}. Gradients are approximately 0.01 - 0.02. *(data sources: Rock Unit Group Aquifer Chapters, GWPS Reports, see references; estimation from maps)*		
	Thickness	The rock unit varies in maximum thickness from 70 to 105 m. The aquifer is formed by the whole interval.		
Overlying Strata	Lithologies	A Teagasc Parent Material Map is not currently available for County Offaly. The Offaly Groundwater Protection Scheme Quaternary Geology Map identifies areas of peat (northeast of the body), gravel deposits, till and till with gravel overlying this GWB. *(The gravel deposits overlying this body were identified in the Offaly Groundwater Protection Scheme as a Potential Locally Important Gravel Aquifer).* *[Information to be added at a later date]*		
	Thickness	Subsoils data are sparse. Available data indicate substantial thicknesses of gravel (9-30 m) overlying the GWB in the west, and subsoil thicknesses of between 5-11 m elsewhere in the GWB. There are no rock outcrops over this GWB.		
	% area aquifer near surface	*[Information to be added at a later date]*		
	Vulnerability	Vulnerability is High over the southwest two thirds of the GWB, and is Moderate in the northeast. *A Groundwater Vulnerability Map has been prepared as part of the Offaly Groundwater Protection Scheme.*		
Recharge	Main recharge mechanisms	Diffuse recharge will occur over the entire GWB via rainfall percolating through the subsoil. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope. Gravel deposits are generally considered to have a 'high' permeability, and where unsaturated facilitate percolation of recharge to the underlying aquifer. Percolation of recharge may be restricted in the northeast of the body where the aquifer is overlain by a large area of peat. Peat deposits in this region are generally underlain by low permeability lacustrine clay and lake marl.		
	Est. recharge rates	*[Information to be added at a later date]*		
Discharge	Important springs and high yielding wells (m^3/d)	The two boreholes at Gallen yield 760 m^3/d and 780 m^3/d (GSI 'Excellent' yield classifications). They are drilled through the confining Dinantian (early) Sandstone, Shales and Limestones (Navan Group). The Bord na Móna borehole at Gallen yields 396 m^3/d, whilst a private well at Strawberry Hill House yields 218 m^3/d (GSI 'Good' yield classifications).		
	Main discharge mechanisms	The normal faults cutting across this GWB are thought to act as discharge zones for groundwater, particularly in the confined portion of the body.		

	Hydrochemical Signature	At Gallen, EPA sampling indicates moderate alkalinities in the range 180-220 mg/l $CaCO_3$. Groundwater conductivity generally ranges from 485–600 µS/cm. Laboratory pH is neutral to slightly alkaline (7.1-8.3); one field sample measured pH 6.95. Sodium concentrations are relatively high (>30 mg/l as opposed to the general levels of 5-15 mg/l), and the hydrochemical signature ranges from calcium-bicarbonate to calcium-magnesium-bicarbonate. This is indicative of ion exchange occurring along long, relatively slow flow-paths in the sandstone aquifer.
Groundwater Flow Paths		Groundwater flows primarily through fissures and joints. The fissuring associated with the faults in this GWB results in higher transmissivities, specific capacities and yields for some wells. However the degree of fracturing and consequently development of permeability can vary over relatively short distances. In certain areas the rock cement has been dissolved and so the rock is crumbly and easily weathered. Here it may have intergranular permeability - a feature that is very unusual in Irish bedrock. Overall flow directions within the body are difficult to estimate given the limited range of ground elevation across the body (40-60 mAOD). Groundwater gradients are extremely low. Groundwater flow is unconfined in the centre of the body but becomes confined beneath the Dinantian (early) Sandstones Shales and Limestones of the Clara GWB. The Ferbane fault, a major fault running northeast southwest along the northwestern side of the body, is likely to act as a no flow boundary. The succession is downthrown to the northwest of the fault. Trial boreholes drilled at ……..(ask Coran for details) just…km from the fault encountered …m of Dinantian Lower Impure Limestones but no Kiltorcan-type Sandstones. It is possible that groundwater in the confined portion of the body discharges through the numerous northwest to southeast normal faults that cut across the inlier. The GWB is partially overlain by a potential gravel aquifer. There is not sufficient information about saturated thickness available at this time to formally classify it as a gravel aquifer.
Groundwater & Surface water interactions		There are no groundwater dependant terrestrial ecosystems with a national designation from Dúchas/Department of the Environment within this GWB.
Conceptual model		• This GWB is bounded on all sides by the contact with the lower permeability Dinantian (early) Sandstones, Shales and Limestones of the Clara GWB. • The topography is flat-lying with ground elevations ranging from 40-60 mAOD across the body. • The groundwater body is composed of high transmissivity fissured bedrock, Devonian Kiltorcan-type Sandstones. • The sandstones of this body form the core of a northeast southwest trending anticlinal structure known as the Ferbane Inlier. They are overlain to the northwest and southeast by low permeability rocks of the Dinantian (early) Sandstones, Shales and Limestones and the Dinantian Lower Impure Limestones. The Ferbane fault runs northeast to southwest along the northwestern side of the body, downthrowing the succession to the northwest of the fault and forming the northwestern boundary of the body. • Flow in this body occurs along fractures, joints and major faults. In certain areas there may be some intergranular permeability, as a result of the dissolution of the rock cement, which leaves the rock crumbly and easily weathered. Groundwater flow is unconfined in the centre of the body but becomes confined beneath the Dinantian (early) Sandstones, Shales and Limestones of the Clara GWB. Groundwater gradients are very low. • Hydrochemistry from wells in the confined portion of the body indicate that ion exchange is occurring along long relatively slow flow paths in the sandstone aquifer. • Diffuse recharge occurs throughout the GWB. The normal faults cutting across this GWB are thought to act as discharge zones for groundwater, particularly in the confined portion of the body.
Attachments		Schematic representation of groundwater movement (Figure 1), Hydrochemical signature (Figure 2).
Instrumentation		Stream gauges: 25006. EPA Representative Monitoring boreholes: Ferbane (Gallen) (OFF 11).
Information Sources		Barber, W. (1979) *Evaluation of Groundwater Resources of the Clonaslee Area Co. Offaly.* Geoex Limited. Daly, D., Cronin, C., Coxon, C. and Burns, S-J (1998) *County Offaly Groundwater Protection Scheme.* Geological Survey of Ireland Report to Offaly Co. Co., 54 pp. Daly, E.P. (1985*). Hydrogeology of the Kiltorcan Aquifer System.* Groundwater Section, GSI Internal Report. Daly, E.P. (1988) The Kiltorcan Sandstone Aquifer. Proceedings of *Eighth Annual International Association of Hydrogeologists (Irish Branch) Seminar, Portlaoise.* Deakin, J., Fitzsimons, V., Gately, C. and Wright, G.R. (revised 2002) *County Laois Groundwater Protection Scheme (draft)*. Geological Survey of Ireland Report to Laois Co. Co., 44 pp. Aquifer chapter: Devonian Kiltocan-type Sandstone.
Disclaimer		Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Figure 1: Schematic Cross Section through the Ferbane Inlier

(From Geology of Galway-Offaly Sheet 15. 1:100,000 Bedrock Map Series)



WA – Waulsortian Limestone
(Dinantian Pure Unbedded Limestones)

BA – Ballysteen Limestone
(Dinantian Lower Impure Limestones)

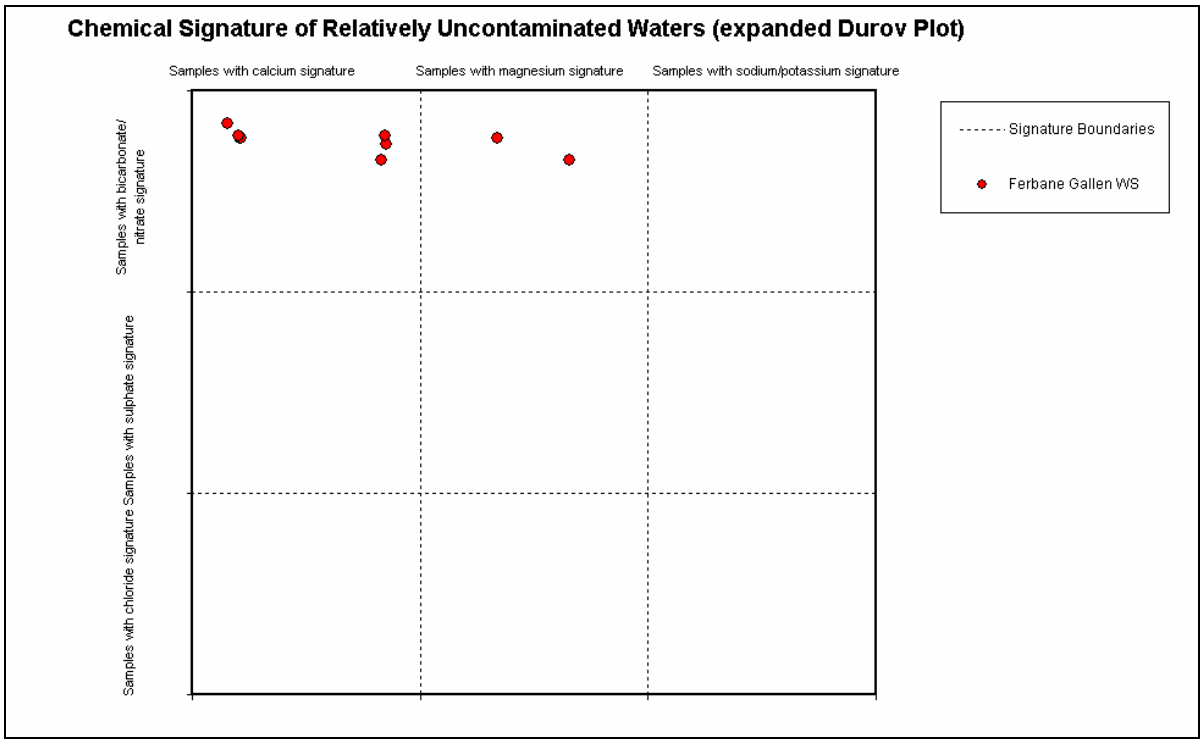
NAV – Navan Group
(Dinantian (early) Sandstones, Shales & Limestones)

ORS – Old Red Sandstone Undifferentiated
(Devonian Kiltorcan type Sandstones)

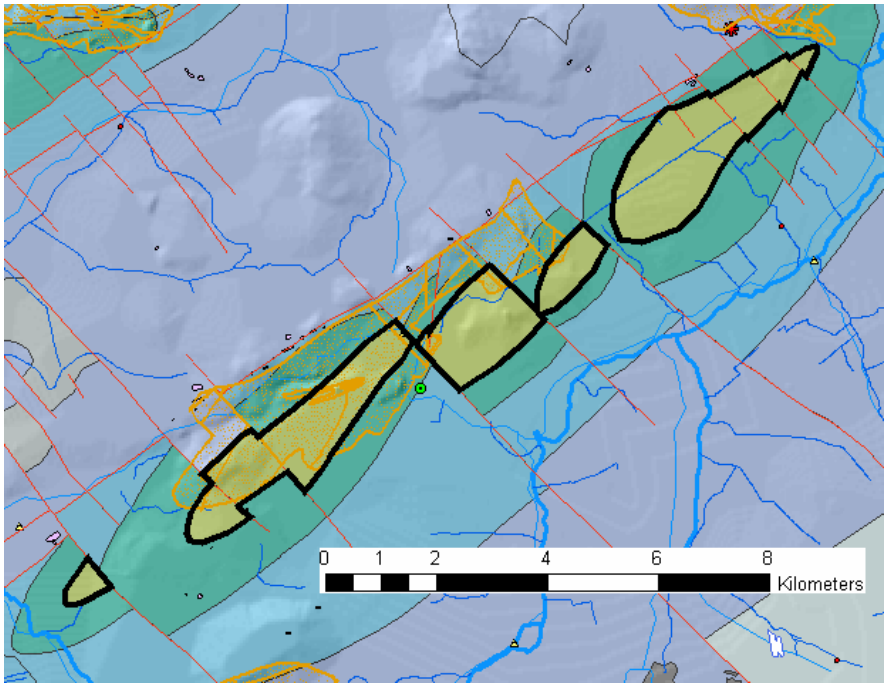
SIL – Undifferentiated Silurian Rocks (Silurian Metasediments)

Horizontal and Vertical Scale 1:100,000

Figure 2: Hydrochemical signature



FERBANE GWB (FOR REFERNCE)



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Old Red Sandstone (undifferentiated)		Kiltorcan-type Sandstones