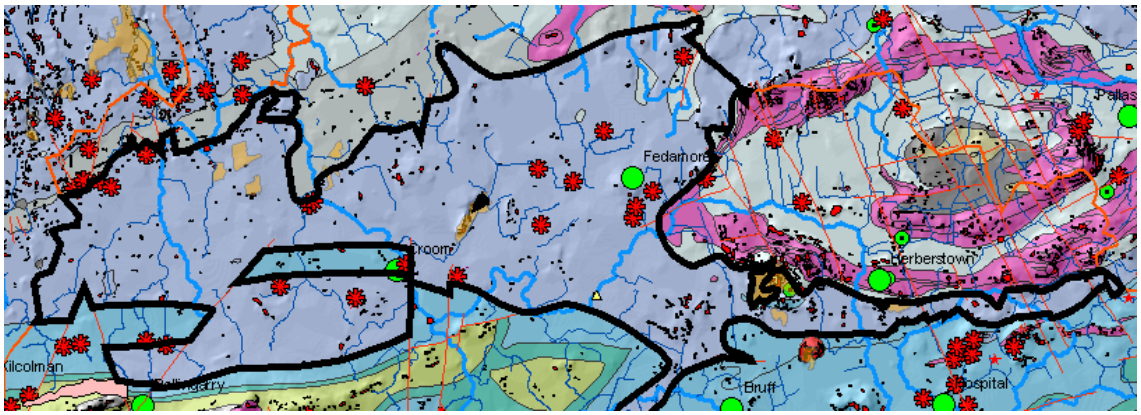
Fedamore GWB: Summary of Initial Characterisation.

Hydrometric Area Local Authorities	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
24 - Maigue, Limerick Co. Co.	Rivers: Maigue, Ahanload, Camoge, Ballynaclough, Ballynamona, Morningstar, Clonshire, Mahore, Barnakyle. Loughs: Gur, Nagirra.	Lough Gur (000437), Herbertstown Fen (000436), Tory Hill (includes Lough Nagirra) (000439).	210

Topography	The GWB is elongated E-W and has an irregular outline as it wraps around the Knockroe NW and SW GWBs in the east, and is partially dissected by rocks of the Hospital GWB in the west. Over most of the GWB ground elevation ranges between 20–60 mAOD, although higher ground is found east of Fedamore, where average elevations are 60-80 mAOD. The lowest ground of less than 10 mAOD is found in the NW of the GWB, near the confluence of the Maigue and Clonshire Rivers. Highest elevations occur along parts of the eastern boundary, including near Lough Gur and Cromwell Hill. High elevations along the eastern boundary are generally associated with the more resistant volcanic rocks or cherty bedded limestones. Within the GWB, more there are more resistant zones within the pure unbedded limestones (e.g. at Tory Hill). Surface water drainage is generally northwards, towards the Shannon Estuary.	
Geology and Aquifers	Aquifer categories	The majority of the GWB is comprised of an **Rk^d:** Regionally important karstified aquifer dominated by diffuse flow. The Pure Bedded Limestones near Lough Gur and in the NE of the GWB are classified as **Lm:** Locally important aquifers which are generally moderately productive. The small areas of volcanic rocks in the east of the GWB are currently classified as **Ll:** Locally important aquifers which are moderately productive only in local zones, as is the small area of Lower Impure Limestones that occur on the south shore of Lough Gur.
	Main aquifer lithologies	Dinantian Pure Unbedded Limestones, Dinantian Pure Bedded Limestones, Dinantian Lower Impure Limestones, Basalts and other Volcanic rocks.
	Key structures	The rocks are part of a synclinal structure, and in this area form the limbs and core of the fold. The axis of the fold is orientated ENE-WSW. Dip angles are between 20^o and 40^o and reflect the steep mounds of the Waulsortian limestones as well as the folding. Overall, strata will dip roughly at right angles to the edges of the GWB (i.e., north and south), but the shapes of the limestone mounds result in measured dips in all directions. NW-SE, N-S and NE-SW trending faults occur in rocks; they are mapped at the edges of the body, and although no faults are mapped in the centre of this area, they will be present. In the southwest of the GWB, faulting has partially compartmentalised the aquifer.
	Key properties	Transmissivities in diffusely karstified aquifers (the Dinantian Pure Unbedded Limestones) are in the range 20–2000 m^2/d. In this area of the country, the median value will probably be towards the lower-middle end of the range. At Croom and Fedamore WSs, transmissivities are 120 m^2/d [estimate range 95–145 m^2/d] and 34 m^2/d [estimate range 23–41 m^2/d], respectively. Groundwater gradients within the karstic aquifer are low, ranging from approximately 0.005 to 0.01. Within the Pure Bedded Limestones, transmissivities will tend to be lower, in the range 10-100 m^2/d. Transmissivities in the volcanic rocks are variable; in places, clays from weathering after their deposition have blocked the fissures; in other areas, these weathering products have been washed out of the fracture system. Transmissivities will be in the range 2–100 m^2/d. Groundwater gradients can be up to 0.05 in these rocks, since they tend to form higher ground with steep slopes. In the Lower Impure Limestones, transmissivities will typically be in the range 2-20 m^2/d. However, in the adjacent Hospital GWB, pumping tests provided transmissivity estimates of approximately 75 m^2/d and 40 m^2/d, showing that higher transmissivities can be achieved in local zones. Gradients in this aquifer will be in the range 0.01-0.05, as the ground surface is quite steep. Specific yield in all aquifers will be low, on the order of a few percent. *(data sources: Rock Unit Group Aquifer Chapters, Limerick GWPS Report, Source Reports, see references)*
	Thickness	The Dinantian Pure Unbedded Limestones attain maximum thicknesses of more than 1200 m. However, the effective flowing thickness is likely to be about 30 m, although much deeper inflows can occur if associated with faults or dolomitisation. An epikarstic layer at least a couple of metres thick is likely to exist at the top of the bedrock, below which a network of fissures and small conduits will exist. Deeper flows can occur along fault zones. Within the less transmissive rocks, the effective thickness is likely to be $\leq$ 20 m, comprising a weathered zone of a few metres and a connected fractured zone below this, although more isolated water-bearing fractures or faults can be intercepted at greater depths.
Overlying Strata	Lithologies	GSI mapping indicates that most of the GWB is covered by Limestone Till, with 'Till with Gravel' pods and areas of Gravel occurring also. Along the courses of the Rivers Maigue and Camogue, and other smaller rivers, there are areas of Undifferentiated Alluvium. There are also areas of Peat in low-lying areas, such as around Lough Nagirra, and part of the course of the Camoge River.
	Thickness	Over most of the GWB, subsoil thicknesses are in the range 1-7 m. Subsoils are thicker (10-25 m) near to the Ballingarry GWB in the SW, and around Fedamore, where subsoils are 10-20 m thick. In the far SE of the GWB, significantly greater subsoil thicknesses are recorded, ranging from 25 m up to 66 m. These depths are recorded in areas where depths to bedrock are relatively shallow (2-5 m), and where there are scattered outcrops. This indicates that there may be swallow holes and/or brecciated bedrock to significant depths in this area. There are no extensive areas of rock outcrop; however, outcrops are scattered across the entire GWB. They are slightly more concentrated in the western part and in the SE.
	% 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	Diffuse recharge will occur over the entire groundwater body via rainfall soaking through the subsoil and directly to the aquifer via outcrop. In areas where the water table is at or very close to the surface, potential recharge may be rejected. Where subsoils are very thick and low permeability, effective rainfall may not be able to recharge the aquifer.
	Est. recharge rates	*[Information to be added at a later date]*
Discharge	Springs and large known abstractions (m^3/d)	Fedamore WS (123 m^3/d – GSI database; 68 m^3/d – EPA database); Croom WS (527 m^3/d – GSI database); Monaster WS (273 m^3/d – GSI database); Lough Gur GWS (up to 655 m^3/d – GSI database); Cahergrass GWS (109 m^3/d – GSI database; 6 m^3/d – EPA database); Golden Vale Industries (218 m^3/d – GSI database); Carrigeen GWS (6 m^3/d – EPA database); Croagh GWS (8 m^3/d – EPA database); Kilfinny GWS (Lisduff) (Bore No.1: 32 m^3/d, Bore No.2: 27 m^3/d – EPA database); Mitchelstown Creameries (Adare) (113 m^3/d – EPA database); Ballinstona North GWS (16 m^3/d – EPA database). *[More information may be added at a later date]*
	Main discharge mechanisms	The main discharges are to the streams and rivers crossing the GWB, particularly the Rivers Maigue, Clonshire and Camoge, and to springs. There are springs within the GWB, and also along the northern edge where the contact with the lower transmissivity impure limestones appears to force the groundwater in this GWB to the surface. Water level data also indicate that this is occurring SE of Croom WS, where a spur of Lower Impure Limestone from the Hospital GWB acts as a barrier to flow within the karstic aquifer. The rivers are in hydraulic continuity with the bedrock aquifer. Drainage is generally good, indicating a high transmissivity aquifer. Specific dry weather flows are relatively low (0.21 – 0.65 l/s/km^2), however, indicating low aquifer storativity.
	Hydrochemical Signature	Limited hydrochemical data are available for this GWB. The hydrochemistry of groundwaters from Croom WS and Fedamore WS indicates very hard (370–430 mg/l as $CaCO_3$), calcium-bicarbonate type waters with high alkalinities (330–380 mg/l as $CaCO_3$) and electrical conductivities, and neutral pHs. At Lough Gur, groundwaters are hard, with corresponding alkalinities, conductivity is in the range 500-600 μS/cm, and pHs in the range 7.2-8.2. At Croom, water quality is variable and it is considered that there is contamination occurring at times. Conductivities are variable (720–1100 μS/cm) and are often elevated. At Fedamore, conductivities are also high, reaching more than 800 μS/cm. Water quality data from volcaniclastic aquifers record conductivities of between 470–700 μS/cm. Groundwaters from these rocks will be soft to moderately hard, and are likely to have a calcium-bicarbonate signature. Iron and Manganese can be problematic in the impure limestones. In general, background chloride concentrations will be higher than in the Midlands, due to proximity to the sea.
Groundwater Flow Paths		These rocks are devoid of intergranular permeability; groundwater flows through a diffuse network of solutionally-enlarged fissures and small conduits, and along faults. The GWB is mostly unconfined. Only in the southwest of the GWB are subsoils sufficiently thick to (partially) confine the aquifer. Groundwater levels are variable. In general, the depth to the water table is from 1-7 m. Near streams and rivers, water levels are generally within 2 m of ground level. Springs are common within the GWB, and, since the rivers and streams are in hydraulic continuity with the aquifer, they represent the water table elevation. Away from surface water bodies, the depth to the water table generally ranges between about 6 m and 18 m. The deepest water levels are measured on local topographic highs and show that the water table gradient is low, and that significant unsaturated zones exist. In the extreme southeast of the GWB, where ground elevation is generally higher than the rest of the GWB, groundwater levels can be up to 24 mbgl in summer months. The water table is likely to generally follow the topography. Water table fluctuation is likely to be up to 8 m. At Carrigeen GWS, which is near to a small stream, the water table fluctuation is 4 m. Groundwater flow paths in this GWB are generally long, and can be up to several km's long. Groundwater may also discharge locally to surface water features or springs, however, if the topography is variable. In discharge zones, flow paths will be shorter, around 100–300 m. The regional groundwater flow direction is from south to north. Local groundwater flow will be from the higher ground between surface water bodies to the rivers and streams.
Groundwater & Surface water interactions		The nature of the karstic system leads to rapid interchanges of water between surface and underground. The epikarst redistributes diffuse recharge in the subsurface, and swallow holes and caves receive surface water at points. Groundwater is discharged to the surface as springs or as baseflow to rivers crossing the groundwater body. The three groundwater-dependent ecosystems defined as NHAs within the GWB have large fen and wetland areas. Herbertstown Fen (NHA000436) is a large wet fen of good botanical and ecological interest. Lough Gur (NHA000437), itself a groundwater-dependent lake, has two large calcareous fens associated with it. Lough Nagirra (NHA000439) has areas of alkaline fen and calcareous fen.

Conceptual model	• The groundwater body is bounded to the north and south by the contact with the low transmissivity limestones of Patrickswell and Hospital GWBs, respectively, and to the west by a surface water catchment boundary. In the east, most of the boundary is defined by the contact with the Knockroe GWBs, except the NE and SE parts, which are surface water catchment boundaries. The ground is generally flat-lying or very gently undulating, with occasional small ridges and hills. Ground elevation decreases westwards and northwards. • The GWB is composed primarily of highly transmissive diffusely karstified rocks. Small areas of lower transmissivity aquifers occur in the NE and SE of the GWB. All rocks within the GWB have low storativity. • Recharge over the entire groundwater body occurs diffusely through the subsoils and at outcrop. A small volume of cross-flow from the upstream aquifers within the Hospital and Knockroe GWBs may occur. • Groundwater flow in this aquifer will be concentrated in an approximately 30 m zone at the top of the bedrock. This zone is likely to comprise an epikarstic layer of a few metres, below which is a network of diffuse solutionally-enlarged joints and small conduits, fractures and faults. Deeper groundwater flow can occur along permeable fault zones or deeper fractures. • Nearly the entire GWB is unconfined. Only in the southwest of the GWB, adjacent to the Lower Impure Limestones of the Hospital GWB do the subsoils attain sufficient thicknesses to (partially) confine the aquifer. Near rivers and streams, the water table is close to the surface. Beneath higher ground, significant unsaturated zones can exist (up to 20 m). • Flow path lengths are generally long (up to several km's). Groundwater also discharges locally to surface water features, or to springs if the topography is variable. In discharge zones, flow paths will be much shorter, at around 100–300 m. • Groundwater discharges to the streams and rivers crossing the GWB, and to the springs within the GWB. At the northern edge of the GWB, groundwater in the karstic aquifer appears to be forced to the surface as springs at the contact with the low transmissivity impure limestones of the Patrickswell GWB. Water level data also indicate that this may be occurring SE of Croom WS, where a spur of Lower Impure Limestone from the Hospital GWB acts as a barrier to flow within the karstic aquifer. • Regional groundwater flow is from south and east to the north but, on a local scale, the distribution of the surface drainage determines groundwater flow directions. • Lough Gur and the other NHA fens are likely to be almost entirely groundwater fed, with their alkalinity and natural water chemistry determined by the nature of the bedrock.
Attachments	Groundwater hydrographs (Figures 1 and 2); Hydrochemical signature (Figure 3).
Instrumentation	Stream gauges: 24001*, 24002*, 24008*, 24062, 24067. *(Stations marked with * have specific dry weather flows calculated.)* EPA Water Level Monitoring boreholes: Carrigeen GWS (LIM031), Bruff (LIM235). EPA Representative Monitoring boreholes: Croom WS (LIM41), Fedamore WS (LIM46), Lough Gur (LIM109).
Information Sources	Deakin, J., Daly, D. and Coxon, C. (1998) *County Limerick Groundwater Protection Scheme*. Geological Survey of Ireland Report to Limerick Co. Co., 72 pp. Deakin, J. (1995) *Croom WS – Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Deakin, J. (1995) *Fedamore WS – Groundwater Source Protection Zones*. Geological Survey of Ireland Report to Limerick Co. Co., 6 pp. Aquifer chapters: Dinantian Pure Unbedded Limestones.
Disclaimer	Note that all calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae



Rock units in GWB

Rock unit name and code	Description	Rock unit group
Waulsortian Limestones (WA)	Massive unbedded lime-mudstone	Dinantian Pure Unbedded Limestones
Lough Gur Formation (LR)	Pale cherty crinoidal limestone	Dinantian Pure Bedded Limestones
Visean Limestones (undifferentiated)		Dinantian Pure Unbedded Limestones (west) Dinantian Pure Bedded Limestones (northeast)
Ballynash Member (BAbn)	Wavy-bedded cherty limestone, thin shale	Dinantian Lower Impure Limestones
Trachyte (T)		Basalts and other Volcanic rocks
Knockroe Vitric-Lithic Tuff Member (KRv)	Vitric-lithic tuff & agglomerate	Basalts and other Volcanic rocks