

Hydrogeology of Wales: Quaternary aquifers - the Upper Lugg catchment

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This page is part of a category of pages that provides an updated review of the occurrence of groundwater throughout Wales.

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The River Lugg flows from the hills to the north-west of Llangunllo, south-east to Presteigne and out of Powys towards Byton in Herefordshire. Gravel deposits floor the valley between Monaulty to the north-west and Byton in the east, below which the valley narrows sharply. The largest area of gravels lies in the broad, level valley floor to the east of Presteigne. The underlying bedrock rises steeply at the edges of the gravels. The bedrock geology is predominantly of Silurian age with isolated faulted inliers and outliers of Proterozoic and Devonian strata respectively.

The main aquifer in the Upper Lugg is the river gravel ([ESI, 2006](#)). At Pilleth these are over 20 m thick and are highly transmissive ($>1000 \text{ m}^2\text{d}^{-1}$). The gravels are overlain by 2 to 3 m of clay which has a low vertical permeability which allows a shallow, upper 'perched' groundwater system to develop in permeable cover above the clay. The water table in this shallow system is controlled by a combination of ditches and field drains in order to improve the quality of the land for agricultural purposes.

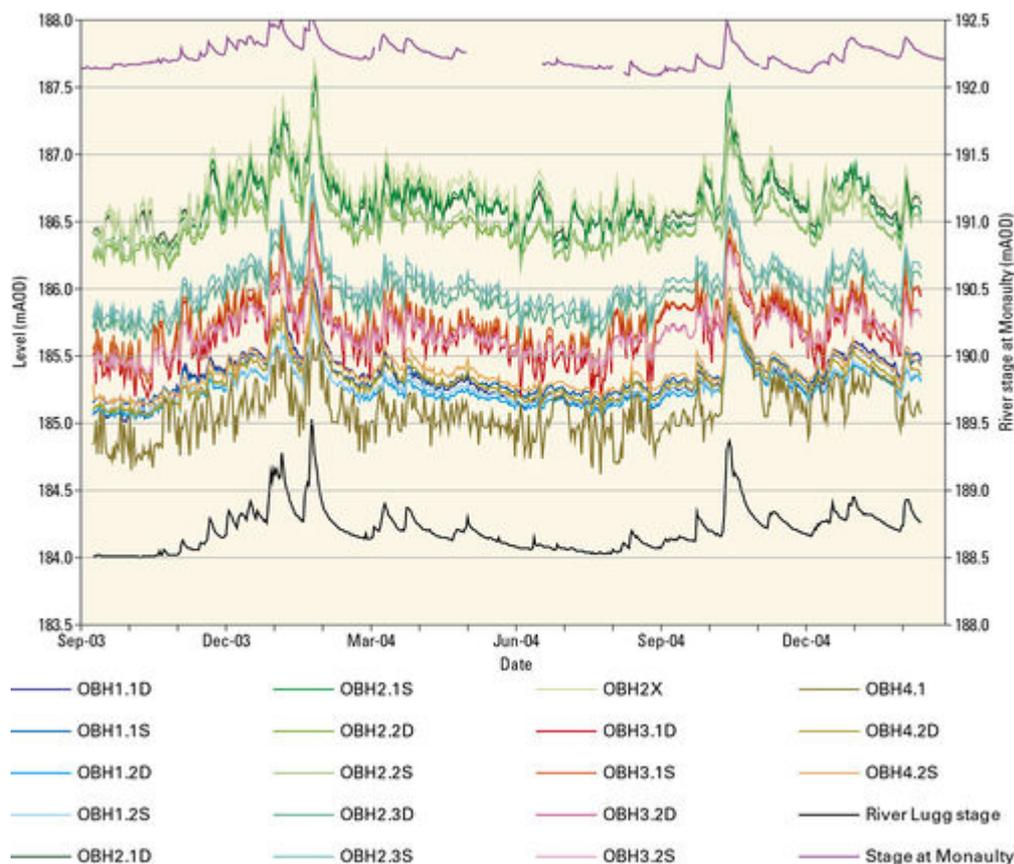
At Glan Llugwy Bridge (Monaulty) and the public supply abstraction boreholes at Pilleth [SO 260 678] the gravels are at least 23 m thick and none of the boreholes penetrate bedrock. The aquifer comprises loose, medium- to coarse-grained grey sand and fine to coarse gravel with occasional cobbles. Silt and clay horizons occur below 7 m depth. The gravels are overlain by a continuous 2 to 3.5 m-thick layer of silty, sandy clay (varying in colour between blue/grey and orange/brown). Drillers' logs for the observation boreholes at Rock Bridge [SO 2914 6558] and Letchmoor Farm [SO 3455 6447] show that the gravels continue with a similar thickness downstream from Pilleth. The driller's log for the Natural Resources Wales observation borehole at Evenjobb [SO 2615 6179] shows 10 m of drift overlying the Silurian Wenlock Formation; 8 m of which is 'clayey gravel'. Average annual rainfall is just over 1000 mm and effective precipitation is about 530 mm. Details of the licensed abstractions in the Upper Lugg are given in the **Licensed abstractions table**.

Details of the licensed abstractions in the Upper Lugg (see **Figure 4.2** for locations of key abstractions).

Licence number	NGR	Annual quantity (m ³)	Daily quantity (m ³)	Surface (s) or groundwater (g)	Use
19/55/8/0030	SO 316 644 41 596		114	g	Industrial services
19/55/8/0030	SO 316 644 72 377		198	g	Industrial services
19/55/8/0134	SO 170584 6636		188	g	General agriculture
19/55/8/0142	SO 238 633 2785		8	g	General agriculture
19/55/8/0179	SO 253 676 1 409 260		3819	g	Public water supply
19/55/8/0046	SO 192 624 141 426		386	g or s	Public water supply
19/55/8/0125	SO 363 641 414 823		1137	g	Public water supply
19/55/8/0193	SO 269 604 9092		318	g or s	Spray irrigation
19/55/8/0210	SO 225 628 7300		20	g or s	Water bottling
	2 105 295		6198		

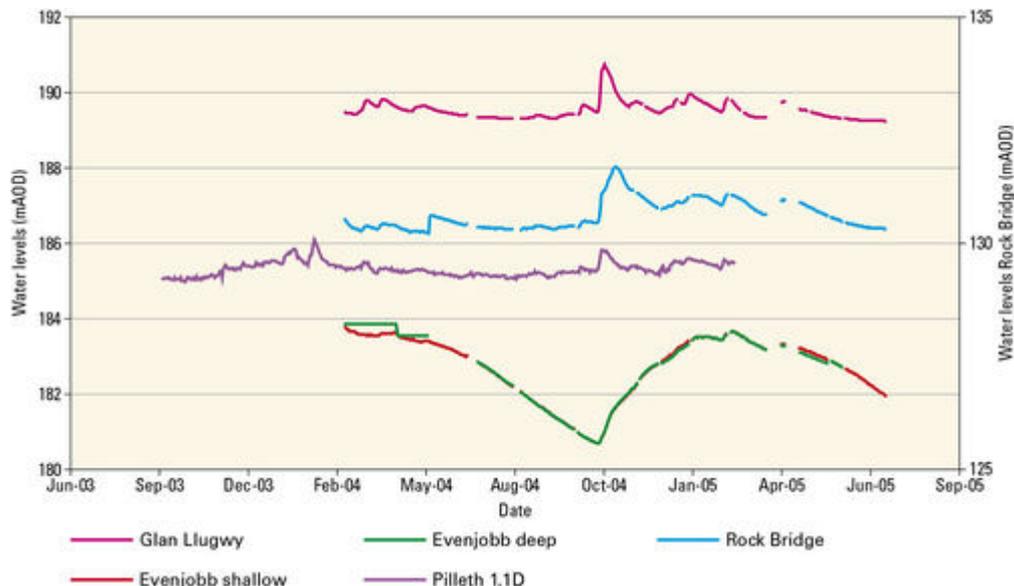
The 19/55/8/0046 abstraction, a source for New Radnor, is currently unused (G. Hyett pers. comm.).

Dŵr Cymru has carried out a programme of testing at Pilleth ([Celtic Water Management, 2005](#)). The specific capacity data indicate that the transmissivity of the aquifer is $>1000 \text{ m}^2\text{d}^{-1}$. Dŵr Cymru monitors groundwater levels in ten observation boreholes. Eight of these boreholes are completed as multiple monitoring points with an upper and a lower screened section within the main gravel horizons. **Figure P859282** shows that groundwater levels at most of these sites do not generally fluctuate by more than 0.5 m. However, during periods of peak river flows, sharp increases in groundwater level occur, increasing the full range at most of the sites to around 1 to 1.5 m. The behaviour of the hydrographs reflects the nature of the environment of the gravel aquifer, i.e. a low permeability clay cover restricting local recharge and creating confined conditions, but with connection to the River Lugg at the margins of the aquifer allowing sudden changes in river stage to manifest themselves in the observed groundwater levels.



Groundwater levels monitored by Dŵr Cymru in the gravel aquifer near Pilleth (after ESI, 2006). P859282.

Natural Resources Wales monitors groundwater levels in the gravel aquifers in the Upper Lugg catchment at Glan Llugwy, Evenjobb and Rock Bridge. Hydrographs of the available data at these sites are shown on **Figure P859283**. Data from one of the Pilleth observation boreholes is shown for comparison. The Glan Llugwy and Rock Bridge hydrographs show fairly sharp responses to the onset of winter recharge. This reflects an unconfined aquifer in which recharge is relatively unimpeded and in which the one or two metres rise in the position of the water table causes a perceptible change in transmissivity (i.e. one or two metres is a significant proportion of the saturated thickness of the aquifer).

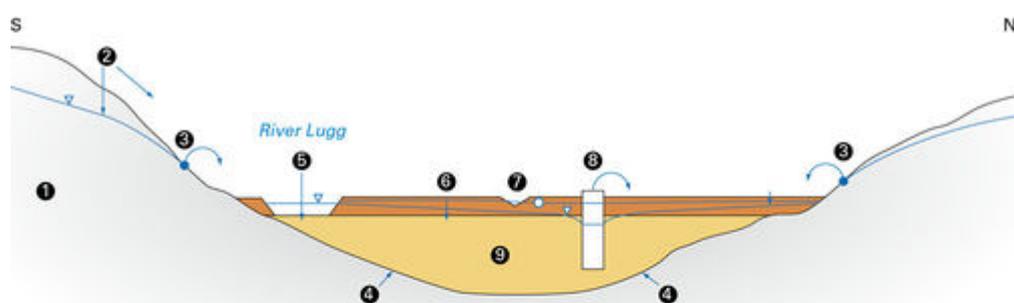


Groundwater levels in Environment Agency observation boreholes in the Upper Lugg catchment (after ESI, 2006). P859283.

Groundwater levels in the gravel aquifer in the vicinity of Pilleth are around 0.5 to 1 m below river stage and, this may contribute to losses in river flow in this reach. However, the gravel aquifer in this area is covered by a clay layer of at least 2 m thickness and a shallow 'perched' groundwater system is present above this that is discharging to surface water at the same time. There is a marsh downstream at Combe Moor just south of Byton which represents the main discharge area for groundwater from the gravels, just upstream of the point at which the gravels pinch out at Byton.

Dŵr Cymru was granted a licence to abstract up to 3.812 Mld¹ from four boreholes at Pilleth in 1974. The water is used to supply Presteigne (and a significant proportion of this will return to the river at Presteigne STW) and the remainder is exported from the catchment to Knighton.

The gravel aquifers of the Upper Lugg are discrete and it is likely that the hydrogeological setting in each subcatchment is subtly different. Available data only allow the conceptual model of the area around Pilleth Pumping Water Station to be described in detail (**Figure P859284**).



- ① Silurian bedrock aquifer dominated by fractures and shallow weathering zone
- ② Effective precipitation on hillsides partitioned between recharge and runoff
- ③ Small springs on valley sides sourced from bedrock — may now be captured by field drains
- ④ Minor contribution from underlying bedrock strata
- ⑤ River in reasonable hydraulic continuity with gravel aquifer. Leakage from river into gravel aquifer
- ⑥ Slow downward leakage from shallow 'perched' water table into underlying gravels.
- ⑦ Water table in shallow system controlled by drains
- ⑧ Abstraction sourced principally from leakage from overlying strata (6) and induced recharge from River Lugg (5)
- ⑨ Thick, highly transmissive gravel aquifer overlain by 2 to 3 m of clay. In reasonable hydraulic continuity with river at edge of valley floor

Schematic conceptual model of the hydrogeology of the Upper Lugg catchment (after ESI, 2006). P859284.

The gravel aquifer is confined below this clay layer and shows the subdued response of groundwater levels to the onset of winter recharge. However, the aquifer is responsive to changes in stage in the River Lugg which indicates that the river, which is located at the edge of the valley floor at Pilleth, is likely to be in good hydraulic connection with the gravels.

The groundwater levels in the gravel aquifer are generally below the river stage in the vicinity of Pilleth - presumably as a consequence of groundwater abstraction and, as a result, the river leaks into the gravels. The peak cumulative loss is around 4 Mld⁻¹ (most of this occurring as the river first crosses onto these gravels) although there is subsequently a gain of around 1.5 Mld⁻¹ further downstream.

The contribution of the bedrock aquifer to the groundwater system in the gravels is uncertain. There is a perception that there is relatively little overland flow on the steep valley sides and this could indicate that much of the effective precipitation on the hills is recharged and subsequently enters the rivers via the gravels. However, the lack of overland flow could, to some extent, be a consequence of land drainage creating storage and intercepting flow.

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