The Saline Water Well at Culver Close, Bradford on Avon Bowls Club

By Simon Kay

In late April 2021, I was approached by a member of the Bradford on Avon (BoA) Bowls Club concerning a water well they had just drilled. The club used mains water for their green and the neighbouring cricket pitch. Water bills were sufficiently high that installing their own well would save money. The BoA Bowls Club initiated the project, assembled the funding package and project managed it. The project was a partnership between the Bowls Club, BoA Cricket Club and the landowners BoA Town Council. Funding came from the Landfill Tax credits fund of the Hills Group via Community First of Devizes, The BoA Area Board and the three partners.

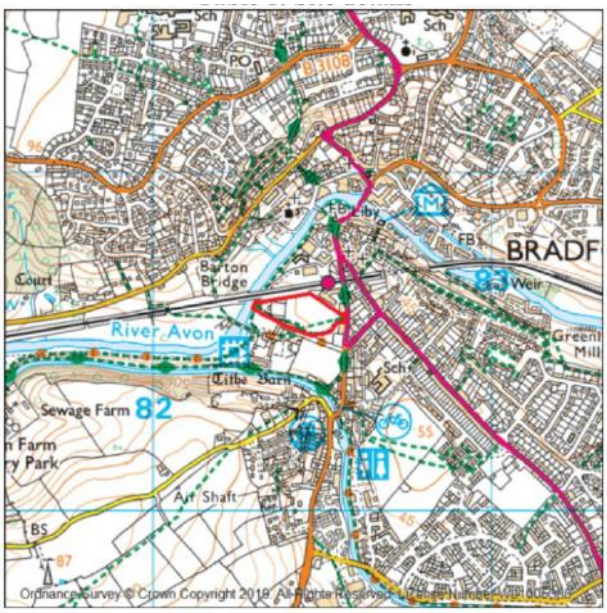


Fig. 1: Borehole location highlighted in red

Unexpectedly, the well encountered brackish water. The club hoped the water would be all right for watering the grass, but it was not potable. This troubled the club and intrigued me. The town water supply comes from groundwater of the Chalfield Oolite and there are also several local springs that are perfectly drinkable. Why is the Bowls Club well water different?

Before drilling, the Bowls Club commissioned a detailed study from B.A. Hydro Solutions of Royston, Herts. They assembled an excellent report with good geological detail. The well location is in the bottom of the Bristol Avon river valley. Their recommendation was to drill through the near-surface Fuller's Earth Formation to target the underlying Inferior Oolite and Bridport Sand aquifers. This makes hydrogeological sense as the overlying Fuller's Earth would be likely to have poor productivity. I would have recommended the same. I've included a diagram of their planned well here alongside what was actually drilled. The well was drilled by Ilminster-based contractor Matthew B Downing Farm Water and Geotechnical Drilling Services. As you can see from the diagram, the well was only drilled to a depth of 37.2 metres below ground level (mBGL). Water was present from 4.05 mBGL onward. At 34 mBGL very salty water was encountered which apparently also was quite gassy but odourless. The deeper water flowed at a higher rate (up to 8 cu m/hr compared to 2.5 cu m/hr for the shallower water). This very salty water was not sampled and the deeper interval was plugged off with bentonite. The Inferior Oolite was reportedly not reached but could have been close, judging from the well plan. The higher flow rate for the deeper water is more consistent with fractured Inferior Oolite and/or Bridport Sand. The Fuller's Earth is described by the driller from the well cuttings as clay and mudstone but was probably mudstone and muddy limestone. The hard pale grey mudstones as described are probably the limestone intervals, which would be naturally fractured and capable of flowing water.

Water Quality

The well was pumped for 3 days to clean up the water, and a sample was taken for analysis by Somerset Scientific Services (part of Somerset County Council). Key results (drinking water limits in parentheses) were:

Total dissolved solids	1171 mg/L
Ammonia as NH4	1.06 mg/L (0.5)
Chloride	288 mg/L (250)
Sulphate	252 mg/L (250)
Calcium	131 mg/L
Sodium	229.7 mg/L (200)
Iron	340 ug/L (200)

Brackish water may be defined as total dissolved solids (TDS) >600 mg/L, while 1000 mg/L is considered the upper limit of human potability (livestock can tolerate higher levels). The dissolved components listed above all exceed limits for drinking water quality in a private supply. For comparison, note that seawater TDS is typically 35,000 mg/L, with chloride 19,000 mg/L, so our water is much fresher. Of course, the water quality may change through time, and follow-up testing is advisable. The elevated ammonia level made me think of groundwater contamination by sewage, but I would expect appreciable levels of nitrate and phosphate in that case, and these were undetectable. A map in Buss *et al*., 2020, indicates that similarly brackish water has occasionally been encountered from boreholes in the area, but brackish groundwater is unusual in southern England except in shallow aquifers around estuaries.

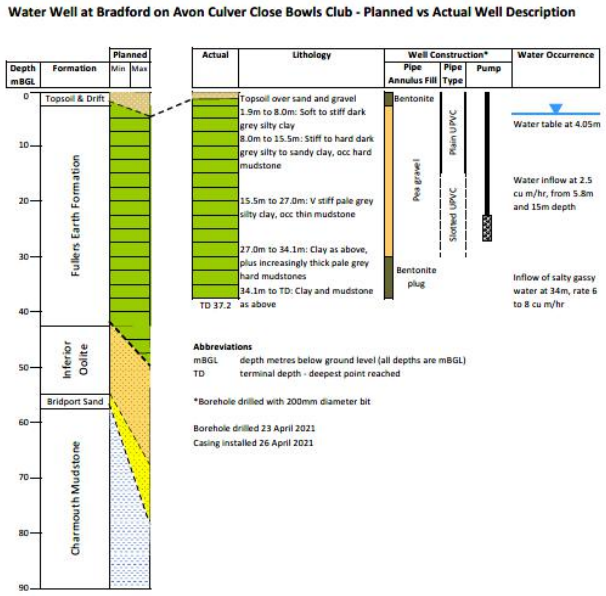
Water Source

The source of the brackish water may be a deeper aquifer connected to Triassic evaporites. This is often the case in northern England where halite deposits are more widespread (Buss *et al*., 2020). Perhaps there is communication via faults/fracture zones. The Bath hot spring water is a good example of a local deep groundwater source. Looking at the water composition for the Bath hot springs as sampled from the Stall Street borehole (Edmunds *et al*., 2014), sodium and chloride levels are

similar, although calcium and sulphate levels are much higher:

TDS	2290 mg/L
Chloride	344 mg/L
Sulphate	1080 mg/L
Calcium	385 mg/L
Sodium	218 mg/L

Another nearby example is at Melksham. In 1770 a shaft was sunk looking for coal. Instead, saline water was encountered flowing from the Forest Marble Formation at around 100 mBGL. It wasn't until 1813 that it was realised the water could have "curative" properties and a spa was constructed by local speculators. Two wells were sunk to supply Melksham Spa, in 1814 and 1815. The spa was briefly fashionable but fell out of use by 1822 and could not compete with Bath Spa or with the changing fashion in favour of sea bathing. Published water analyses (Whitaker and Edmunds, 1925) give a concentration of 552 grains per gallon of "saline matter", chiefly sodium chloride. This equates to 7,868 mg/L TDS which is saltier than the Bath or Bradford on Avon waters.



It's a pity that the deeper more saline water was not sampled in the Bradford on Avon well, or that a water temperature was not taken. Who knows – Bradford on Avon may be sitting on its own spa or thermal water source!

Both BoA Bowls Club and BoA Cricket Club are very happy with their new water supply. The total project cost was £15,000 and the club estimate that the saving is £2,000 per year. The untreated, chlorine-free water is better for the grass than mains water. Moreover, it is much greener and less wasteful to use a local water source; rather than using mains water that has been treated to drinking water standards at a high energy cost, and then just poured away onto the ground!

The Club will be closely monitoring the effects on the bowling green and the water quality over the next few seasons.

References

Buss, S., Herbert, A., Rivett, M., Rukin, N., 2020: Perspectives on Protection of Deep Groundwater. Environment Agency 2020.

Edmunds, W.M., Darling, W.G., Purtschert, R., Corcho Alvarado, J.A., 2014: Noble Gas, CFC and Other Geochemical Evidence for the Age and Origin of the Bath Thermal Waters, UK. In: Applied Geochemistry, vol 40, pp 155-163.

Whitaker, W., Edmunds, F.H., 1925. The Water Supply of Wiltshire from Underground Sources. Memoirs of the Geological Survey, England and Wales, pp 20, 73, 116.

Should anyone wish to know more about this project contact Derrick Hunt, Honorary Secretary. Bradford on Avon Bowls Club via the website:

http://www.westwilts-communityweb.com/site/Bradford-on-Avon-Bowls-Club/

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Book Review
Digging Bath Stone – A Quarry and Transport History by David Pollard Published by Lightmoor Press, Lydney, Glos.,UK ISBN 9781911038 86 3. Cost £50, 512 pages.

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Anybody with an interest in English building stones, in Bath stone and the industrial history of the Bath area or who is just inquisitive about stone, old quarries and mines in general, will love this book. The use of Bath stone as a building material is well documented: first used by the Romans for their town *Aquae Sulis* here in Bath, then again during medieval times for churches and mansions, including Malmesbury Abbey (7^{th}-12^{th}C), Bath Abbey (7^{th}-16^{th}C) and Longleat House (1568). It was also then the stone of choice for John Wood the Elder and architects after him in the construction of Georgian Bath with its impressive crescents and public buildings. This book is a comprehensive account of Bath stone contained within 512 pages of text and 100s of images; many of the latter are historic B&W photographs – all fascinating to ponder over: seeing the masons at work, their various roles, their tools and devices. David Pollard began his career as a boiler maker and engineer at Swindon railway works building locomotives in the 1960s. In the early 1980s he was an industrial archaeologist with Avon County Council and his deep interest in the stone industry eventually resulted in him buying his own underground quarry at Hartham, Cors-