Wells and boreholes

When all is not well with the well!

Iain Howley: specialist in feasibility and design of water wells

Once, during a discussion with a client a few years ago, I was talking about maintenance of his new well when he quipped ... 'but its just an 'ole innit?' Well yes, it is an 'ole', but there is a bit more to them than that and wells or boreholes drilled to abstract water from do need to have been constructed properly and may require periodic maintenance by specialists to ensure that they continue to deliver. In my experience, most people operating groundwater supplies adopt a 'fit and forget' attitude, but that can be a costly stance to take! Iain Howley **of Howley Energy & Water Ltd explains more**

When you stand over a water well or borehole and look down (I must confess there isn't that much to look at), it seems slightly odd that, in order to install something that probably measures between 6 and12" in diameter in the ground, an awful lot of diligent work probably went in to creating it - or at least it should have done anyway! From assessing the geology and hydrogeology, feasibility studies, through to design, the drilling, test pumping, equipping and licensing - it was a pretty involved and long-winded process to end up with, well, an 'ole!

Through this article, I wanted to communicate to those in the turf industry that there are tell-tale signs of problems to look out for with the operation of a well, and recognising those signs can either prevent unnecessary use interruption or save you money ... or both!

For this article, let's assume that a sports turf irrigator had a well installed that was 120m deep and finished at a diameter of 150mm. When the drilling rig has done its job, the 'ole must be developed properly to rid the bore of any drilling debris introduced by the drilling operation itself. It is not enough to stick a pump in it and simply switch it on and, if water comes out, it's job done.

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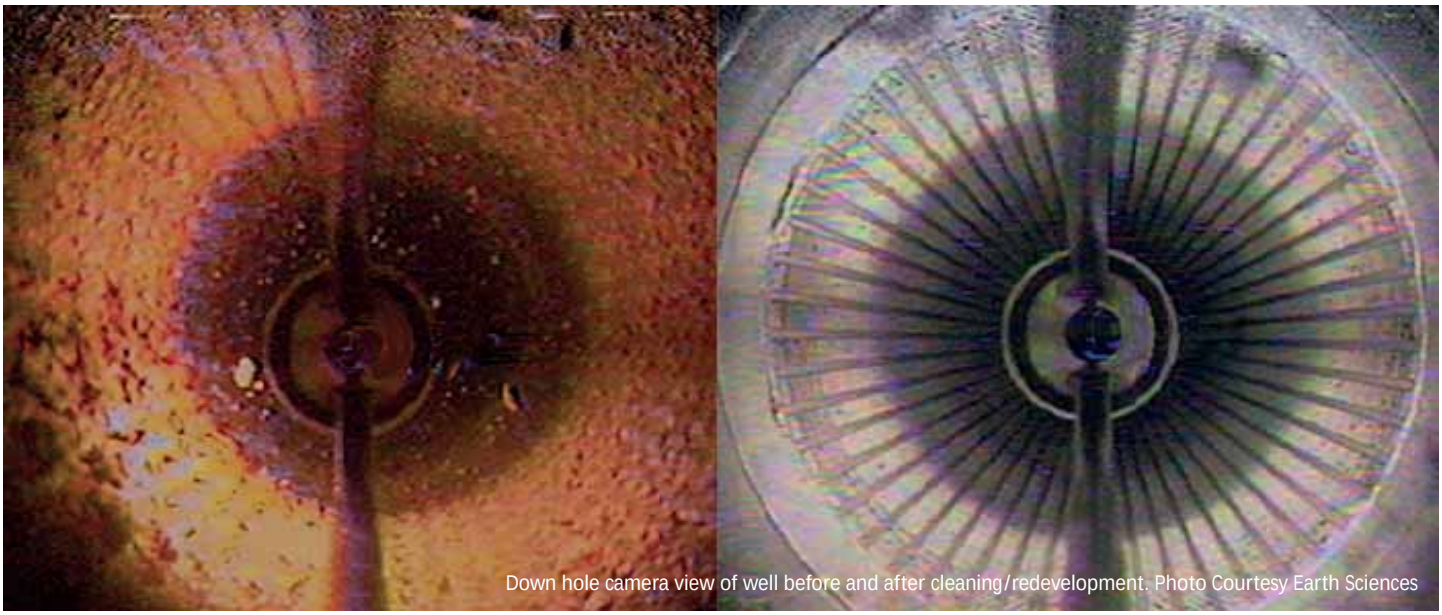

Down hole camera view of well before and after cleaning/redevelopment. Photo Courtesy Earth Sciences

Yes, the well might be pumping water, but if the water level depresses a long way down the well to say 90m, because it hasn't been developed properly, then your pump might need to be a 5kW unit rather than a 1kW unit required to pump it from a depth of only 25m. So it is very important that a proper development exercise has been carried out after initial drilling to 'unplug' much of the water-bearing strata formation.

So, how is the well actually developed ?

Well, the contractor should install pipework into the base of the well for air to be trickled in at an ever increasing rate via a small injection pipe, and this introduces bubbles which rise up the borehole pipework bringing groundwater and, importantly, any debris with it. With increasing air injection, the process can be quite ferocious with water (and debris) being extracted at very high rates - a real gusher - but this is a good thing because the more violently the groundwater is removed, the greater the agitation in the well and the more debris is typically removed.

This is called an airlift system. It is like an air operated vacuum cleaner and, after a period of time, the well should eventually be delivering clear water. So long as the well water levels are not naturally too deep, an airlift system will tend to try and pull much more groundwater from the rock fractures and through any well screen, if fitted, than will ultimately be demanded of it. This 'over-pumping' means that, once the final pump is selected, the well will be under less 'stress' and should provide the water as easily as possible with the least possible depression in water levels.

Ultimately, this should mean that you can draw your groundwater with the most efficient pump-set and save money on both your capital and running costs associated with the pumping operation; potentially more than the days airlifting development cost. So, assuming all is tickety-boo with the drilling and development of the new borehole, the process thereafter all goes quite scientific.

But it's just an 'ole' I hear you say. Well, read on!

We all know that, as human beings, we are unique from each other through DNA, fingerprints and all that sort of thing, but this is also true of wells. Each has its own unique characteristics driven by the strata into which it's drilled and the flows demanded from it. These unique characteristics are generated through a formal pumping test.

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Original Benchmark data		Comment
Sustained Pumping Rate	5m³/hr	Design Flow Rate achieved
Rest Water Level	31.85m bgl	
Pumping Water Level	48.75m bgl	
Drawdown	16.90m	

Scenario 1 – Well issue		Comment
Sustained Pumping Rate	3.8m³/hr	Flow dropped from 5m³/hr
Rest Water Level	32.14m bgl	Slight difference - can occur (e.g. seasonal term)
Pumping Water Level	68.93m bgl	Much deeper in well
Drawdown	36.79m	Significantly increased drawdown

Scenario 2 – Pump Issue		Comment
Sustained Pumping Rate	3.8m³/hr	Flow dropped from 5m³/hr
Rest Water Level	32.14m bgl	Slight difference - can occur
Pumping Water Level	41.65m bgl	Much shallower in well
Drawdown	9.51m	Significantly reduced drawdown

Environment Agency (EA) anyway for schemes that require more than 20,000 litres a day, but aside from the mandatory regulatory reasons for doing the test, it is just as important to do it to get the benchmark data about how the well performs when new for your own benefit. Only when this data is generated do you have the ability to select the correct pump for your application but, just as importantly, it allows you to compare operational data against it in the years to come to see how the well is performing. Without it, you are very much in the dark.

I think it very likely that most systems throughout the UK operate with little or no inkling as to what might be happening in terms of degrading performance - something that, if understood, can serve to offer a preventative maintenance regime rather than an emergency scenario potentially when you most need the water.

After a period of time and if the user starts to see one or two undesirable changes with the performance of the groundwater system (e.g. low flow), very often, a call will be made to a local pump installer to say the pump appears to be delivering less flow. The default assumption is that the pump is worn out and you need a replacement one.

However, this may not always be the case. Over time, wells can suffer with a little bit of bio-fouling or clogging and, when this happens, it means that the transmissivity (the ease of which groundwater moving through the formation and into the well) reduces - the well is said to be experiencing 'losses'. When this occurs, your pumping water level goes deeper, meaning the pump struggles to deliver the water against a higher head pressure and, as a result, the flow drops-off. You think the pump is worn and buy a new one when, in actual fact, this may not be the case at all and your pump (not cheap!) might be fine! This can be a costly, yet avoidable mistake!

So how do you know if the problem you are seeing with lower flow lies with the pump or the well itself?

Well, you can get a specialist in, or it is something that could be done yourself if you invest in a bit of kit. To carry out some comparison testing, you need to dust off your hand-over file that should contain your original test pumping data when first installed. The test pumping standard that is required by the EA for formal pumping tests on water wells is BS14686, but you don't necessarily need to adhere to that to simply gain an insight into the way your well is performing. You do, however, need to conduct any testing so that you remain within your licence stipulations or within the 20,000 litres per day cap for unlicensed extractions.

In terms of equipment, you will also need an electronic dip meter or get someone in who has one, a stop watch and something to write your recordings on. This dip meter is a specialist bit of kit that basically consists of a long tape measure with an electrode on the end which illuminates a light and/or makes an audible beep when the probe end touches the water in the well.

With the pump idle in our imaginary well, you read off the depth detail from the measure and Bob's your uncle - that's your well's rest groundwater level.

Now, here is the important bit! If you switch your pump on, you can literally follow the water level down - as it recedes further down the well - with your dip meter. If you jot down your water level reading at exactly one minute intervals - and also note the flow rate if a meter is fitted - for perhaps 30 minutes or so, the groundwater level will eventually begin to stabilise in the well, i.e. stop depressing, to a point known as equilibrium and, when completely stable, you will have determined your pumping or dynamic water level. The difference between the rest water level and your pumping water level is what is known as your drawdown. This information is your well's unique performance fingerprint.

Having completed your very own pumping test (Gold Star!), you can compare the data scribbled on your bit of paper to the original test pumping data carried out by your contractor. If the water levels have depressed more quickly and further into the well since it was installed, then the well isn't performing as well as it once was and you may need to get a specialist to look at what might be the cause and put a plan for remediation in place.

However, if you are suffering with some loss of flow and, during these tests, it is noted that the flow is down, but the water levels do not recede further down the well, or note that they recede less into the well than the original test data demonstrated, then it is probably the pump that is the issue - not the well. It is important to identify which is the problem - the pump or the well itself.

Electronoc dip meter


With increasing air injection, the process can be quite ferocious!

You shouldn't adopt the 'out of sight, out of mind' stance because the well, or indeed the pump, could be slowly deteriorating and the steps outlined in this article can help to nip any issues in the bud before they worsen to a point of failure

If we assume that our imaginary well has shown scenario 1 characteristics, and the well needs some form of remediation then how do we go about that ?

Well, first things first, the pump will generally need to come out and it would be a good idea to have a CCTV camera survey carried out. This will show the level of deterioration in the well and give you a valuable insight into what the contaminant/encrustation might be and how advanced it is. Although a team could make an educated guess towards the type of problem in the well, there is nothing like a clear video or pictures to clearly show the issue and its severity.

Differing ground conditions require different treatments. Limestone or chalk wells would benefit from treatment with acid based solutions. Sometimes, calcium carbonate builds up in the well and begins to block the water bearing fissures through which groundwater flows. The acid basically dissolves the undesirable build up and brings the well back it is former performance capabilities and, in many cases, actually improve it over its original capacity.

Other techniques will involve the use of other chemicals, such as sodium hypochloride (bleach), which will neutralise and dissolve bacterialogical build-up such as iron or manganese deposits that may be impacting the groundwater flow. Scrubbing and jetting, followed by airlifting, is another cleaning method. All of these methods need to be undertaken by specialists but, once completed, you should have many more years of uninterrupted use of your well.

This article was compiled generally so irrigators don't necessarily jump to the wrong conclusions and fork out for something they don't need.

With just a little bit of know-how and a bit of kit, you can try to understand whether the problems you are experiencing are generally down to the well itself or the pump. There are other potential impacts to consider, such as blocked or undetected leaking surface pipework or controls issues, but clearly it is easier to investigate things above the ground

So, to summarise ...

I think the point is that you shouldn't jump to what might be the wrong conclusions.

There are some relatively simple steps that an irrigator can take to diagnose whether the impaired performance of the well is down to the pump or the well itself. You shouldn't adopt the 'out of sight, out of mind' stance because the well, or indeed the pump, could be slowly deteriorating and the steps outlined in this article can help to nip any issues in the bud before they worsen to a point of failure.

Understanding the problem could prevent you paying a lot of money for a new submersible pump that you might not need and compound your problem with not addressing the issues with the well itself.

So, when all is said and done, hopefully you can see that your irrigation well is a living, breathing part of your system ... and not just an 'ole !

Iain Howley is the owner of Howley Energy & Water Ltd and offers specialist consultancy services to clients who may be looking to introduce benefits towards their water usage through consideration of a groundwater supply.