

## TECHNICAL NOTE

### **Monitoring report for the committee meeting, 23/10/08**

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Groundwater monitoring continues on a regular basis, and is now entirely confined to the subcatchments with Yarra Yarra drains in them. The enormous network of bores, drilled seemingly at random along drainage lines throughout the region, has been useful for prioritising subcatchments and for designing drainage works, but isn't very useful for monitoring. YYCMG doesn't have the time or resources to track the entire network of bores, many of which are poorly sited or not functioning properly for whatever reason. We are now concentrating on bores which have been drilled over the past few years and have been specifically designed to monitor the impact of recently constructed drains on groundwater levels.

The long-awaited report on the acid groundwater component of EEI1 (Engineering Evaluation Initiative, Phase 1) is now available. [This initial phase ended in 2005, and is confined to the Avon catchment. The Yarra Yarra catchment has been included in EEI2 – a second phase of the Engineering Evaluation Initiative, which is just now winding up.] The report describes the phenomenon of acid groundwater in southwestern Australia – its known geographical distribution, associated minerals & sediments, and possible mechanisms for its origin. It also discusses geochemical risks of discharging acid groundwater into lakes and waterways, and makes some practical management recommendations about drain design and maintenance.

And now, to clear up some misunderstandings that seem to be about, a few words about the nature of science. When people say that it's possible to use science to prove anything, what they're really saying is that it's possible to misuse science to prove anything. In fact, science isn't even in the business of proving things. What it can do is falsify, i.e. demonstrate that a statement isn't true. The way it does this is by assigning a 'probability' to the demonstration, to show how likely it is to happen.

For example, the statement 'The sun always rises in the east' might seem quite reasonable, but it's probably not the way a scientist would put it. It might well be the case that the sun has appeared over the eastern horizon every morning for the four & a half billion years that the earth's been rotating around the sun. Personally, I can only vouch for the last 50 years, but I'm prepared to accept the rest for now. However, it's conceivable that the earth's spin might be reversed at some time in the distant future, or the earth might stop spinning (in which case, the sun wouldn't seem to move across the sky at all). Or there might be a drastic collision that knocks the earth out of its orbit and messes up the way the sun comes up over the horizon (incidentally, such events would probably wipe out all life on the planet).

On one side, it doesn't matter how many times you observed the sun coming up in the east, you'd never cover all possible occasions (since there's always tomorrow). So you couldn't say with absolute certainty that the sun always rises in the east. On the other hand, it'd only take one occasion of the sun rising in the west (or not rising at all) to falsify the claim. A more-acceptable way of putting it is that it's extremely unlikely that the sun doesn't always rise in the east.

This might seem like a petty and pedantic difference, but it's a difference that becomes important in less-extreme and less-obvious situations -- questions like 'Does deep drainage impact on downstream vegetation?'

## **The nature of science (continued)**

Ian Fordyce, 26/10/08

Continuing my ramblings about the nature of science from Thursday's monitoring report ..... Just so there aren't any unrealistic expectations. Maybe the sunrise example was just a teeny bit trivial. The main message is worth restating, though. For those who missed it

(1) Science is incapable of proving that something's true. [In practical terms, it gets around this inconvenience by demonstrating that the contrary position's false – which's almost the same thing, but not quite.] The statement 'This has been scientifically proven' is a logical nonsense. If somebody tells you this (probably about an item they're trying to sell), then either they're being very naïve or they're trying to pull the wool over your eyes.

(2) Rather than any claim of absolute certainty, what science actually delivers is a 'probability'. This probability doesn't have quite the same meaning as its vernacular usage; it's a formally defined number that's provided by a statistical test (statistics, in this sense, is a branch of mathematics that analyses populations of things, e.g. populations of numbers, rather than the numbers themselves (as in Australian Bureau of Statistics)).

For example, even after examining the vegetation in drain-discharge areas for several years, we won't be able to claim categorically that drains have or don't have an effect on downstream vegetation. If we do try to make such a claim, then we'll blow all of the credibility we've been gradually achieving. Our results will have to be analysed statistically and couched in 'statistics-speak'. What we eventually conclude will be along the lines of 'there's an 85% probability (or 97% or 76% or whatever) that deep drains in the Yarra Yarra catchment are having no effect on downstream vegetation'. This might sound a bit lame, but we'll just have to get used to it.

(3) It doesn't matter how obvious or obscure an issue is, it's still subject to the same laws of probability. This's where blind justice comes into it. Even an unemployed, atheist, homosexual child-molester of middle-eastern appearance gets the same

treatment as a TV star. And the question 'Does the sun always rise in the east?' merits the same critical examination as our question 'Do drains affect downstream vegetation?'

Now a digression in support of the EEI (Engineering Evaluation Initiative) – in particular, its reporting arrangements. It's not simply that the agencies involved (CSIRO, and the WA Departments of Water and of Agriculture & Food) are any more slack or unfocussed than any other government bureaucracy. Their particular problem is the slowness of the land's response to being drained. 2008's been the first high-rainfall year since the Madden and Pithara drains were built (2004-5), so it's their first real test. Funding's about to end (for many of the EEI projects, it's ended already). The analysis won't have the benefit of several wet seasons, so they'll be using single rain events instead. This's still valid, but it's statistically a much-weaker way of going about it. The people involved have been told that this report has to be a final one; there won't be any more funding to put together any follow-up reports. In any case, most of the monitoring winds up this year, and key personnel have already been assigned to other projects.

Yarra Yarra CRC's going to be faced with a similar problem at the end of this financial year. There'll be clamour from NACC to hand over a final report. As long as all that's expected is an account of cubic metres of dirt excavated, man-hours worked and diesel consumed, then no doubt some kind of report could be produced. However, if there's an expectation that the report should include some assessment of the drain, i.e. how well it's working and is likely to work, then that would be a quite unrealistic expectation.