Dear people,

I spent yesterday up on the Patho Plains with John Toll. It was a great day of looking at all the things that John has done to improve his property over so many years. Each time I go up there I learn a little bit more, and yesterday I learnt quite a lot. We downloaded all the numbers that our little data loggers have been happily recording over the last couple of years. We had a wonderful lunch prepared by Leanne, picked and ate some of the most delicious peaches I have ever tasted, walked amongst John and Zoe's amazing floriculture plantation, and drove out to see Kow Swamp filled to the brim with Murray River water. The latter was a very strange sight given these dry times.

I spent most of last night pulling the data together from the bore loggers and I am quite pleased with the result. I am always a little nervous when the loggers are filled with up to 2 years of numbers. I have downloaded John's loggers a few times but each time I have not cleared the memory becasue it is easier to deal with one big file at the end of the maximum downlaod time than it is to piece several Excel fils together. The loggers work well, but they are not without their issues, so I was happy that they were prepared to offer up their records without a struggle and that the numbers were as they should be.

I completed the usual routine: (1) compensated each logger file for atmospheric pressure changes from the barometric data we recorded via the logger in Fort Gunbower (fenced area that contains our climate logging gear), (2) exported each file into an Excel spreadsheet and used the manual measurements John and I collected yesterday to convert the of 'head of water above above sensor' readings to actual watertable depths, and (3) took the data from all three of the logger spreadsheets and merged the files so that I could plot them all on the same graph.

The records (once again) reflect a regional climate-driven groundwater recession. The watertable has fallen about one metre over the past two years. It was at or near the land surface prior to the 1990s and is now more than 3 metres below it. Whilst the salt remains in the soil and the subsoil, the groundwater is too deep for saline groundwater to reach the surface via the capillary fringe. The lack of rainfall and the loss of irrigation have changed the water budget and the groundwater is falling in response.

When we drilled on John's property to establish the bores about two years ago we found coarse sand and minor gravels carrying saline groundwater at depths ranging from 5 to 15 metres. It was obvious his farm was located over a large regional or sub-regional groundwater system filled with saline groundwater. Each bore tapped into the same system. We see this in our results.

The upper surface of the groundwater (watertable) occurs at a similar height above sea level throughout most of John's farm and where different depths to groundwater occur they are more a reflection of the land rising and falling a little. The watertable will always be shallower in the depressions than under adjacent rises. This is particularly true where it is sustained by a regional aquifer (in this instance the sand and gravel layers we intersected in our drilling).

The groundwater surface tends to flatten because it can rapidly flow through the aquifer from high points to low points, in the same way it would in a pipe. When we look at the three hydrographs presented on the attached image the observations come from three different points in a geographic sense, but in each instance the fluctuations occur in the same groundwater surface. The depths appear a little different simply because the land is at a slightly different elevation at each point. If we had graphed the watertable as height above sea level the graphs would have (most likely) plotted on top of one another. If you look closely you will see that each graph has a very similar form and the trend is almost the same consistent with the words above. If you look in more detail, however, you see that the fit is not perfect, and that small differences in trend do occur over time. We only get to see these small differences because we have been able to deploy loggers that are able to measure very small changes in water level (down to 0.2 of a mm).

The small difference in trend reflect minor adjustments in the groundwater surface as it attempts to flatten. It gets a little bit out of shape when rainfall or irrigation adds more water in one area than another. The lumpiness cause by this recharge is lost in the dry times. Lumpiness can also occur in response to evaporation/transpiration. If groundwater is taken up by vegetation gravity acts on the groundwater system to replace it. In a clay system, such as that at Kamarooka, the vegetation takes out groundwater faster than the aquifer can replace it, but in regional aquifers the groundwater system tends to win the battle. It can shove the water back in almost as fast as the vegetation is taking it out.

Note that bore to the east of the highway and the bore in the distant swamp act in unison for from late November 07 though to about February of 2008. From that point on they separate by up to 20 cm. We might speculate that they were held at the same depth because of irrigation or rainfall events in 2007 and appear to diverge as the groundwater system retreats to a flat surface in the dry conditions of 2008. It is interesting that the two graphs move down together quite suddenly in about January of this year. Something is extracting groundwater at this time. Could John's plantations be transpiring enough saline groundwater to produce this result? Could it be that the groundwater system is influenced by the level of the Murray river, or the Gunbower forest? I don't have the answers, but I (now) have my doubts about the latter two because the trend is much weaker at Fort Gunbower well away from John's plantations. So maybe the trees, shrubs and lucerne are doing the job.

Finally, it is also interesting that the rainfall of the last month (over 115 mm) has managed to produce a little recharge. Once again, we see the biggest rise in watertable under the most saline land. The rise in the swampy saline depression is greater than the rise in in the depression closer to the highway.

We could never hope to make any sense out this stuff without the loggers, so I am very happy with the little beasts.

Regards Phil