

Monitoring of observation wells at tree sites in the Mid North of SA

Farrell Flat
Anama
Snowtown

Andrew Harding
August 2005



RURAL SOLUTIONS SA



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Funded by the Hummocks Soil Conservation Board

1 Introduction

In the mid 1980s to early 1990s trees and shrubs were planted by the Department of Agriculture and/or the Hummocks Soil Conservation Board in or adjacent to saline seepage areas at Farrell Flat, Anama and Snowtown with the aim to ameliorate these areas. Observation wells were installed in these areas and monitored for a number of years to assess if trees had an impact on the groundwater levels. Due to a number of reasons the monitoring process ceased.

The Hummocks Soil Conservation Board has requested if these areas could be monitored again for a short period to assess if there has been any effect of the trees and shrubs on the groundwater levels since planting.

2 Description of tree sites

Outlined below is a general description of the various tree sites and some of the results after the initial monitoring period.

2.1 Farrell Flat tree site

The Farrell tree site (section 422, Hundred Hanson) was planted in 1985 with support from the National Soil Conservation Program (NSCP) and State Government. The general aim of this demonstration was to achieve amelioration of an unsightly and unproductive salinised area. A mixture of Australian native trees and shrubs were planted on 2.5 hectares at 3 metre row spacings on the eastern edge of the saline area. Puccinellia (*Puccinellia ciliata*) and tall wheat grass (*Thinopyrum ponticum*) was planted on the saline area which was previously dominated by sea barley grass (*Hordeum marinum*) and samphire (*Halosarcia spp*). The soil is a deep red-brown earth overlying shale at greater than six metres below ground level. The long-term average annual rainfall at Farrell Flat (three kilometres south of the tree site) is 477mm.

Twenty observation wells were installed in the tree demonstration and surrounding area. These wells were monitored periodically from December 1985 - November 1998 to assess the impact of the trees and shrubs on the shallow groundwater table. The results showed that the water table varied from a winter high average of 0.7 metres below ground level to a summer low average of 1.4 metres.

Moore and Ciganovic (1999) reported that there were no trends in the static water level that could be attributed to increased soil moisture consumption by the plantation. There was a seasonal trend that in the winter the water tables rose followed by a drop in the summer to a lower level. The ground water level appeared to respond directly to rainfall. In 1992 and 1996, which was an exceptionally wet year and wet winter respectively, the water tables rose significantly (refer to Appendix II: Well numbers 1-20).

Two species of trees that had outstanding growth were flat topped yate (*Eucalyptus occidentalis*) and Kangaroo Island paper bark (*Melaleuca halmaturorum*). Other eucalypts to have performed well in varying degrees were: salt river gum (*E. sargentii*); SA blue gum (*E. leucoxydon*); moort gum (*E. platypus*); SA mallee box (*E. porosa*); swamp mallet (*E. spathulata*); river red gum (*E. camaldulensis*). Old man saltbush (*Atriplex nummularia*) is doing well but is being heavily shaded by overgrowth from the other trees.

2.2 Anama tree site

The Anama tree site (section 392, Hundred Andrews) was planted in 1989 with support from the National Afforestation Project (NAP). The aim of this project was to test trees to a range of soil salinity levels and assess their salt tolerance. A mixture of trees and shrubs were planted including eucalypts, acacias, casuarinas, melaleucas, atriplex, hakea, pittosporum and westringia. Tall wheat grass and puccinellia was established in the early 1990s. The soil was a sandy loam to sandy clay loam (pH 7.0) over a sandy clay (pH 8.5). The surface soil had an ECe ranging from 0 to 60 dS/m while the sub-soil had an ECe up to 8.9 dS/m.

The best performing trees and bushes after the first year included old man saltbush (*Atriplex nummularia*); Kangaroo Island paper bark (*Melaleuca halmaturorum*); river cooba (*Acacia stenophylla*); yellow flowering gum (*E. stricklandii*); gum-barked coolibah (*E. intertexta*); southern mahogany (*E. botryoides*) and river box (*E. largiflorens*).

Six observation wells were installed in the project area and were monitored periodically from February 1990 - November 1992. The results shown that the water table during the monitoring period varied from a winter/spring level of 0 to 0.4 metres below ground level to a summer/autumn level of 0.9 to 2.0 metres below ground level (Dooley, *pers. comm*). There was a seasonal fluctuation of the water table but due to the short monitoring period a trend could not be established to ascertain if the trees and shrubs were having any effect on the watertable. The groundwater salinity ranged spatially from 2 to 40 dS/m with an average of 15 dS/m (Dooley, *pers. comm*). The water quality for Well 3 and Well C rose significantly during July 1991 (Appendix III).

2.3 Snowtown tree site

The Snowtown tree site (section 294, Hundred Boucaut) was planted to demonstrate the amelioration of soil salinity by using various tree and shrub species (Appendix I). The site was part of a major landcare project organised by the Hummocks Soil Conservation Board with assistance from the National Soil Conservation Program (NSCP). The project was launched at the tree site on April 24th 1990 by the Director-General of Agriculture Dr John Radcliffe. This site was supported by the Blyth-Snowtown District Council and Trees for Life.

Only one observation well was installed in this tree site. Every effort was made to find the initial reading (depth to water table and water quality) but this could not be found.

3 Results

The observation wells in the tree sites were monitored in February 2004, August 2004 March 2005 and August 2005. The change in the depth of the groundwater is shown in Appendix II. The water quality is outlined below in Tables 1 and 2.

Table 1: Water test results from the Farrell Flat tree site.

Well No.	Water quality							
	5 th February 2004		11 th August 2004		29 th March 2005		29 th August 2005	
	EC (dS/m)	TDS (mg/L)	EC (dS/m)	TDS (mg/L)	EC (dS/m)	TDS (mg/L)	EC (dS/m)	TDS (mg/L)
1	Dry	Dry	19.25	12,320	Dry	Dry	24.30	15,550
2	16.80	10,750	17.80	11,390	6.66	4,262	6.67	4,270
3	33.60	21,500	9.91	6,340	Dry	Dry	24.12	15,440
4	32.10	20,540	28.28	18,100	23.28	14,900	20.36	13,030
5	36.16	23,140	30.50	19,520	27.00	17,330	31.10	19,900
6	31.68	20,270	13.30	8,510	10.50	6,720	10.70	6,850
7	50.00	32,000	31.92	20,430	29.00	18,585	28.30	18,110
8	17.25	11,040	13.05	8,350	9.30	5,952	11.40	7,300
9	29.74	19,030	29.52	18,890	19.55	12,512	25.60	16,380
10	Dry	Dry	12.70	8,130	Dry	Dry	11.75	7,520
11	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
12	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
13	Not found							
14	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
15	Not found							
16	Not found							
17	Dry	Dry	12.12	7,760	Dry	Dry	14.50	9,280
18	Not found							
19	Not found							
20	17.31	11,080	16.70	10,690	Dry	Dry	16.50	10,560
Sea water quality is about 50dS/m (32,000 mg/L). 1 mg/L = 1ppm = 640 EC dS/m								

Table 2: Water test results from the Snowtown tree site.

Well No.	Water quality							
	5 th February 2004		11 th August 2004		29 th March 2005		29 th August 2005	
	EC (dS/m)	TDS (mg/L)	EC (dS/m)	TDS (mg/L)	EC (dS/m)	TDS (mg/L)	EC (dS/m)	TDS (mg/L)
1	54.0	34,560	46.11	29,510	49.5	31,680	48.0	30,720
Sea water quality is about 50 dS/m (32,000 mg/L). 1 mg/L = 1ppm = 640 EC dS/m								

The results at Farrell Flat and Snowtown indicate that all the water samples are highly saline. The water sample from test well No.7 (5th Feb 2004) and the water samples from the Snowtown site were of sea-water quality.

The water table depth at Snowtown was measured at: 5.20 metres in February and August 2004; 5.60 metres in March 2005 and 5.10 metres in August 2005. All the test wells at Anama were broken off and could not be located.

4 Discussion

4.1 Farrell Flat tree site

In February 2004 and 2005 the water tables were significantly lower than the last readings in November 1998. This is due to the last few years of below average annual rainfall and dry seasonal conditions. Over the last two years the water tables have fallen and risen due to seasonal conditions. It will be interesting to see if the water tables will rise to similar levels pre 1998 and how long this will take.

Table 3 shows the spatial variation of the groundwater salinity for the summer/autumn and winter period for 2004 and 2005.

Table 3: Spatial variation of groundwater salinity

	Spatial variation of groundwater (dS/m)	
	February/March	August
2004	17 - 50	10 - 32
2005	7 - 29	7 - 31

There does not appear to be any relationship between groundwater levels and salinity levels.

The 15 year records up to November 1998 showed that there were no trends in the static water table levels which could be attributed to soil moisture consumption by the tree plantation. With the dry year of 2002 (290mm) and the reasonably dry seasonal conditions from late 2003 to 2005 it is likely that the trees would have use some of the water but are unlikely to have any significant effect on the overall groundwater system. Moore and Ciganovic (1999) indicate that to have a significant effect on the groundwater system the area planted must comprise a significant proportion of the basin involved.

Although the tree plantation will not have a significant effect on the overall groundwater system, it does have other benefits. The plantation is a habitat for an increasing range of birds, animals and reptiles. The trees have also transformed a saline discharge area into a relatively attractive site, which may help to improve the market value of the land. Other benefits would include a windbreak effect and a site for beehives for honey production.

5 Recommendations

It is recommended that monitoring be continued at the Farrell Flat site every six months for at least another two years to see if the water tables will rise to similar levels pre 1998 and determine how long this will take.

The observation wells at the Anama site could be reinstalled and this would cost in the order of about \$1600.

6 References

Moore SD and Ciganovic P, (1999) *A review of the vegetation planting trial on a saline discharge zone at Farrell Flat (1985- 1999)* Primary Industries and Resources SA.

Appendix I:
Trees and shrub species
planted at the Snowtown site
1990

Table 1.1: Trees and bushes species planted at the Snowtown site 1990

Botanical name	Common name
<i>Acacia Brachybotrya</i>	Grey mulga
<i>Acacia Ligulata</i>	Umbrella bush
<i>Acacia Rotundifolia</i>	Round leaf wattle
<i>Acacia Oswaldii</i>	Umbrella wattle
<i>Acacia Pycnantha</i>	Golden wattle
<i>Acacia Retinodes</i>	Wirilda
<i>Acacia Rigens</i>	Nealie wattle
<i>Acacia Paradin</i>	Kangaroo thorn
<i>Acacia Hakeoides</i>	Hakea wattle
<i>Acacia Sclerophylla</i>	Hard leaved wattle
<i>Acacia Notabilis</i>	Notable wattle
<i>Allocasuarina Verticillata</i>	Drooping sheoak
<i>Cassia Nemophila</i>	Punty bush
<i>Callitris Preissii</i>	Cypress pine
<i>Casuarina Cristata var Pauper</i>	Black oak/Belah
<i>Dodonaea Viscosa</i>	Sticky hop bush
<i>Eucalyptus Calycogona</i>	Square fruited gum
<i>Eucalyptus Camaldulensis</i>	River red gum
<i>Eucalyptus Foecunda</i>	Narrow-leaved mallee
<i>Eucalyptus Leucoxydon var Pruinosa</i>	Inland blue gum
<i>Eucalyptus Oleosa</i>	Red mallee
<i>Eucalyptus Porosa</i>	Mallee box
<i>Eucalyptus Socialis</i>	Summer red mallee
<i>Eucalyptus Gracilis</i>	Yorrell
<i>Melaleuca Acuminata</i>	Mallee honey-myrtle
<i>Melaleuca Lanceolata</i>	Dryland tea tree
<i>Pittosporum Phylliraeoides</i>	Native apricot

Appendix II:
Water table fluctuations (1985-2005)
at the Farrell Flat tree site

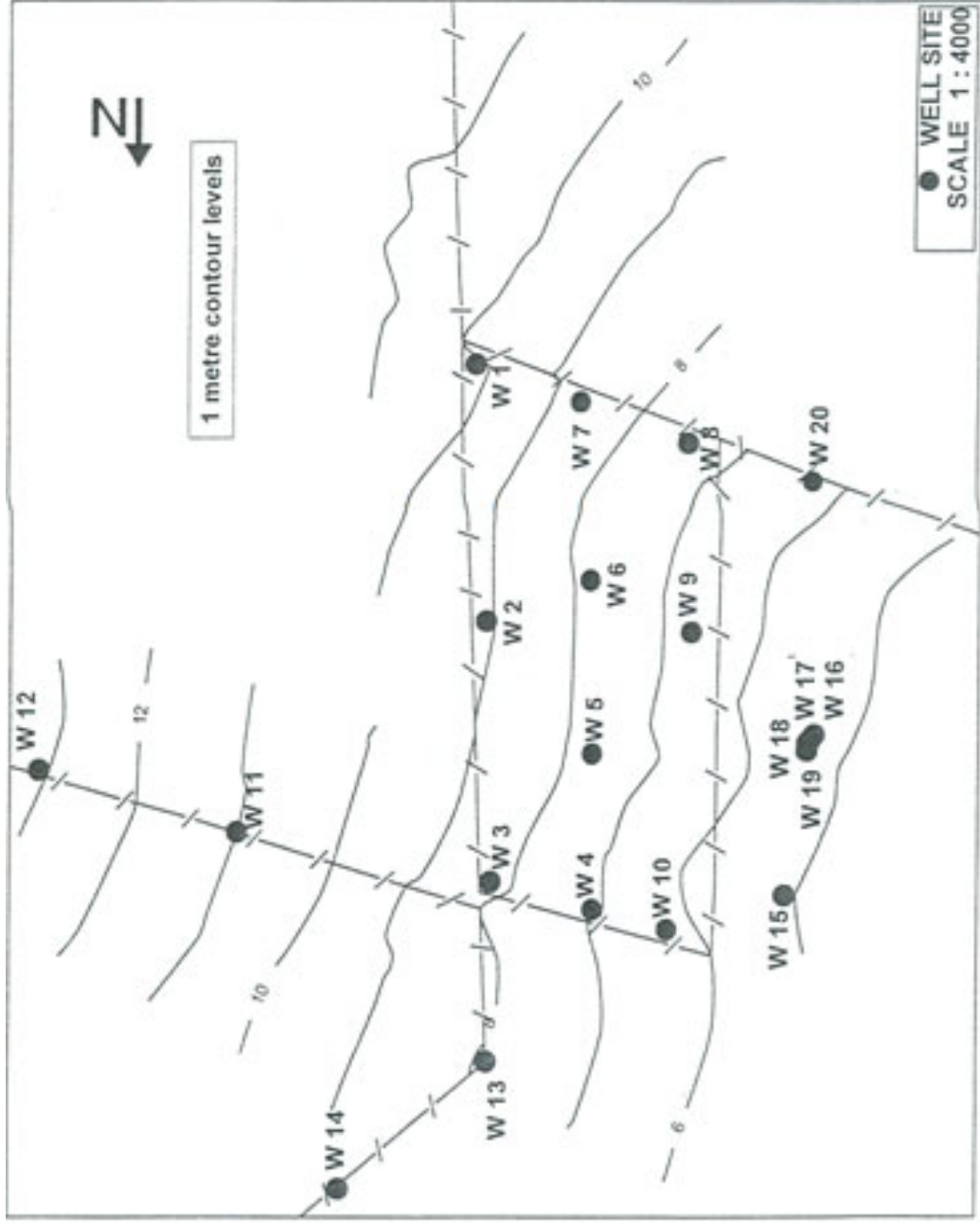
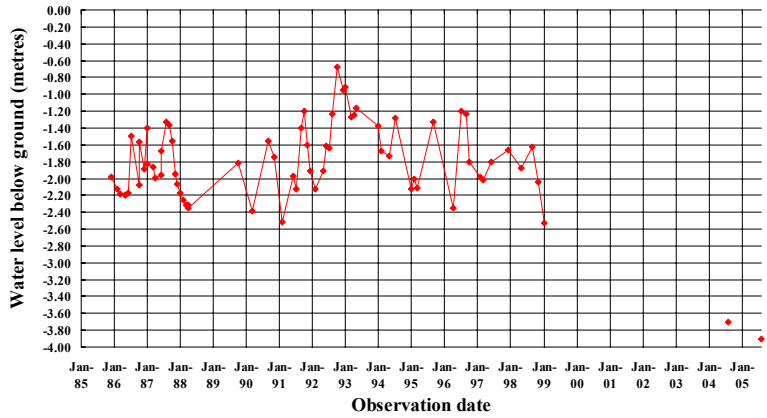


Fig 1 : Location of Test Wells

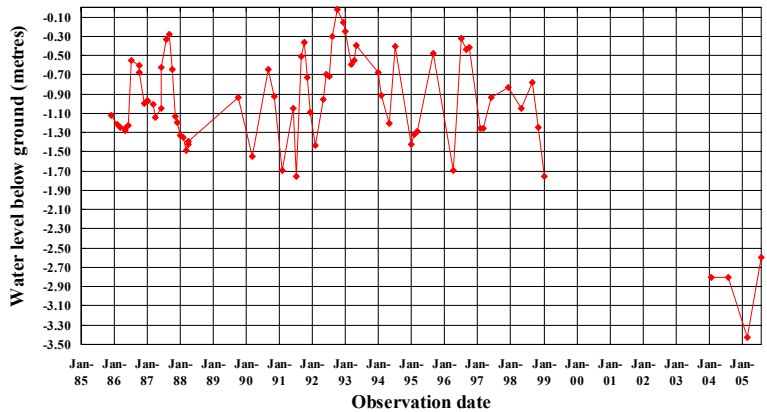
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Well No.1



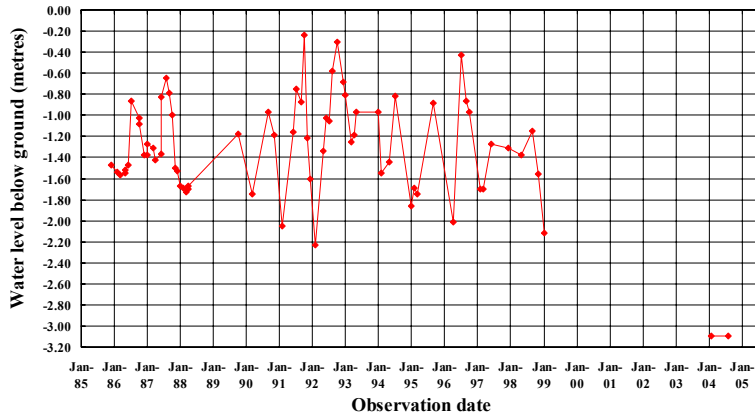
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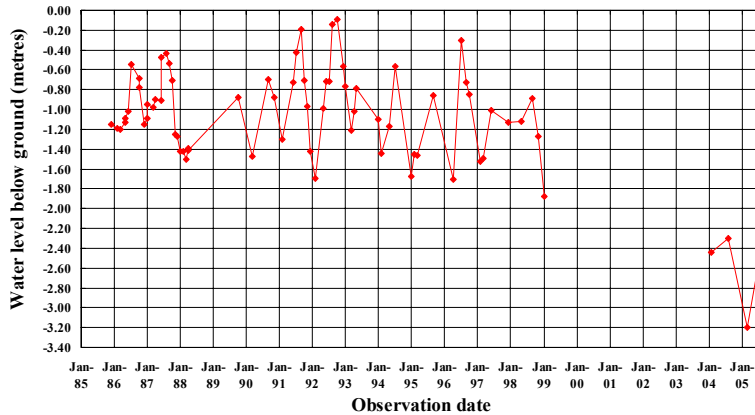
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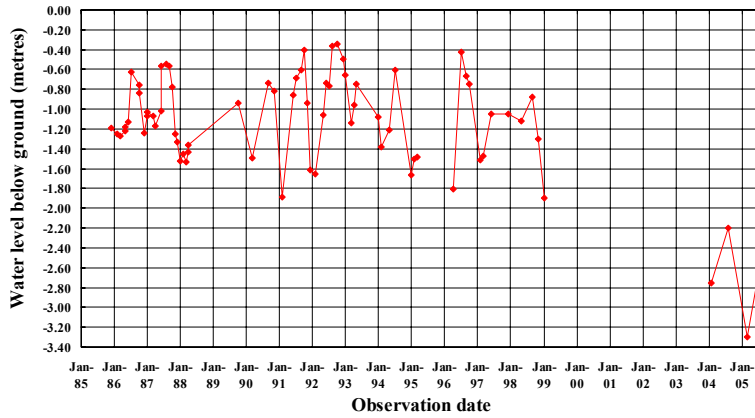
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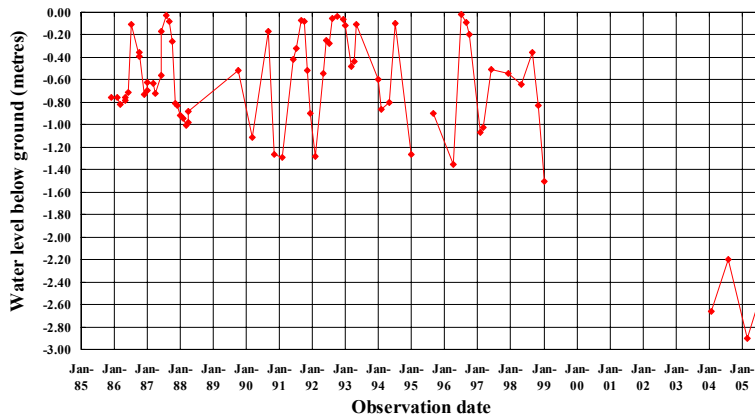
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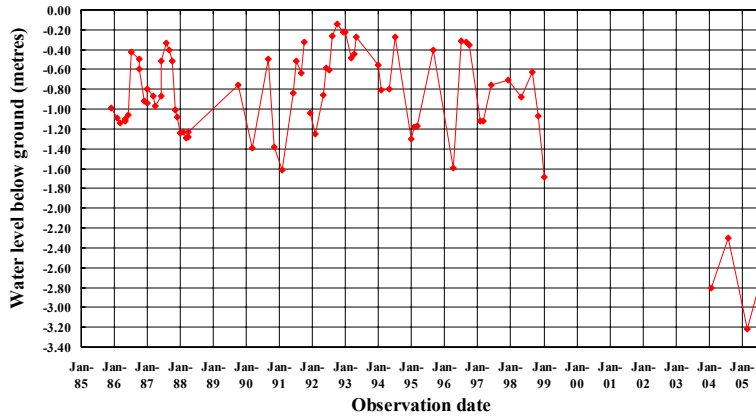
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Well No. 6



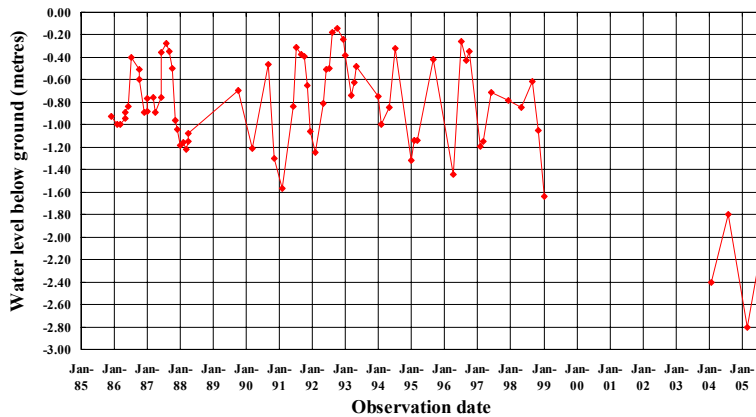
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Well No. 7



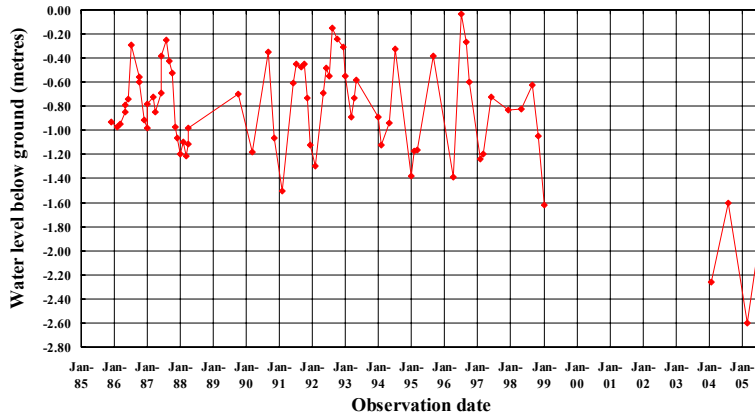
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Well No. 8



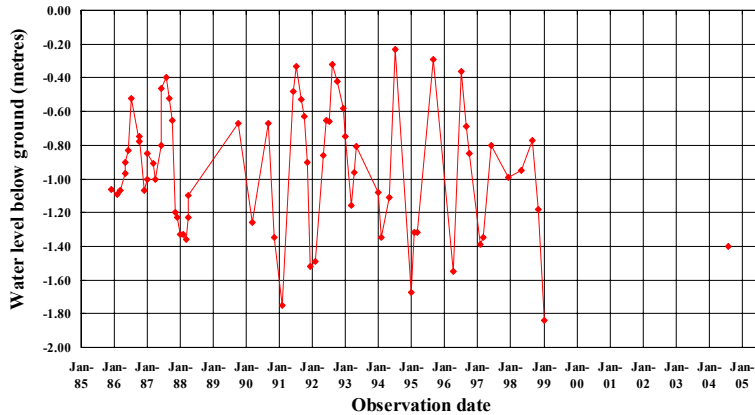
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Well No. 9



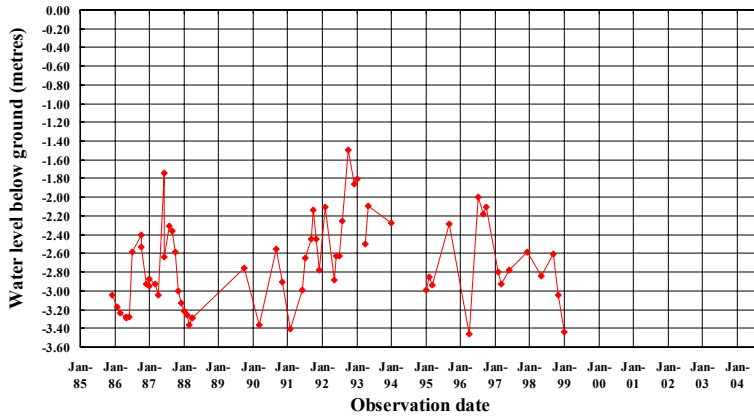
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Well No. 10



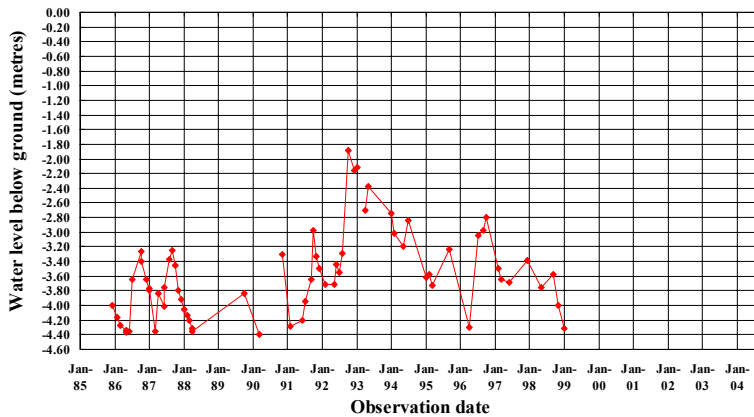
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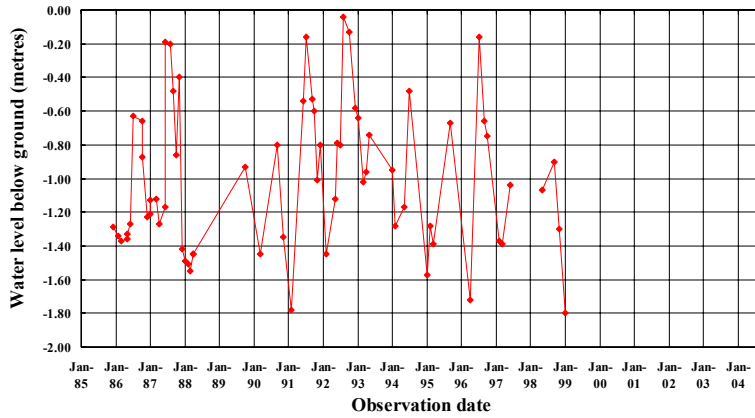
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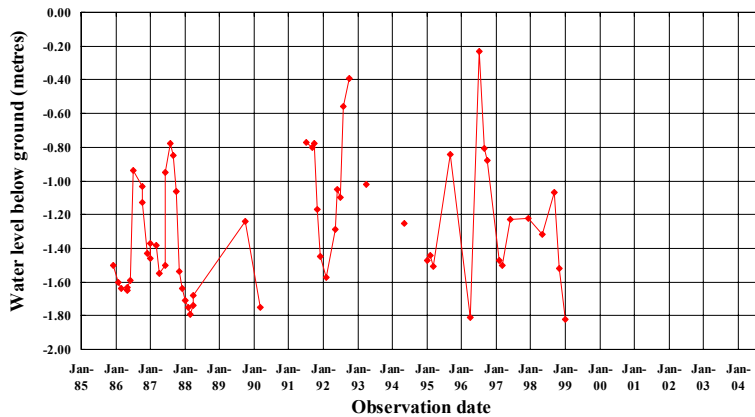
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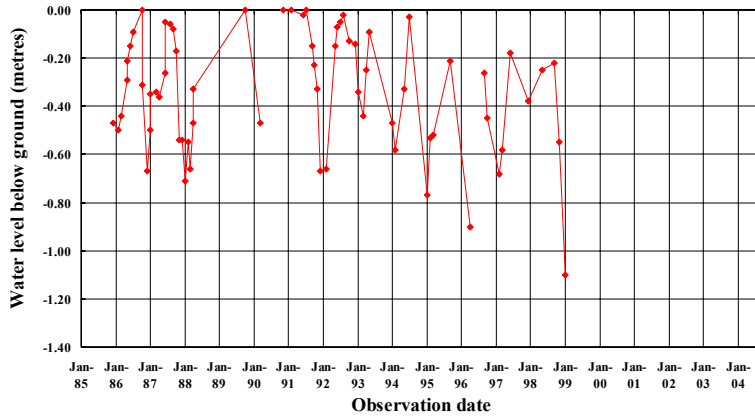
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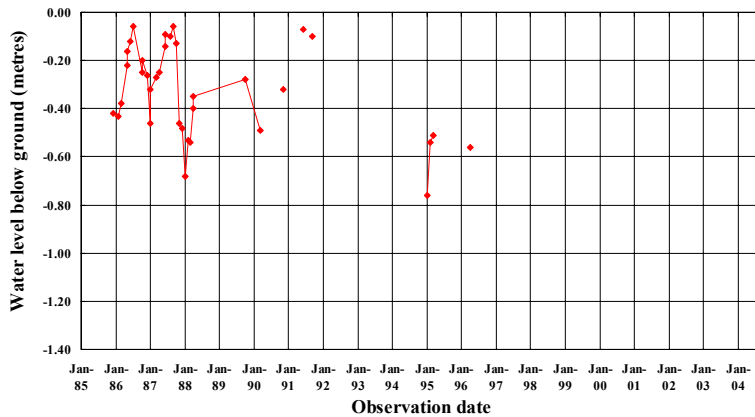
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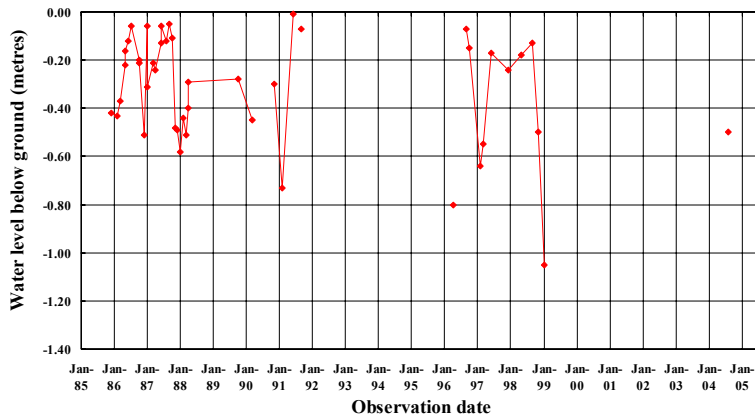
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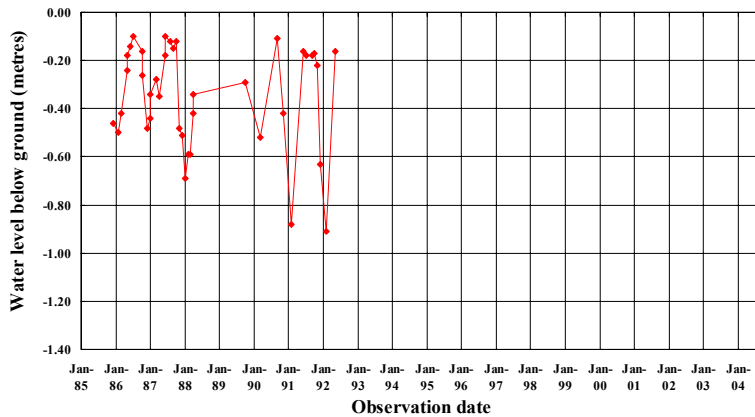
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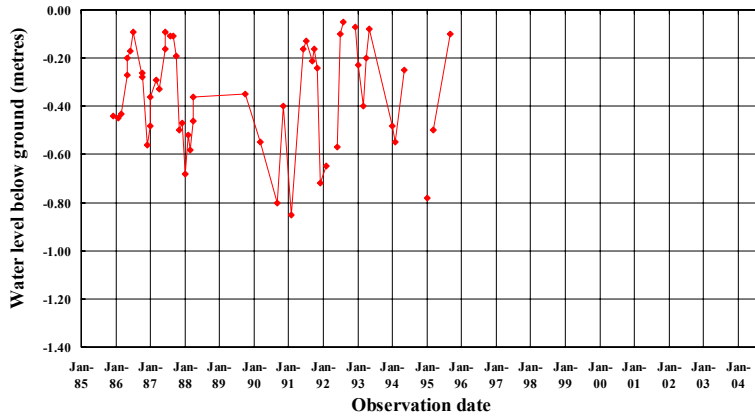
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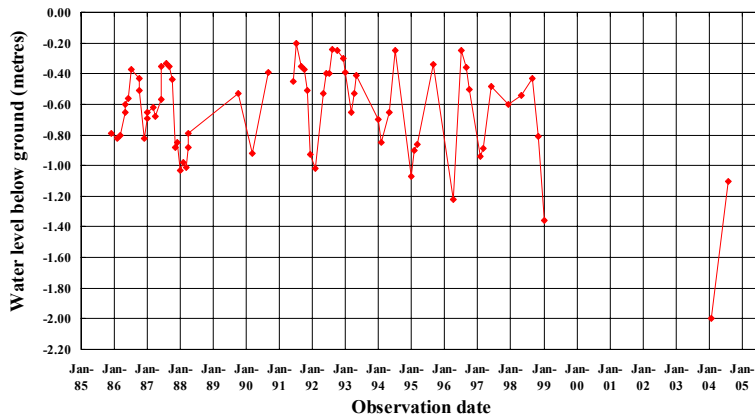
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Well No. 19



FARRELL FLAT

Well No. 20

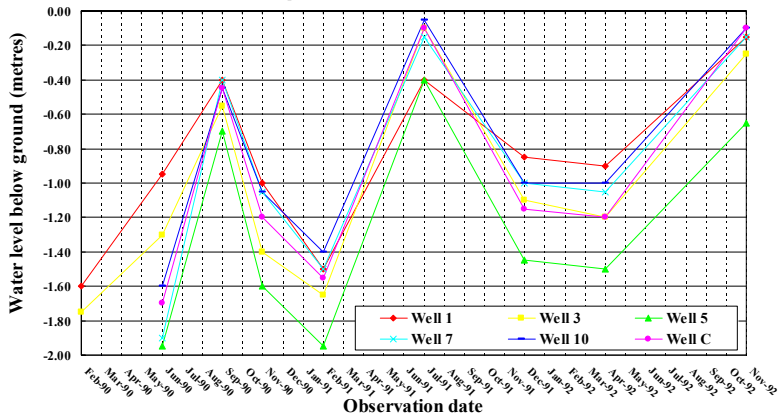


Appendix III

Water table fluctuations and water quality (1990-1992) at the Anama tree site

ANAMA SITE

Depth to watertable



ANAMA SITE

Water quality

