HYDROGEOLOGICAL REPORT ON WATER WELL MONITORING IN ABORIGINAL LANDS TO MAY 2002

DWLBC
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2002/26

The Department of
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Biodiversity
Conservation

Government
of South Australia

Hydrogeological report on water well monitoring in Aboriginal lands to May 2002

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Groundwater Assessment
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Department of Water, Land and Biodiversity Conservation

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Foreword

South Australia's natural resources are fundamental to the economic and social wellbeing of the State. One of the State's most precious natural resources, water is a basic requirement of all living organisms and is one of the essential elements ensuring biological diversity of life at all levels. In pristine or undeveloped situations, the condition of water resources reflects the equilibrium between rainfall, vegetation and other physical parameters. Development of these resources changes the natural balance and may cause degradation. If degradation is small, and the resource retains its utility, the community may assess these changes as being acceptable. However, significant stress will impact on the ability of a resource to continue to meet the needs of users and the environment. Understanding the cause and effect relationship between the various stresses imposed on the natural resources is paramount to developing effective management strategies. Reports of investigations into the availability and quality of water supplies throughout the State aim to build upon the existing knowledge base enabling the community to make informed decisions concerning the future management of the natural resources thus ensuring conservation of biological diversity.

Bryan Harris
Director, Knowledge and Information Division
Department of Water, Land and Biodiversity Conservation

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ABSTRACT

Water well monitoring data from wells on Aboriginal lands (Pitjantjatjara, Yalata, Nepabunna and Oak Valley) are summarised for the period April 2001 to May 2002. This report also shows plots and analysis of all data for each well since monitoring began.

In the Pitjantjatjara lands aquifers at all communities except Kalka, Mimili and Fregon showed significant recharge and water levels have recovered to, or are above, the levels recorded at the time of drilling. The three exceptions are probably extensive aquifers that have generally been free from signs of depletion. The only community for which there is any short term (5-10 years) concern is Indulkana. Whilst there was recharge to the older wells, the community now relies on the Indulkana Range wells for a larger portion of its water supply. The aquifer in which these wells is completed was not recharged and water levels are declining.

At Nepabunna supplies are still marginal and the heavy pumping regime has made monitoring insensitive to small but possibly significant changes. Modification of the monitoring is required, preferably with separate monitoring wells.

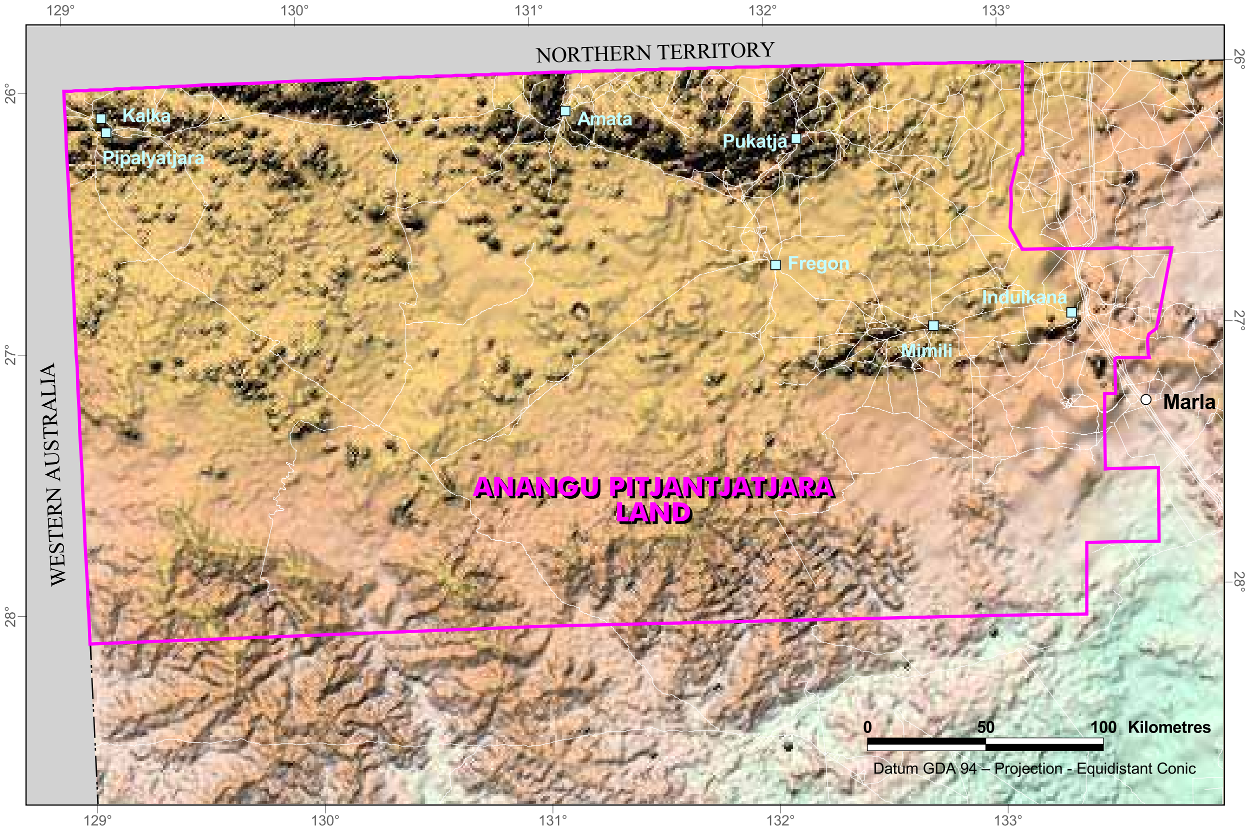
The Yalata aquifer is unaffected by pumping, but the groundwater level appears to be declining by natural drainage. No recharge is observed.

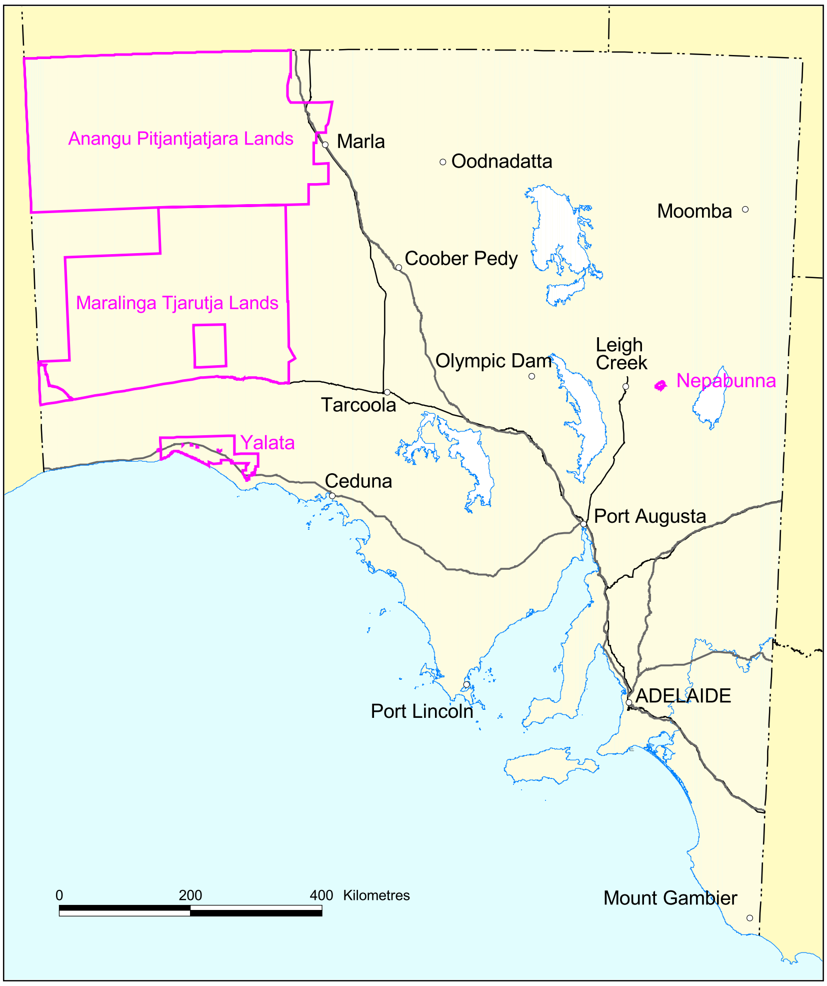
Oak Valley supplies have held up remarkably well, but are still regarded as fragile. Stringent water management is essential if the additional costs of importing water are to be avoided.

INTRODUCTION

This report comprises analysis of the standing water level (SWL), well production and rainfall data for monitored wells on Aboriginal lands (Pitjantjatjara, Yalata, Nepabunna, and Oak Valley) up to May 2002. It includes all data from the start of monitoring, but the reader is referred to an earlier report that contain the results of geophysical logging of the wells and background well information (Dodds and Sampson, 2000). Other reports contain discussions of specific downloads of data and equipment problems (Dodds and Sampson, 1999a, b, 2001; Sampson and Dodds, 2000). Publications that might assist with understanding the hydrogeology, in particular those concerning the search for water resources for particular communities, are listed in the Bibliography.

The program to monitor water supplies in the Aboriginal lands is run by the Resource Assessment Division of the Department of Water Land and Biodiversity Conservation under the auspices of the Department of State Aboriginal Affairs, which supplies funding and guidance. Areas undergoing well monitoring are located in Figure I.





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Water well monitoring in Aboriginal Lands

LOCALITY MAP

PIRSA Publishing Sevices AV:200213-001

Figure I

PRESENTATION OF DATA

The basic data comprises hourly readings of the pump rate (L/s), the standing water level (SWL in metres) and, for one well in each community, the rainfall (mm). To compact this large mass of data, the daily maximum and minimum SWL, the daily water production (kL) and the daily rainfall are calculated. The minimum and maximum SWL and water production parameters are plotted on one graph and the daily rainfall, recorded at a well near the same community, is plotted on the second graph. The minimum SWL maps the non-pumping water level unless the well was pumped for 24 hours a day. The maximum SWL maps the pumping water level unless the well was not pumped in that 24-hour period. The two curves coincide in the two exception cases mentioned above apart from a gap indicating random variations in the measured water level. Use of the term 'SWL' generally refers to the non-pumping water level.

Where necessary to demonstrate some aspect of a well's performance the basic hourly data are plotted for an interval of a few days or weeks.

The table of water production data presented for each community is the accumulated flow (kL) recorded by the flow meter whereas the daily and monthly production figures are a summation of the hourly flow readings as recorded by the data logger. A data integrity check is made, for each bore, by comparing the accumulated flow with the summation of hourly flow values. Differences can occur where a pump operates on an intermittent basis for short durations. Where a large difference occurs, the daily and monthly figures are used to indicate the trend in pumping regimes rather than the absolute values.

ANALYSIS OF LOGGING DATA

Pitjantjatjara lands

1. INDULKANA

Water Production

The water production plot (Fig. 1.2) and Table 1 show the dominance of the new Indulkana Range Wells, IR-1 and IR-2, in supplying Indulkana's water since early in the year 2000. Water usage overall in the summer months has nearly doubled since these two wells came on line.

Table 1. Water production at Indulkana, 1998–2002

Well	Unit number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr. –Nov. 2001*	*Nov. 2001 – May 2002*
IMB-19	5544-101	954.1	990.9	2 096.2	125.2	192.7	286.0	132.5
IMB-19A	5544-132	1 828.7	2 159.0	3 340.0	512.4	879.7	436.3	158.2
IMB-25	5544-157	6 039.0	3 367.0	1 347.0	1.5	0.1	0	0
IMB-26	5544-158	1 145.6	2 816.0	0.8	0.3	0.1	0	0
IMB-27	5544-159	1 528.7	787.8	111.3	0.2	0.0	0	0
IR-1	5544-172	–	–	5 565.6	–	12 433.0	7 835.3	18 704.0
IR-2	5544-169	–	–	4 863.1	4 970.6	5 246.8	2 910.3	4 566.7
Total		**11 496.1**	**10 120.7**	**17 324.0**	**5 610.2***	**18 752.4**	**11 467.9**	**23 561.4**

* Not including IR 1 which had a faulty flow meter.

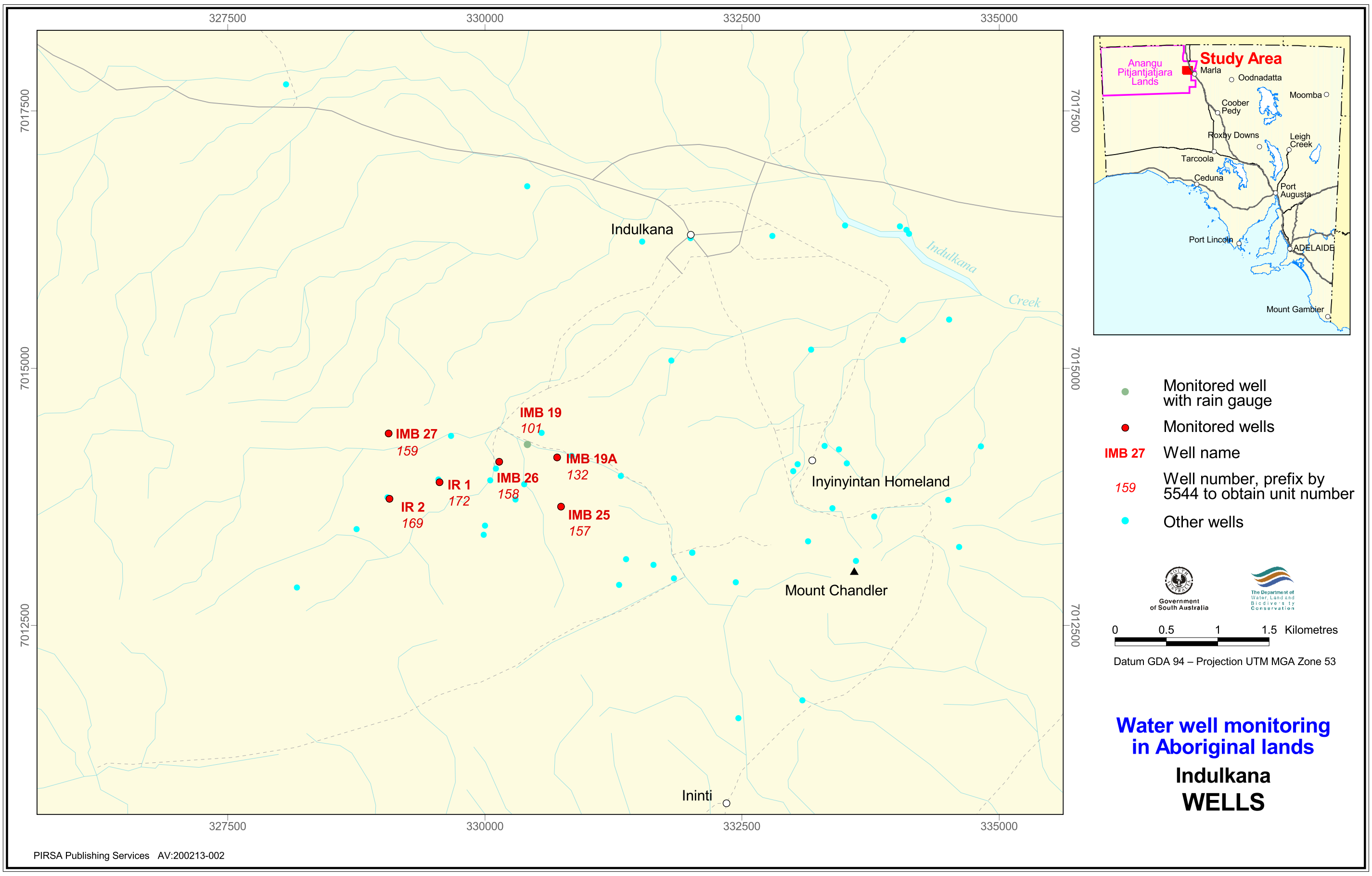
Wells

IMB-19

Good rainfall over the last two and a half years has produced results that reinforce the conclusions of the last two reports – that the well is close to a point of recharge to the aquifer.

The SWL has risen to 14.6 m (May 2002), higher than when the well was drilled in 1977 (15.6 m) and considerably higher than the low of 17.5 m in 1997 (Fig. 1.3). Each rainfall event of 20 mm or more (eight since July 1998) has resulted in an immediate and large rise in water level (ranging from 2 to 12 m), followed by a gradual decline over the next few weeks (Fig. 1.4). In most cases there has been a net rise in water level.

Although there has been a marked decrease in the amount of water extracted from this well since early 2000, when the Indulkana Range wells came on stream, we consider that this does not account for the long-term rise in SWL. The evidence is clear enough that recharge to the aquifer is occurring at a point close to this well, if not through the well itself. This recharge causes a mounding of the waters in the aquifer in the area of the well that gradually dissipates over the succeeding weeks.



327500
330000
332500
335000
7017500
7015000
7012500
Indulkana
Indulkana
Creek
IMB 19
101
IMB 27
159
IMB 19A
132
IR 1
172
IMB 26
158
IR 2
169
IMB 25
157
Inyinyintan Homeland
Mount Chandler
Ininti
Study Area
Anangu Pitjantjatjara Lands
Marla
Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
IMB 27 Well name
159 Well number, prefix by 5544 to obtain unit number
Other wells
Government of South Australia
0 0.5 1 1.5 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 53
Water well monitoring in Aboriginal lands
Indulkana
WELLS
PIRSA Publishing Services AV:200213-002

Figure 1.1

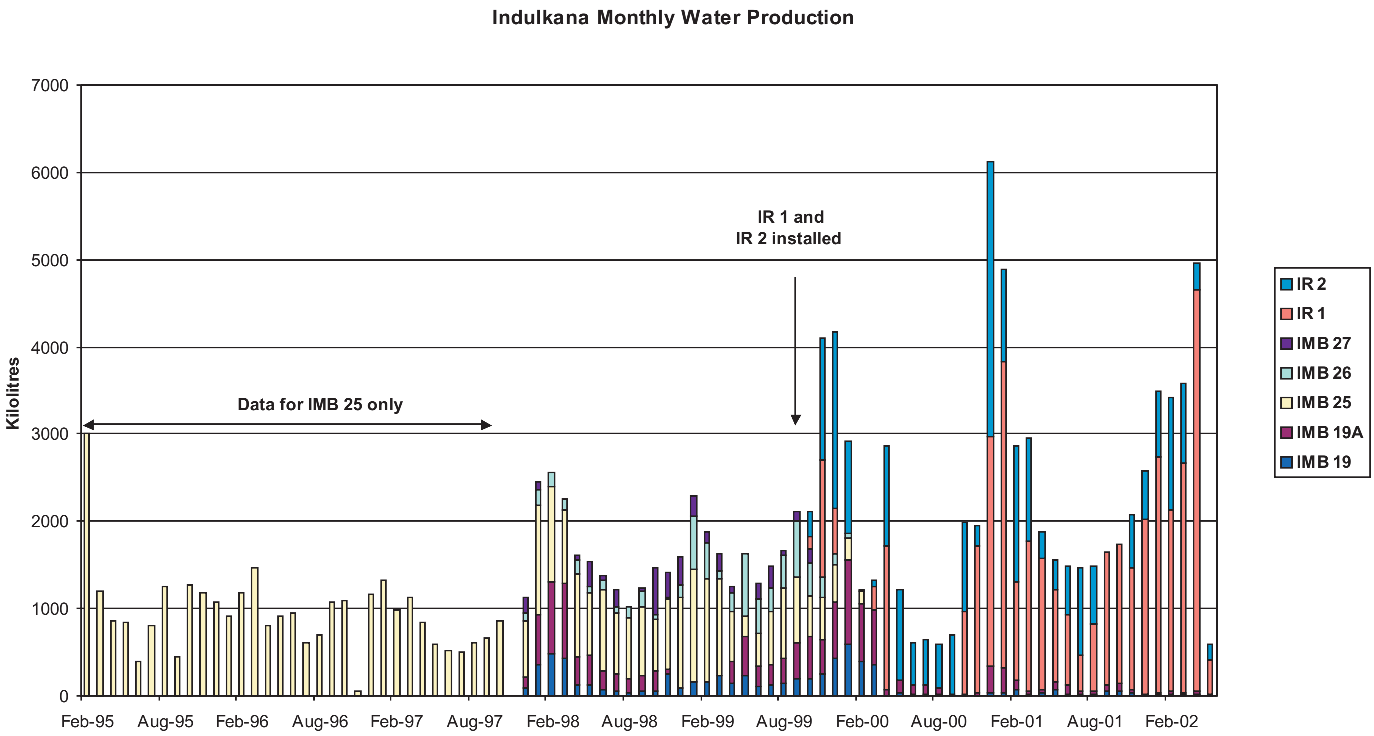


Figure 1.2 Community water production at Indulkana

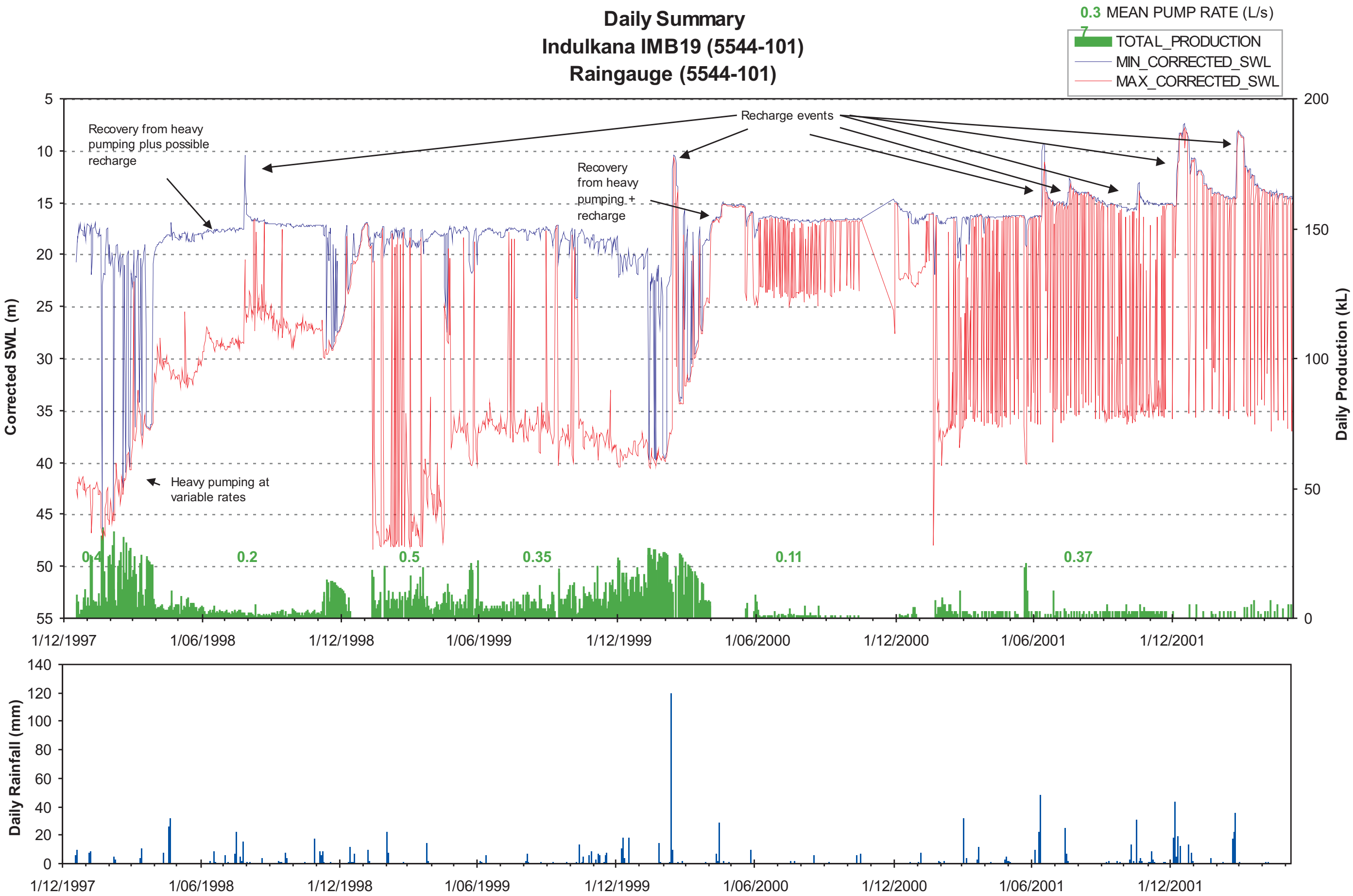


Figure 1.3 Daily Summary, Indulkana IMB 19

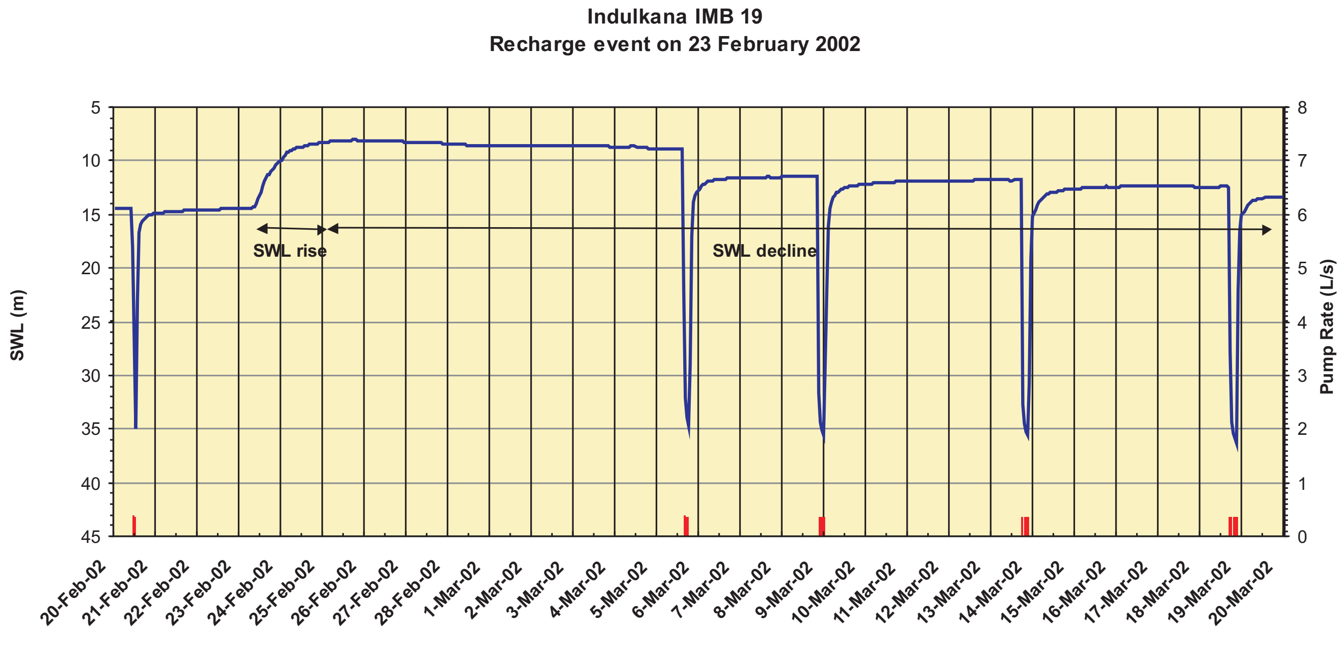


Figure 1.4 Recharge Event, Indulkana IMB 19

The pump rate for this well has ranged from 0.1 L/s to 0.5 L/s, with proportional drawdowns of 6 m to 30 m. The latter drawdown dropped the pumping SWL to nearly 50 m, which is getting close to the water cut at 55 m and could cause problems if sustained for extended periods. The current pumping rate of 0.37 L/s results in an acceptible pumping SWL of about 35 m.

It is also evident that the total water withdrawal per day is important. The well was stressed in March 1998, when being pumped at 0.3 L/s for long periods, and again in January and February 2000 when the pump rate was 0.35 L/s. After such spells the well took much longer to recover to its pre-pumping SWL. Daily pumping rates of over 20 kL/day (0.37 L/s for 15 hours a day) clearly stress the well, while the current rate of 5 kL/day (0.37 L/s for 3.5 hours a day) does not.

This well should yield at least 5 kL/day indefinitely, barring extended droughts of over 10 years. Higher daily pumping rates should be restricted to a day or two duration. The water quality, which deteriorated to 1110 mg/L TDS by 1997, was quite variable over the 1977-97 period (see RB 2000/27). It is probable that this variation correlates with recharge, and that the water extracted now is of much lower salinity than in 1997. This would be worth checking.

IMB-19A

The SWL has now risen steadily over the past four years from 28 m to above 25 m, which is the highest level recorded to date (Fig. 1.5). While there are no immediate obvious responses to potential recharge events, as was seen for well IMB-19, the steadily rising SWL probably results primarily from recharge. Some of the SWL rise, particularly that before the year 2000, may result from lower pumping regimes that put less stress on the aquifer.

The pumping rate was 0.6 L/s (sometimes 0.7-0.9 L/s) in the early years with pumping sometimes sustained for up to 24 hours a day (50 kL/day). Such rates caused a drawdown in the pumpimg SWL to 63 m, about that of the water cut, and probably stressed the aquifer (Fig. 1.6). Whether the times of slow SWL recovery shown on the plot (3 days) result from this is uncertain. The regime since the start of the year 2001 of pumping at 0.5 L/s for a few hours each day (5-10 kL/day) is certainly less stressful on the aquifer and, combined with steady recharge, has resulted in the rise in SWL to its current level of 24.5 m.

IMB-25

The well has not been pumped since early 2000. The SWL has risen steadily since then, reaching a level of 8.7 m in May 2002, compared with 11.7 m in February 2000 (Fig. 1.7). This 3 m rise may partly result from long-term recovery from pumping, but we consider that there is a significant contribution from recharge. The water level now is above that at the time of drilling the well in 1987 (9.7 m), and considerably higher than the lowest reading recorded (13.7 m in 1997).

While there is some unreliable SWL data, as indicated in Figure 1.7, most of the data is good. It shows the depressing effect of heavy pumping in February 1998 and 1999, and the subsequent recovery in the following winters, especially July 1999, when the demand on the well eased. Superimposed on these effects is the gradual rise in SWL from 1997 to

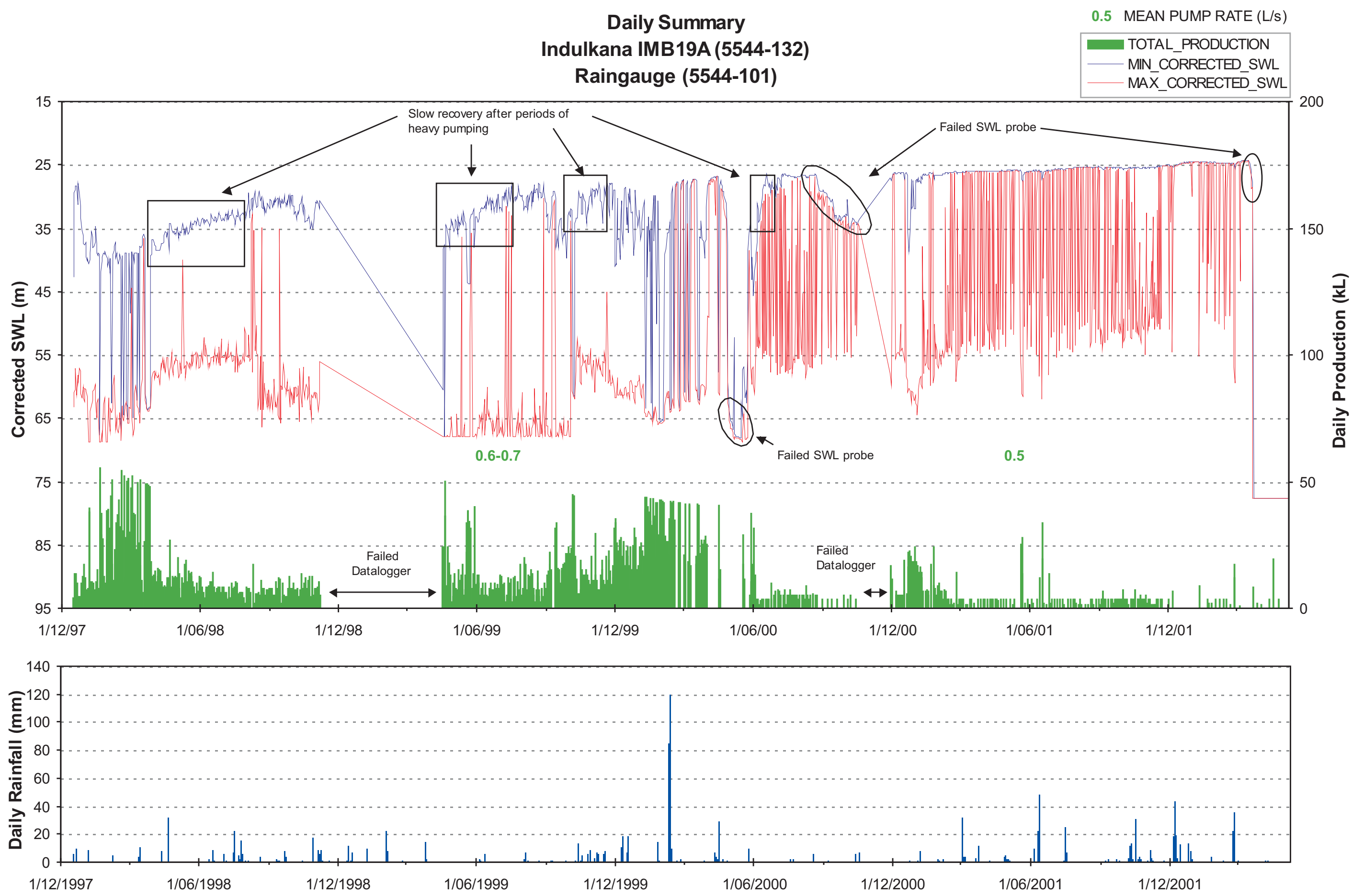


Figure 1.5 Daily Summary, Indulkana IMB 19A

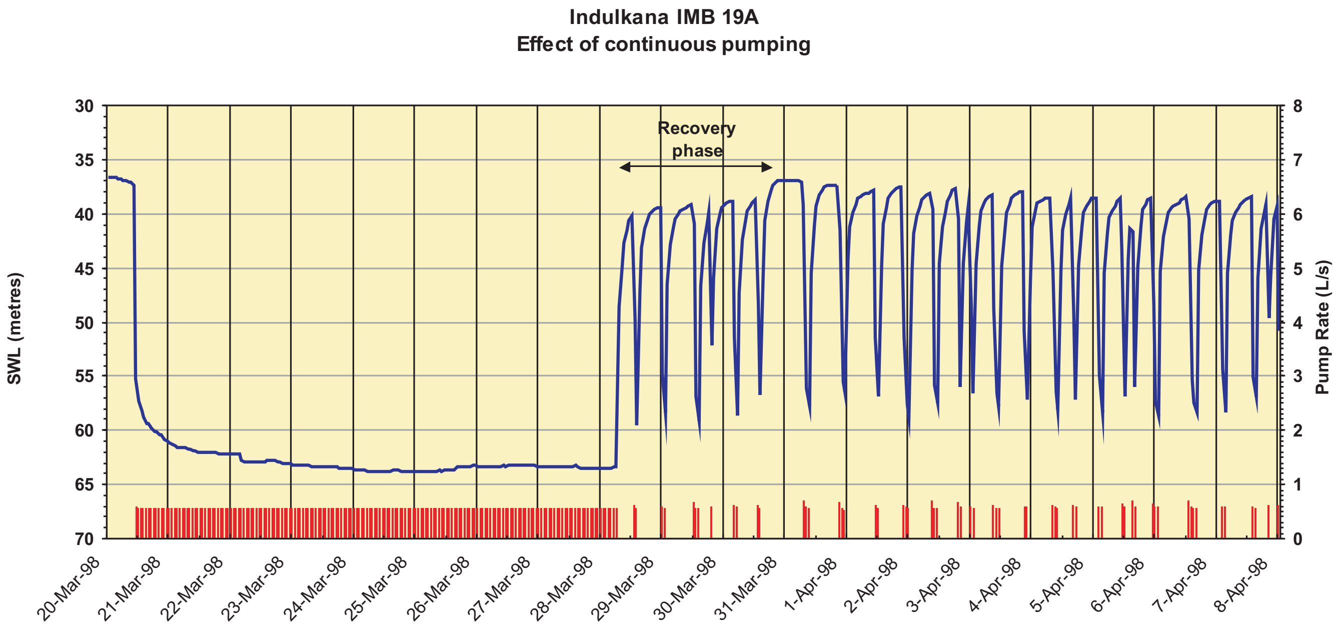


Figure 1.6 Effect of continuous pumping, Indulkana IMB 19A

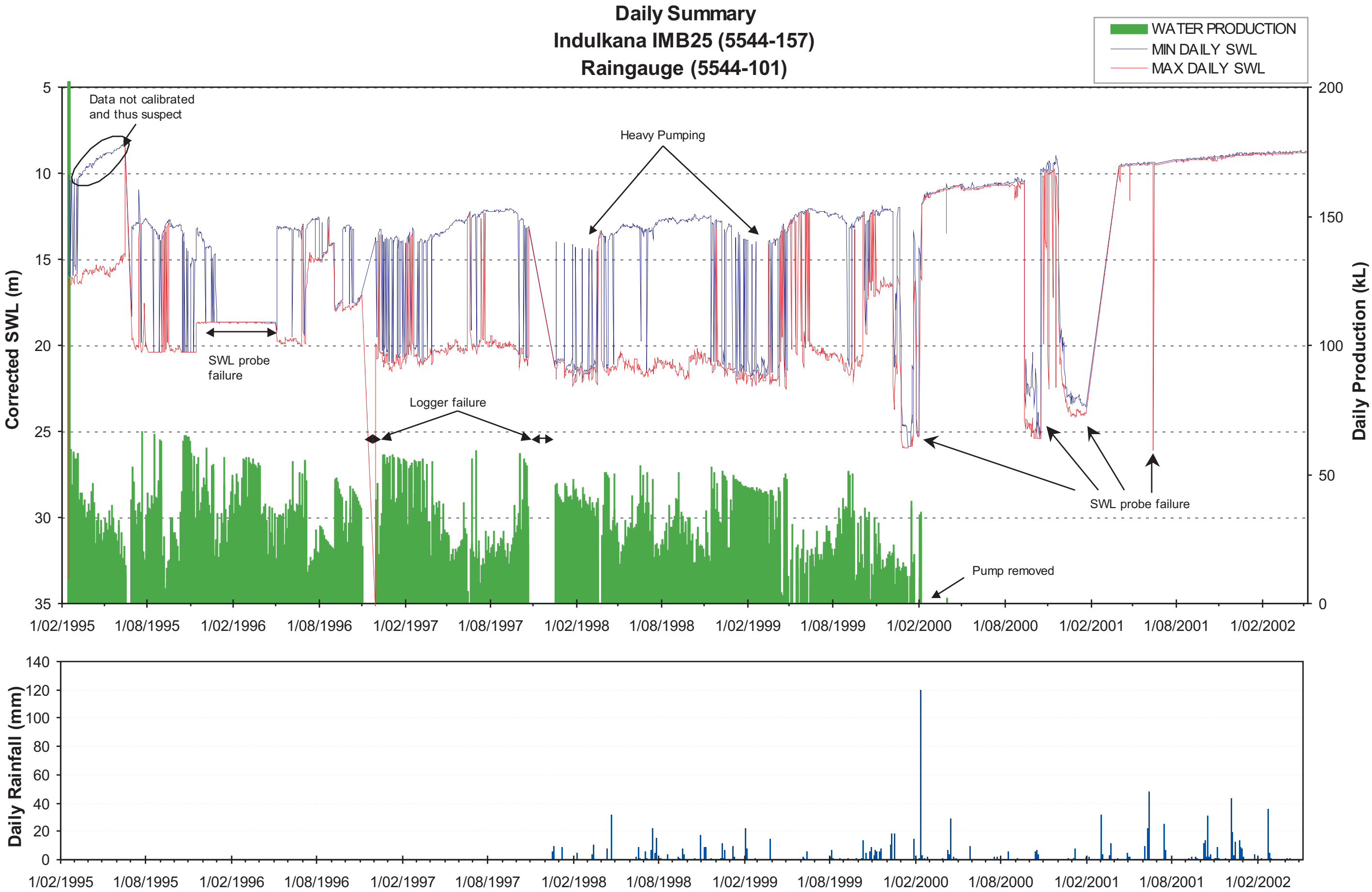


Figure 1.7 Daily Summary, Indulkana IMB 25

the present. It seems likely that the rainfall events do not have any immediate or dramatic effect on water levels in the aquifer and that the evidence points to a gradual recharge of the aquifer over months and years.

IMB-26

No longer monitored.

IMB-27

Now that the well is no longer pumped, the SWL monitoring shows clear signs of recharge. These are similar to those for IMB-19 except that the rise in SWL at the time of the recharge event is less abrupt and the subsequent drop in level is gentler (Fig. 1.8). All this points to the well being near a point of recharge for the aquifer, but lacks the probability of direct recharge through the well itself.

This well has always been slow to recover from pumping, so an accurate non-pumping SWL was impossible to achieve before the year 2000. The SWL was 17.5 m at the time of drilling the well in 1987, and appeared to be much the same from estimates in 1998 and 1999. A major rise in SWL of over 5 m occurred between October 1999 and April 2000, unfortunately at a time when equipment failure caused a gap in the hourly data. Knowledge of the hourly changes during this rise might have been helpful in understanding the recharge mechanism.

The current level of 8.9 m is much higher than at any time in the past. We have no way of knowing why the rains of the past 2-3 years have had such a marked effect on this aquifer as compared to the aquifers at IMB-19 and 19A. Perhaps there is a small secondary aquifer that produces this elevated SWL. It also points to the discrete nature of these fractured rock aquifers, and the dangers of treating them as an integral system.

IR-1

There are major errors in the flow rate throughout 2002, resulting in grossly exaggerated Daily Production figures. Similar problems occurred in 2000-2001, symptomatic of a known problem that has proved difficult to correct.

This well is the main water supplier to Indulkana, and as such has been heavily pumped. As a result the SWL has dropped steadily from 37.5 m at the time of drilling (late 1998) to 40.4 m in May 2002 (Fig. 1.9). During one period of about a month, in July 2001, the well was rested, and over the 7-month period from March to November 2001 the well was pumped at about one-third of the normal rate. The combined effect was that the SWL recovered to 39.0 m (0.8 m recovery). All in all, it seems fairly clear that the water in the aquifer is being coned downwards by the current level of pumping (best estimate 36 kL/day). This amount of drop is not drastic, but does limit the potential output of the well. The non-pumping SWL is 22.6 m above the water cut at 63-72 m, but the pumping SWL at the current pump rate of 1.4 L/s is 16 m lower, giving a margin of only 6 m. The characteristics can be expected to change within 6 years, probably for the worse, when the pumping SWL goes below the water cut. The most optimistic estimate of well life is 15 years. We are still uncertain about whether this aquifer is being recharged and, as there are no signs of recharge, we have assumed none. This is one uncertainty, which could lengthen the life of the well if the assumption is incorrect. A second assumption is that the

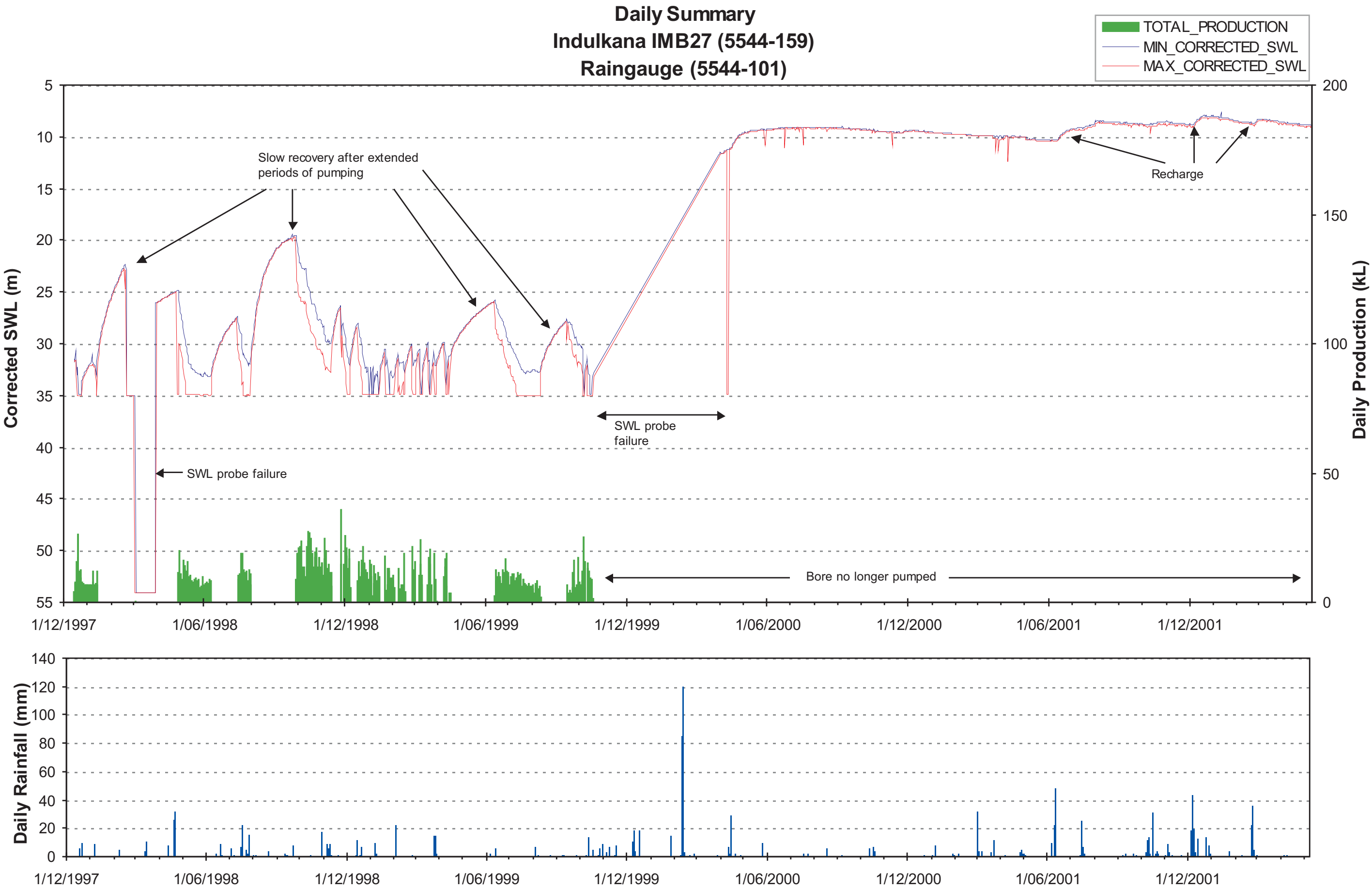


Figure 1.8 Daily Summary, Indulkana IMB 27

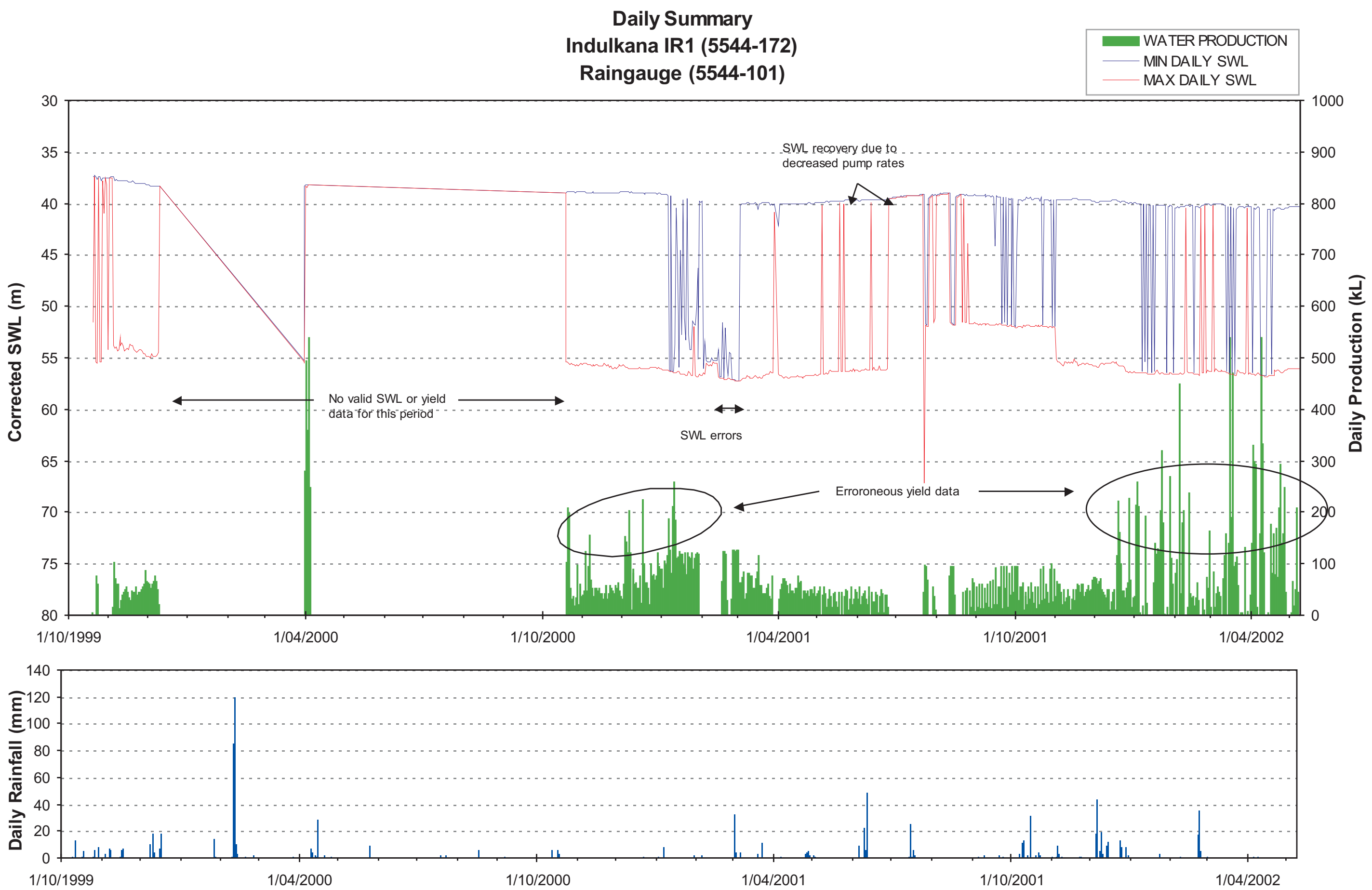


Figure 1.9 Daily Summary, Indulkana IR 1

rate of SWL decline will remain constant, whereas it could increase or decrease. Changes in the pumping rate would also vary the life estimate of the well.

IR-2

Much of the data is again defective, particularly since early September 2001 (Fig. 1.10). The upward spikes in the non-pumping SWL between March and June 2001 result from a malfunctioning non-return valve which allows water from the pipeline to flow back into the well on cessation of pumping (flowback). The general response of the well to pumping can still be observed, however.

This well has also contributed significantly to the water supply. The non-pumping SWL has dropped from 55 m at the time of drilling in 1998 to 56.6 m in May 2002 (1.6 m). With the water cut at 69-75 m and a rate of decline of 0.6 m/year the life of the well is 15 years, based on the same assumptions as for well IR-1 above. Pumping rates are uncertain because of monitoring errors.

Recharge

The water levels in both wells IR-1 and IR-2 have declined as a result of water extraction (Figs 1.9 and 1.10). Moreover, there is no indication of recharge in either well, in spite of substantial rains and strong recharge indications in most of the other wells in this area. It is therefore possible that the water in these aquifers is not of recent origin and may not be replaced. In that case the wells have a life of about 6-15 years, assuming no change in the pump rates or in the rate of SWL decline for other reasons. Continued monitoring should clarify this situation.

The other wells all showed clear signs of recharge from four rainfall events and all SWLs have risen to levels comparable to or above those at the time of drilling the wells. The life of these wells is extended indefinitely, but still may be limited by droughts of over 10 years.

Conclusions

The monitoring of Indulkana's wells over the past two years has changed the prognosis considerably. While recharge of the older wells has lengthened their potential life, the decline in SWL in the Indulkana Range wells IR-1 and IR-2 has limited their potential.

The evidence of active recharge to the aquifers supplying all IMB wells (those in the valleys) is unassailable. The sustainability of this supply is only limited by the possibility of an extended drought of over 10 years, and probably more, at the recommended pumping rates. These 5 wells should be capable of supplying 2 300 kL/month between them. We suggest that the quality of water from these wells, particularly IMB-25, be retested, as the recharge may have improved the water quality.

The SWL in IR-1 and IR-2 has declined slowly but steadily as a result of pumping, hence the life limits of 6 and 15 years. The main concern is the absence of evidence of recharge over years when rainfall has been considerable. It is possible that the water in this aquifer is ancient, and is not recharged in the current climatic regime, in which case the life limits are absolute with possible adjustments only for changes in the rate of SWL decline.

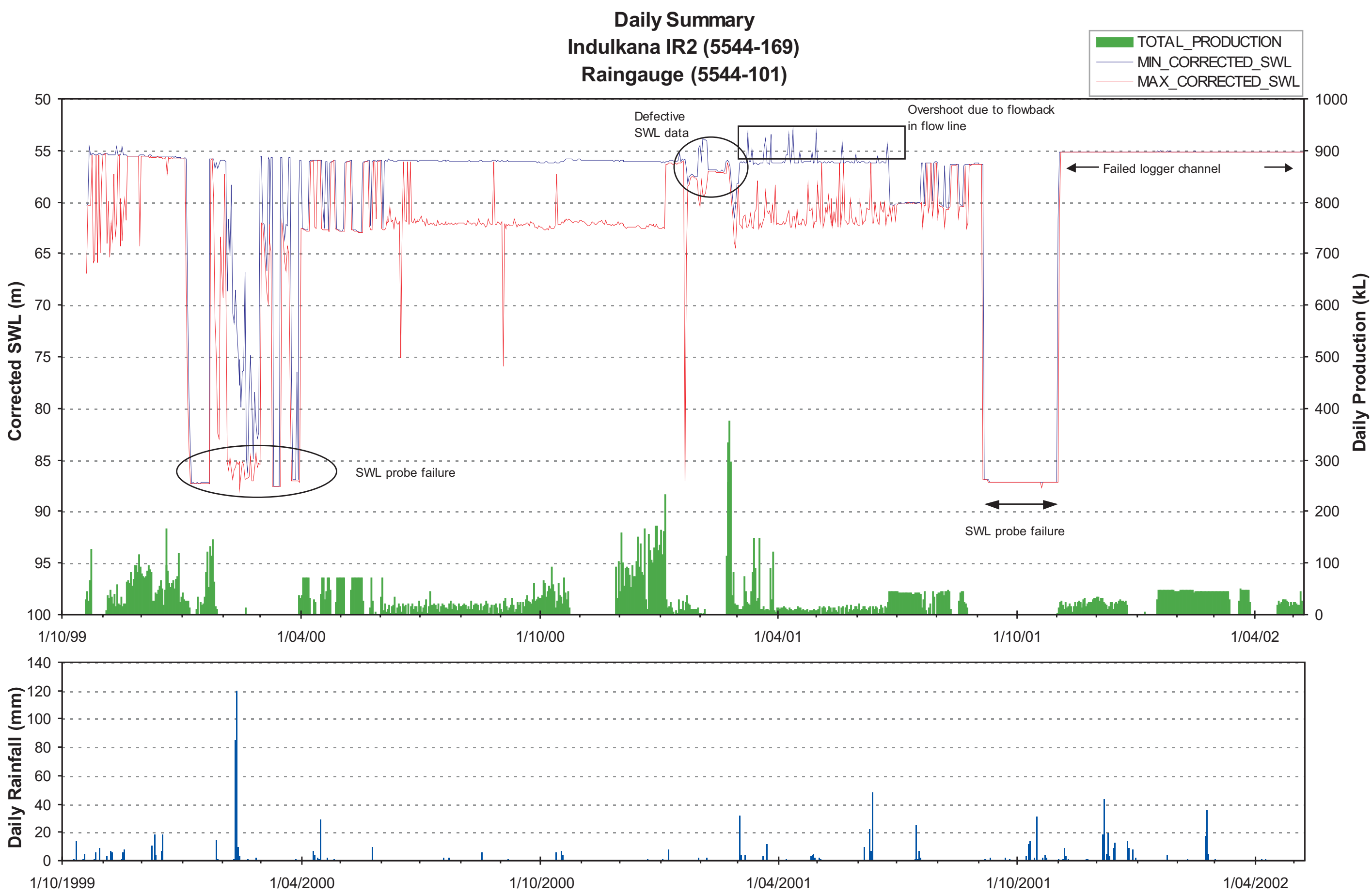


Figure 1.10 Daily Summary, Indulkana IR 2

However, rain in the AP lands tends to be very local, and it is still possible that recharge to the Indulkana Range aquifer will take place under the right circumstances. Monitoring has also commenced of IR-3, which is not equipped and will hopefully give a more sensitive indication of water level changes.

2. MIMILI

Water Production

Both wells, M-1 and M-3, contributed significantly to the community production of up to 3 500 kL/month. The average production is ~2 500 kL/month (Fig. 2.2).

Table 2. Water production at Mimili, 1998–2002

Well	Unit Number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
M-1	5443-25	11 502.0	6 481.0	7 451.0	6 591.9	8 952.7	4 152.7	7 603.7
M-3	5443-28	8 126.0	3 319.0	6 390.0	6 304.0	6 556.0	*6 281.0	9 245.4
Total		**19 628.0**	**9 800.0**	**13 841.0**	**12 895.9**	**15 508.7**	***10,433.7**	**16 849.1**

* M3 suffered a lightning strike, losing possibly 3 months data.

Wells

M-1

The well has been pumped on most days over the past year and since 1998. The pumping rate has been lowered over the past year from 1.3 L/s to 1.0 L/s, but the average daily production has been maintained by extra pumping hours.

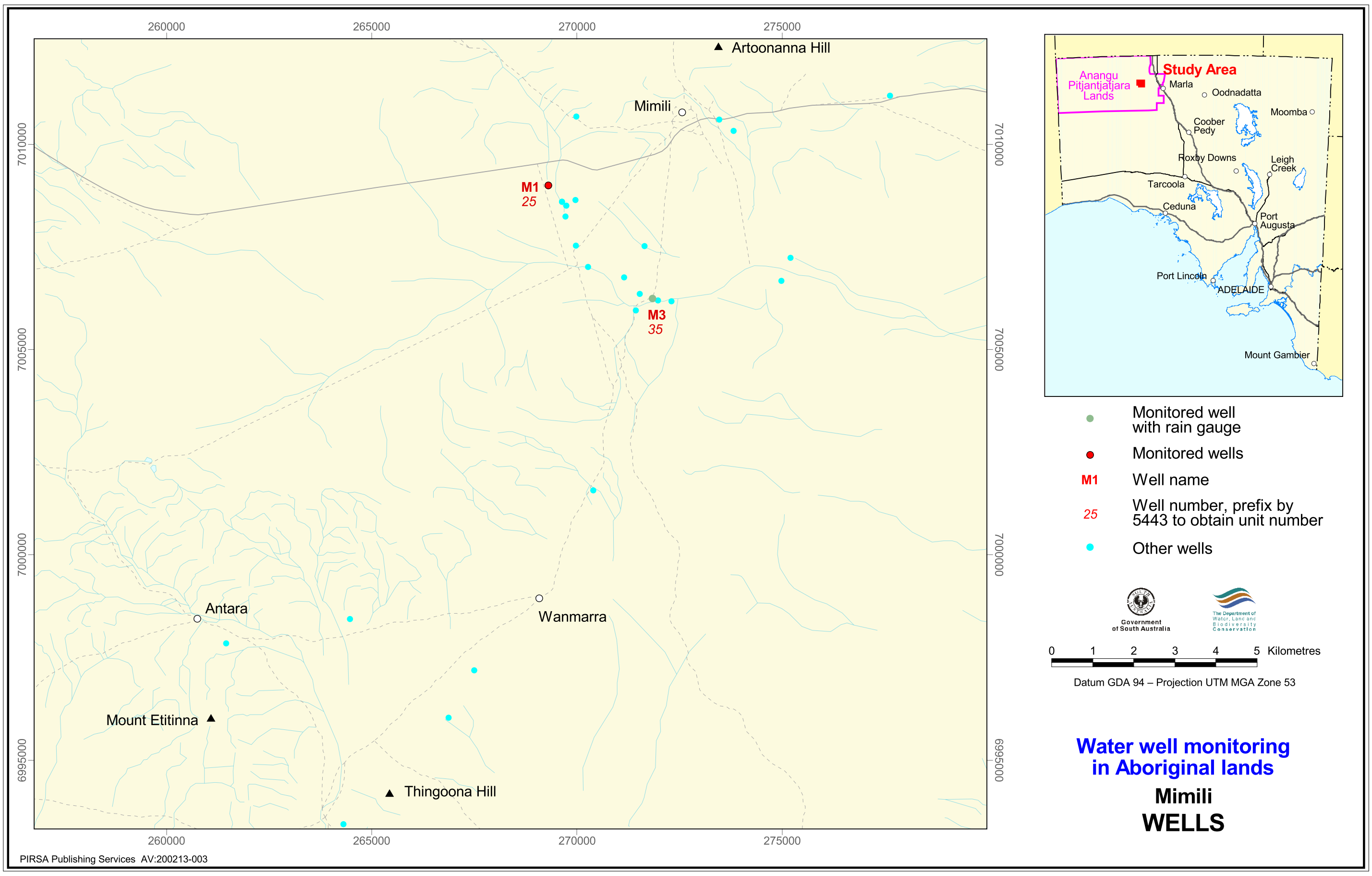
A number of problems with water flowback (April 1998 and April 2000 to April 2001) make the SWL graph rather untidy (Fig. 2.3). However, this does not conceal the fact that the level has not varied much over the past four years and is still only slightly lower, at 15.6 m, than it was at time of drilling in 1978 (14.7 m). The water cuts were mostly below 29 m, giving 14 m of head (9 m from the pumping SWL) and little danger of losing production. Monitoring results over the past year, in particular, indicate that the current pumping rate is sustainable indefinitely.

This well was pumped at 0.9 L/s continuously for four days in January 2002 without any decline in SWL. It appears that this pumping rate could be used for a matter of weeks in case of need.

M-3

Only manual SWL data is of much value before July 1997.

The water level in this well takes at least four hours to return to its non-pumping level after pumping ceases, so that comparable non-pumping SWLs requires that the well has been rested for at least this time. The earliest reliable non-pumping SWL is 11.1 m in November 1996. In May 2002 the level was 11.0 m and has varied little in between these dates (Fig. 2.4). There is therefore no sign of aquifer depletion, either by pumping or by natural drainage. The only sign of stress is the slowness of recovery after pumping, a feature which sometimes becomes more marked if pumping is continuous over a matter of days.


260000
265000
270000
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Artoonanna Hill
Mimili
M1
25
M3
35
Antara
Wanmarra
Mount Etitinna
Thingoona Hill
7010000
7005000
7000000
6995000
Study Area
Anangu Pitjantjatjara Lands
Marla
Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
M1 Well name
25 Well number, prefix by 5443 to obtain unit number
Other wells
Government of South Australia
0 1 2 3 4 5 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 53
Water well monitoring in Aboriginal lands
Mimili
WELLS
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Figure 2.1

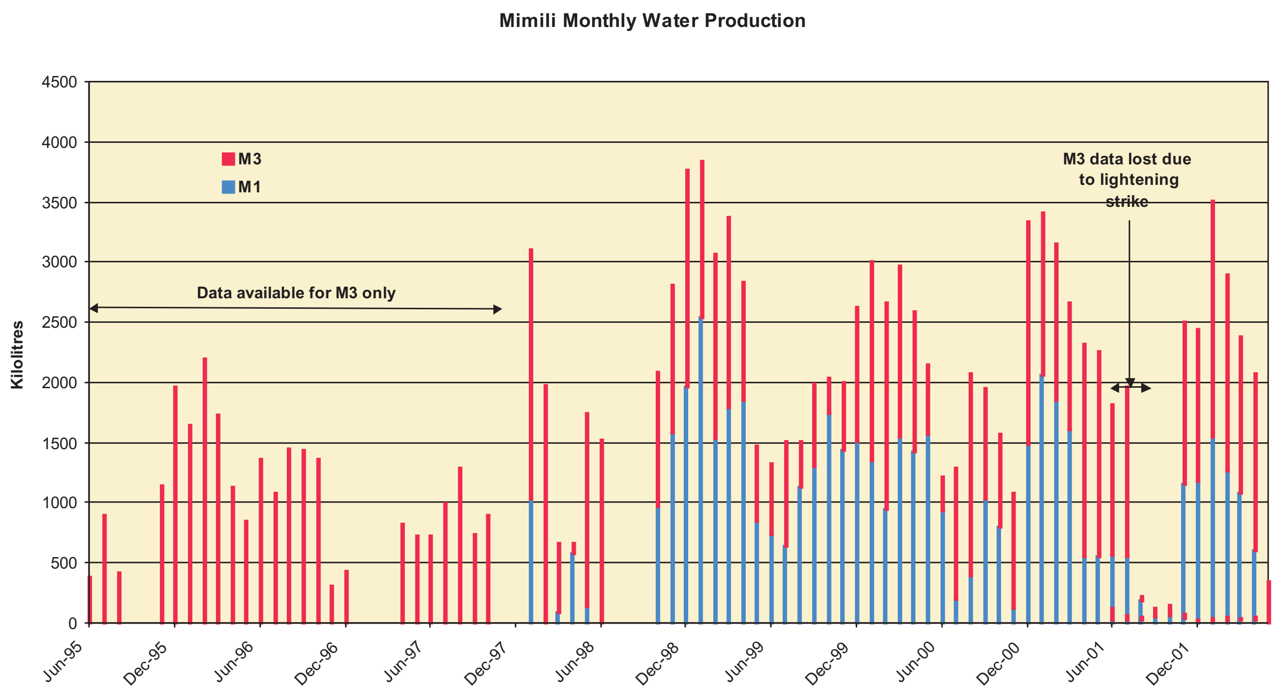


Figure 2.2 Community water production at Mimili

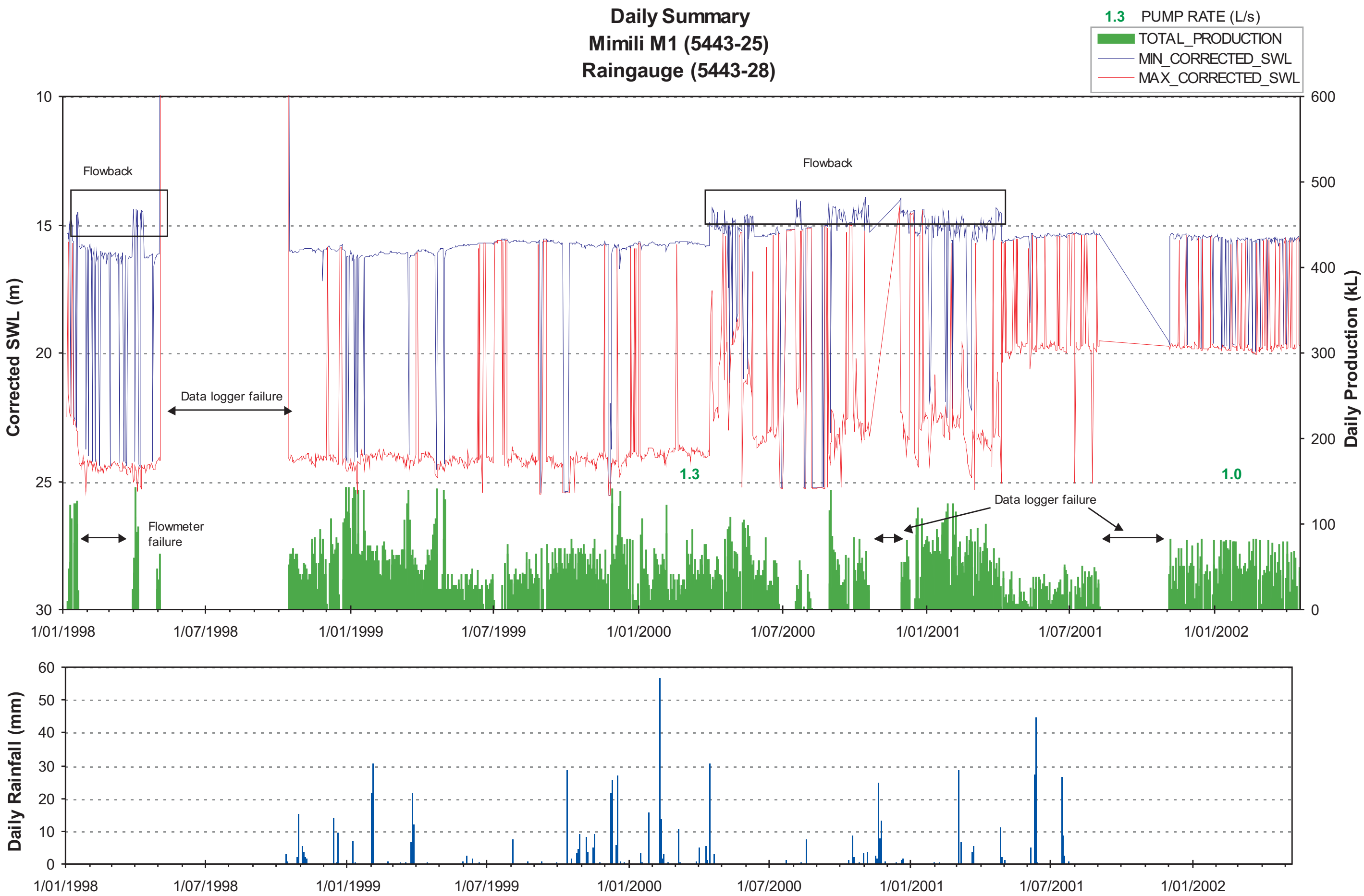


Figure 2.3 Daily Summary, Mimili M 1

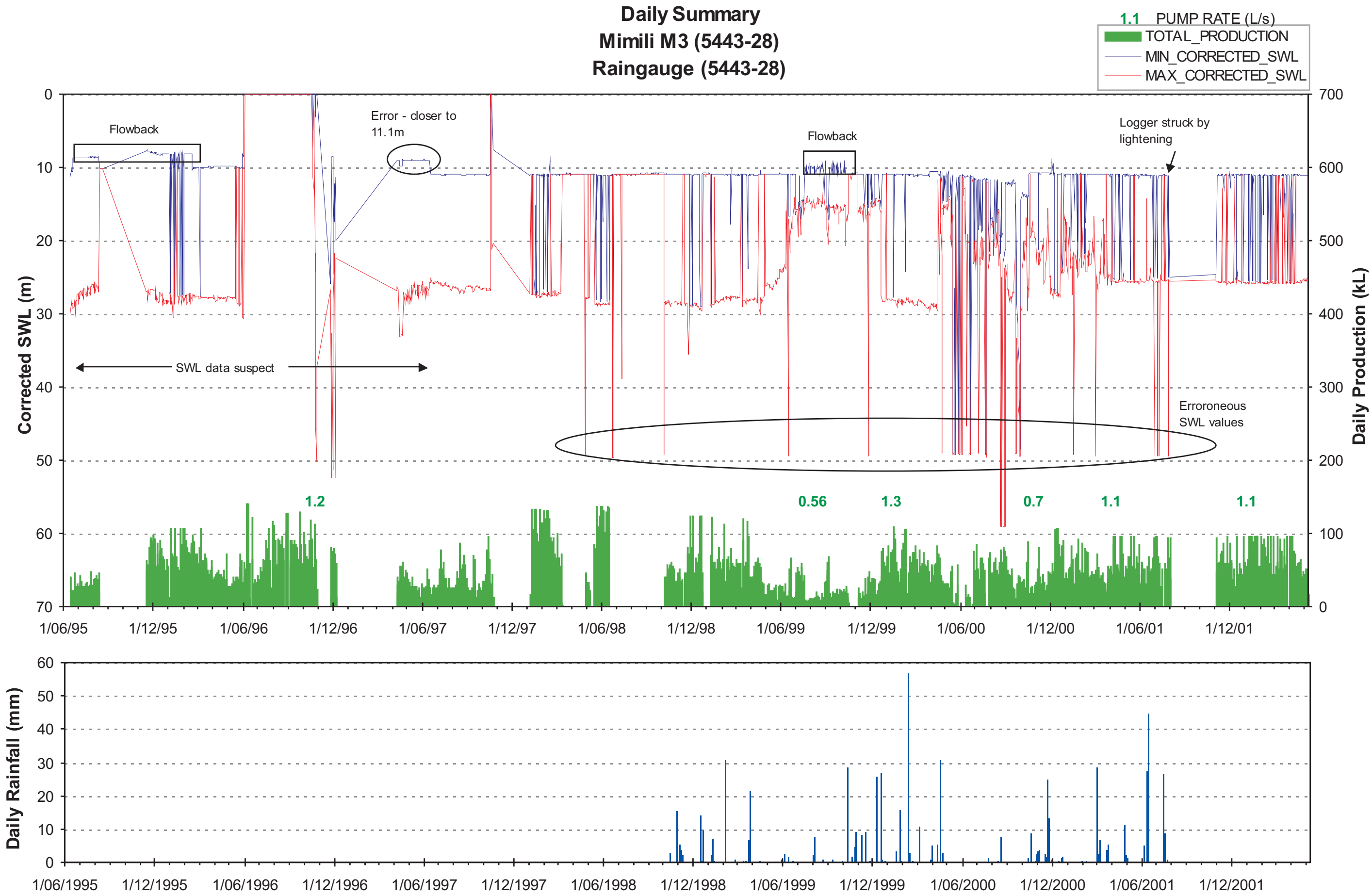


Figure 2.4 Daily Summary, Mimili M 3

At current pumping rates of 1.1 L/s the SWL drops 14 m to about 25 m. The water cuts are below 40 m, so the prognosis is favourable.

The well was pumped at 1.1 L/s continuously for 6 days in January 2002 (Fig. 2.5) with a further drop in SWL of only 0.2 m. On this occasion the SWL still recovered to 11.1 m in about four hours. With 14 m of head this pumping rate could therefore be sustained for several weeks without worry.

Recharge

There have not been any major rainfall events recorded since 1998, but some periods, including the last year, have been missed due to instrument malfunction. There is no indication that recharge of the aquifer(s) has taken place.

Conclusions

The SWL in both wells is being maintained, and there is no evident danger of either well drying up, now or in the foreseeable future. The two wells jointly can produce 180 kL/day for an indefinite period. It appears that lack of capacity is the major concern, and it is expected that new wells drilled this year will provide a backup supply in the event of equipment problems in a well or of extra demand.

The short-term (several weeks) capacity of M-1 and M-3 is 2.0 L/s, or 5 000 kL/month. Recent tests on two new wells (M2002C and M2002E, Fig. 2.1) indicate a short-term capacity of 2.4 L/s, or a further 6 000 kL/month. While such rates would not be sustainable indefinitely they should be sufficient to provide extra supplies for extreme conditions or extra demand.

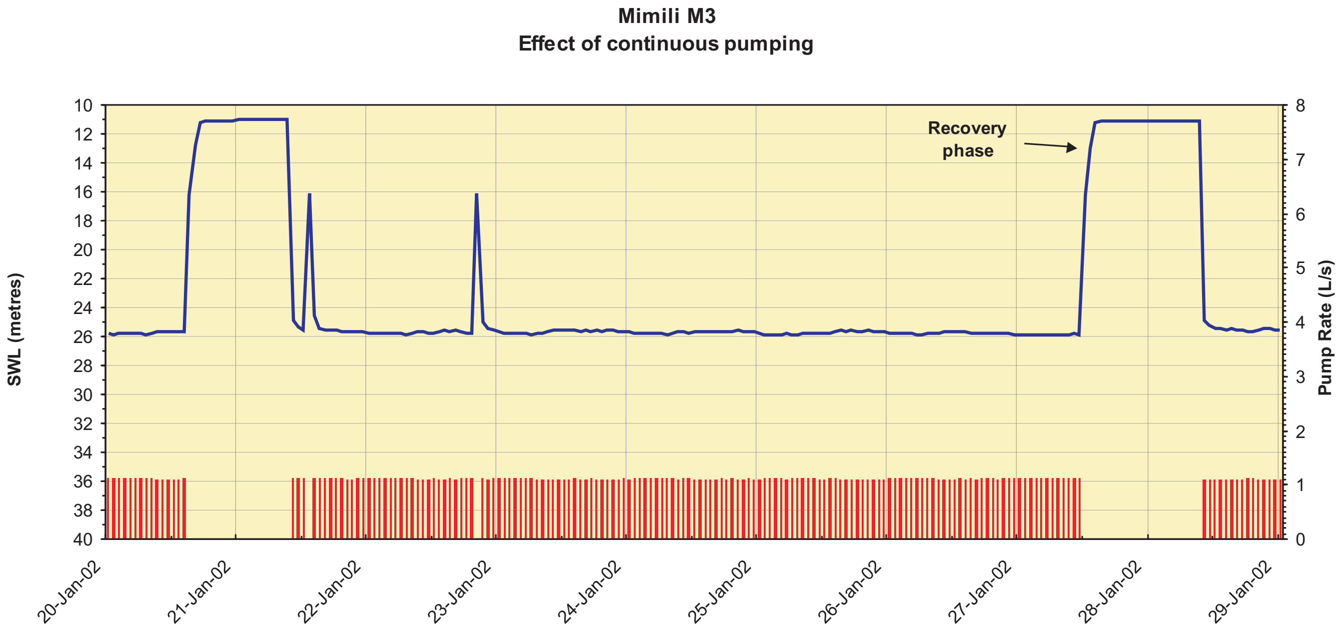


Figure 2.5 Effect of continuous pumping, Mimili M3

3. FREGON

Water production

All four wells have been used extensively, and the rotation policy is good for assessing the aquifer characteristics. Water usage for the summer of 01-02 was lower than for the same season in previous years (Fig. 3.2).

Table 3. Water production at Fregon, 1998–2002

Well	Unit Number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
FRG-1	5344-09	8 583.0	11 676.0	5 139.0	2 515.0	6 075.0	607.6	3 728.0
FRG-7	5344-31	14 178.0	4 845.9	8 600.9	4 237.5	15 250.0	5 011.9	12 562.0
FRG-14	5344-47	18 325.0	7 430.9	13 199.0	22 752.0	13 903.0	11 570.2	9 114.1
FRG-E4	5344-19	7 528.9	9 803.7	5 841.2	4.3	0.8	10 264.1	4 758.6
Total		**48 616.9**	**33 756.5**	**32 780.1**	**29 508.8**	**35 228.8**	**27 453.8**	**30 162.7**

Wells

FRG-1

The well was pumped quite heavily in February 2002, but was otherwise little used in the last year. This has been the general pattern since 1995, with the well being used primarily to supply 150 kL/day to fulfil the extra demand during the summer months (Fig. 3.3).

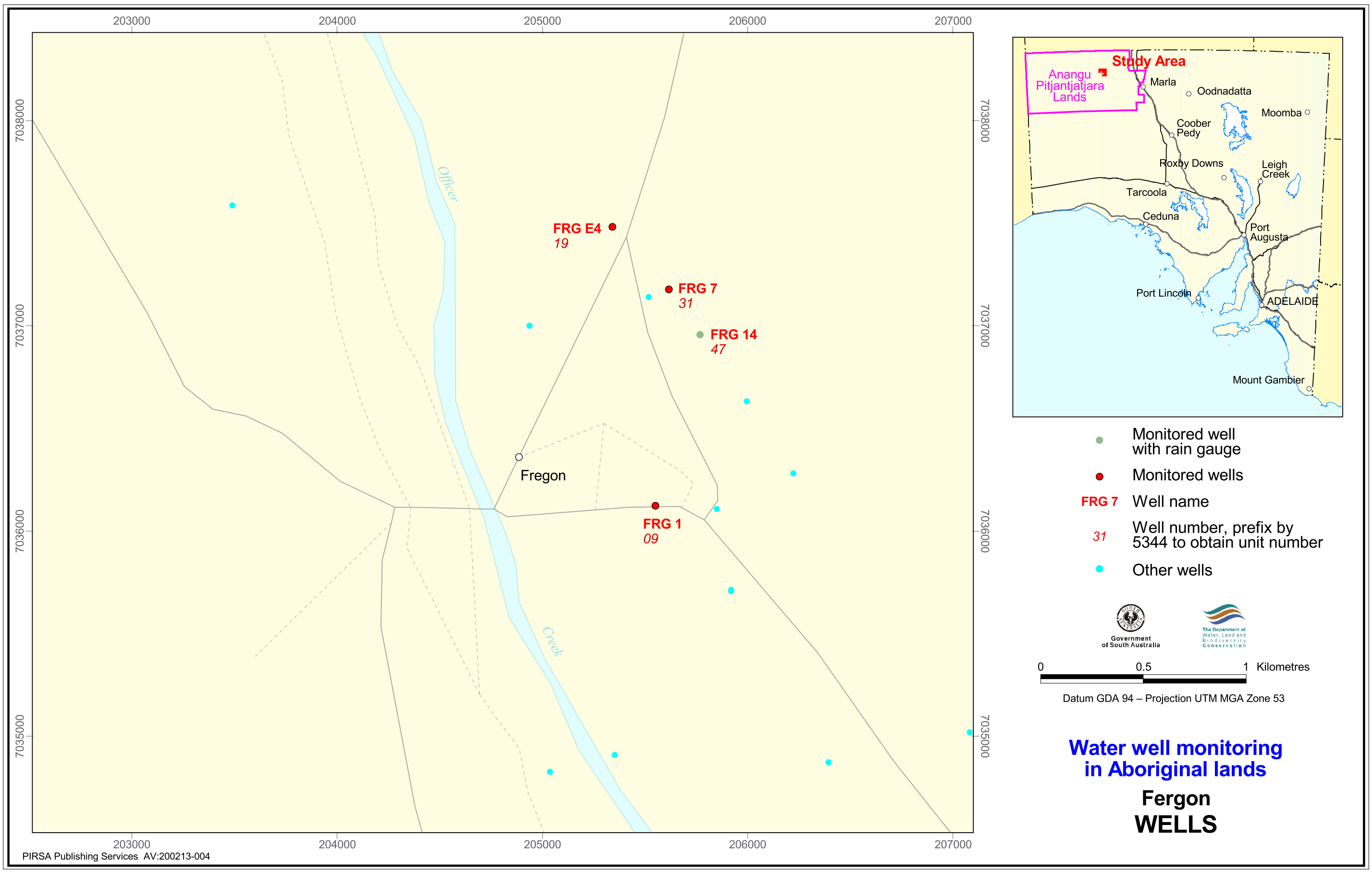
The SWL has remained at about 10 m since 1995 (earlier levels are not known) and only declines temporarily during periods of steady pumping (Fig. 3.4). However, the water level is slow to recover from such extensive periods of pumping, taking several weeks to regain its non-pumping SWL. It would be wise to limit such usage and to maximise the recovery periods.

It seems likely that there will be no long-term changes in SWL (up or down) unless the well is used continuously for many months, and possibly not even then. A long-term drought (15-30 years) might also cause a drop in SWL.

FRG-7

The well was used extensively from mid February onwards, pumping about 200 kL/day. While the latest SWL (11 m) is about 1 m lower than in 1998, this is probably temporary, resulting from the extensive withdrawals and the lack of recovery time (Fig. 3.5). The well takes at least 6 hours to recover, and has not been rested for that time since April 2002.

Overall the non-pumping SWL has a range of 9.93 m to 10.69 m and does not appear to have a long-term trend. The current SWL would be expected to recover to about 10.2 m if the well were rested for a day or so. The current pump rate of 2.3 L/s appears sustainable, having been used continuously for the last month without any increase in drawdown.



203000
204000
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7037000
7036000
7035000
Officer
Creek
FRG E4
19
FRG 7
31
FRG 14
47
Fregon
FRG 1
09
Study Area
Anangu Pitjantjatjara Lands
Marla
Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
FRG 7 Well name
31 Well number, prefix by 5344 to obtain unit number
Other wells
Government of South Australia
0
0.5
1 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 53
Water well monitoring in Aboriginal lands
Fergon
WELLS
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Figure 3.1

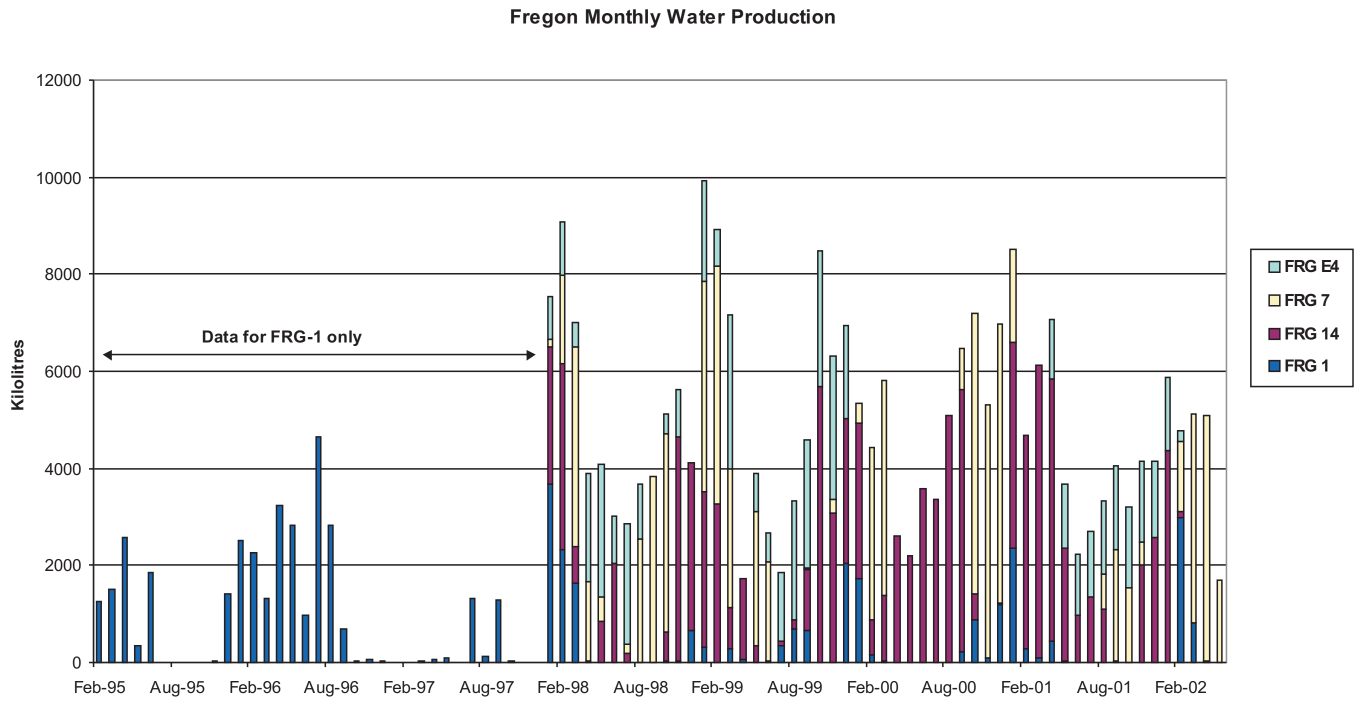

Figure 3.2 Community water production at Fregon

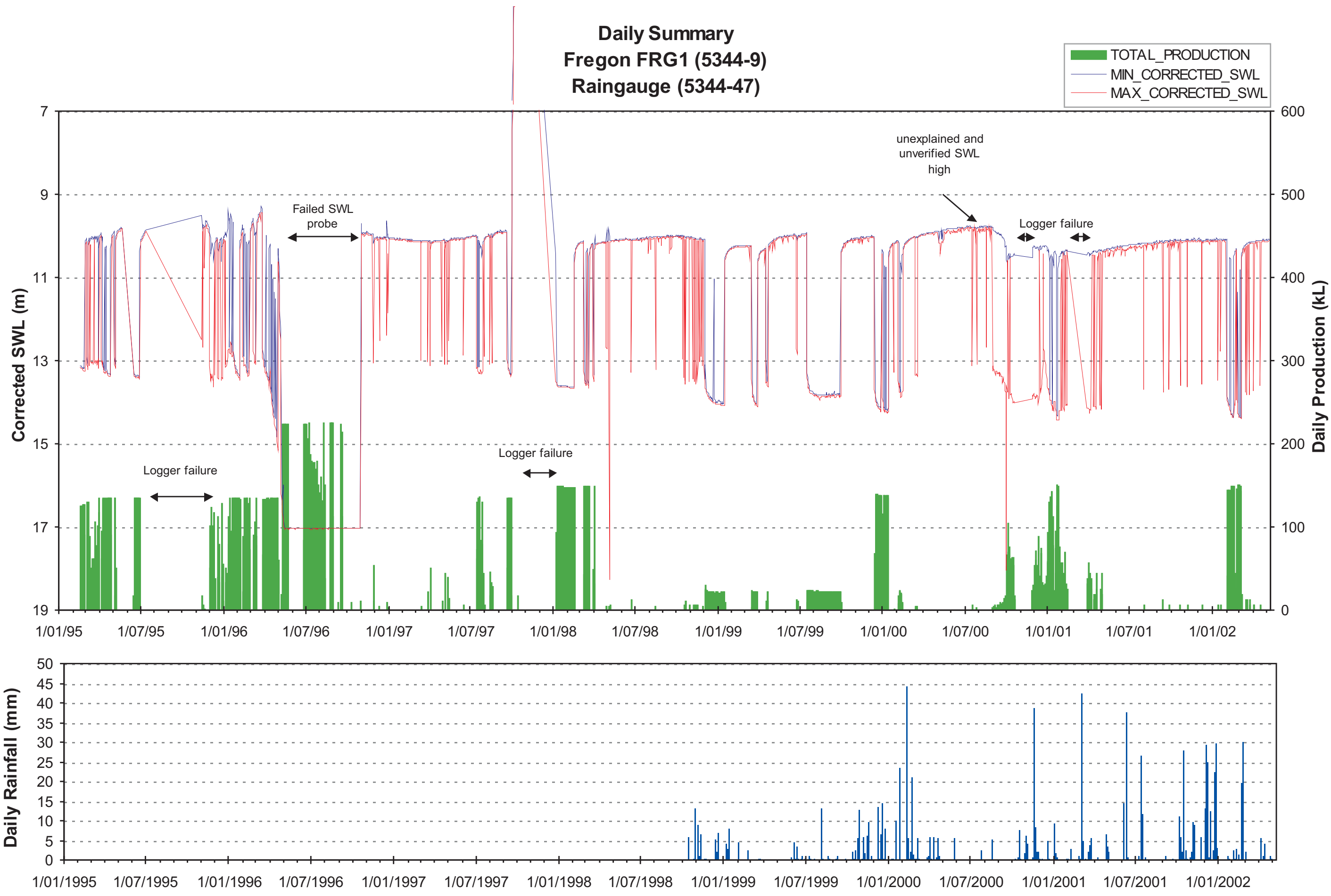

Figure 3.3 Daily Summary, Fregon FRG 1

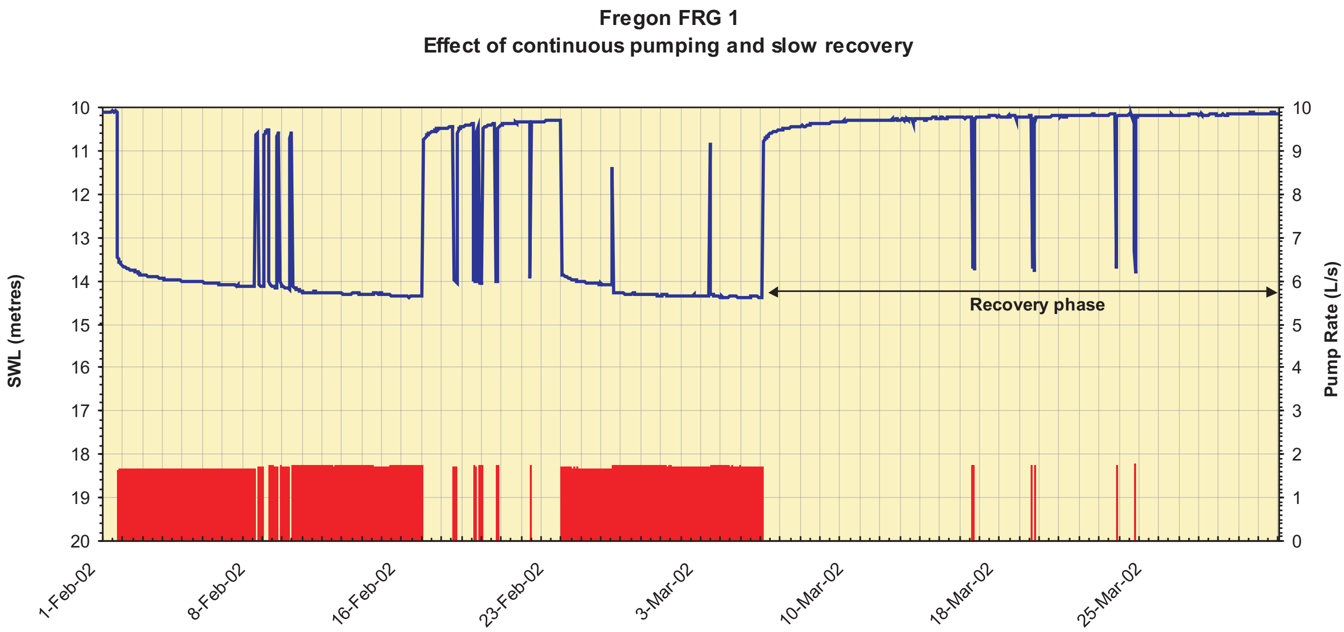

Figure 3.4 Effect of continuous pumping and slow recovery, Fregon FRG 1

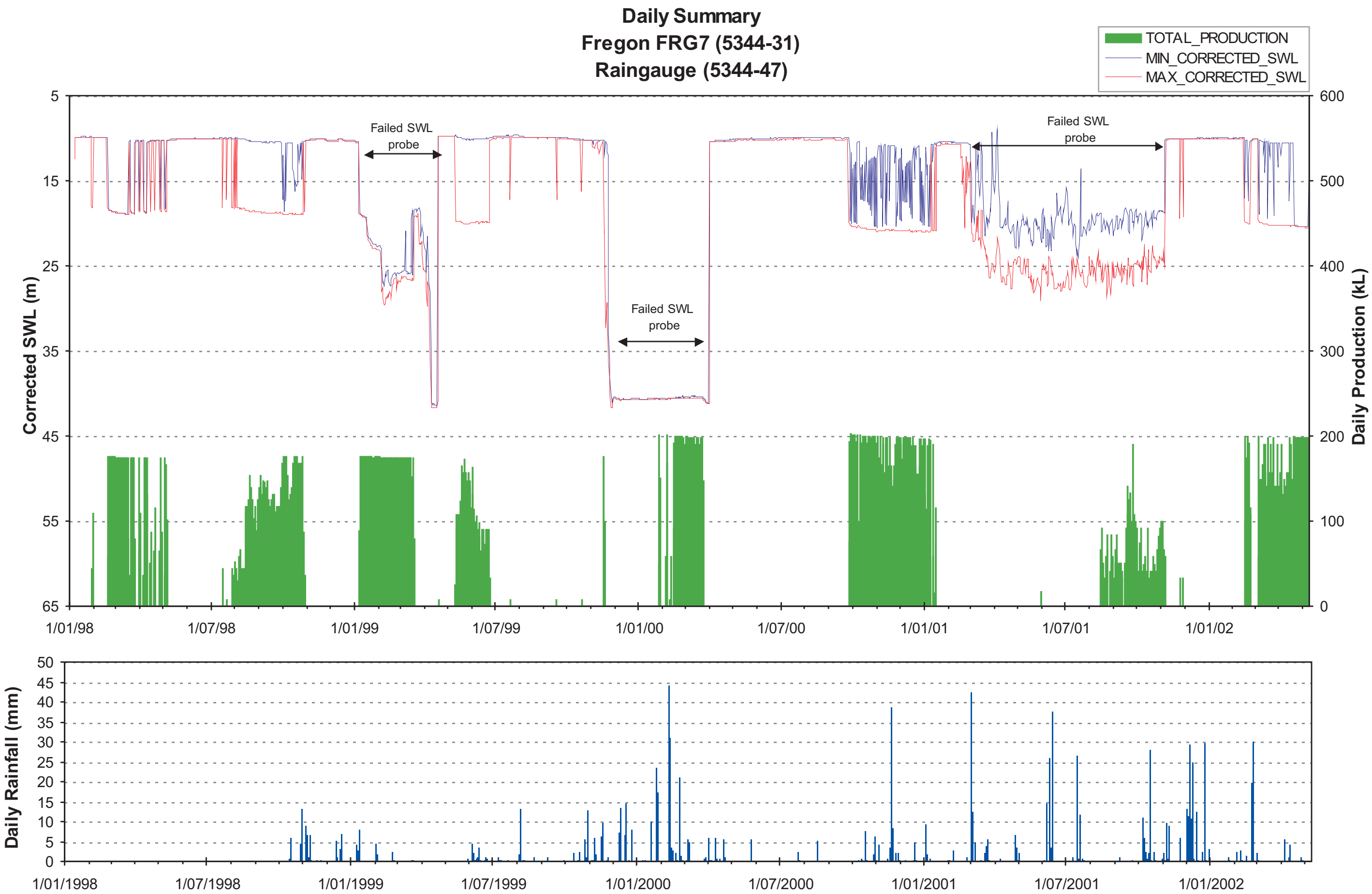

Figure 3.5 Daily Summary, Fregon FRG 7

FRG-14

The well was used continuously from November 2001 through January 2002, but has been unused since. The SWL at 10.3 m has not changed since 1987, when the well was drilled, other than minor oscillations between 10.2 m and 11.0 m (Fig. 3.6). The yield of over 200 kL/day is provided without stress to the well, even for prolonged periods.

FRG-E4

The SWL unit was defective from November 2001 onwards and the data logger from March 2002, so there is little new data to talk about. There are also blocks of defective data in March-April 1998 and February-March 2001, and a problem with flowback elevating the non-pumping SWL by 0.7 m before January 2000 (Fig. 3.7). Variations in non-pumping SWL between 9.9 m and 10.1 m appear random, and may be influenced by other factors such as pumping of another well.

Over the four years of monitoring the true non-pumping SWL has ranged from 9.91 m to 10.33 m and lacks any long-term trend. Thus the well appears capable of supplying 100 kL/day indefinitely without stress.

Recharge

There is no evidence of recharge but nor has the rainfall ever exceeded 50 mm in a day, which appears to be the basic requirement for recharge in the Musgrave Block. It is likely that the water in these aquifers comes from the Musgrave Ranges via Ernabella Creek, and that local recharge is minimal. In this case recharge effects will be diffused by distance and probably will not be obvious.

Conclusions

All four wells have very similar characteristics and are probably tapping the same aquifer. This aquifer is extensive and has a very time-consistent water level. While there is a certain amount of down-coning when a well is pumped continuously for several months, this is recovered within a month or two on resting that well. Water sustainability does not appear to be a problem in the Fregon area.

Two additional production wells have recently been drilled some 3 km north of Fregon. These produce rather better water than the current production wells at good yields, but have not yet been pump tested because of problems with anthopological clearance.

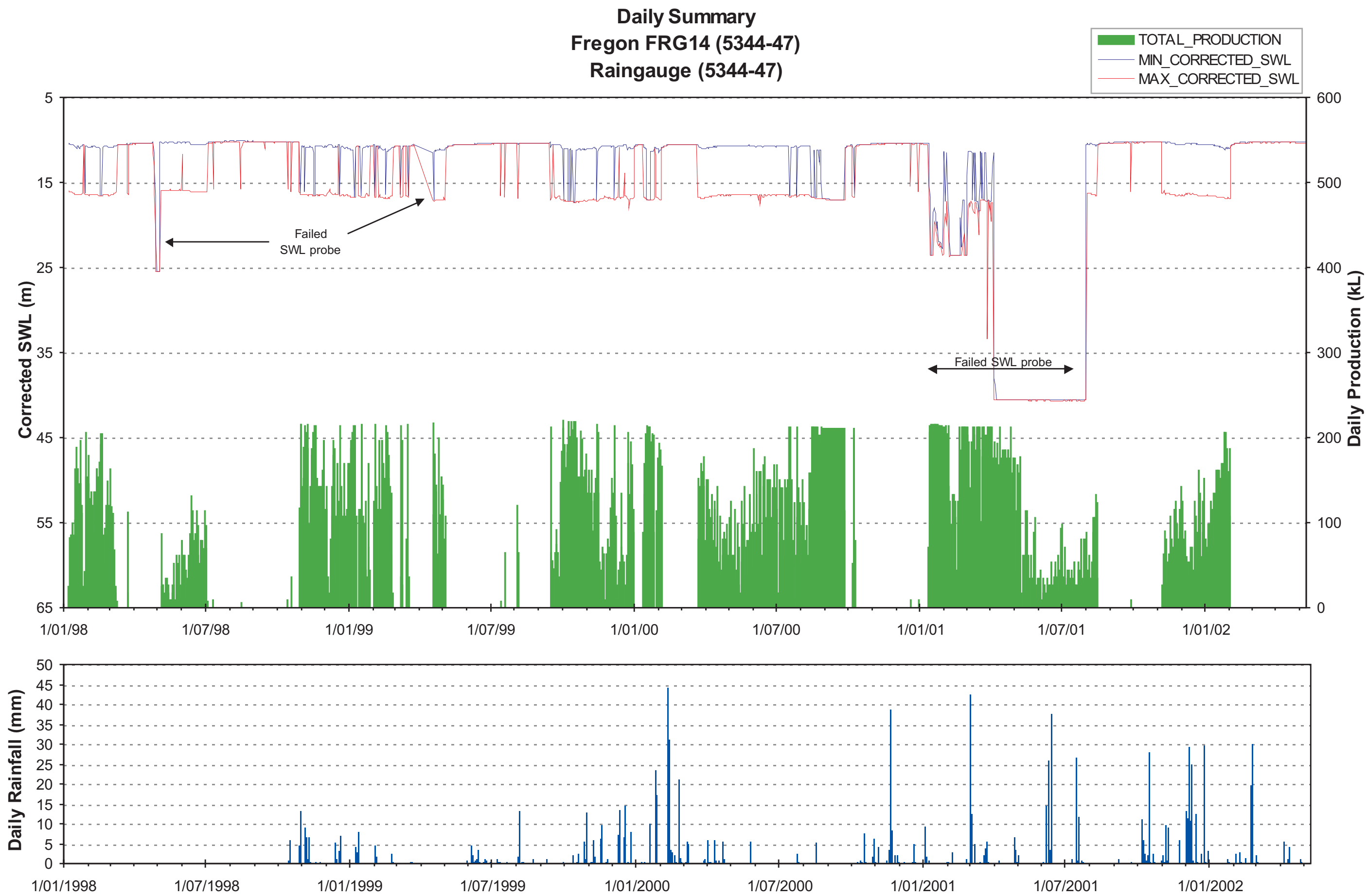

Figure 3.6 Daily Summary, Fregon FRG 14

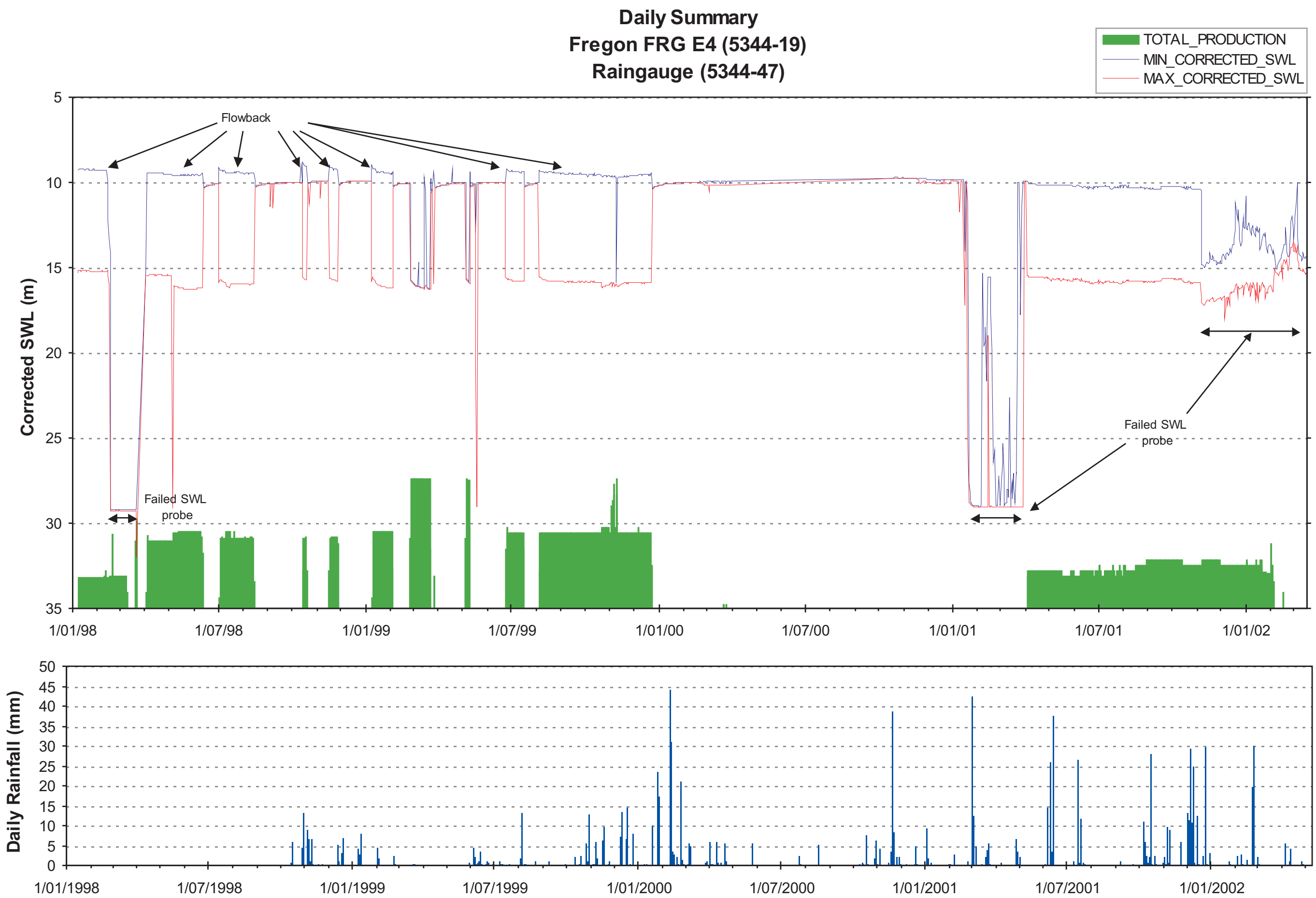

Figure 3.7 Daily Summary, Fregon FRG E4

4. KENMORE PARK

Water Production

Much the same as in previous years. Monitoring of well KP-6 failed early in April, so consumption figures for April and May are incomplete (Fig. 4.2). Again the bulk of supply came from KP-6, with a minor, but increasing, contribution from KP-98 (this well was called KP-94B).

Table 4. Water production at Kenmore Park, 1998–2002

Well	Unit Number	Production (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
KP-6	5345-67	10 529.0	4 767.0	6 405.0	1 773.0	7 458.0	*5 114.9	*6 128.6
KP-7	5345-68	978.1	798.6	584.6	3 413.0	1 246.6	1 334.0	1 156.0
KP-98	5345-98	275.0	112.0	556.0	1 253.0	1 458.0	495.9	595.2
Total		**11 782.1**	**5 677.6**	**7 545.6**	**7 439.0**	**10 162.6**	**6 944.8**	**7 879.8**

Note: production for KP 98 was derived from the hours pumped, assuming a rate of 0.5 L/s, to Nov 2001.

* KP-6 flow meter failed. Figures taken from hourly pump rate.

Wells

KP-6

Data gathered since April 1998, when the submersible transducer was replaced by a surface unit, is more reliable than earlier data (Fig. 4.3). The latter contained numerous shifts that have been corrected as far as possible, but variations in SWL during 1997 and earlier are less reliable than those from 1998 onwards.

The well was pumped fairly continuously throughout the current period, but was unstressed and even gained somewhat in SWL.

Since October 2000 the pumping regime has been much more sustainable. When the hours of pumping were decreased in the winter of 2001 the SWL gradually rose by a metre or more, and the level of 8.7 m in February 2002 is as high as has been recorded for nearly four years. For this well it is clear that the SWL is slow to recover, and that reduced pumping caused some of this recovery. However it is likely that there is a recharge contribution which should help to lift the SWL when pumping hours are reduced this winter. The true non-pumping SWL has not been reached this year because of the slow recovery and extensive pumping times (Fig. 4.4).

Other than the water level at time of drilling (6 m), which may not have stabilized, the non-pumping SWL was shallowest in 1995 (8.2 m). The SWL dropped (with some oscillations) over the next three years, reaching a low of 10.96 m in 1998 before rising again to the present figure.

We have no record of the level of water cuts in this well, but the casing is slotted from 12-24 m so it is probable that the water cut is as high as 12 m, which is 1.5 m below the

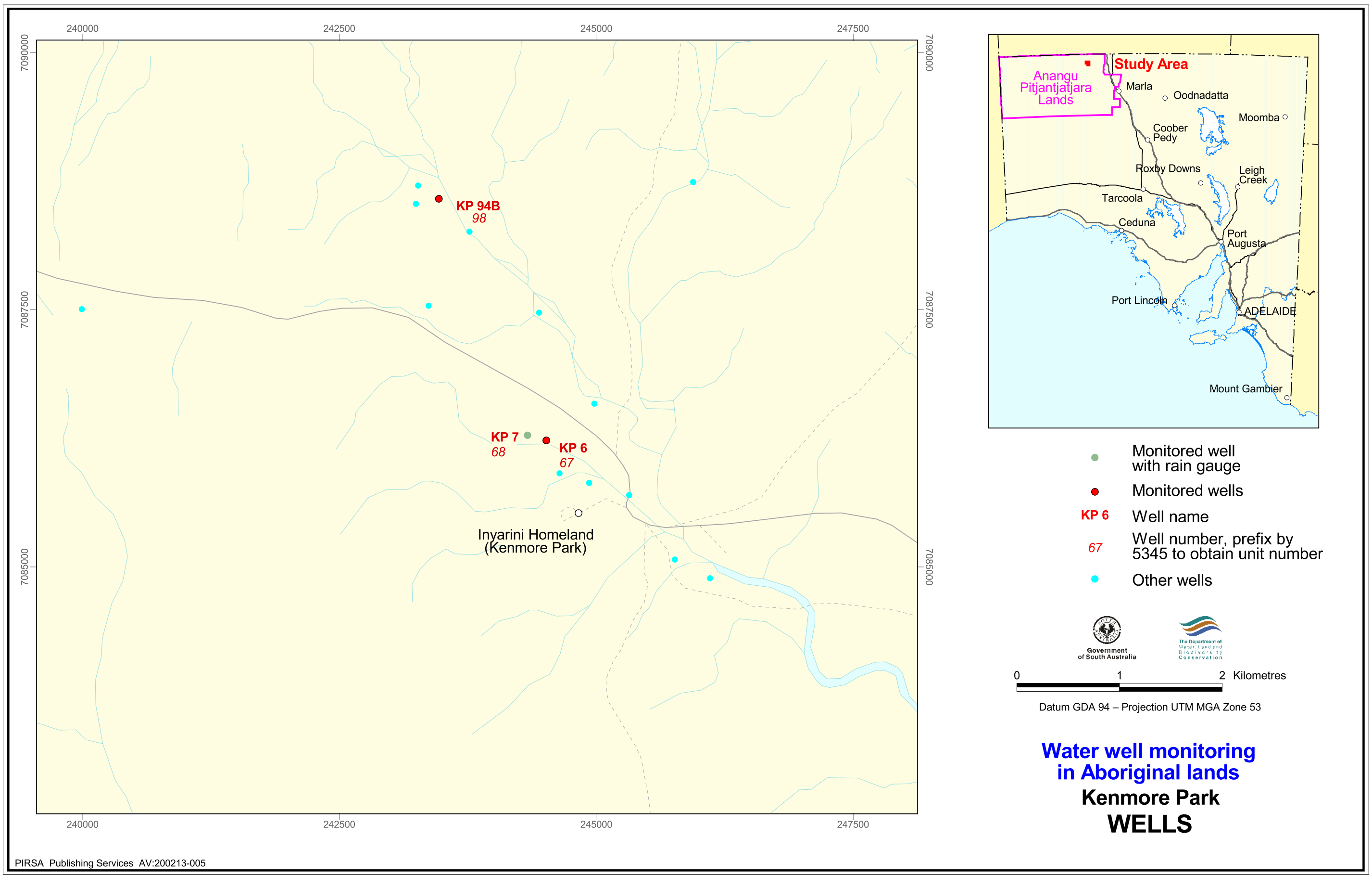
240000
242500
245000
247500
7090000
7087500
7085000
KP 94B
98
KP 7
68
KP 6
67
Inyarini Homeland
(Kenmore Park)
Study Area
Anangu
Pitjantjatjara
Lands
Marla
Oodnadatta
Moomba
Coober
Pedy
Roxby Downs
Leigh
Creek
Tarcoola
Ceduna
Port
Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well
with rain gauge
Monitored wells
KP 6 Well name
67 Well number, prefix by
5345 to obtain unit number
Other wells
Government of South Australia
0 1 2 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 53
Water well monitoring
in Aboriginal lands
Kenmore Park
WELLS
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Figure 4.1

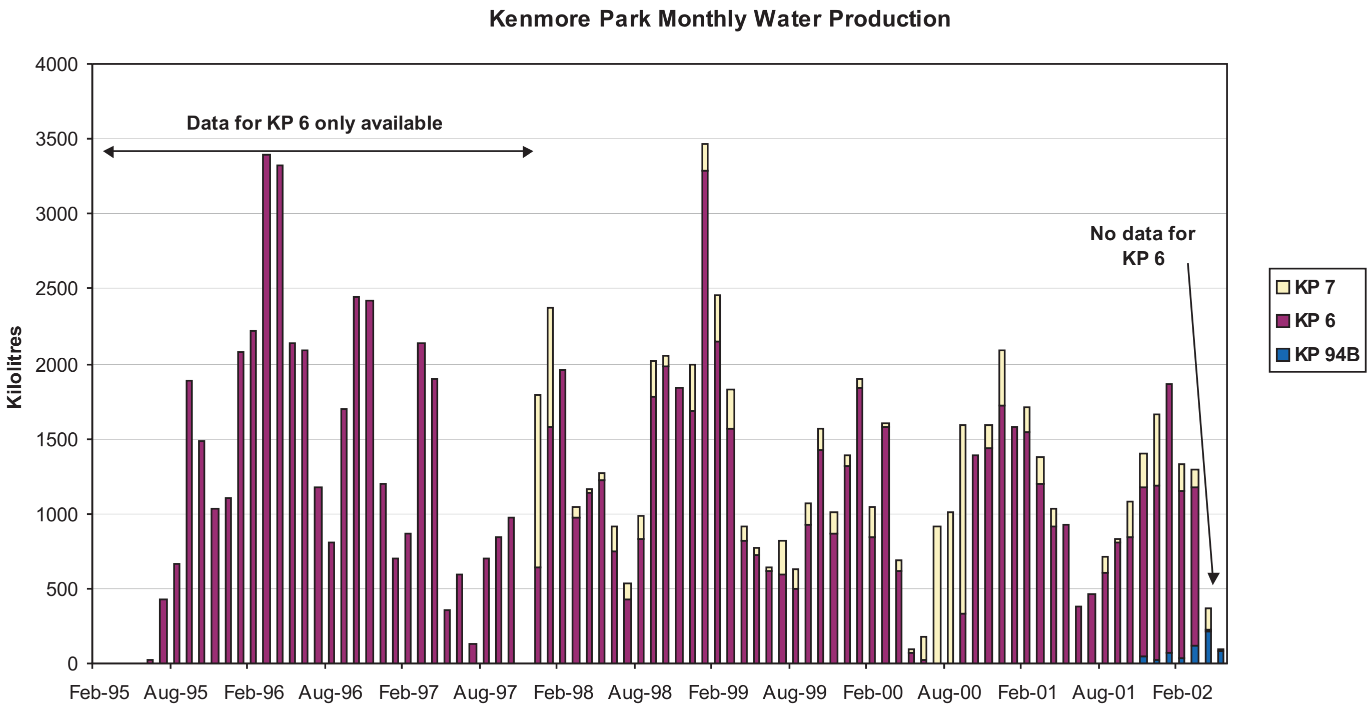


Figure 4.2 Community water production at Kenmore Park

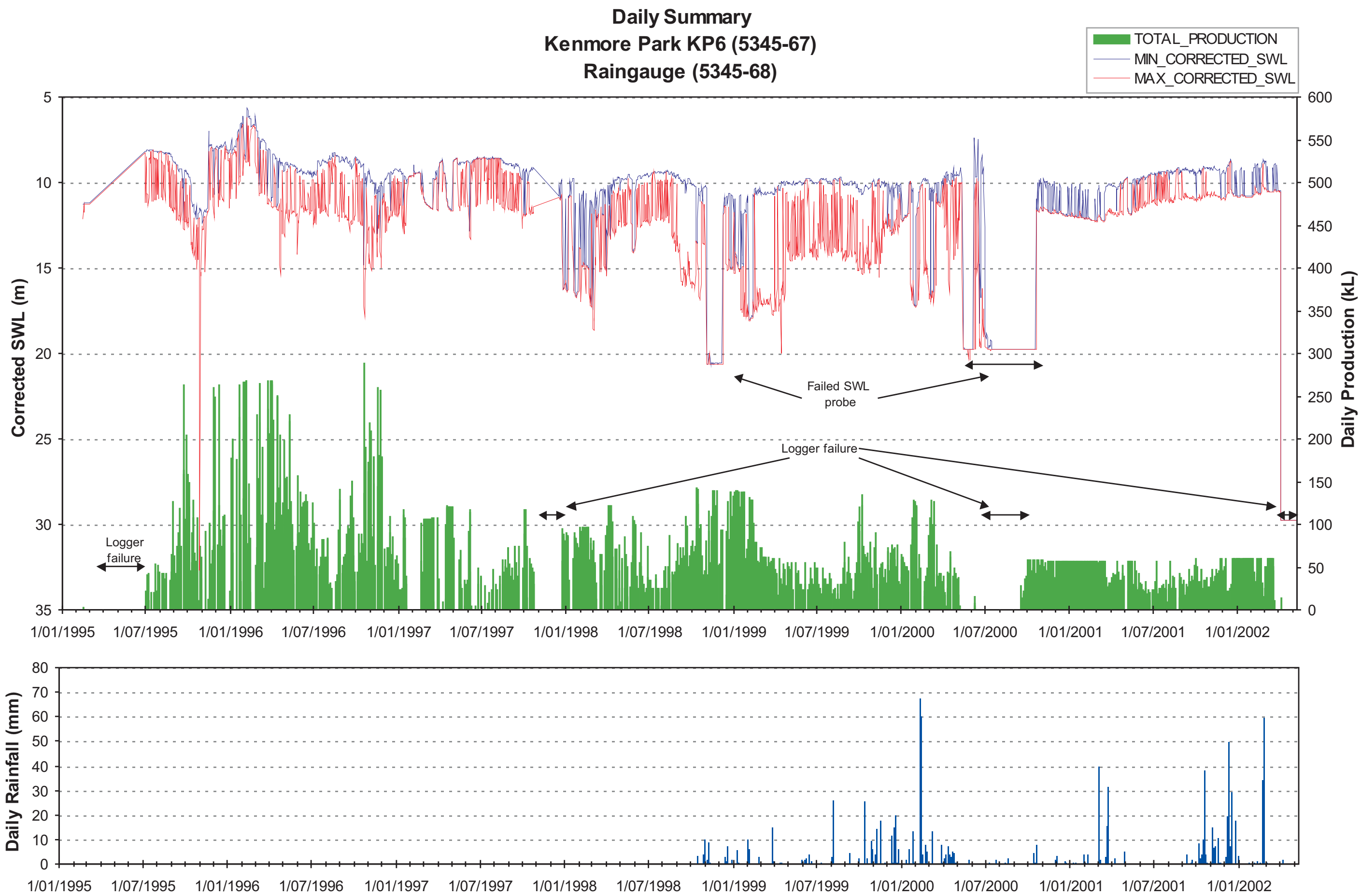


Figure 4.3 Daily Summary, Kenmore Park KP 6

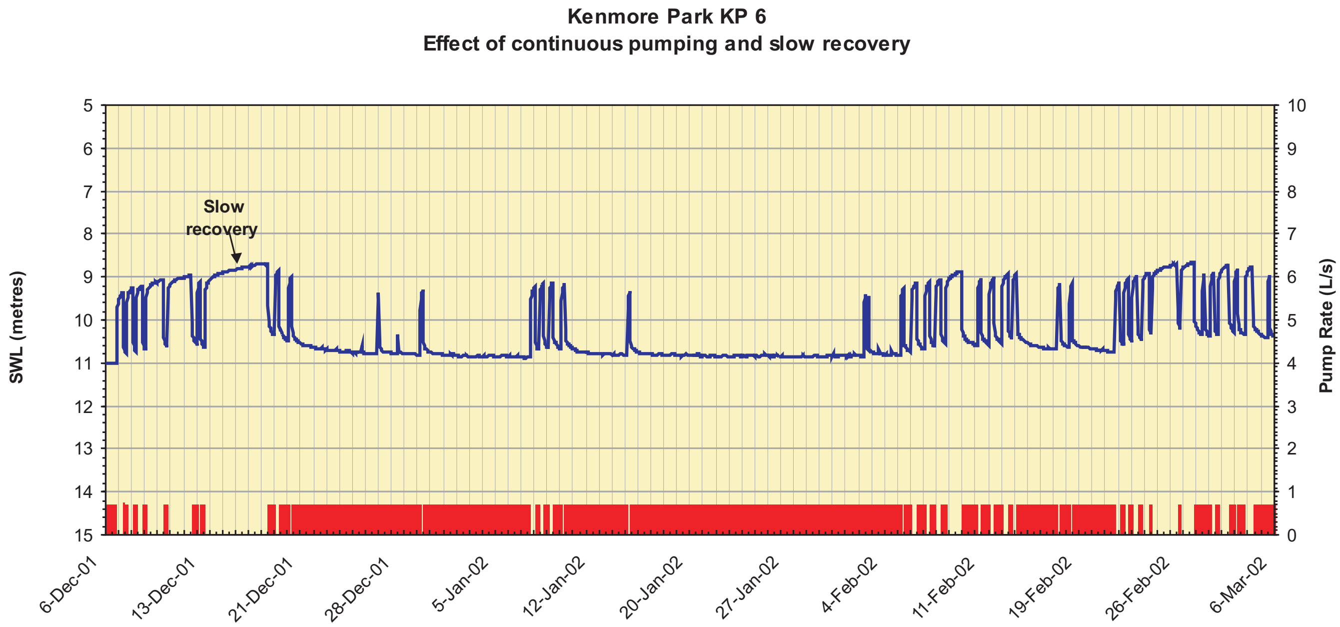


Figure 4.4 Effect of continuous pumping and slow recovery, Kenmore Park KP 6

current pumping SWL. While the current pumping regime appears sustainable, care should be taken not to increase the pump rate and to rest the well whenever possible.

KP-7

The SWL monitor failed in late December, so that hourly levels are not available. Otherwise, apart from a period in late 2000 and early 2001, the SWL data for this well is very good (Fig. 4.5).

The non-pumping SWL dropped slowly but steadily through 1998 and 1999 from 10.8 m to a low of 11.31 m. Since then the SWL has risen, again slowly, to a level of 8.9 m in May 2002 (manual measurement). The volume of water pumped from the well has increased (see Table 4). A major rainfall event occurred in January 2000 and others occurred in the summer of 2001-2002. It is clear that recharge to the aquifer is occurring and that the long-term sustainability of the well has improved.

The current SWL of 8.9 m is the highest on record for this well, although we have no knowledge prior to 1997.

The well was pumped continuously for 5 days at 0.7 L/s in December 2000, without undue drawdown (Fig. 4.6). A similar trial for 17 days in December 1997 at 1.4-1.2 L/s (Fig. 4.7) resulted in a much greater and continuing drawdown that, apparently, affected the well's performance for years to come. It is apparent that the former pump rate (0.7 L/s) is much more sustainable, probably for several weeks if needed, yielding 60 kL/day.

KP-98

This well has only been monitored since November 2001 and has not been pumped heavily (Fig. 4.8). The most extended pumping was on April 21-22, when the well was pumped for 12 hours at 0.5 L/s (Fig. 4.9). This caused a drop in SWL of 0.7 m at start of pumping, but minimal further decline over the 12 hours, indicating that the rate could be continued for much longer times. More extensive use of this well would allow KP-6 to be rested and to recover.

There are clear indications of recharge in this well, with a steady rise in SWL of 2.15 m over the 6-month period from 6.92 m to 4.77 m. When the well was drilled in 1994 the SWL was 7.2 m, and dropped to a low of 11.66 m in 1999 (manual measurements). Clearly the SWL is quite dynamic, with significant recharge having occurred since 1999. Whether the decline in water level resulted from water withdrawal or natural drainage is not indicated by the existing data, but it is probable that a considerable proportion is natural drainage considering the low production from this well.

Recharge

Recharge has clearly taken place in the aquifers at all three wells, although the indications at KP-6 are somewhat hidden by the heavy pumping regime.

Conclusions

While there are no immediate concerns, the sustainability of KP-6 would be enhanced by sharing the load with KP-98 that, on current records, could sustain a much heavier pumping regime. We suggest that KP-98 be pumped for 24 hours at least once a week, which would test the sustainability of this well and allow KP-6 to be rested.

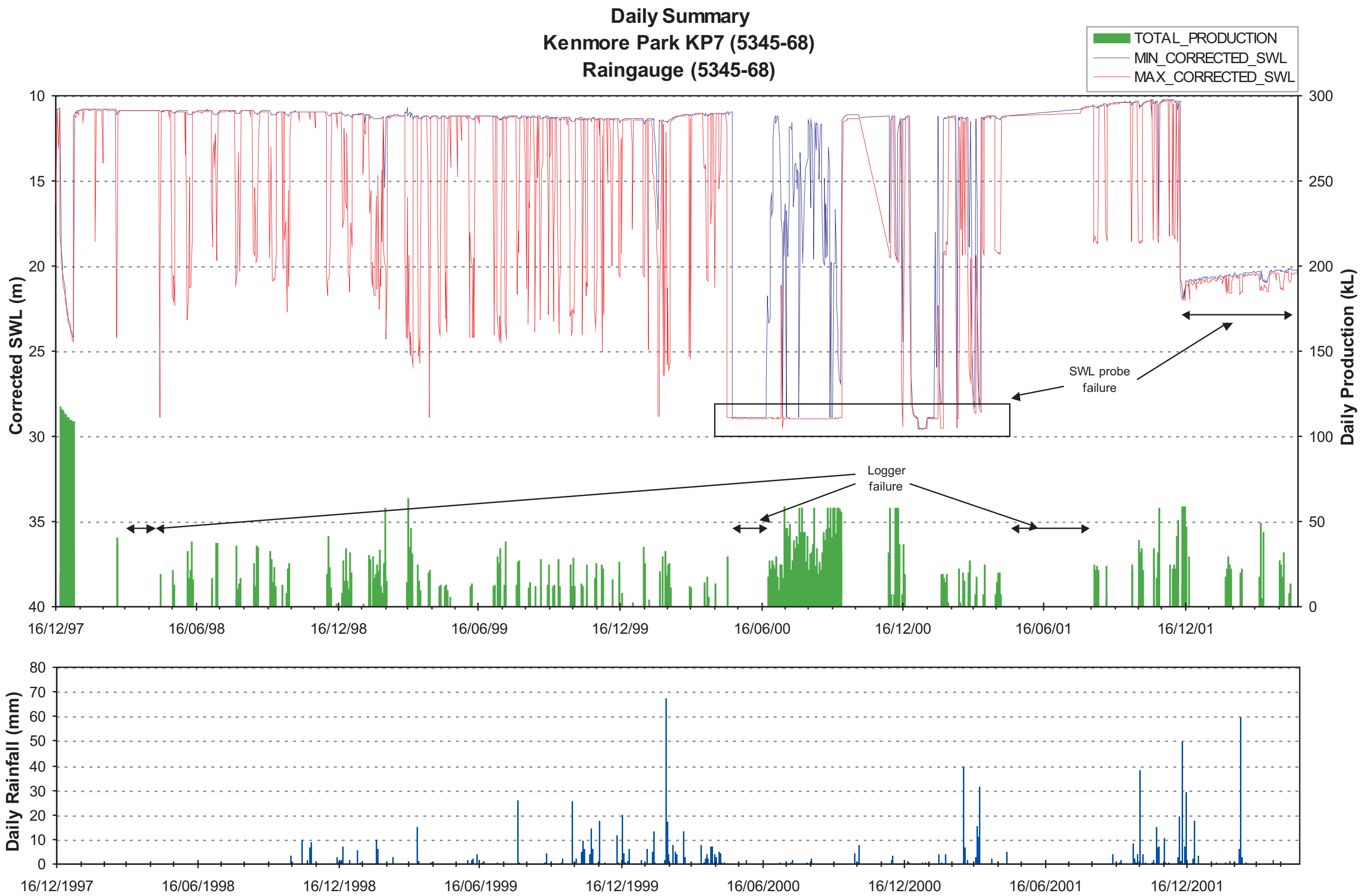


Figure 4.5 Daily Summary, Kenmore Park KP 7

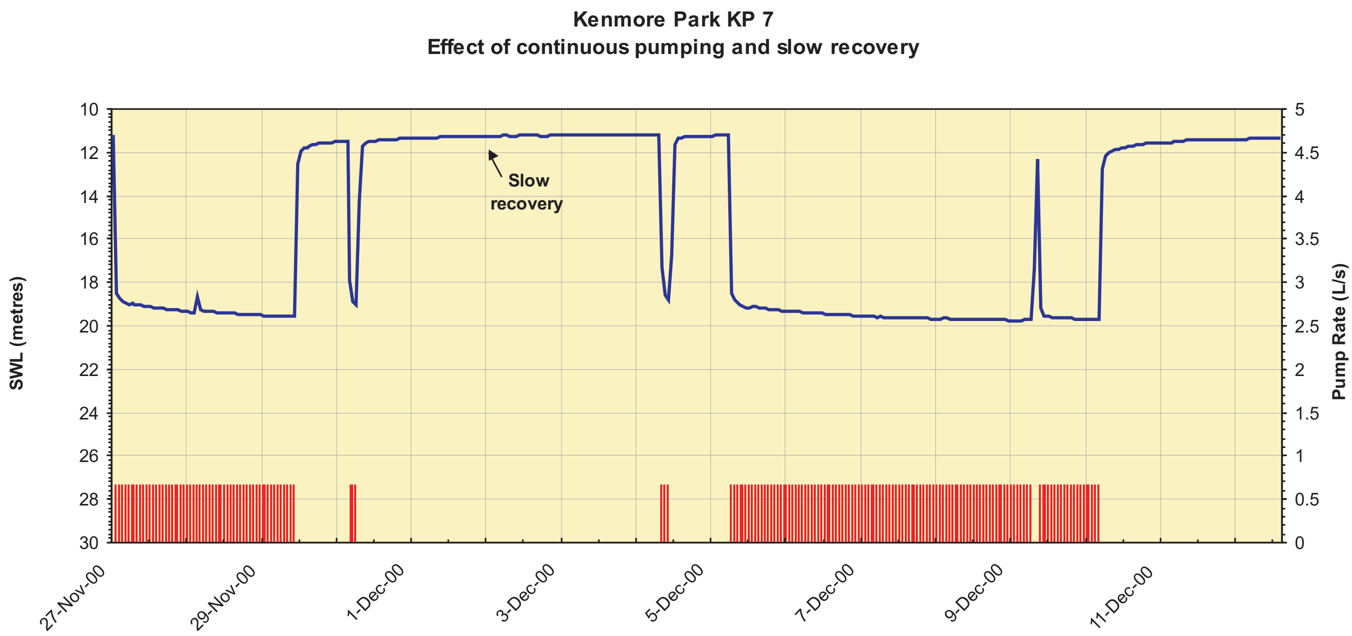


Figure 4.6 Effect of continuous pumping. December 2000, Kenmore Park KP 7

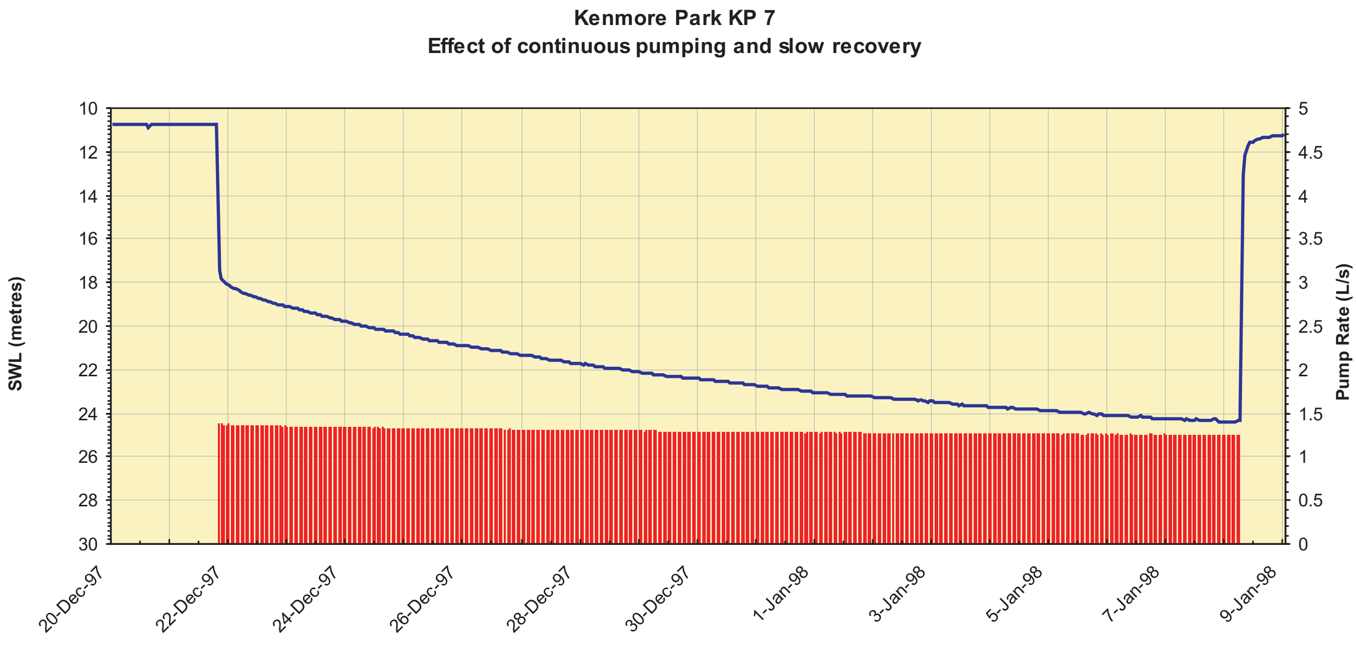


Figure 4.7 Effect of continuous pumping, Dec 2000-Jan 2001, Kenmore Park KP 7

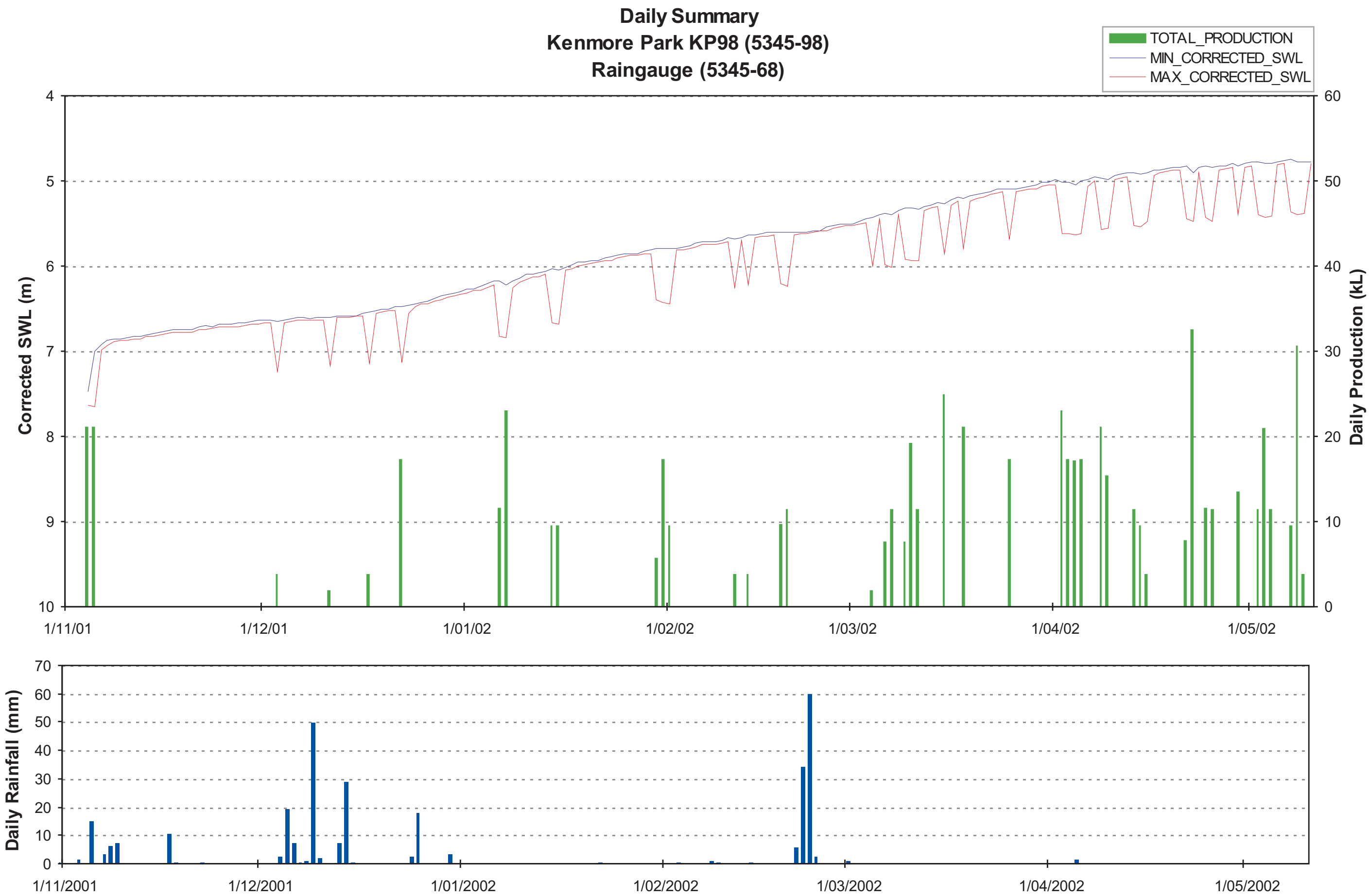


Figure 4.8 Daily Summary, Kenmore Park KP 98

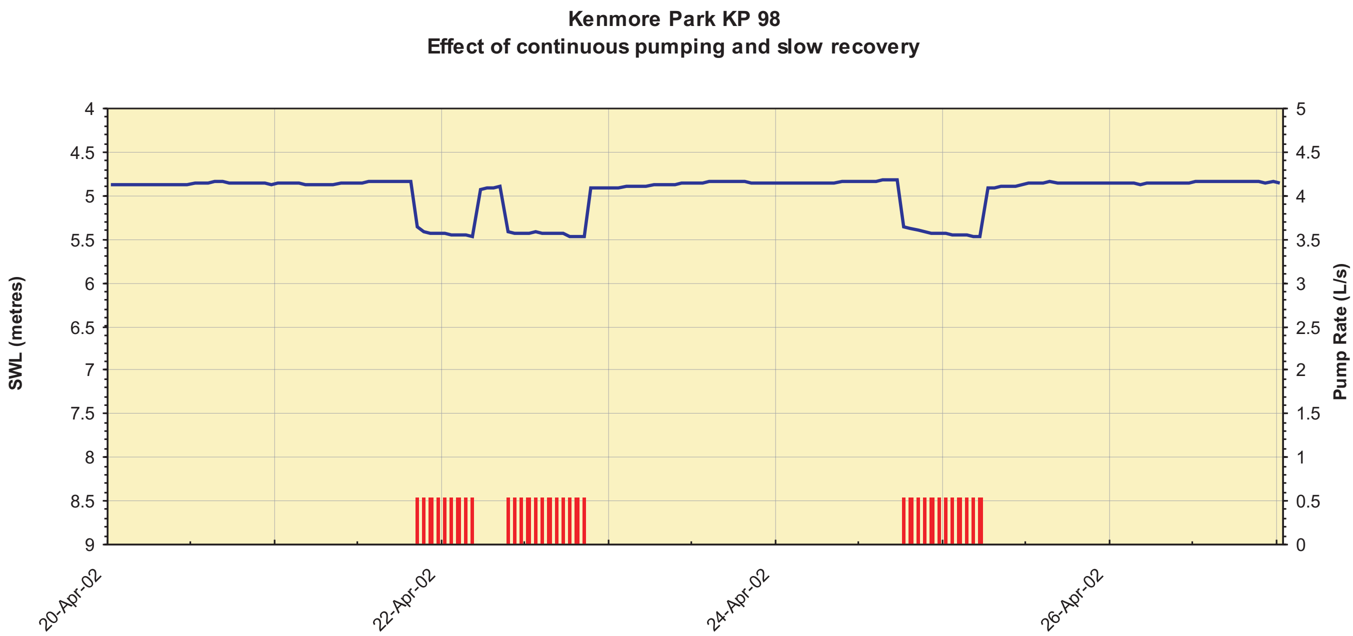


Figure 4.9 Effect of continuous pumping, Kenmore Park KP 98

5. PUKATJA

Water Production

Water came mainly from four wells, E-12, E-45, E97B and E-97L (Fig. 5.2). The monthly water production plot omits E-97L for the last 6 months as the logger had failed, but the accumulated flow figure in the table below is correct. Overall the water consumption is marginally higher than earlier years.

Table 5. Water production at Pukatja, 1998–2002

Well	Unit Number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
E-01	5345-06	–	–	–	–	–	–	–
E-12	5345-12	18 280.0	16 193.0	4 801.9	16 802.3	10 746.0*	16 829.2	18 020.0
E-42	5345-33	638.4	1 563.2	2 395.0	2 726.7	1 839.9	3 362.2	1 000.2
E-44	5345-85	–	7.2	0.2	0.1	3.0	520.2	2 277.2
E-45	5345-84	9 802	8 205.0	9 346.3	10 579.0	6 294.0	8 385.0	11 385.0
E-97B	5345-114	–‡	19 310.0	6 899.6	1 913.9	30 126.0	8 399.1	17 493.0
E-97L	5345-124	–‡	7 200.5	9 680.5	7 009.9	2 985.1	18 282.4	11 109.0
Total		**28 720.4**	**52 478.9**	**31 123.5**	**39 031.9**	**51 994.0**	**55 778.1**	**61 284.4**

* The production of E 12 was derived from the pumping hours, assuming a rate of 1.1 L/s.

‡ Monitoring equipment was not installed.

Wells

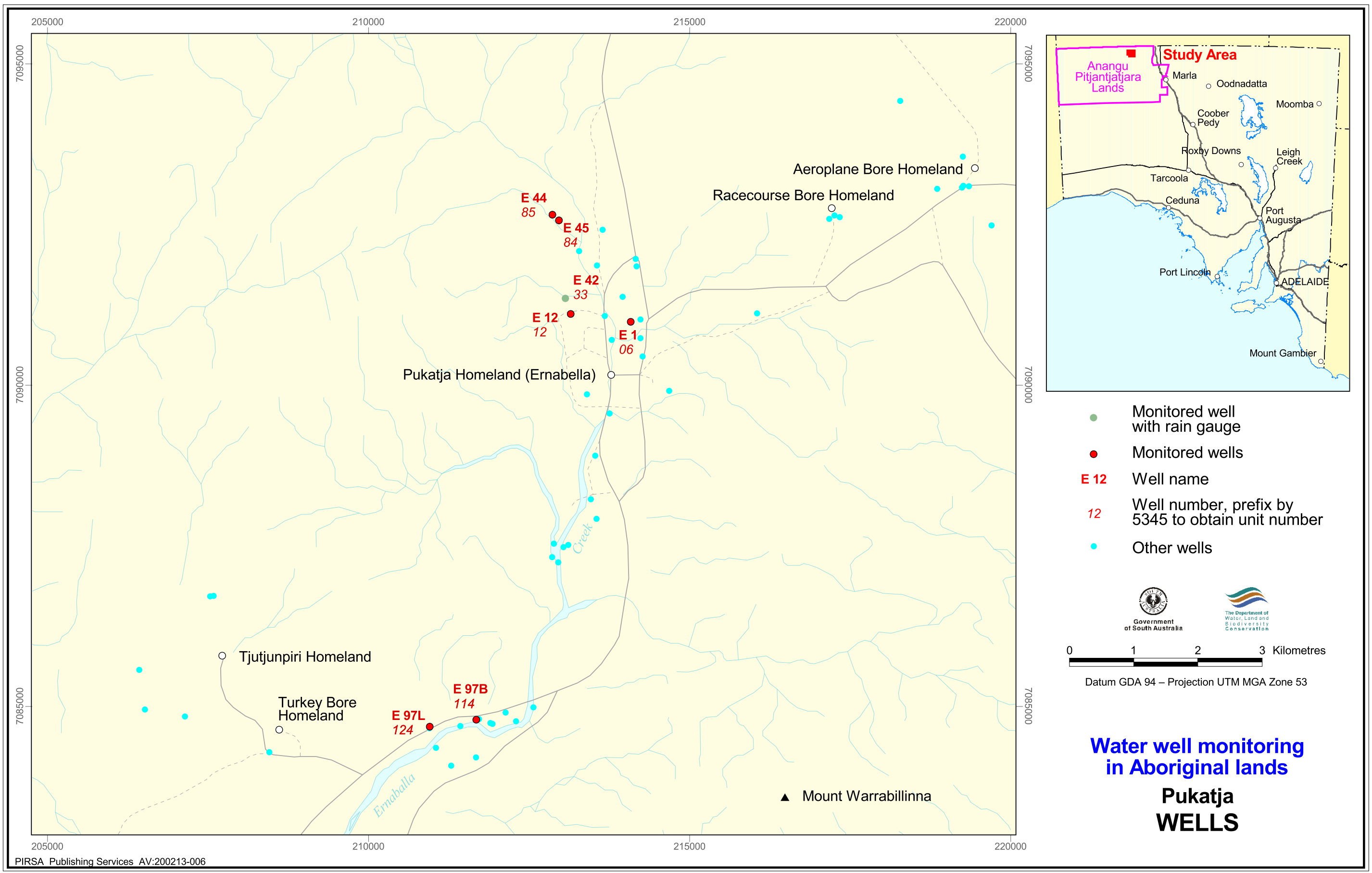
E-01

The water level is this well, which is no longer pumped or monitored (other than manual SWL measurements), has risen to it's highest level on record (3.95 m), the rise mostly occurring in the last year. It has evidently benefited from recharge in 2001 and 2002. The lowest SWL (8.86 m) was reached in October 1999, the level having dropped 0.7 m after pumping ceased in early 1998.

The well was pumped continuously through the summer of 1997-98 at rates of 0.5-0.1 L/s, with the rate being decreased over a period of weeks, presumably to prevent the well forking. It appears that the well can be used for prolonged periods, but only at rates of about 0.2 L/s or 17 kL/day.

E-12

The well has again been pumped very heavily, and still maintains it's sustainability. The SWL unit failed in late December 2001, but the trend is clear. The non-pumping SWL in May 2002 was 3.7 m (manual measurement), which is the highest on record by 4.4 m. This figure is probably conservative, as the well is never rested for long enough for it to fully recover to a non-pumping rate (at least a week is required).



Study Area
Anangu Pitjantjatjara Lands
Marla
Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
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E 42
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E 1
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E 97B
114
E 97L
124
Aeroplane Bore Homeland
Racecourse Bore Homeland
Pukatja Homeland (Ernabella)
Tjutjunpiri Homeland
Turkey Bore Homeland
Mount Warrabillinna
Creek
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Monitored wells
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Other wells
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Water well monitoring in Aboriginal lands
Pukatja
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Figure 5.1

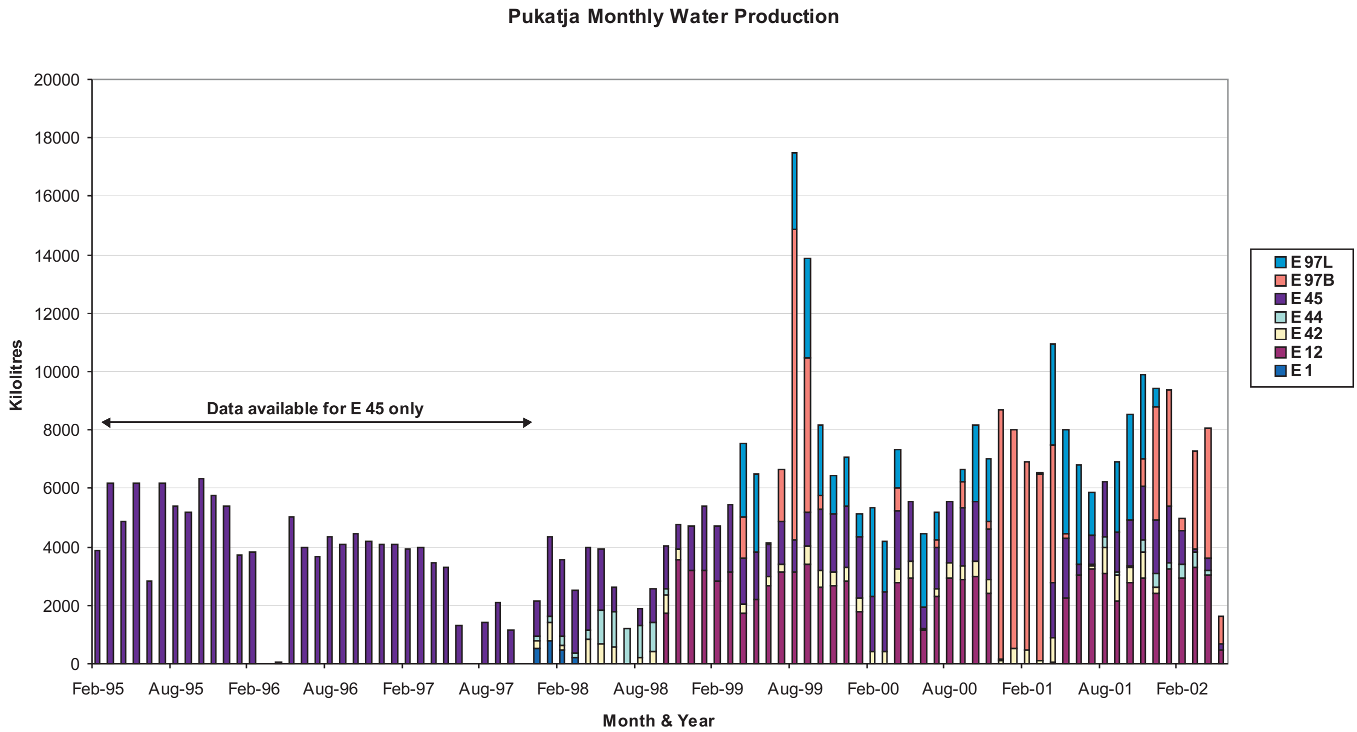


Figure 5.2 Community water production at Pukatja

From 1971 to March 2000 the non-pumping SWL was consistently between 8.1 m and 8.4 m (Fig. 5.3). Neither continuous pumping (100 kL/day) nor natural drainage caused any decline in this level. It seems probable that recharge started with the rains of February 2000, with a clear rise in SWL to above 8 m when the well was rested in June 2000. While it will be interesting to see what happens to the SWL once recharge has ceased, past history indicates that the base level of about 8 m is unlikely to be affected other than by an extended period of drought.

Thus the well shows no sign of stress over the three and a half years of monitoring, and the aquifer has shown clear indications of recharge over the past year.

E-42

The final SWL of 4.43 m is easily the highest on record – the previous peak being 9.3 m in1997. The SWL data between December and May indicates copious recharge from both rainfall events in January and March, with the subsequent declines caused by natural drainage (Fig. 5.4). Continuous pumping during August, September and December 2001 resulted in negligible drawdown, unlike similar periods of pumping in 1998 and 1999 which resulted in drawdowns of 2 to 10 metres. Recharge from 5 rainfall events in the last two and a half years has stabilized this aquifer and should permit its use for more extensive pumping, at least until the SWL drops to 10 m again. Even then the aquifer may be more able to cope with higher withdrawals, as evidenced by the difference in drawdown between November 1999 to February 2000 (over 2 m) and April to May 2000 (0.5 m). In both of these periods the non-pumping SWL was about 10 m.

This well was originally rated at a yield of 5 L/s in 1981. In recent years, since monitoring started, it has been pumped at 0.2-0.4 L/s, presumably because higher yields could not be sustained. While it would be unwise to revert to the maximum pump rate, it is possible that higher rates of, perhaps, 1-2 L/s could now be sustained.

E-44

This well was pumped at 0.2 L/s for extensive periods in 2002 with minimal drawdown (Fig. 5.5). Meanwhile recharge has occurred steadily since June 2001 and dramatically since the rains in December 2001 and February 2002. The water level, which is still rising, has now reached 5.8 m which is within 3.2 m of the level at the time of drilling in 1989 and well above the level of ~12 m which has persisted since 1987, when monitoring began.

This well is now back to its state of 1989, and could probably yield 10 L/s again. However, such a yield would be short-lived. The well should be used primarily as a backup, and for emergency supplies, but could be used on a regular basis so long as the pump rate was kept low, say 1 L/s.

E-45

The SWL monitor failed on 5 November 2001, only a few days after the download, so only pump rates are available for the rest of the period (Fig. 5.6). This is unfortunate because the SWL rose by 6 m in this interval to 5.9 m (from manual measurement in May 2002) and it would have been instructive to see the graph of this rise. The aquifer has benefited from five recharge events over the past two and a half years, but this was by far the biggest rise. The water level is now above the stabilized level at the time the well was drilled in 1989 (9.2 m).

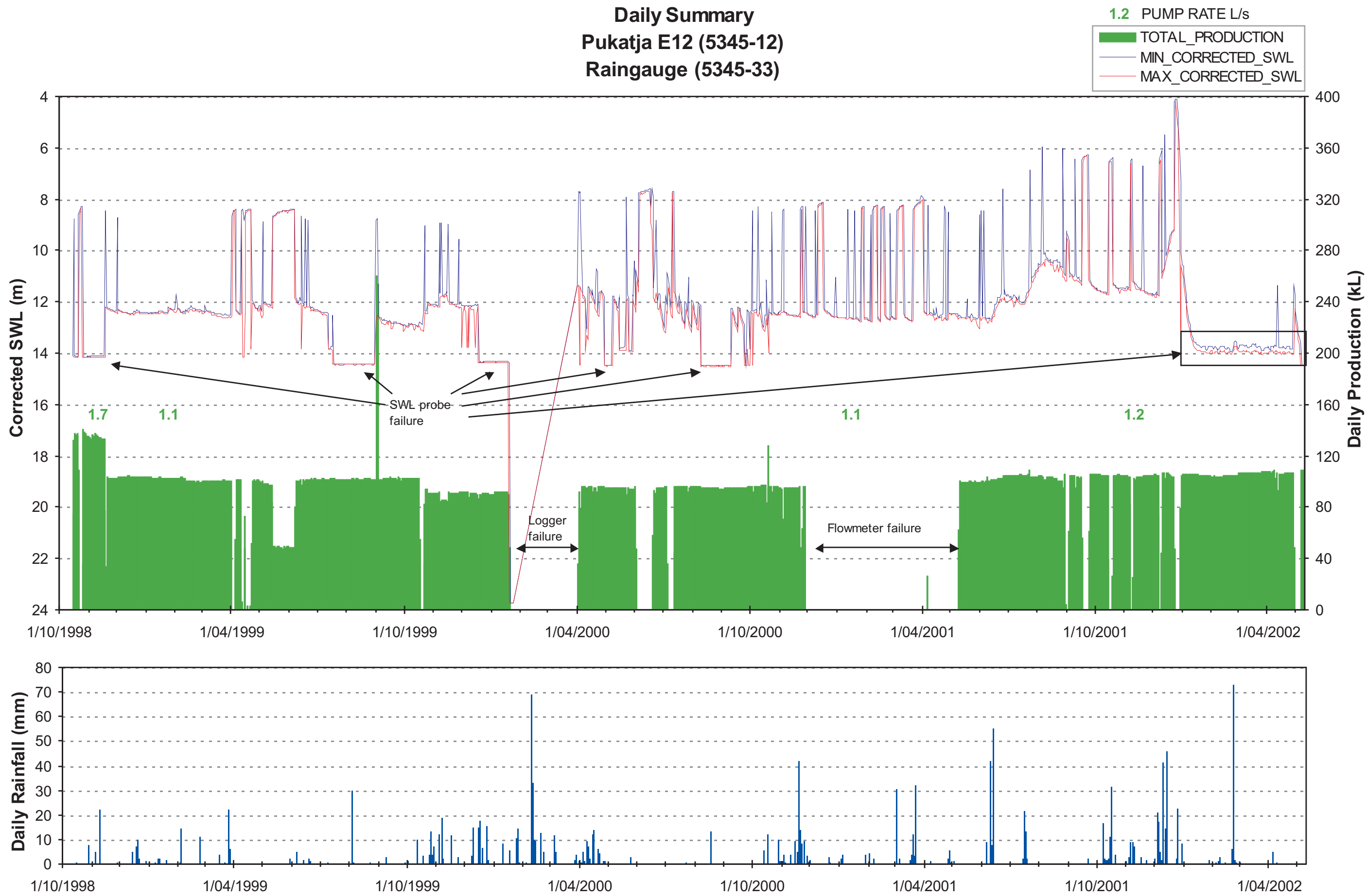


Figure 5.3 Daily Summary, Pukatja E 12

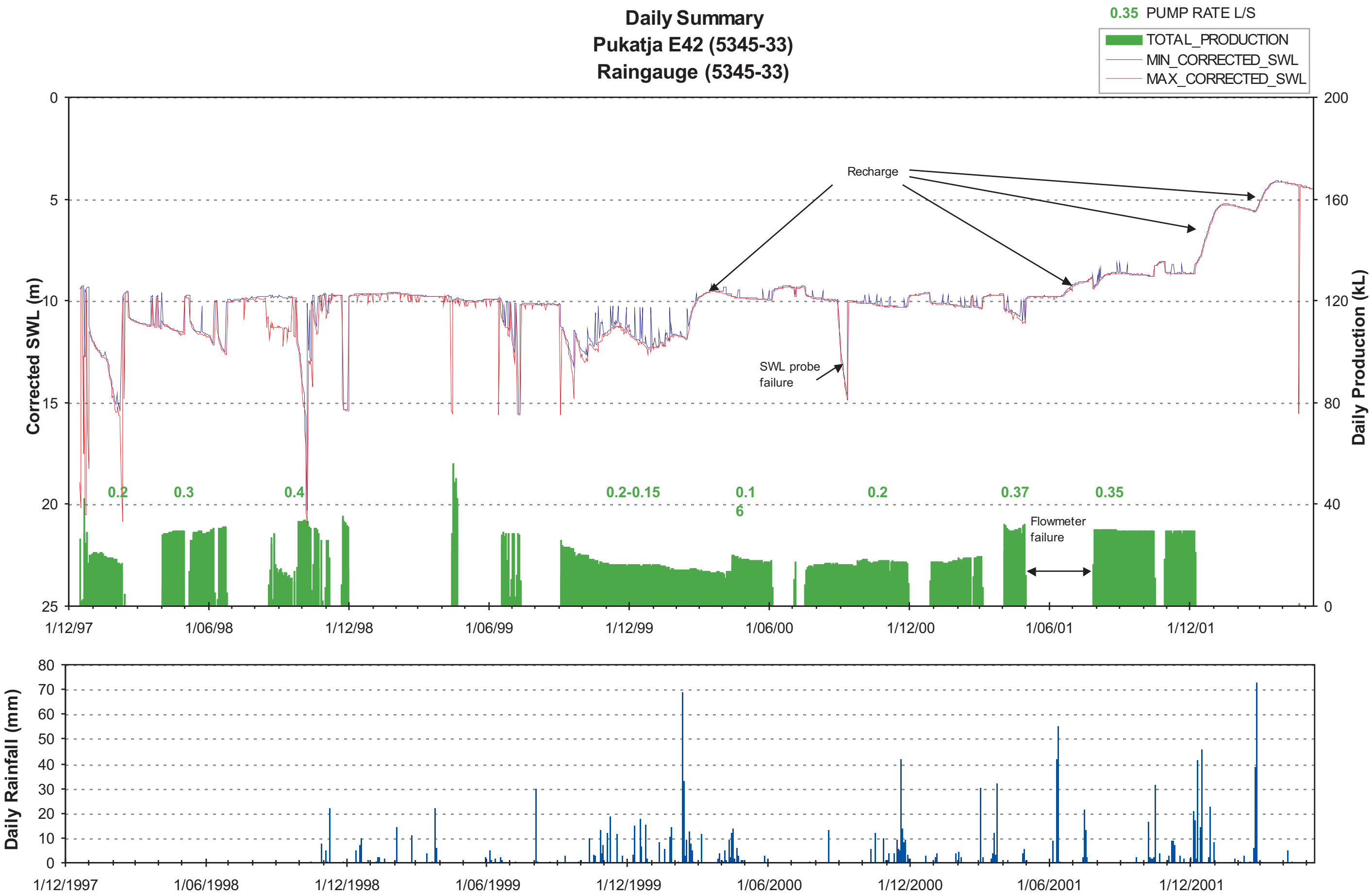


Figure 5.3 Daily Summary, Pukatja E 42

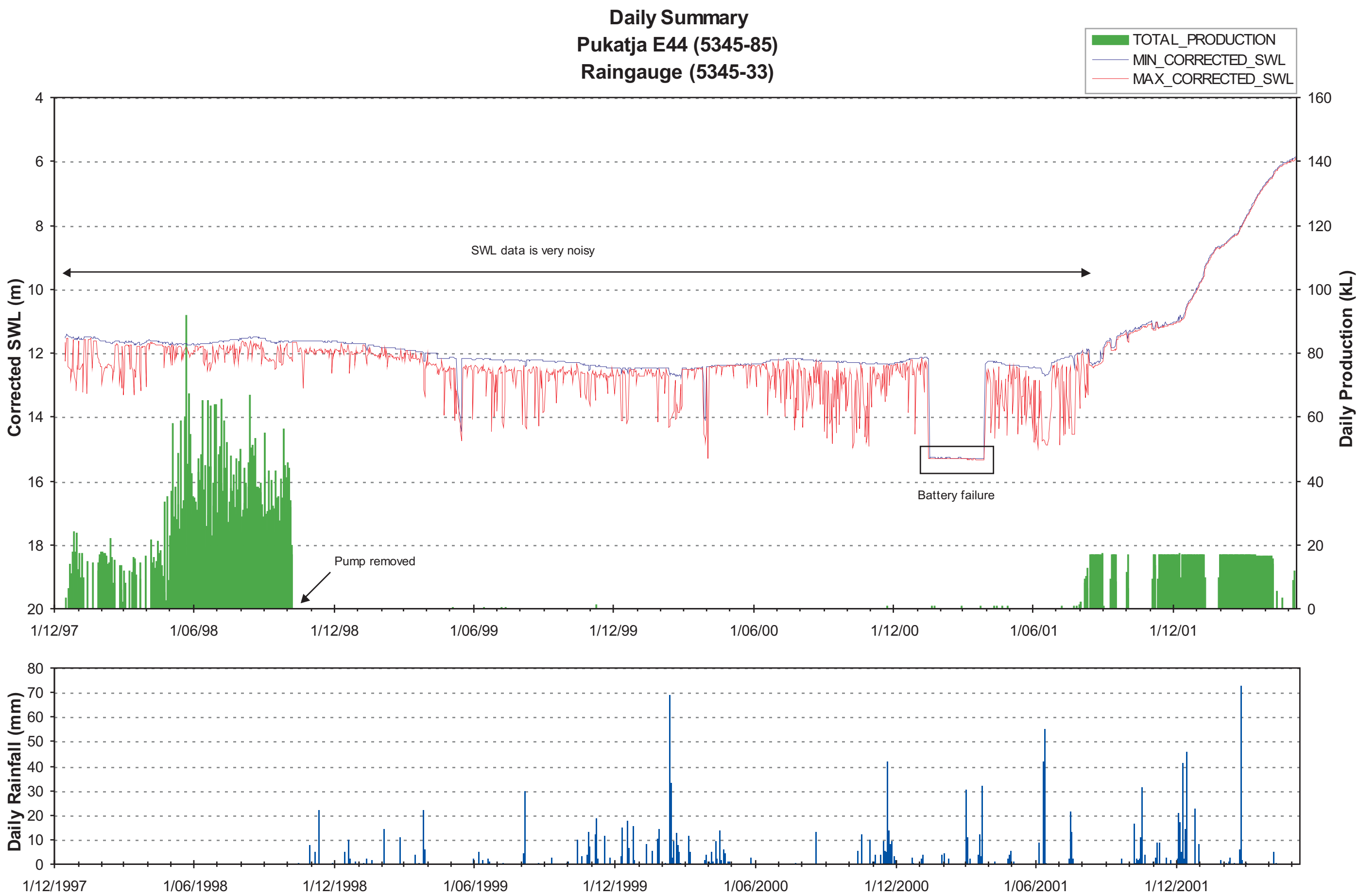


Figure 5.5 Daily Summary, Pukatja E 44

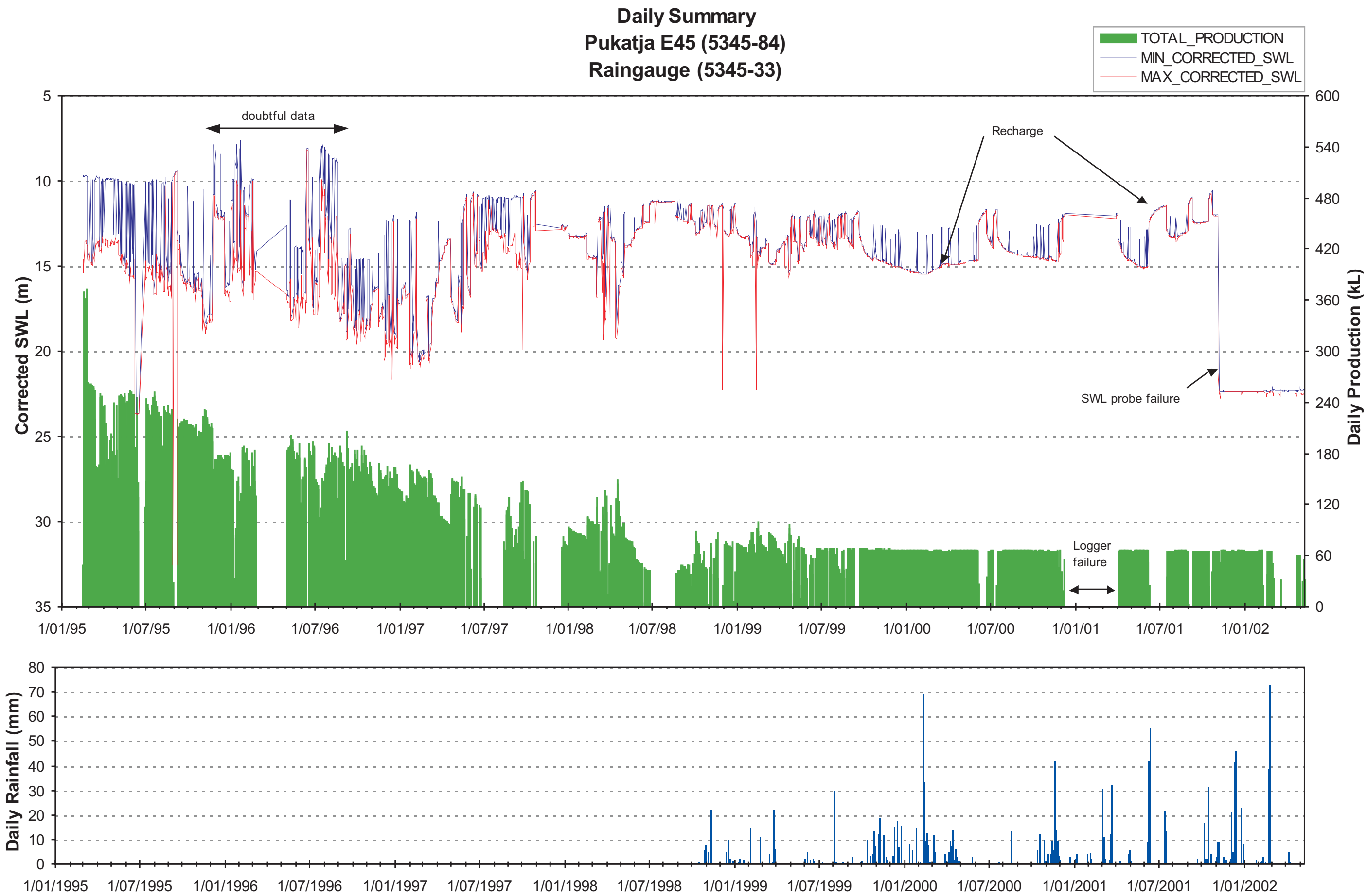


Figure 5.6 Daily Summary, Pukatja E 45

E-45 has contributed a steady 65 kL/day to Pukatja's water supply for the last 3 years without any sign of stress, although the SWL was declining gradually before the recent recharge events. Before 1998 pumping at higher levels caused considerable stress to this well, but it appears that the recent regime of pumping 0.75 L/s continuously is sustainable. Higher pumping rates should be avoided other than possibly for short periods.

E-97B

The SWL data for this well has many errors, but general patterns can still be seen (Fig. 5.7). The pump rate has been consistently high (3.0-3.5 L/s) and has been carried reasonably well. The recharge events in February 2000, December 2001 and February 2002 show a prompt effect on the SWL of a rise for about 3 weeks and then a decline, both rise and fall occurring whether the well is being pumped or not (Fig. 5.8). The envelope of pumping and non-pumping SWLs clearly shows this. After reaching a peak of 7.4 m in March, the final SWL was 9.2 m - 4.3 m higher than that when the well was drilled in 1997.

This well has been a major contributor to the water supply and does not appear to be stressed by current pumping levels. It also clearly gets recharge when rains are sufficiently heavy. It is probable that long term changes in water level are unrelated to pumping, and depend solely on recharge and natural drainage. The pumping rate should not be increased, as this may stress the aquifer in the short term. However, the daily hours of pumping could probably be increased without any damage to water supplies in either the short or long term.

E-97L

The logging unit failed in early December 2001, so there is no record of the well's response to the subsequent recharge events. However, it is clear that there was recharge as the water level in May 2002 was 11.6 m, 3.4 m higher than in December and 2.7 m higher than in 1997. Like E-97B, this well sustains long term pumping at the current rate of 1.4 L/s, but this rate should not be increased (Fig. 5.9).

Recharge

The rainfall events of December 2001 and February 2002 had a much more dramatic effect on the water levels in the aquifers than earlier events (e.g. February 2000) of equal magnitude. It is uncertain whether this is caused by earlier rains having saturated the subsurface, by the precise area in which the rain fell, or some other cause. Whatever the mechanism, all wells benefited substantially from these recharge events. It appears that all wells, including those north of the community which were getting fragile, are now restored to their productivity at the time of drilling.

Summary

The water supply for Pukatja has improved markedly, firstly by the inclusion of the two wells at Pupalyatjara (E-97B and E-97L) and secondly by the recharge of the older wells closer to the community. All wells appear to be unstressed by current production levels and, generally, seem capable of increases in the duration of pumping, though not in the pump rate.

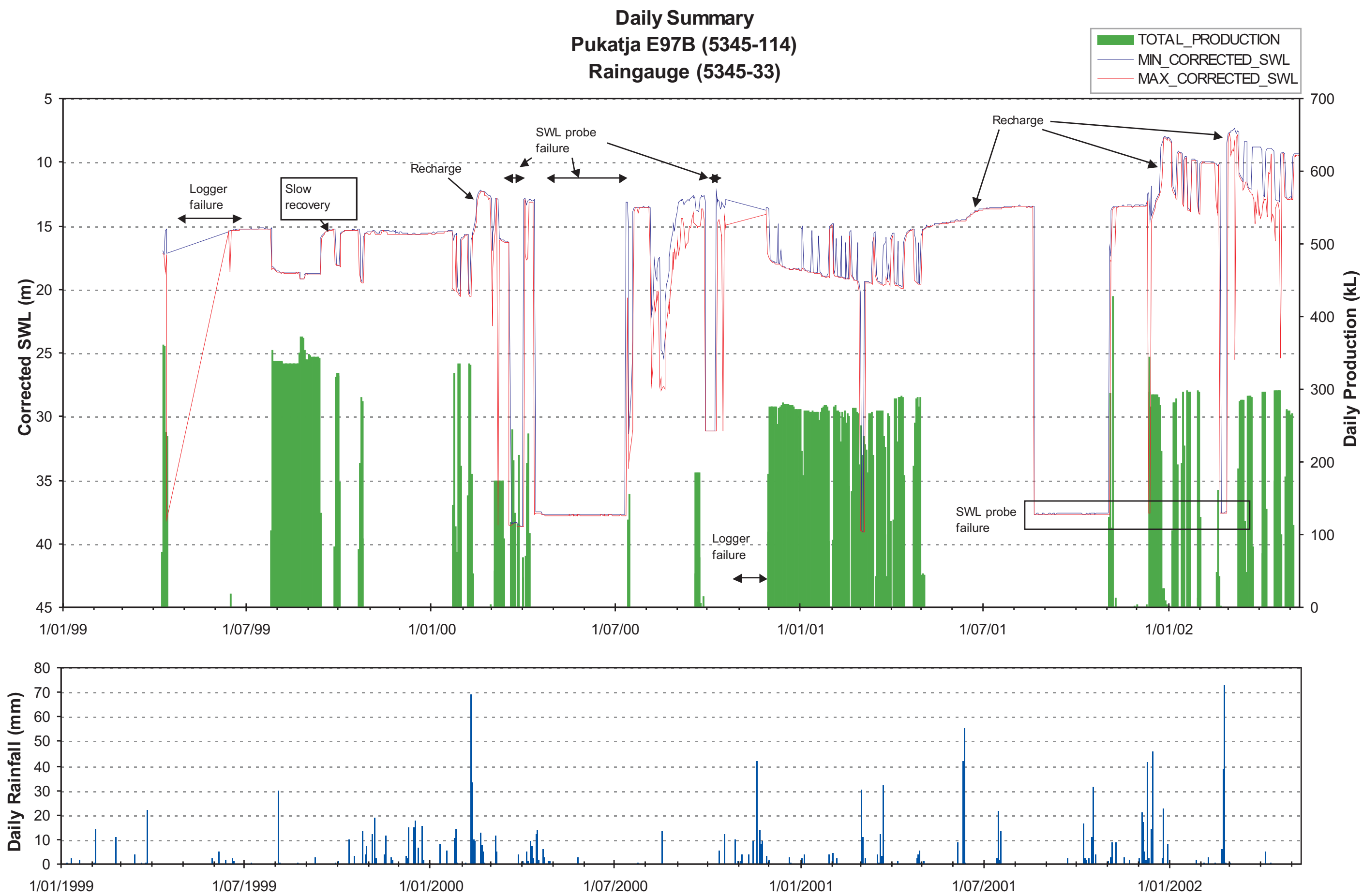


Figure 5.7 Daily Summary, Pukatja E 97B

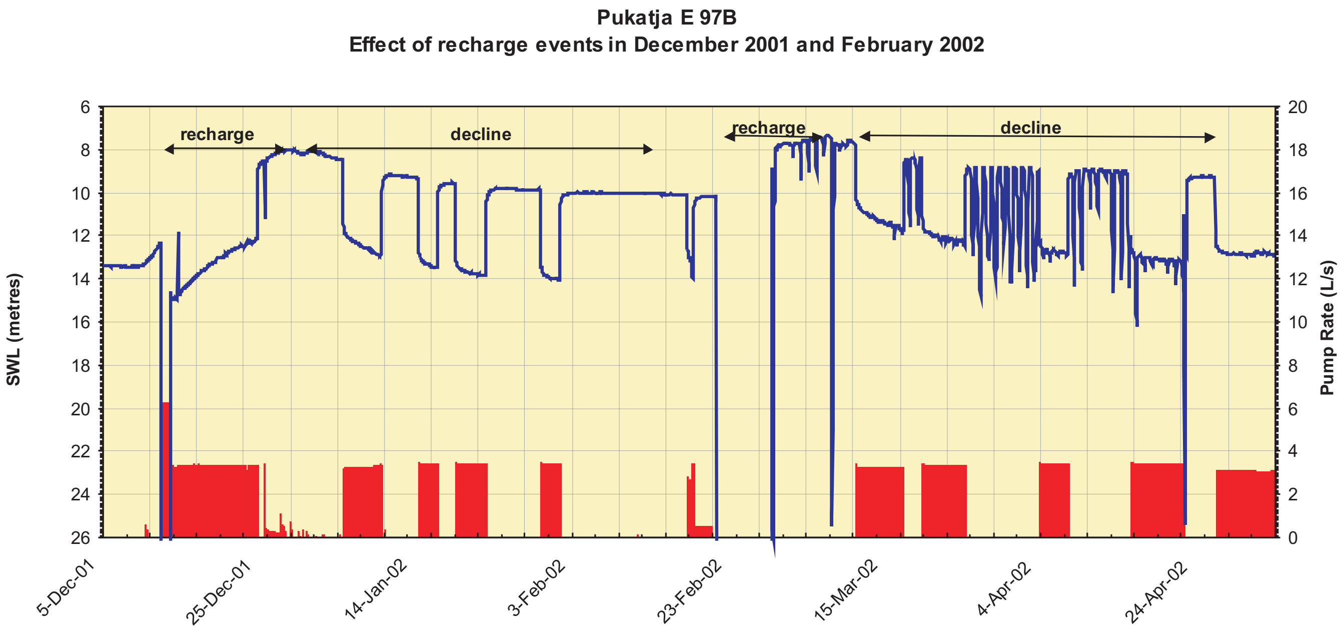


Figure 5.8 Effect of recharge Dec. 2001 and Feb. 2002, Pukatja E 97B

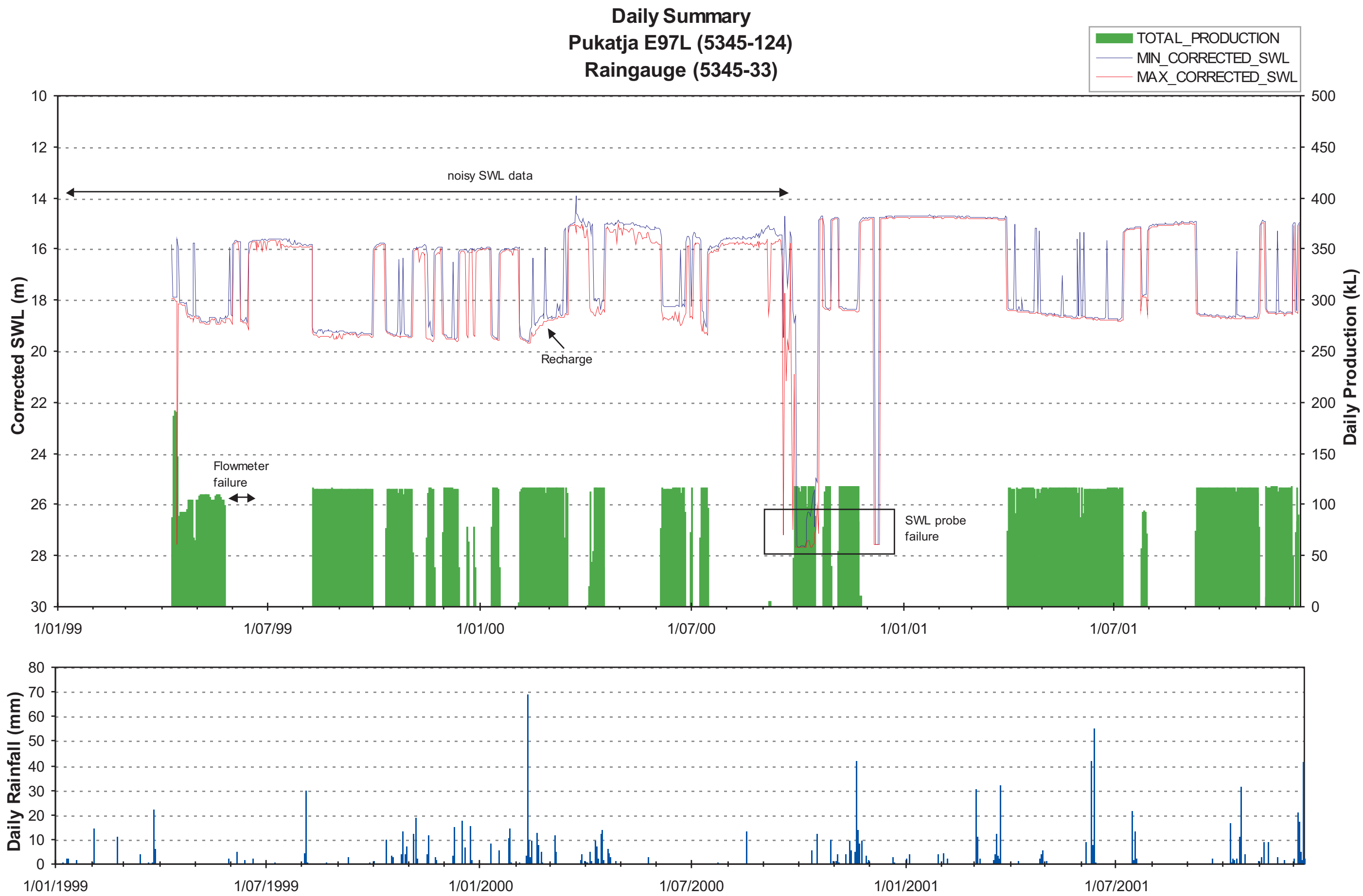


Figure 5.9 Daily Summary, Pukatja E 97L

6. AMATA

Water production

All four wells have contributed significantly at various times (Fig. 6.2). However, well A-15 was decommissioned after a failed attempt to clean it out, and was replaced by A-109 drilled a few metres away. The latter well appears as good a supplier as, if not better than, its predecessor.

Table 6. Water production at Amata, 1998–2001

Well	Unit Number	Production (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
A-15	5145-55	16 300.0	12 853.0	14 251.0	–	2 097.0	2 036.0	–
A-17	5145-84	9 685.1	8 150.7	7 647.0	11 030.0	13 887.0	5 487.2	**8 796.2
A-26	5145-19	1 361.2	–	8 602.2	10 400.0	11 688.0	4 878.7	2 660.7
A-109	5145-109						2 197.0	12 589.0
Total		**27 346.3**	**21 003.6***	**30 500.0**	**21 430.0†**	**27 672.0**	**14 598.9**	**24 045.9**

* A 26 value is missing from total.

† A 15 value is missing from total.

** this output figure is taken from integration of hourly pump rates, as the accumulated flow figure was incorrect.

Wells

A-17

This well has been pumped gently over the past year, with an average yield of about 50 kL/day. The SWL has risen steadily over the period, as it has since the major recharge event in February 2000 (Figs 6.3 and 6.4). A further lesser recharge event occurred in late February 2002, again causing an immediate jump in SWL on top of the steady rise.

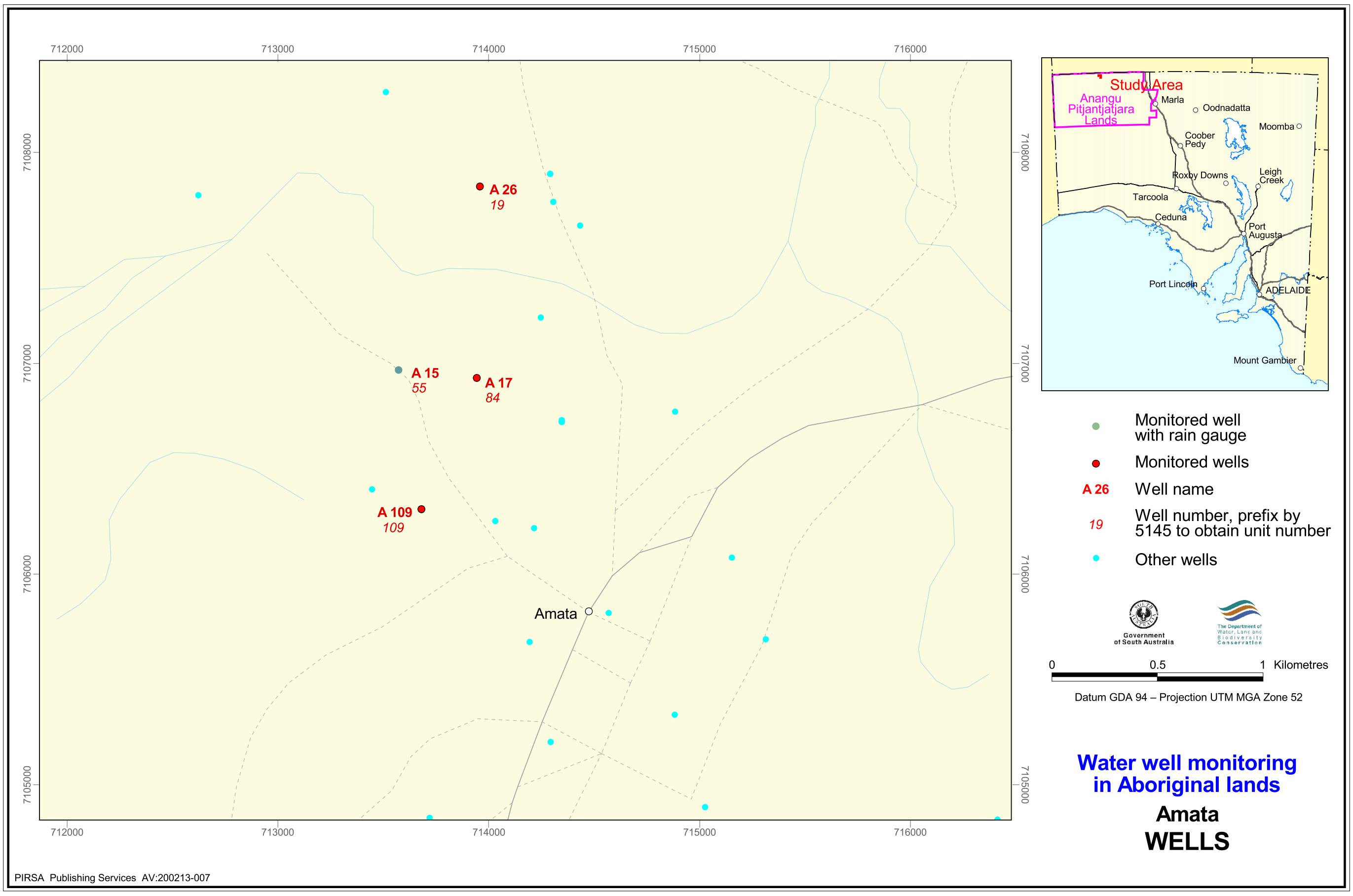
The non-pumping SWL is now 8.7 m compared to 14.7 m three years ago and comparable to the level of 7.9 m in 1990, the earliest record available.

The well has never been stressed, even when pumped at over 100 kL/day for several weeks (January 2001).

A-26

The well was pumped gently until A-109 was brought on line, after which it was pumped continuously for short periods (a week or so) and rested in between (Fig. 6.5). This routine is good for analysis as it: (a) shows how well the aquifer stands up to extended pumping and (b) allows a non-pumping level to be achieved.

The well was pumped for 12 days continuously at 1.1 L/s, resulting in an initial 4 metre drawdown but minimal further decline in SWL (Fig. 6.6). This indicates that the well can sustain pumping for such periods, and probably much longer. However, this test is at a time when the aquifer has just been recharged and the non-pumping SWL is still rising, so the results may be rather more encouraging than they would be at less favourable times.



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Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
A 26 Well name
19 Well number, prefix by 5145 to obtain unit number
Other wells
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Datum GDA 94 – Projection UTM MGA Zone 52
Water well monitoring in Aboriginal lands
Amata
WELLS
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Figure 6.1

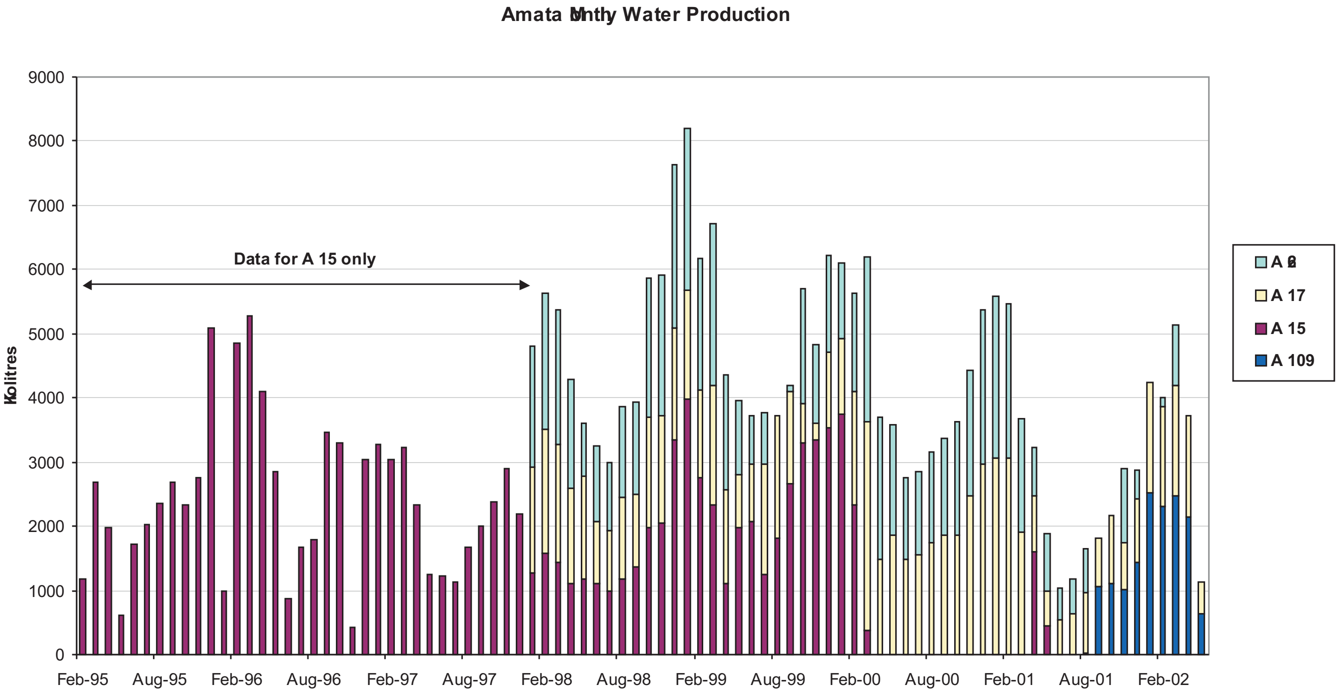


Figure 6.2 Community water production at Amata

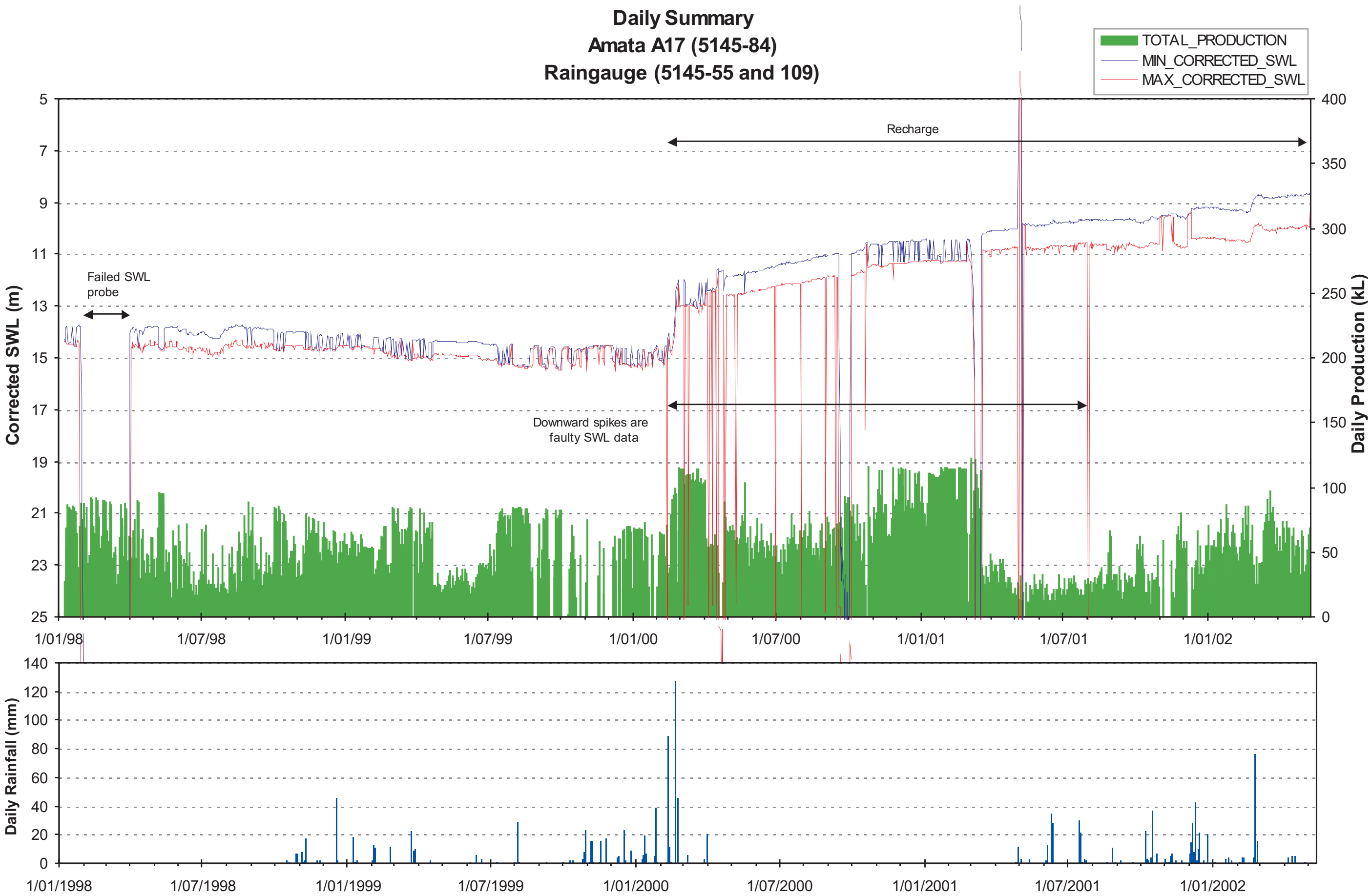


Figure 6.3 Daily Summary, Amata A 17

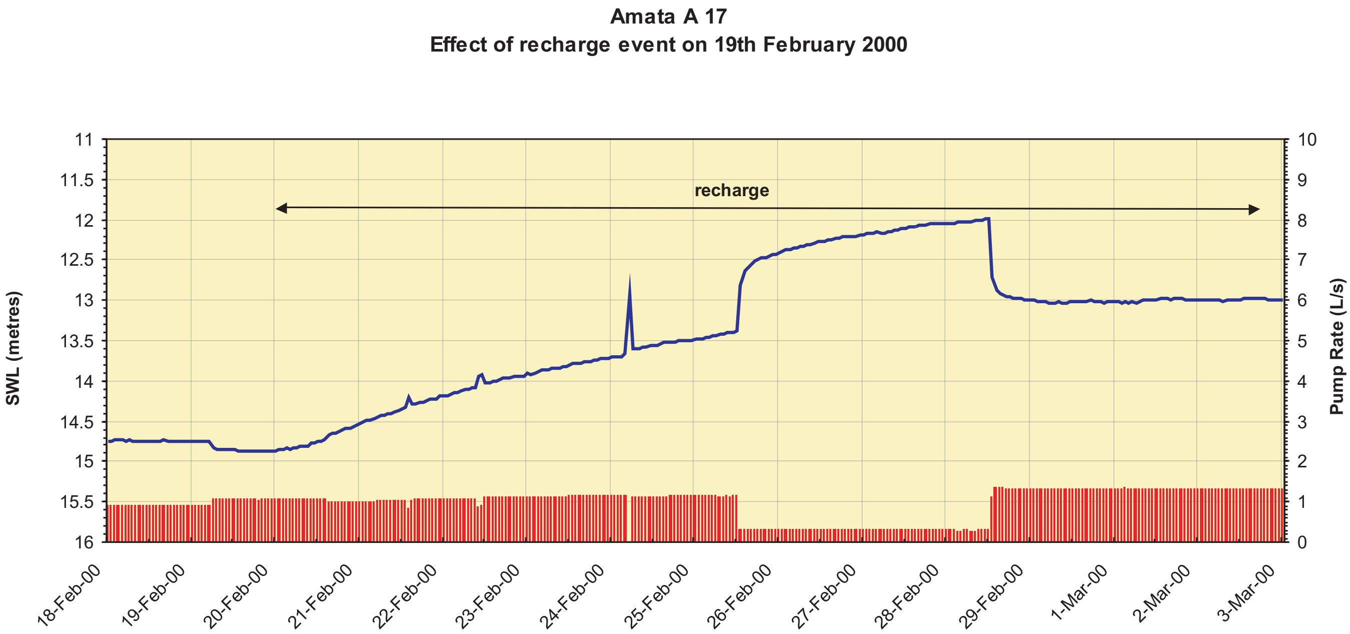


Figure 6.4 Effect of recharge event in February 2000, Amata A 17

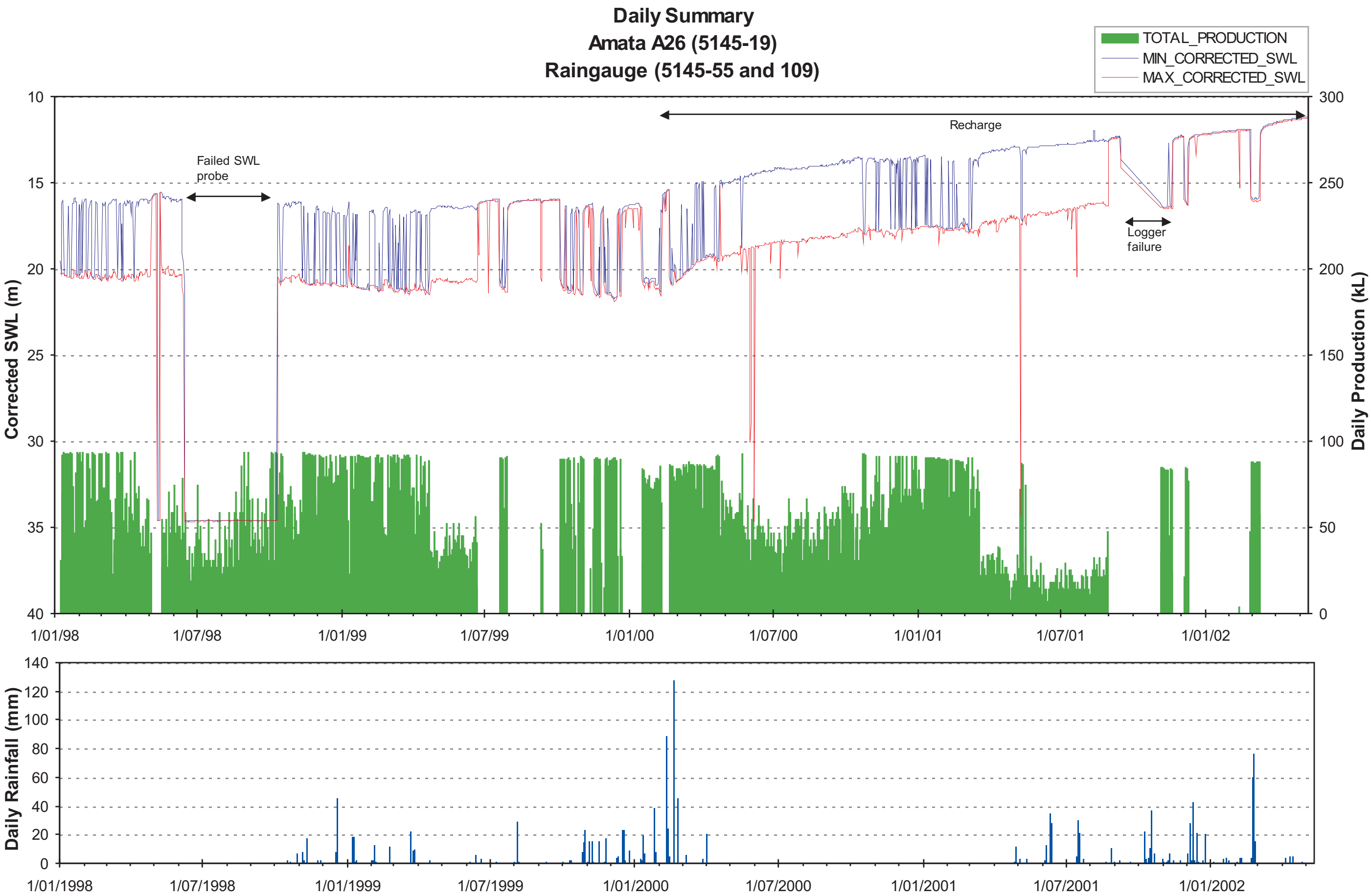


Figure 6.5 Daily Summary, Amata A 26

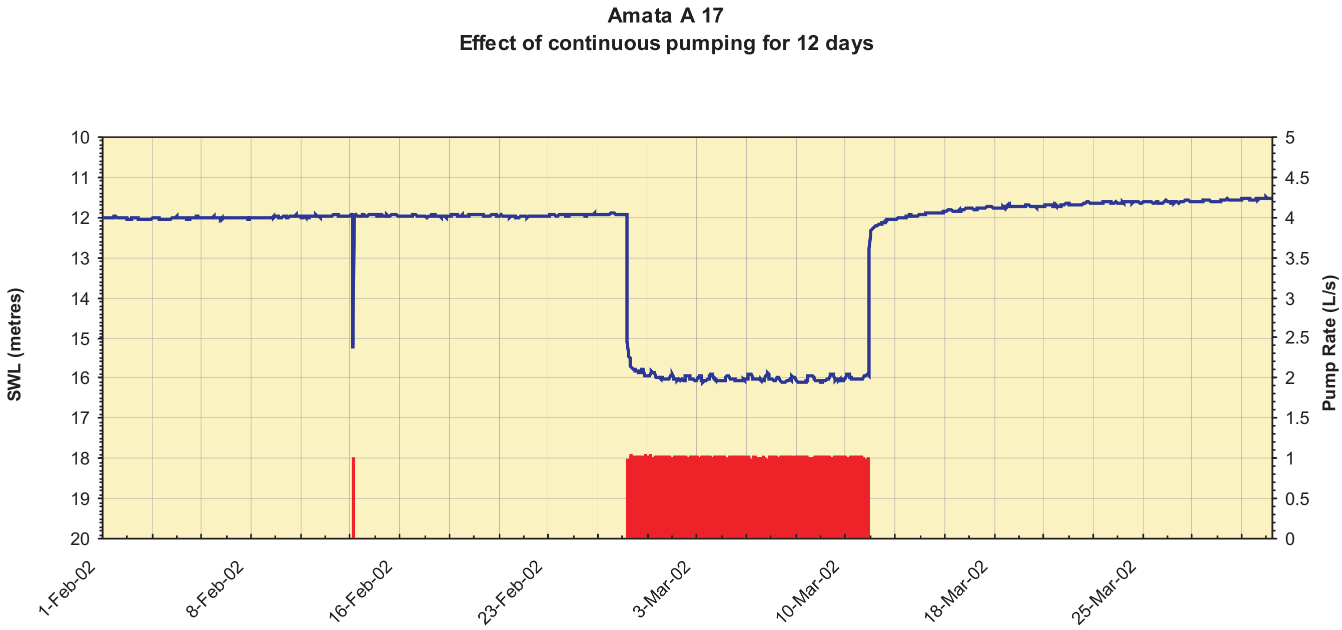


Figure 6.6 Effect of continuous pumping, Amata A 26

Like A-17, this well shows a steady rise in SWL since the recharge event of February 2000 and an accelerated rate of rise after the event of February 2002. The level of 11.2 m in May 2002 is almost back to the level of 10.6 m of 1966, when the well was drilled.

A-109

The well has been pumped for a few hours most days since it was brought on line in May 2001, although the flow rate was not recorded until September. This rate of extraction – 30 to 130 kL/day – puts no pressure on the well (Fig. 6.7). As in the other wells the SWL has risen steadily from 9.7 m to 8.6 m over the period, with a slight surge in rise rate after the rains in February 2002.

Recharge

All wells have shown the effects of recharge continuously since the rains of February 2000, and are close to their all time peak levels. It is evident from a continued rise in SWL for a year after a recharge event that recharge occurs both close to the wells and many kilometres away.

Conclusions

The similarity between these wells indicates that they are all tapping the same aquifer. It would be useful to check potentiometric gradients by obtaining accurate collar elevations for each well.

All wells appear to be operating comfortably within their potential, with reserves for emergencies such as increased demand or a breakdown of the equipment in one well. The water level in the aquifer is almost as high as records show, and is still rising.

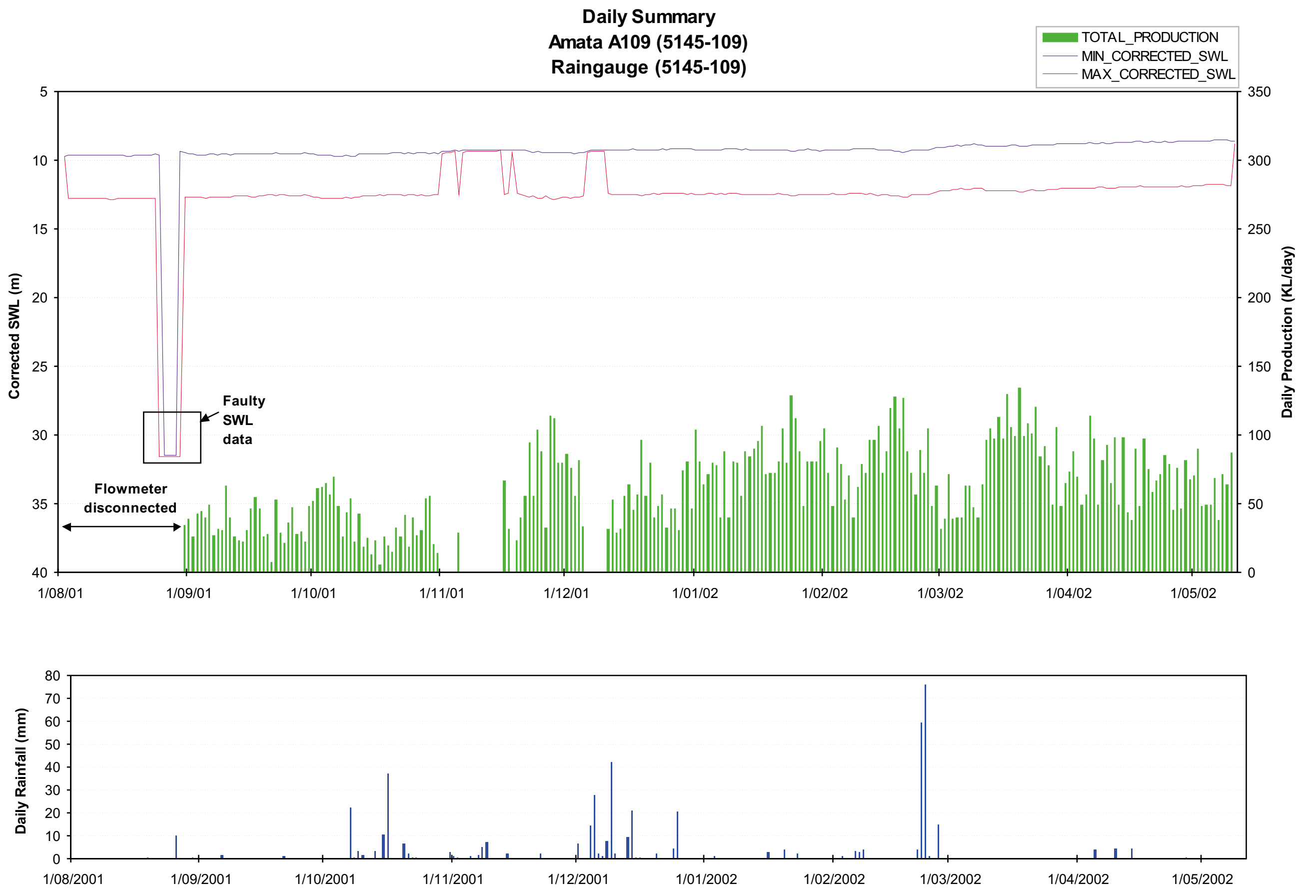


Figure 6.7 Daily Summary, Amata A 109

7. KALKA

Water Production

Water consumption was similar to previous years, with a high consumption month of 2 000 kL in February 2002 (Fig. 7.2). Similar high consumptions occurred in February 1998 and March 1999. As usual the brunt of this demand, two-thirds, was supplied by KA-3.

Table 7. Water production at Kalka, 1998–2001

Well	Unit Number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
KA-1	4745-78	928.9	676.3	21.9	342.4	786.6	363.5	**1 196.7**
KA-2	4745-94	1 733.8	1 216.2	1 214.4	656.5	1 748.1	1 161.3	**1 286.2**
KA-3	4745-85	6 310.3	4 710.7	4 503.9	2 677.0	5 111.5	5 092.6	**5 762.5**
Total		**8 973.0**	**6 603.2**	**5 740.2**	**3 675.9**	**7 646.2**	**6 617.4**	**8 245.4**

Wells

KA-1

This well was pumped at 0.2 L/s and was unstressed, even when pumped continuously for 60 hours in January 2002 (Fig. 7.3). There are a number of setts in the SWL data, but overall the non-pumping SWL is probably steady at 27.5 m $\pm$ 0.1 m, a level it has maintained since 1998.

KA-2

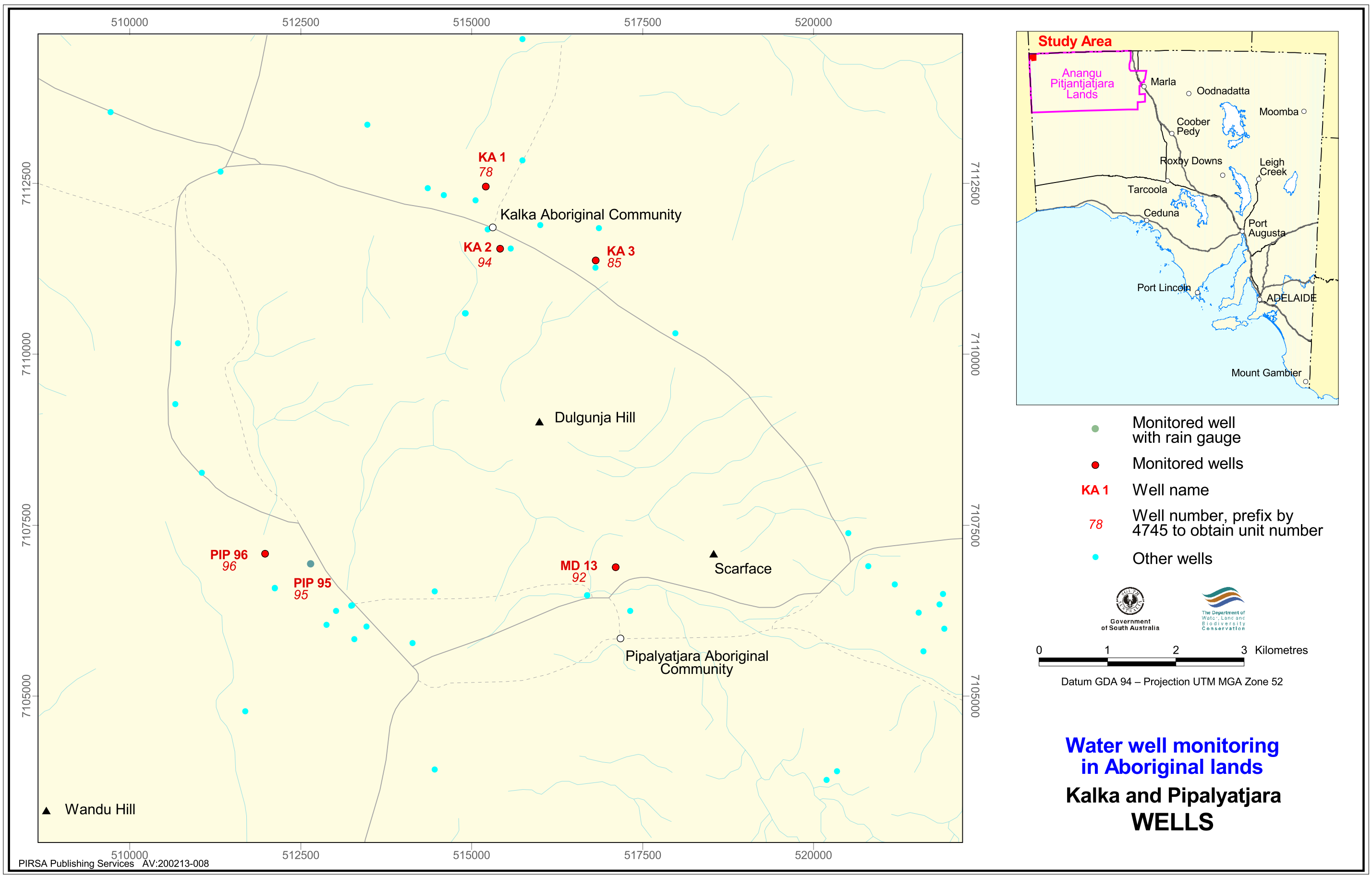
As for KA-1 the well was unstressed by demands upon it over the past year. The SWL was steady at 28.2 m, with a drop of about 0.4 m over the past 4 years (Fig. 7.4).

The data for the last year has been very reliable. Before that there were many setts and drifts in the SWL that have been corrected as far as possible. However, some of the variations, particularly during the year 2000, are caused by instrument malfunction and could not be corrected. The general trend over the full period is clear, however, and the rate of decline indicated above (0.1 m/year) is reliable.

The aquifer extends from 29 m to about 50 m, so this rate of decline is not considered to be serious, in spite of the absence of indications of recharge.

KA-3

This is still the main water supply for Kalka. The biggest demand was in January 2002, as with the other two wells. While this stressed well KA-3 in the short term with 80 hours of continuous pumping causing a drop in SWL to 26.5 m, the well recovered within a day to



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Dulgunja Hill
PIP 96
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PIP 95
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MD 13
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Scarface
Pipalyatjara Aboriginal Community
Wandu Hill
PIRSA Publishing Services AV:200213-008
Study Area
Anangu Pitjantjatjara Lands
Marla
Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
KA 1 Well name
78 Well number, prefix by 4745 to obtain unit number
Other wells
Government of South Australia
The Department of Water, Land and Biodiversity Conservation
0 1 2 3 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 52
Water well monitoring in Aboriginal lands
Kalka and Pipalyatjara
WELLS

Figure 7.1

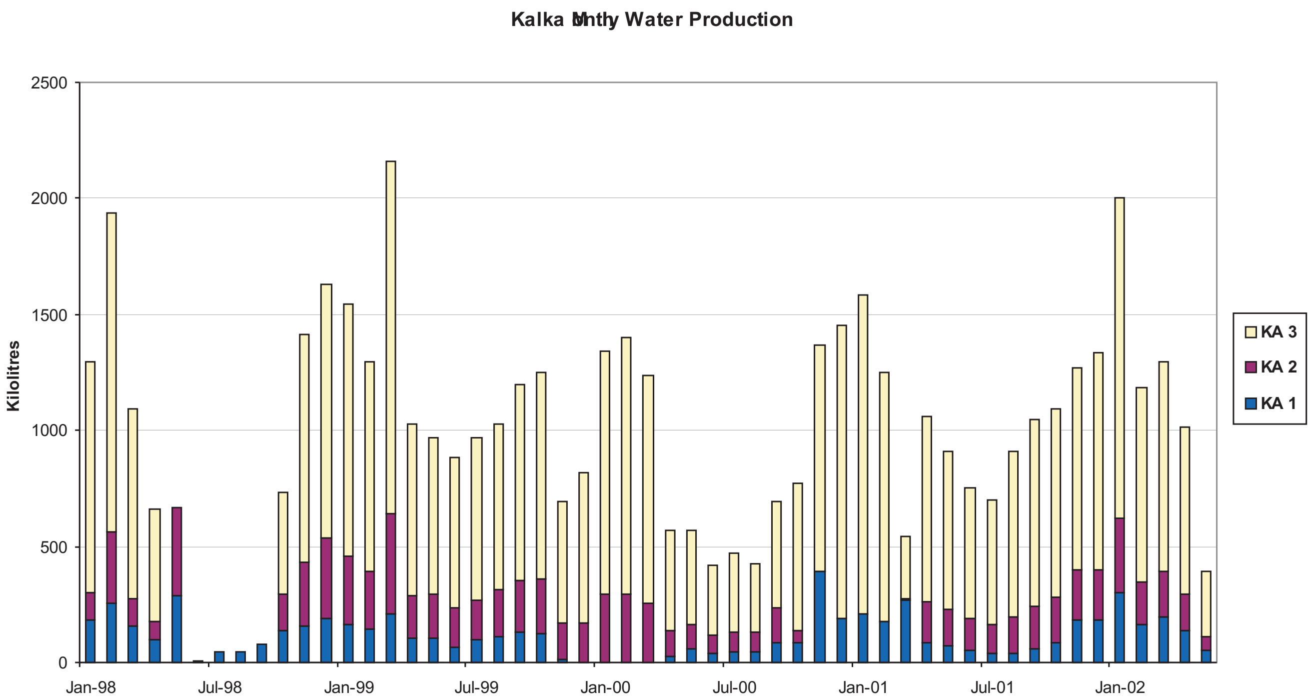


Figure 7.2 Community water production at Kalka

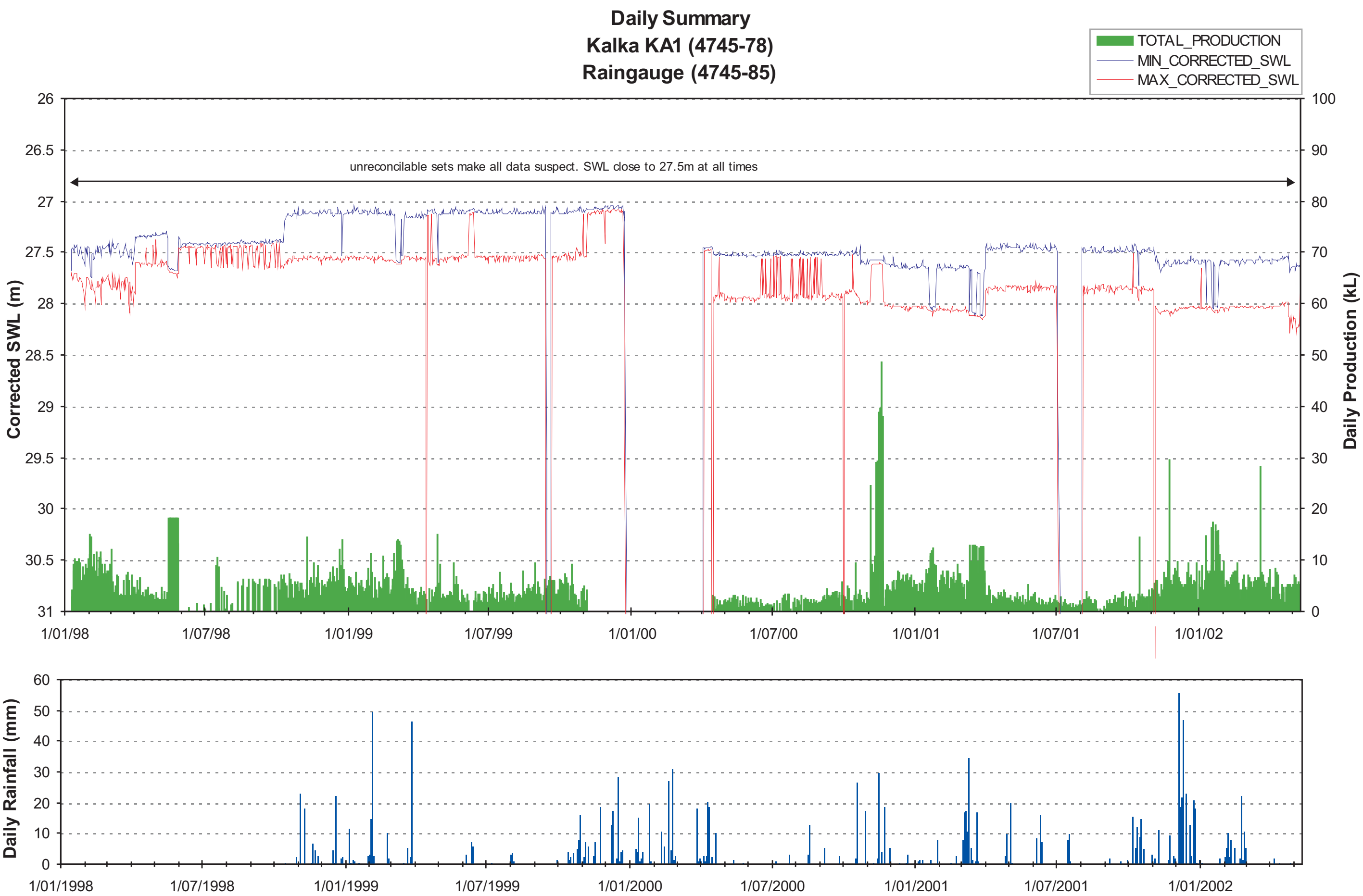


Figure 7.3 Daily Summary, Kalka KA 1

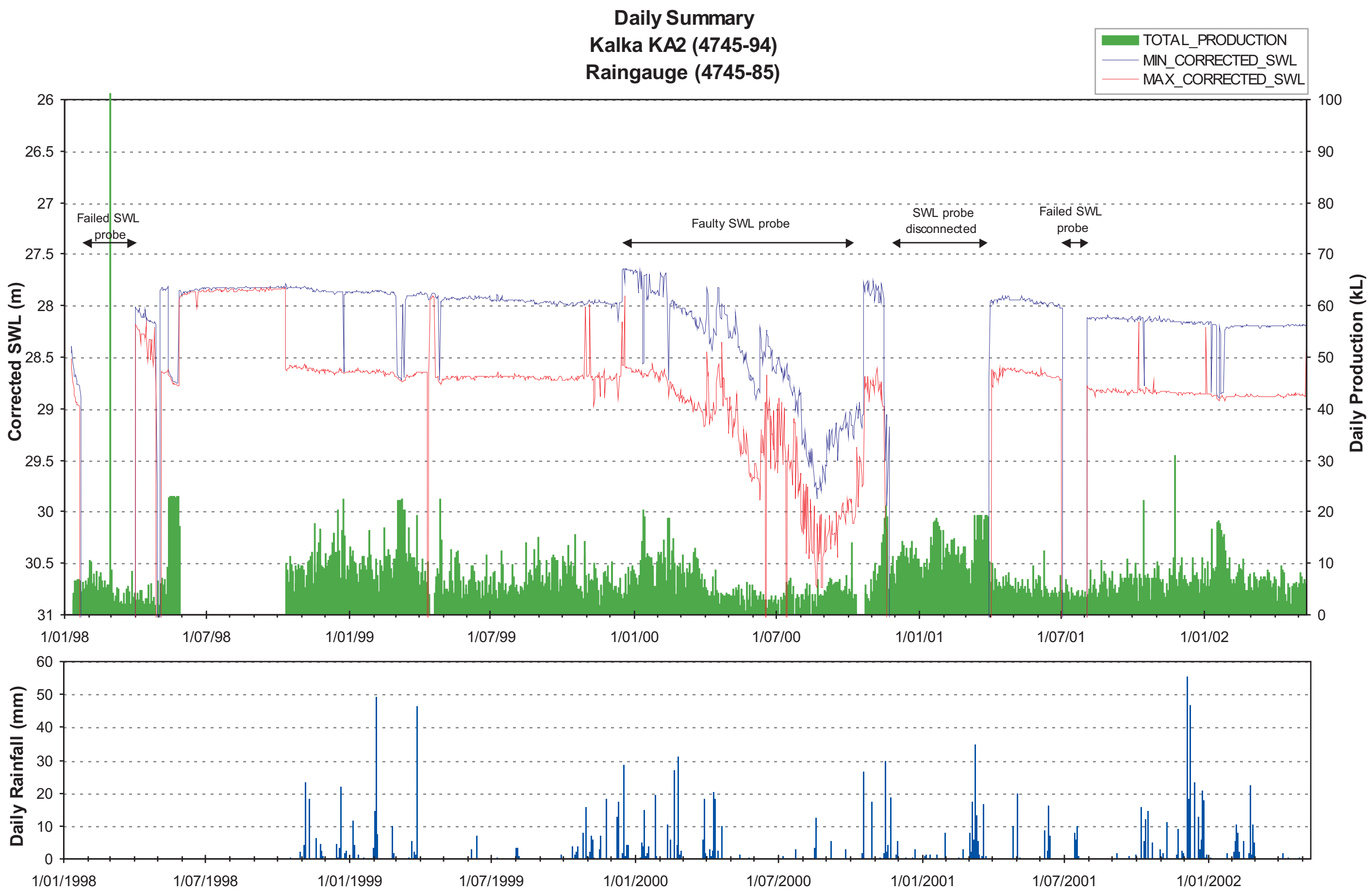


Figure 7.4 Daily Summary, Kalka KA 2

its normal non-pumping level of 20 m (Figs 7.5 and 7.6). However, the SWL has dropped by about 1 m over the past 4 years. It may be significant that after this period of heavy demand the drawdown of the well increased by about 1 m, from 4 m to 5 m, although the pump rate (0.8 L/s) remained the same and the daily duration of pumping decreased (11 hours to 9 hours). This brings the drawdown to within 2 m of the watercut and may reduce the potential of the well for higher pump rates or extended pumping times.

Figure 7.6 shows the effect of pumping on the SWL clearly. On starting pumping there is an initial drawdown of 3 meters within an hour or so, followed by a steady but slower drop in SWL of 0.5-1.0 m/day for as long as the well is pumped. The first hour of recovery on cessation of pumping brings the SWL to within about 1 m of the non-pumping level, but the rest of the recovery takes about 8 hours. It is clear that the pumping regime of 9-16 January 2002 (pumping 8-10 hours per day) is sustainable, but that of 17-21 January (pumping 24 hours a day) is not.

Overall the data for this well is of good quality. There was some data contamination from water flowing back into the well from the distribution system in late 1999 and 2000, and some intermittent equipment failure in the heavy pumping period between December 2000 and March 2001. The only trends to be seen are the steady drop in non-pumping SWL over the four years of monitoring and the increased drawdown for lower pump rates. Periods of withdrawal exceeding 60 kL/day result in a temporary drop in the SWL that is recovered in a few weeks once the demand drops off.

Recharge

Rainfall for the latest 6-month period here comprised 358 mm, less than half that experienced at Pipalyatjara 6 km away on the other side of Dulgunja Hill. This demonstrates the local nature of rainfall in the Musgrave Block area. The rain fell mostly in December 2001, and is still sufficient to anticipate some recharge. No recharge can be seen in the SWL data for any well, in this or any of the monitoring periods. The lack of any signs of recharge during this favourable period, when both Amata and Pipalyatjara wells showed dramatic rises in SWL, is disturbing.

Summary

While there was no drop in aquifer water level in any of the wells over the past year, KA-2 and KA-3 have both shown a decline since 1998. The increased drawdown in KA-3 since January 2002 is also a concern, as is the lack of evidence of recharge.

It might be wise to commence the basic infrastructure for getting KA-137 into production, before the possible extra stresses of summer 2002-3.

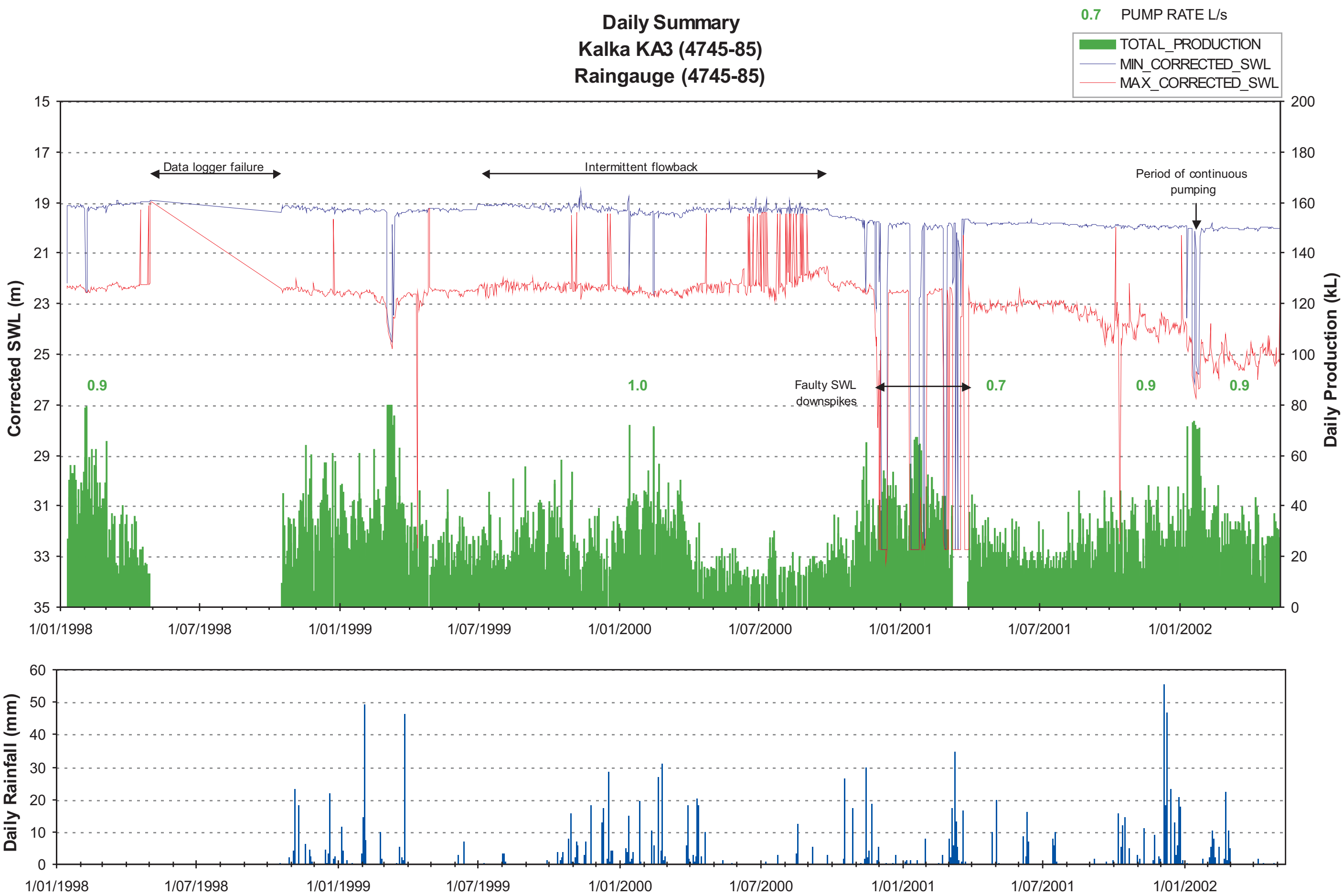


Figure 7.5 Daily Summary, Kalka KA 3

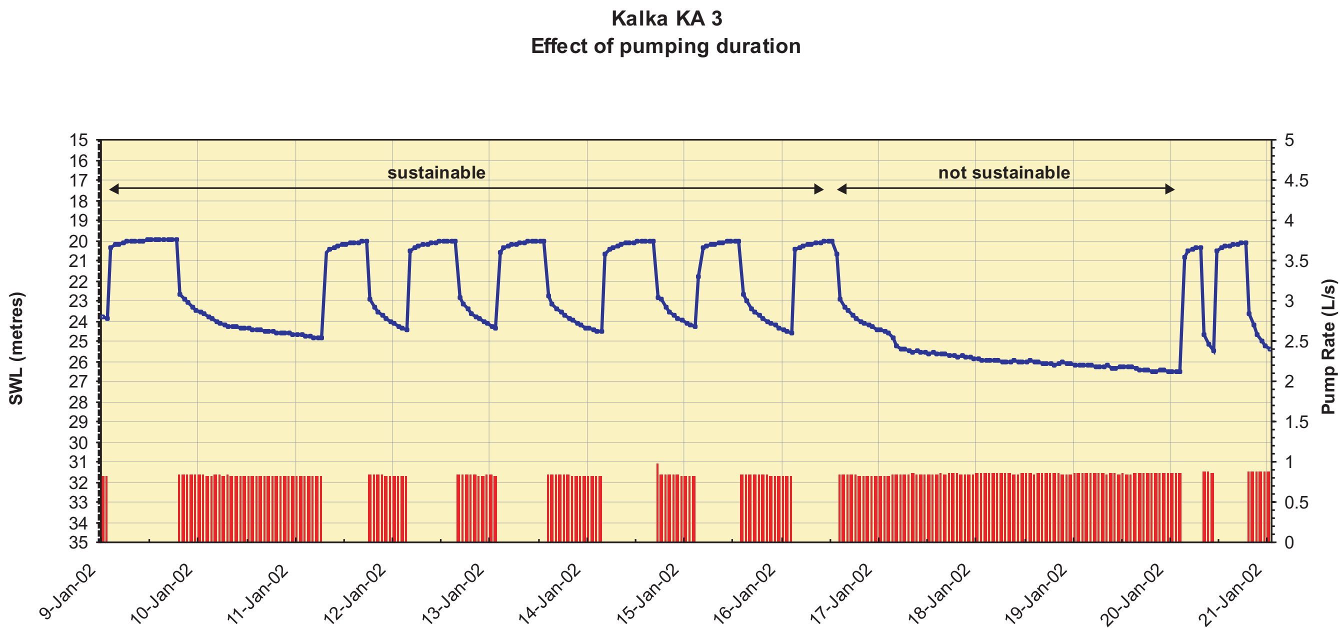


Figure 7.6 Effect of continuous pumping and slow recovery, Kalka KA 3

8. PIPALYATJARA

Water Production

Water consumption for the past year has been quite low, averaging just over 1 000 kL/month and never exceeding 2 000 kL/month (Fig. 8.1). The load is spread evenly between the two wells.

Table 8. Water production at Pipalyatjara, 1998–2001

Well	Unit Number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
PIP-95	4745-95	9 903.0	8 335.3	6 757.0	4 342.8	6 016.7	#3 638.7	**4 944.7**
PIP-96	4745-92	6 564.1	8 475.1	2 840.8	5 009.9	6 339.0	3 535.9	**5 163.5**
MD-13*	4745-96	–	–	–	–	–		
Total		**16 467.1**	**16 810.4**	**9 597.8**	**9 352.7**	**12 355.7**	**7 174.6**	**10 108.2**

* There was no constant level of water production for MD 13 and no volume readings are available. The well was pumped for 577.61 h in Apr.– Oct. 1999, 8.28 h in Oct. 1999 – Apr. 2000, 32.71 h in Apr. – Oct. 2000 and 333.68 h in Oct. 2000 – Apr. 2001.

\# This figure comes from the hourly pump rate, rather than accumulated flow.

Wells

PIP-95

The non-pumping SWL remained at about 17 m until the recharge from the summer rains, which caused an immediate but gradual rise (Fig. 8.2). In May the SWL had risen to 16.6 m and appears to be still rising. Pumping causes a drawdown in SWL to about 18.5 m, still well above the water cuts at 22-30 m.

The well was pumped at 1.2 L/s continuously for over 8 days in January 2001 (Fig. 8.3). After the initial (well component) drawdown of 1.6 m the SWL remained constant over this pumping period. After pumping ceased the well recovered to within 0.1 m of its pre-pumping level within an hour or two, but took a few days to fully recover. It appears that the well can be pumped for several weeks at this rate without stress.

The SWL declined very slowly from 16.9 m in 1998 to just below 17 m in 2000. It appears to be largely unaffected by pumping or natural drainage (0.1 m in two years). This slow decline makes the 0.4 m rise in 2002 all the more significant. The water supply appears sustainable indefinitely.

PIP-96

The non-pumping SWL declined slowly but steadily over the four years 1998-2001 inclusive from 20.7 m to 21 m, but recovered 0.5 m following the late 2001 rains (Fig. 8.4). At last date the SWL was still rising. While the potential drawdown to the top of the water cut is only 1.0 m, this is probably adequate bearing in mind the steadiness of the SWL and the thickness of the water cut (14 m).

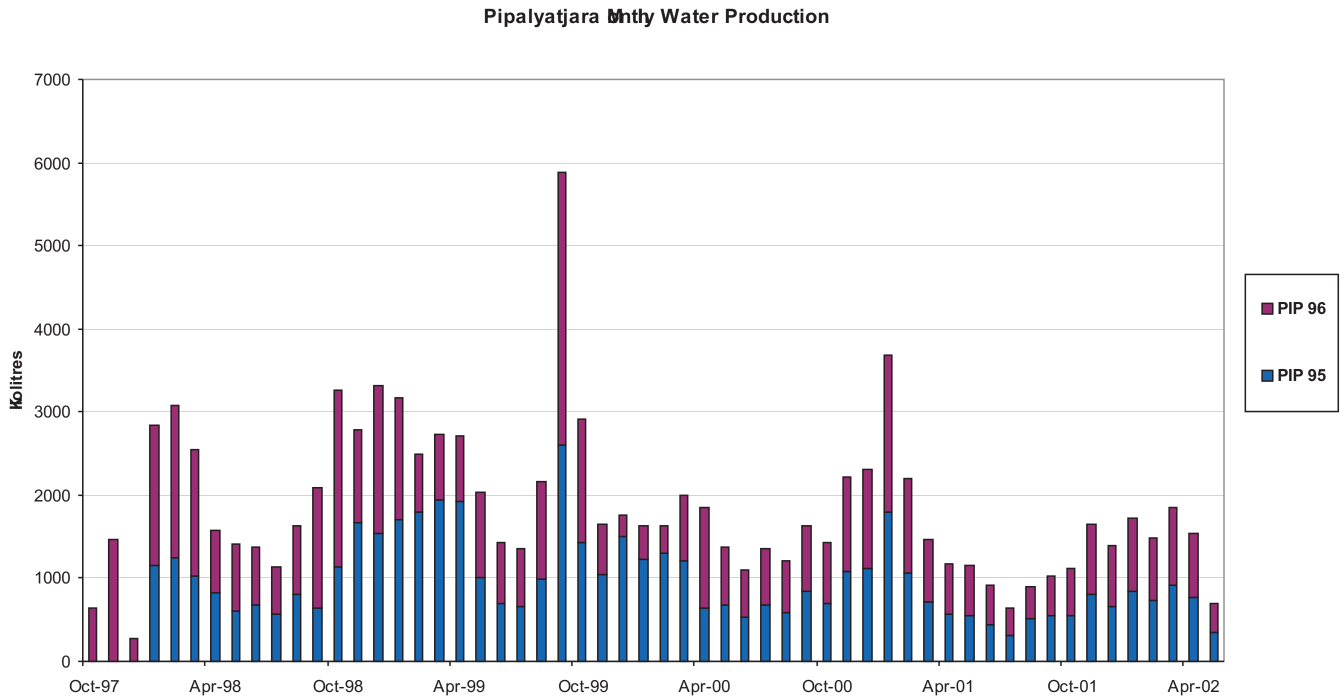


Figure 8.1 Community water production at Pipalyatjara

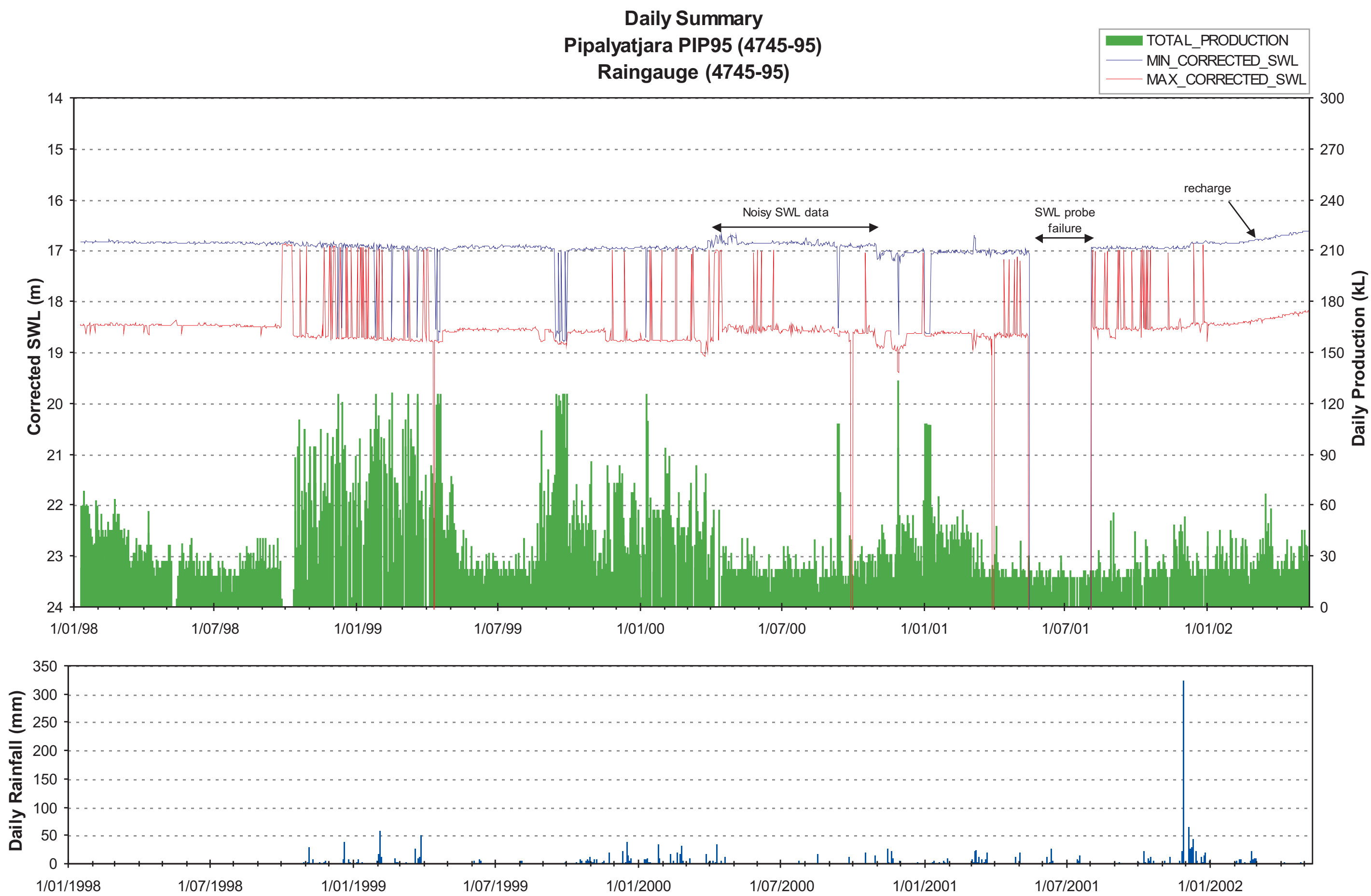


Figure 8.2 Daily Summary, Pipalyatjara PIP 95

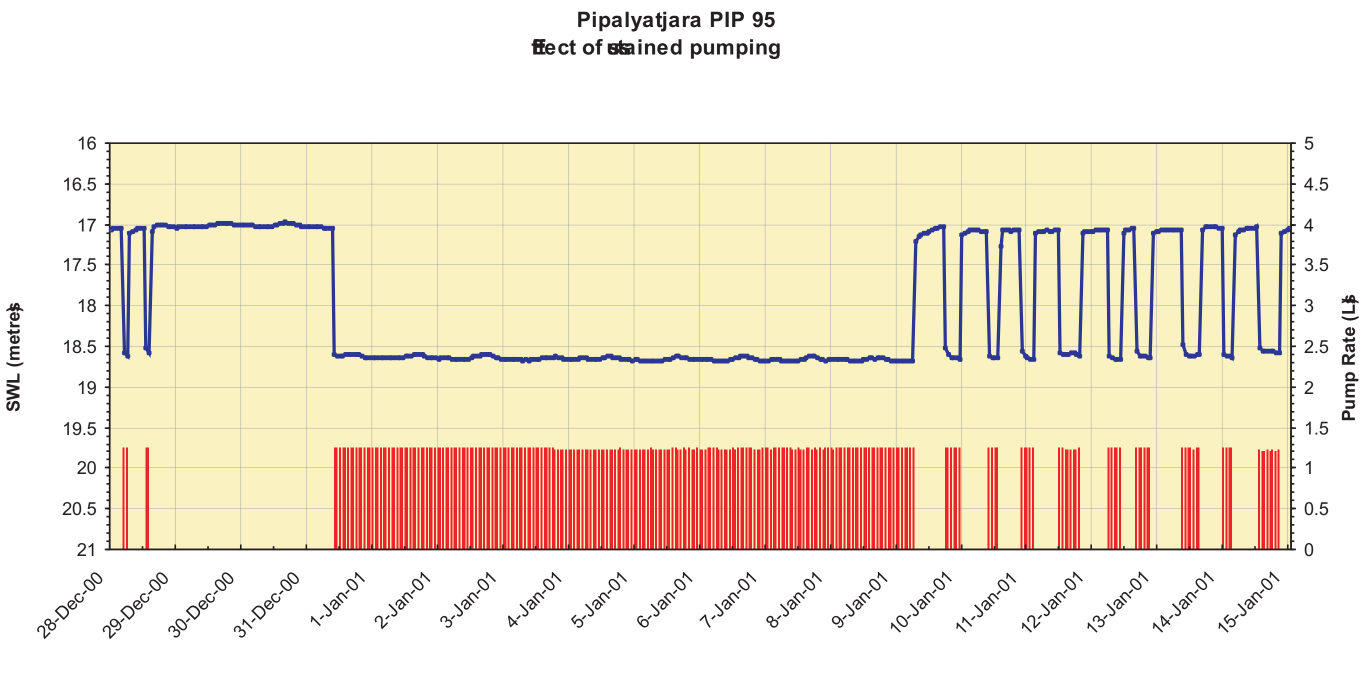


Figure 8.3 Effect of sustained pumping, Pipalyatjara PIP 95

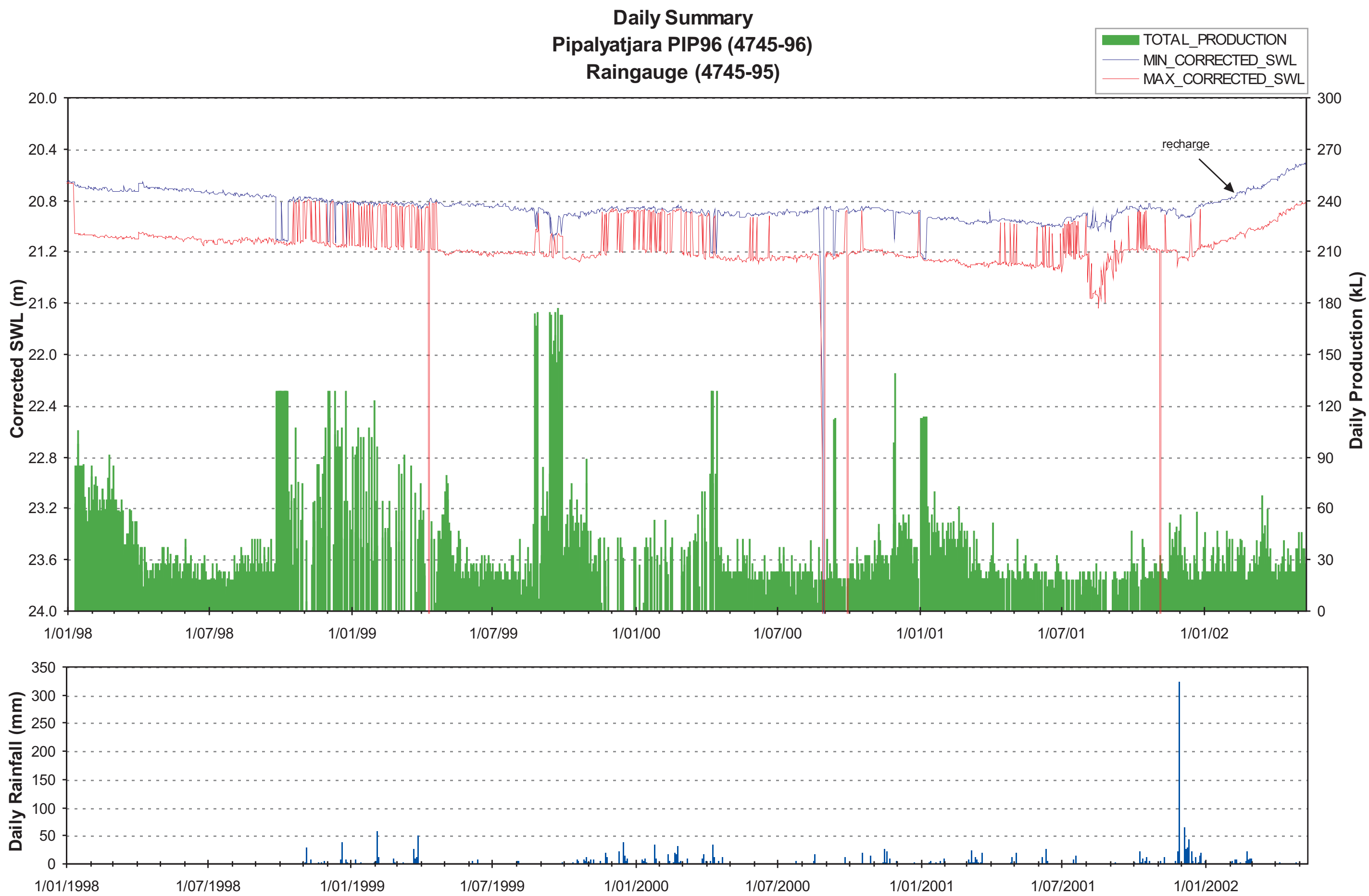


Figure 8.4 Daily Summary, Pipalyatjara PIP 96

The well was pumped at 1.3 L/s continuously for over 8 days in January 2001 (Fig. 8.5). The initial drawdown was less than that for PIP-95 (0.3 m), but otherwise the response was similar. PIP-96 can also be pumped for a matter of weeks at this rate without stress and is more robust than PIP-95.

Recharge

The area received exceptionally heavy rains in late November and December 2001, amounting to 749 mm for the six-month period. Recharge is evident from the rise in SWL in both wells.

Summary

The aquifer appears strong and the water supplies sustainable indefinitely at rates of 1.2 and 1.3 L/s (104 and 112 kL/day). It is evident that recharge takes place and probable that the aquifer is fed by recharge over a considerable area.

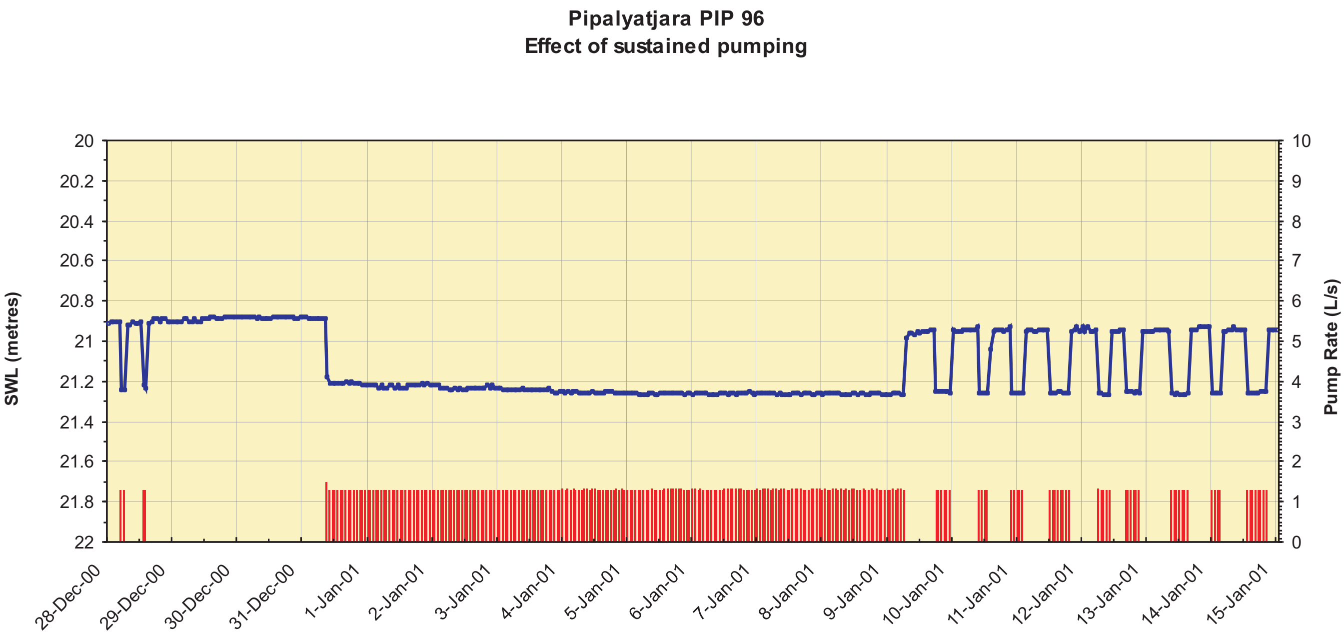


Figure 8.5 Effect of sustained pumping, Pipalyatjara PIP 96

Aboriginal Lands Trust lands

9. NEPABUNNA

Water Production

Water production has been 20% lower in the last two download periods. There have been considerable variations in the daily production and in pump rates, suggesting that maintaining the water supply has been difficult.

Table 9. Water production at Nepabunna, 1998–2002

Well	Unit Number	**Production** (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
N-101	6636-101	–	–	6 126.3	5 937.8	3 558.2	8 527.5	**5 393.4**
N-149	6636-149	–	–	6 846.7	6 682.2	8 447.1	2 103.5	**4 621.5**
Total		**–**	**–**	**12 973.0***	**12 620.0**	**12 005.3**	**10 631.0**	**10 014.9**

* Monitoring equipment was not installed until late November 1999; production figures are for 4 months only.

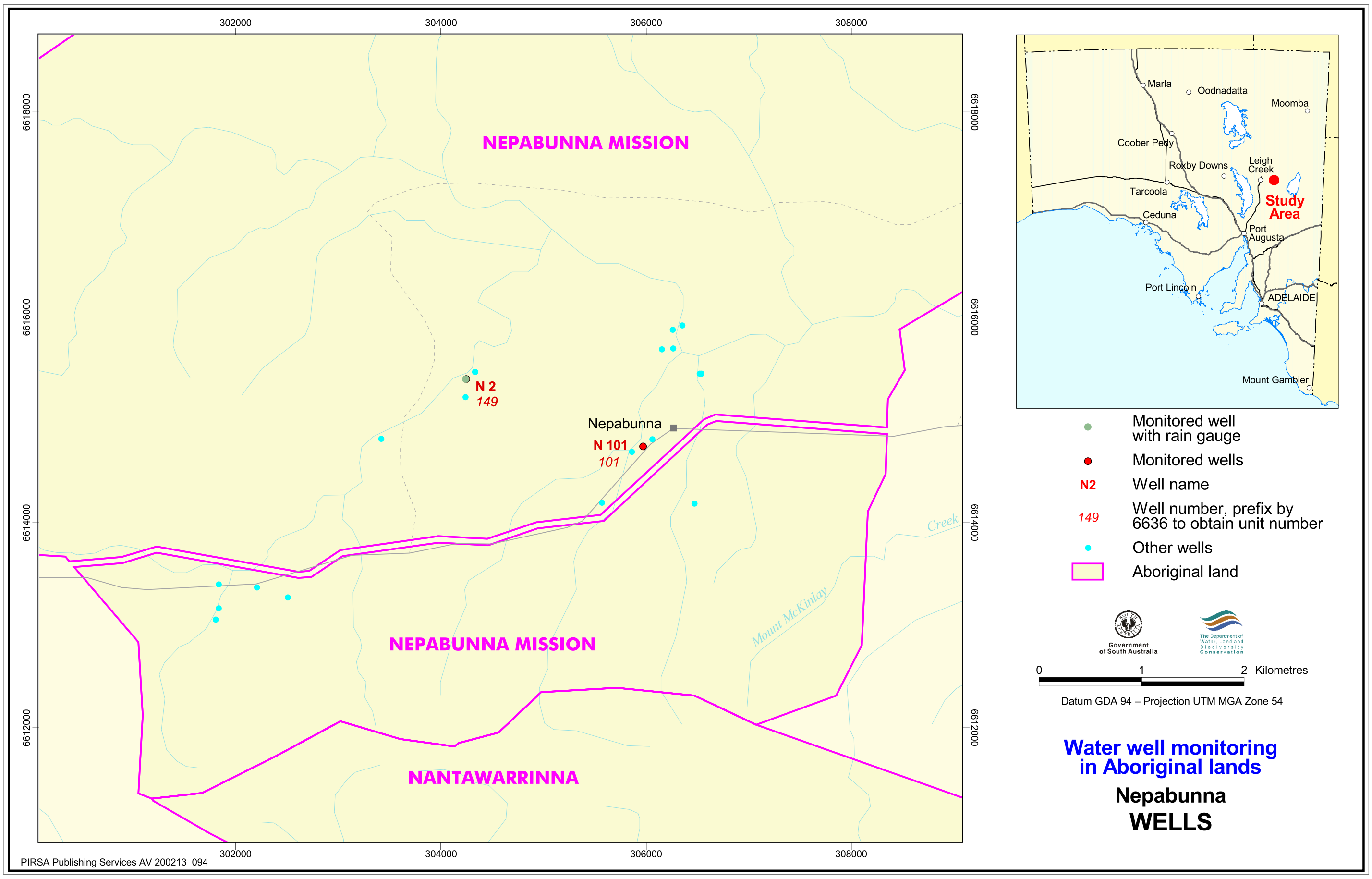
N-101

Basic Data

Year drilled	1980	
Total Depth	64 m	
Geology	0-64 m	Silcrete
Aquifer	57-60 m	Jointed weathered siltstone
Water Cuts	40 m	0.06 L/s
	57 m	0.8 L/s
	58 m	1.7 L/s
Yield	1980	1.2 L/s (Pump Test, with 5 years to forking)
SWL	1980	38.5 m
	2000	41.0 m
	2002	47.3 m
TDS	1986	1 770 mg/L
Casing	0-20.5 m	152 mm

Most of the data before August 2001 is suspect, with changes in SWL unrelated to pumping and sometimes random in trend (Fig. 9.3). However, the envelope of the mimimum SWL correlates reasonably with measured values and the general trend in non-pumping SWL from around 45 m at the start of 2000 to 37 m in April 2001 may be correct.

After August 2001 the data are consistent, but the non-pumping SWL is still impossible to determine because of the very slow recovery rate in this well and the short intervals between pumping. The well has not had sufficient time to fully recover since records have been kept.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Moomba
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Roxby Downs
Leigh Creek
Study Area
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
N2
Well name
149
Well number, prefix by 6636 to obtain unit number
Other wells
Aboriginal land
Government of South Australia
0
1
2
Kilometres
Datum GDA 94 – Projection UTM MGA Zone 54
Water well monitoring in Aboriginal lands
Nepabunna
WELLS
PIRSA Publishing Services AV 200213_094

Figure 9.1

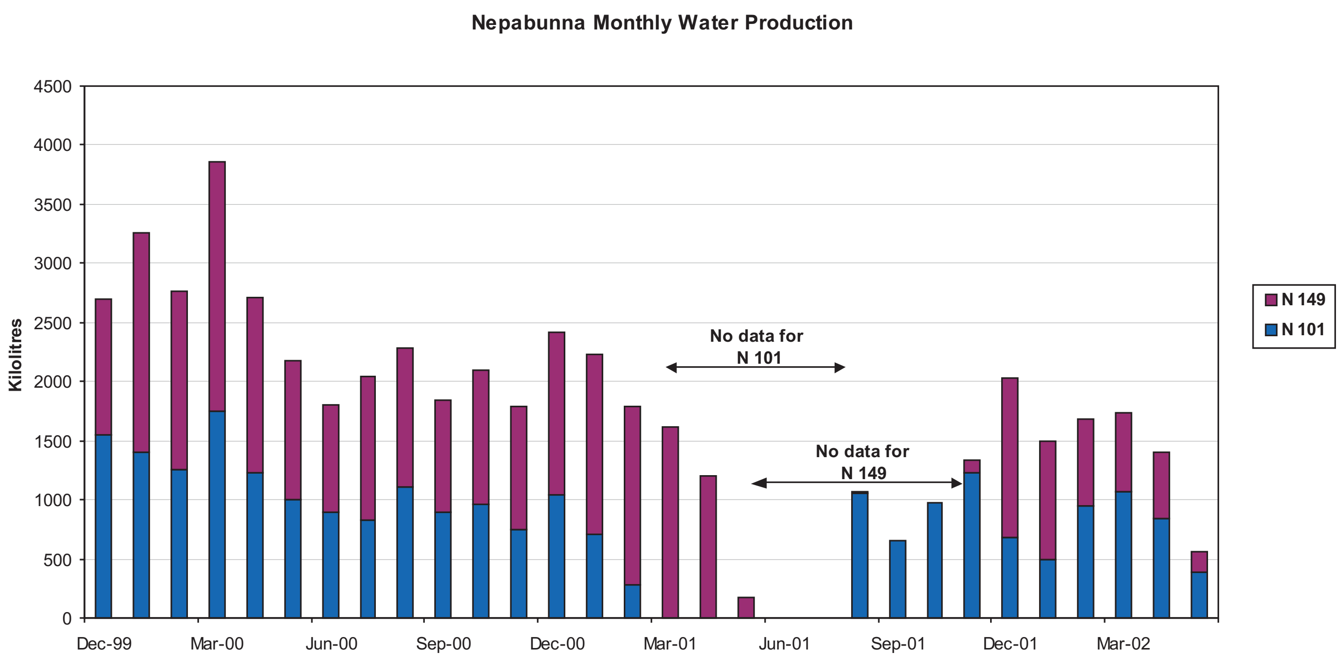


Figure 9.2 Community water production at Nepabunna

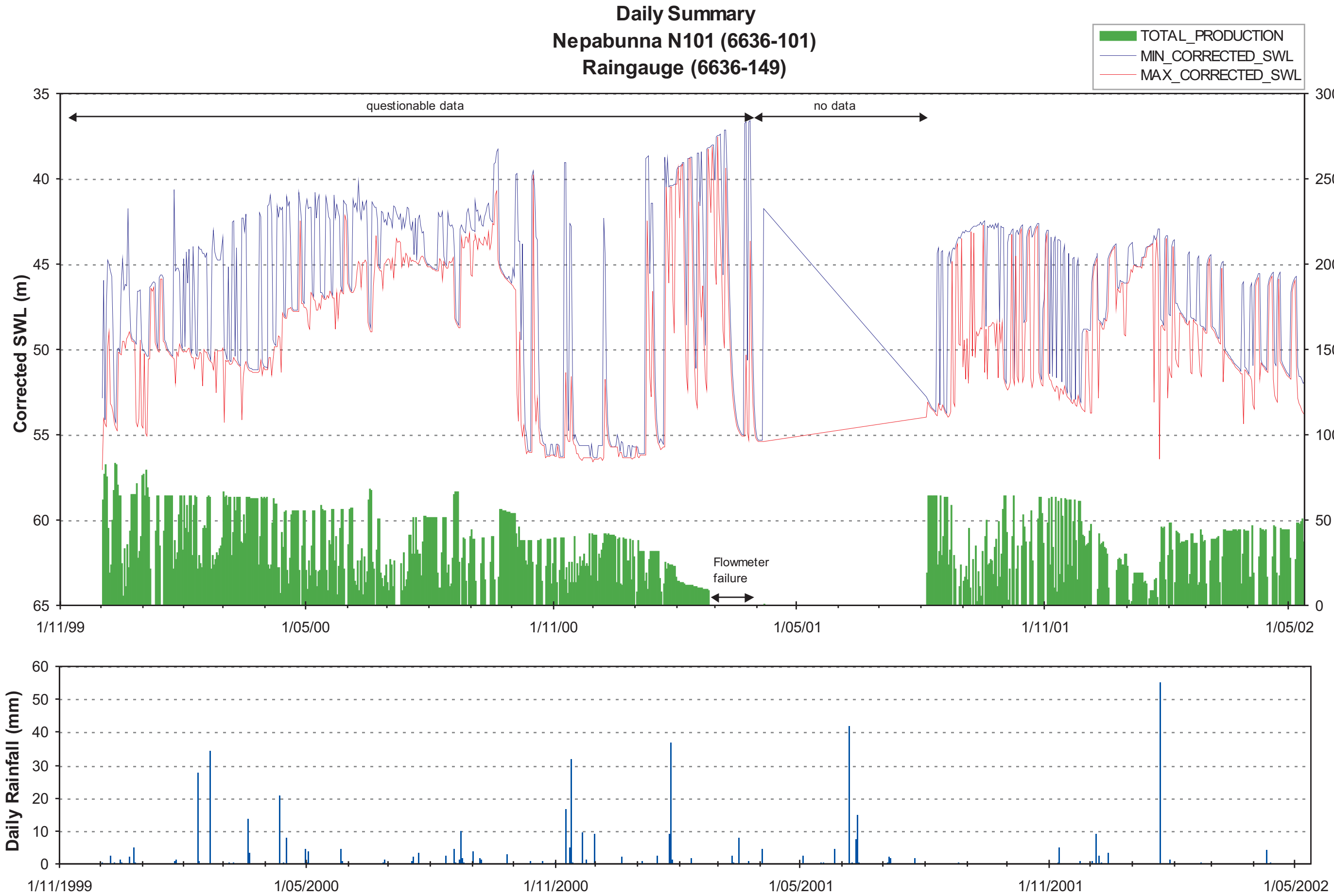


Figure 9.3 Daily Summary, Nepabunna N 101

The plots indicate that current pumping regimes are beyond the sustainability of this well. A pump rate of 0.2 L/s (17 kL/day) could be sustainable indefinitely, but any increase on this rate will require rest periods to allow the SWL to recover. Continuous pumping at 0.5 L/s results in a drop in SWL of ~0.1 m/day which, based on a current pumping SWL (May, 2002) of 52 m, would result in forking within 60 days.

Major problems with interpreting the monitoring results are:

- The well is rarely rested, and then for only a day or two.
- The SWL recovery rate after pumping is slow, but variable – in Dec '01 5 days were not sufficient (Fig. 9.4), while in late Feb '00 the well apparently recovered in a few hours (Fig. 9.5).
- A combination of the above points means that the non-pumping SWL is rarely if ever achieved.
- The pump rate varies from 0.2-1.2 L/s
- Inexplicable apparent 'flowbacks' occurred on 21/12/99 & 24/1/00 (Fig. 9.6).
- The non-pumping SWL appears to range randomly between 37 m and 45 m

Additional monitoring data should clarify the state of this well and aquifer.

N-149

Basic Data

Year drilled	1983	
Total Depth	120 m	
Geology	0-2 m	Soil
	2-120 m	Wilkawillina Limestone
Water Cuts	82 m	4.5 L/s
	100 m	10.5 L/s
	120 m	11 L/s
Yield	1983	12 L/s (not pump tested)
SWL	1983	51 m
	2000	53 m
	2002	53 m
TDS	1983	954 mg/L
	1989	1066 mg/L
Casing	0-120 m	150 mm ID PVC
Production Interval	Slotted 82-120 m.	

The well was pumped almost continuously, but at a declining pump rate (0.6-0.2 L/s), over the past 6 months (Fig. 9.7). So far as can be ascertained the non-pumping SWL was constant at 52.5 m, while the pumping SWL rose from 57 m to 54.6 m with the reducing pump rate.

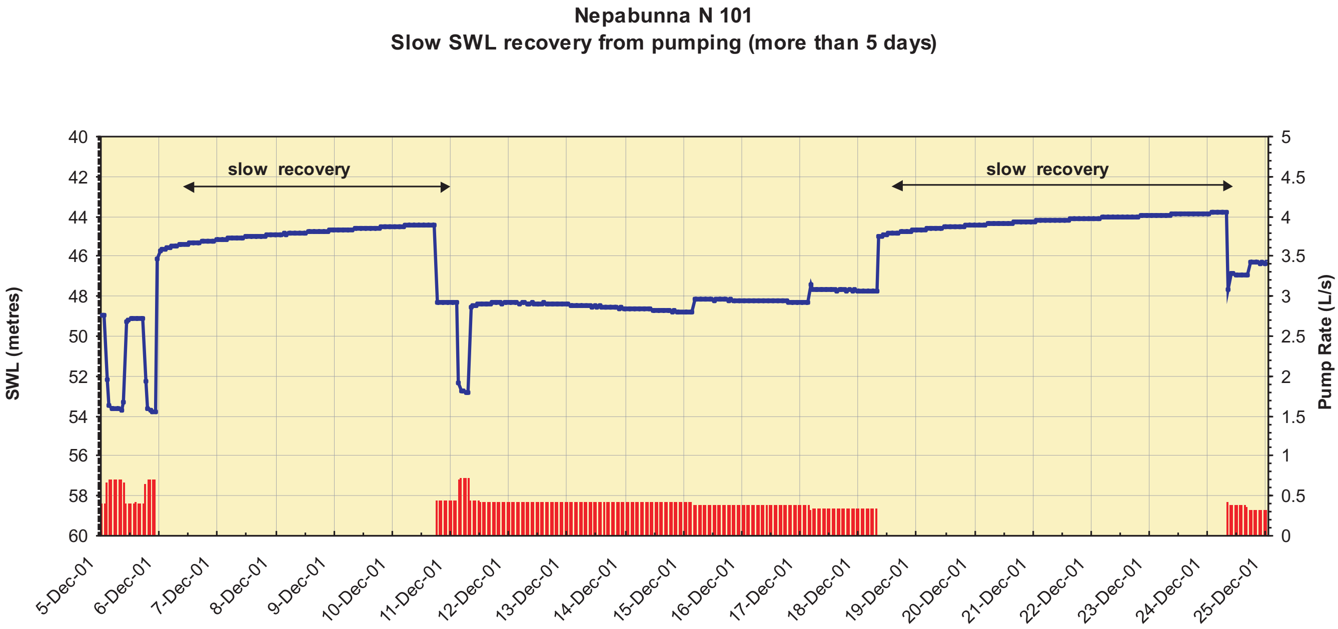


Figure 9.4 Effect of sustained pumping and slow recovery, Nepabunna N 101

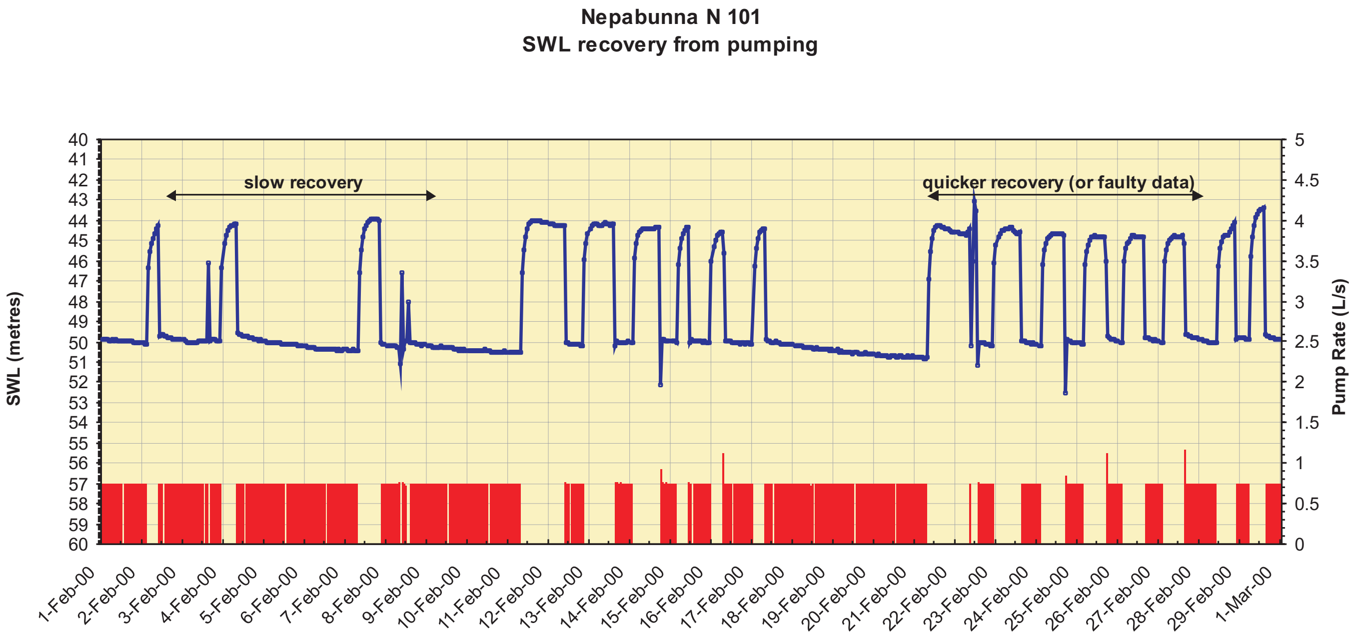


Figure 9.5 Effect of slow and variable recovery, Nepabunna N 101

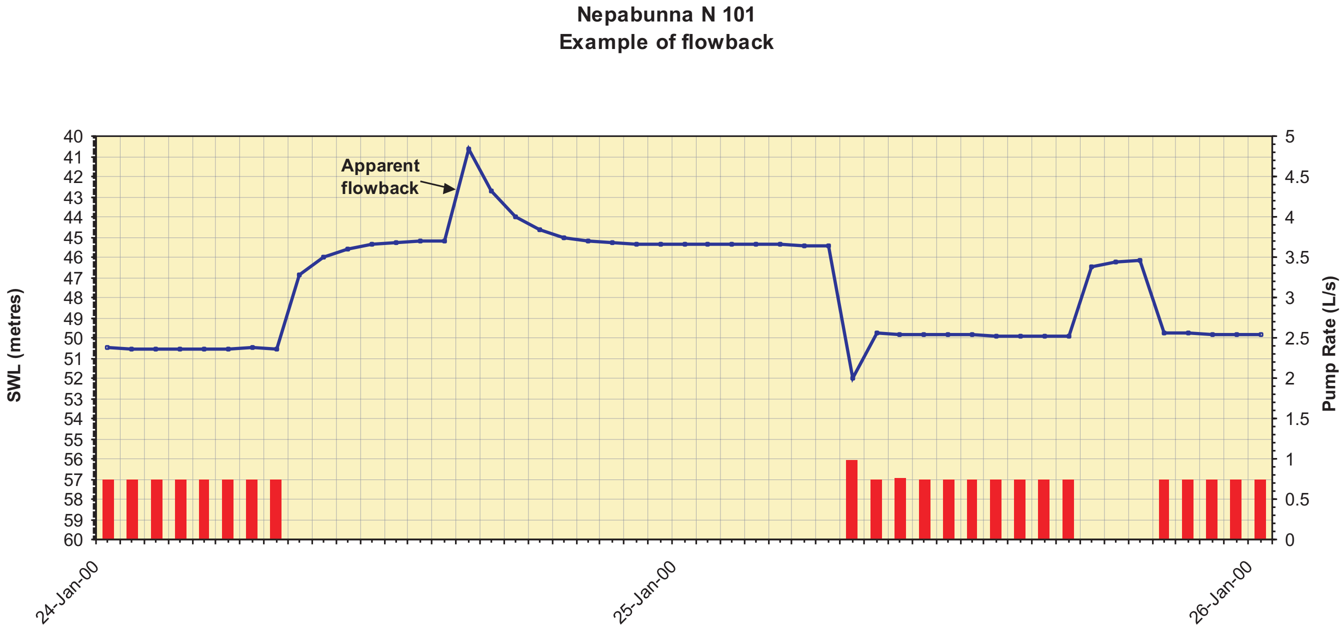


Figure 9.6 Effect of apparent flowback, January 2000, Nepabunna N 101

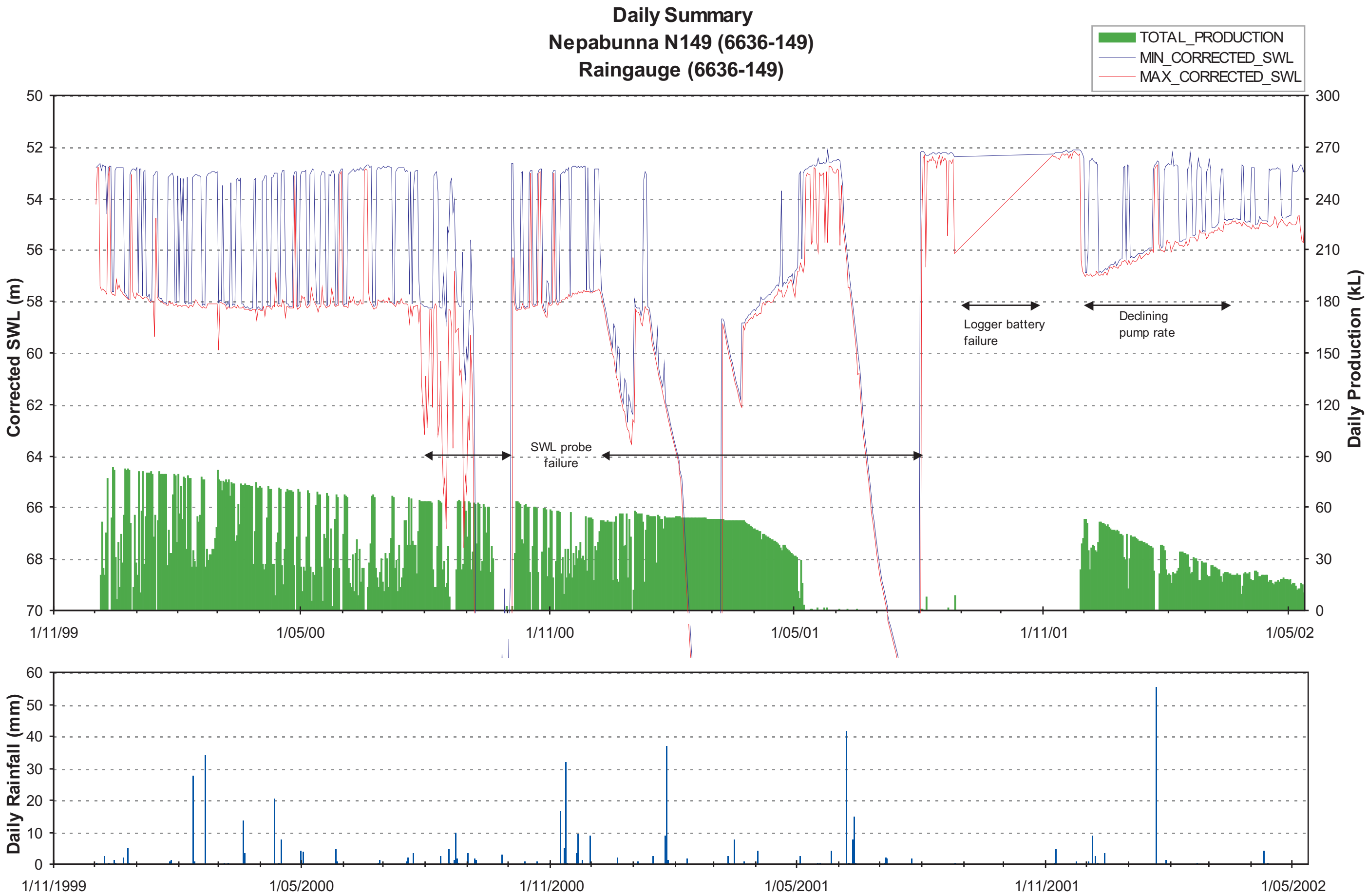


Figure 9.7 Daily Summary, Nepabunna N 149

N-149

Basic Data

Year drilled	1983	
Total Depth	120 m	
Geology	0-2 m	Soil
	2-120 m	Wilkawillina Limestone
Water Cuts	82 m	4.5 L/s
	100 m	10.5 L/s
	120 m	11 L/s
Yield	1983	12 L/s (not pump tested)
SWL	1983	51 m
	2000	53 m
	2002	53 m
TDS	1983	954 mg/L
	1989	1066 mg/L
Casing	0-120 m	150 mm ID PVC
Production Interval	Slotted 82-120 m.	

The well was pumped almost continuously, but at a declining pump rate (0.6-0.2 L/s), over the past 6 months (Fig. 9.7). So far as can be ascertained the non-pumping SWL was constant at 52.5 m, while the pumping SWL rose from 57 m to 54.6 m with the reducing pump rate.

Between August 2000 and November 2001 there was a lot of equipment failure, so informative data is rather sparse. However, overall the earlier data indicates a similar picture, with a pump rate varying from 0.9 to 0.2 L/s and the non-pumping SWL remaining between 52 and 53 metres. There is some uncertainty about the non-pumping SWL because this well is slow to recover the final metre or so (a week or more) and the well is never rested this long (Fig. 9.8).

Thus the SWL has remained virtually constant since the well was drilled and there is no sign of any stress to the aquifer. Most of the water comes from below 80 metres, so the pumping SWL, which never drops below 60 metres, is 20 metres above the possible danger levels. The reason for the varying pump rate is not known, since on the evidence available a pump rate of 0.6 L/s should be sustainable.

Recharge

Although the 55 mm of rainfall recorded at N-149 in January in two hours would be expected to result in recharge, there is no evidence of this in the water levels. Nor is there any evidence of recharge at any time since December 1999.

For well N-101 the questionable data prior to late 2001 and the very slow recovery rate could conceal more subtle recharge indications. It should also be noted that rainfall measurements are made at well N-149, two kilometres away from well N-101, and may not apply to the immediate area of the latter.

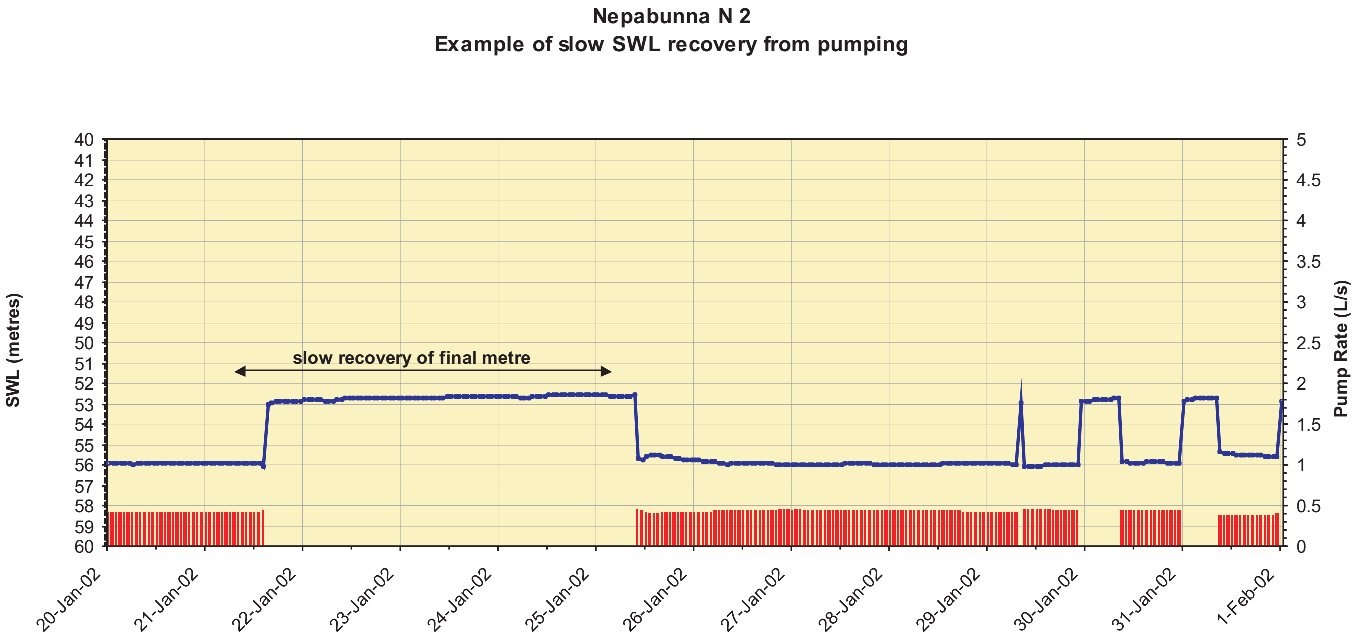


Figure 9.8 Effect of slow recovery, Nepabunna N 2

Conclusions

Well N-101 is limited in its output to about 500 kL/month, even in the short to medium term, although it could, in an emergency, produce more that 17 kL/day for a few days. Well N-149 can produce more, but the constantly changing pump rate makes assessment difficult. Probably 0.4-0.6 L/s (1 000 to 1 500 kL/month) is sustainable in the long term and twice this level for a few weeks. This total production level from both wells of 1 500 to 2 000 kL/month is in line with water production over the past two years. The reasons for N-149 being pumped so variably should be ascertained, if possible.

The rainfall event in January (55 mm in two hours) did not have any immediate effect on the SWL in either well. A longer-term slower recharge may have occurred, but would be hidden by the continuous pumping.

It might be worth considering drilling wells to be used solely for monitoring these aquifers. This would not be easy as the aquifers are not defined, but would enable a more detailed analysis of potential water supplies, as well as providing information for further evaluation of the Aquifer Storage and Recovery scheme that was under consideration recently.

10. YALATA

Water Production

Water production is much the same as for the previous summer, but lower than last winter. As usual, YT-3 provides over 90% of the water. Water production is greater in winter than in summer, which is unusual (Fig. 10.2).

Table 10. Water production at Yalata, 1998–2001

Well	Unit Number	Production (kL)						
		Oct. 1998 – Apr. 1999	*Apr.–Oct. 1999*	*Oct. 1999 – Apr. 2000*	*Apr.–Oct. 2000*	*Oct. 2000 – Apr. 2001*	*Apr.-Nov. 2001*	*Nov. 2001 – Apr. 2002*
YT-2	5235-15	–	–	1 268.9	1 901.0	**4 584.3**	2 484.5	****1 164.0**
YT-3	5235-18	–	–	16 041.0	27 026.0	**23 985.0**	36 465.0	**28 992.0**
Total		**–**	**–**	**17 309.9***	**28 927.0**	**28 569.3**	**38 949.5**	**30 156.0**

* Monitoring equipment was not installed until late November 1999; production figures are for 4 months only.

** Accumulated flow was not recorded. Production figure is derived from the hourly pump rate.

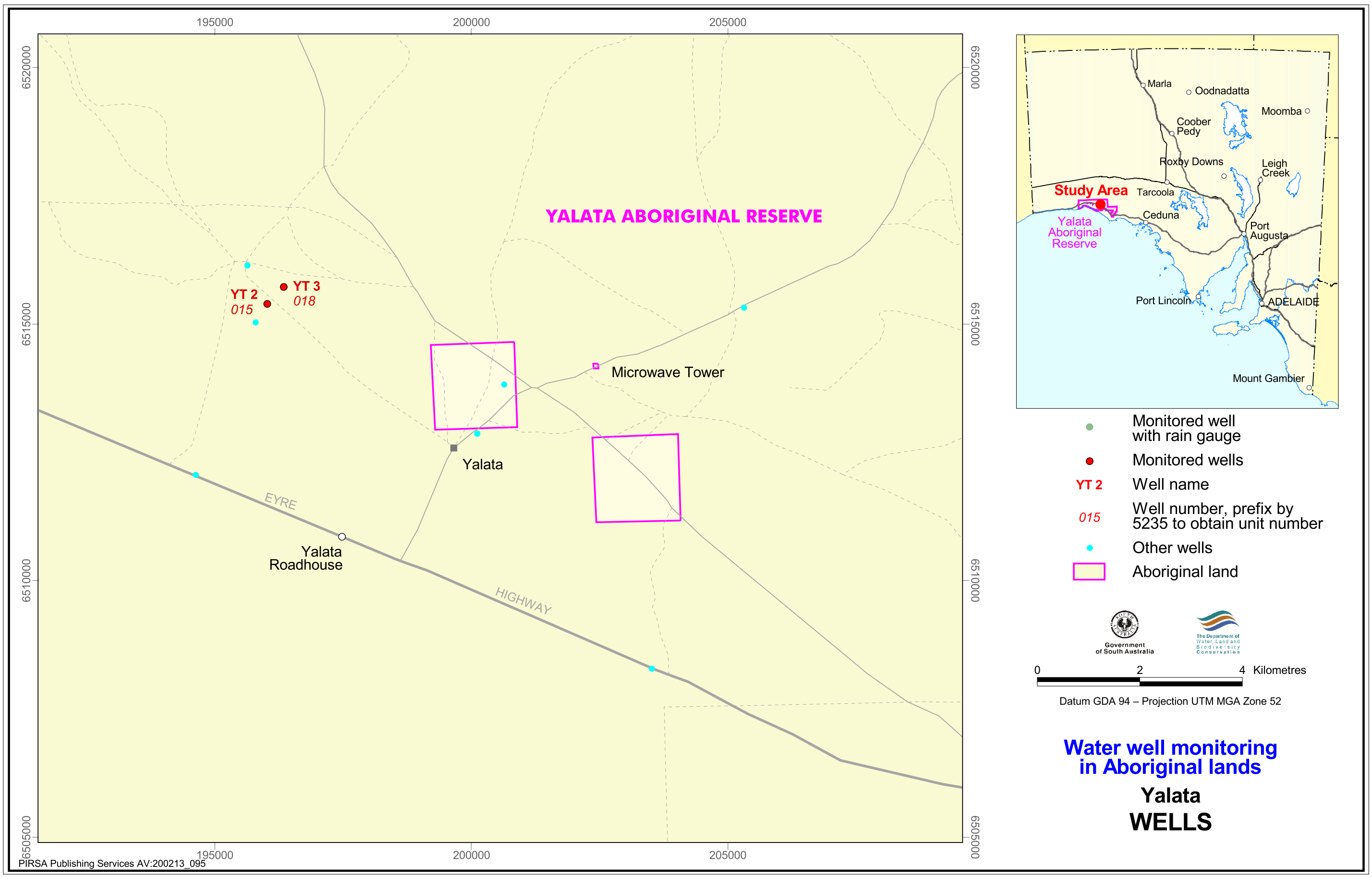
Wells

YT-2

Basic Data

Year drilled	1982	
Total Depth	72 m	
Geology	0-6 m	Calcrete
	6-38 m	Nullarbor Limestone
	38-63 m	Wilson’s Bluff Limestone
	63-eoh	Pidinga Formation – quartz sand
Water Cuts	64.5 m	Quartz Sand
Yield	1982	4.2 L/s
SWL	1982	58.5 m
	2000	60.0 m
	2002	60.4 m
TDS	1982	9 500 mg/L
Casing	0-69 m	150 mm ID PVC
Production Interval	Stainless Steel Screen 69-72 m.	

The well has only been pumped intermittently in the last period, for a total production of 1164 kL. Even so, the non-pumping SWL has continued to decline and has now dropped by about 0.4 m over the past two years (Fig. 10.3). It is not a result of pumping this well. This probably indicates that the water level in the aquifer generally has dropped by this amount (natural drainage), but could result from pumping of YT-3, 500 m away. When possible water levels in other wells in the area, such as Tallowan-1 (5235-5), should be checked to confirm the cause. Overall, since 1982, the SWL has declined 1.9 m, or an average of 0.1 m/year.



195000
200000
205000
6520000
6515000
6510000
6505000
YALATA ABORIGINAL RESERVE
YT 3
018
YT 2
015
Microwave Tower
Yalata
EYRE
HIGHWAY
Yalata Roadhouse
Marla
Oodnadatta
Moomba
Coober Pedy
Roxby Downs
Leigh Creek
Study Area
Tarcoola
Yalata Aboriginal Reserve
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
YT 2 Well name
015 Well number, prefix by 5235 to obtain unit number
Other wells
Aboriginal land
Government of South Australia
0 2 4 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 52
Water well monitoring in Aboriginal lands
Yalata
WELLS
PIRSA Publishing Services AV:200213_095

Figure 10.1

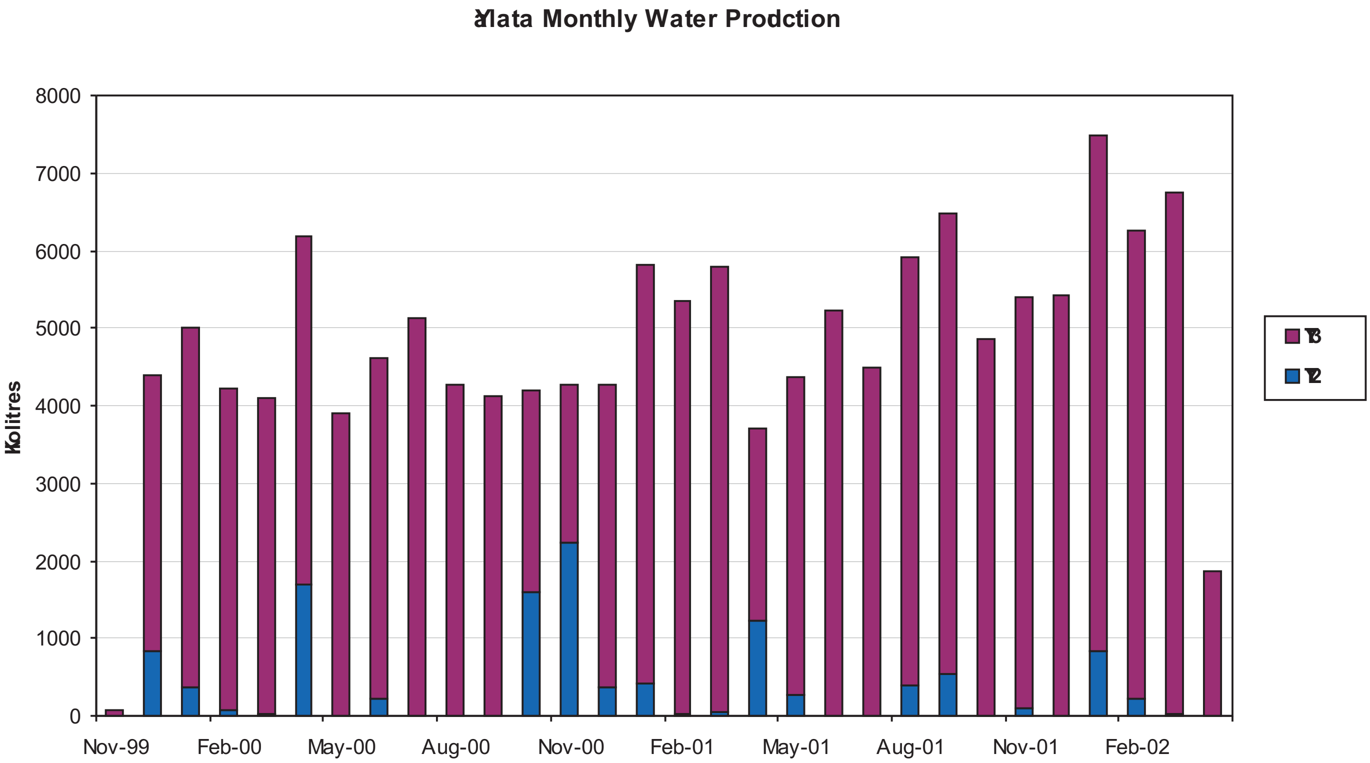


Figure 02 Community water production at Yalata

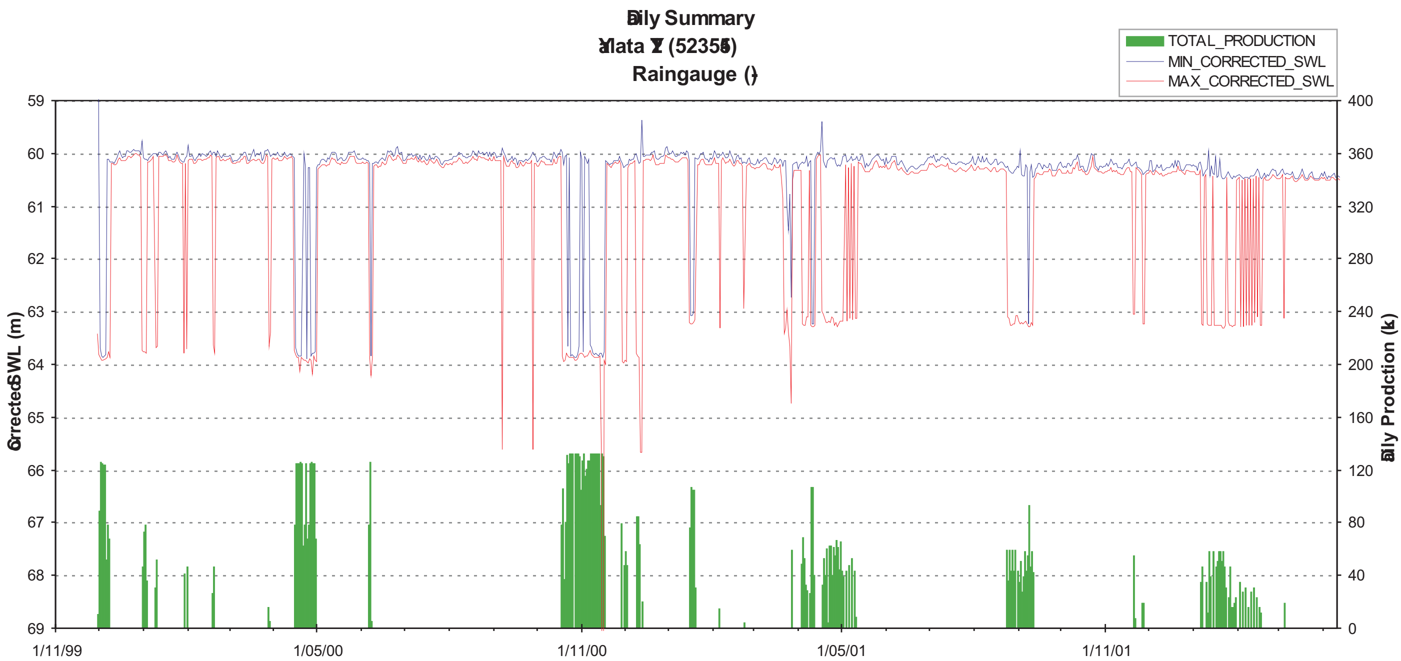


Figure 08 Daily Summary, Yalata YT 2

The non-pumping SWL in August 2002 was 60.44 metres, well above the water cut at 64.5 metres. However, the drawdown for the pumping rate of 1.2 L/s dropped the water level to 63.2 metres, or within 1.3 metres of the water cut. Thus the water cut will be reached in about 13 years, after which the rate of decline could well be much faster. Reducing the pumping rate will not reduce the rate of decline in SWL, but will reduce the drawdown. Thus the life of the well could be increased if the pumping rate is decreased when the pumping water level gets close to 64.5 metres. The hours of pumping could be increased to offset this drop in production.

YT-3

Basic data

Year drilled	1988	
Total Depth	74 m	
Geology	0-4 m	Calcrete
	4-28 m	Nullarbor Limestone
	28-58 m	Wilson’s Bluff Limestone
	58-eoh	Pidinga Formation – quartz sand
Water Cuts	63 m	
Yield	1988	3.5 L/sec
SWL	1988	59.5 m
TDS	1988	9660 mg/L
Casing	0-69 m	152 mm ID FRP
Production Interval	Stainless steel screen 69-72 m	

The well has been pumped almost continuously over the period, particularly during January-April 2002 when records indicate that it was being pumped 24 hours a day and 7 days a week at 2.6 L/s (Fig. 10.4). Unfortunately SWL measurements for February and March 2002 are questionable (is it possible that dewatering occurred during this period – the water level is below the recorded top of the water cut. During such an extensive period of pumping de-watering could have occurred), but in the two and a half years up to May 2002 there are indications that the SWL has dropped by perhaps 0.5 m. The drop since the well was drilled in 1988 is less than 1 metre.

The main problem here is the pumping water level, which is dependent on the pump rate. Before 2001 the pump rate was less than 2 L/s, which took the pumping water level down to about 63 metres, or close to the water cut. During 2001-2 the pump rate was increased to 2.4-2.7 L/s, increasing the drawdown to 64.7 metres. This is below the recorded top of the water cut, and could result in faster or more erratic declines in water level. To increase the sustainability of the well it would be better to decrease the pump rate back to 2 L/s and to increase the pumping hours.

Summary

Both wells seem unstressed at current pumping levels. The decline in water level, recorded at both bores, is most likely due to regional of the aquifer water table rather than

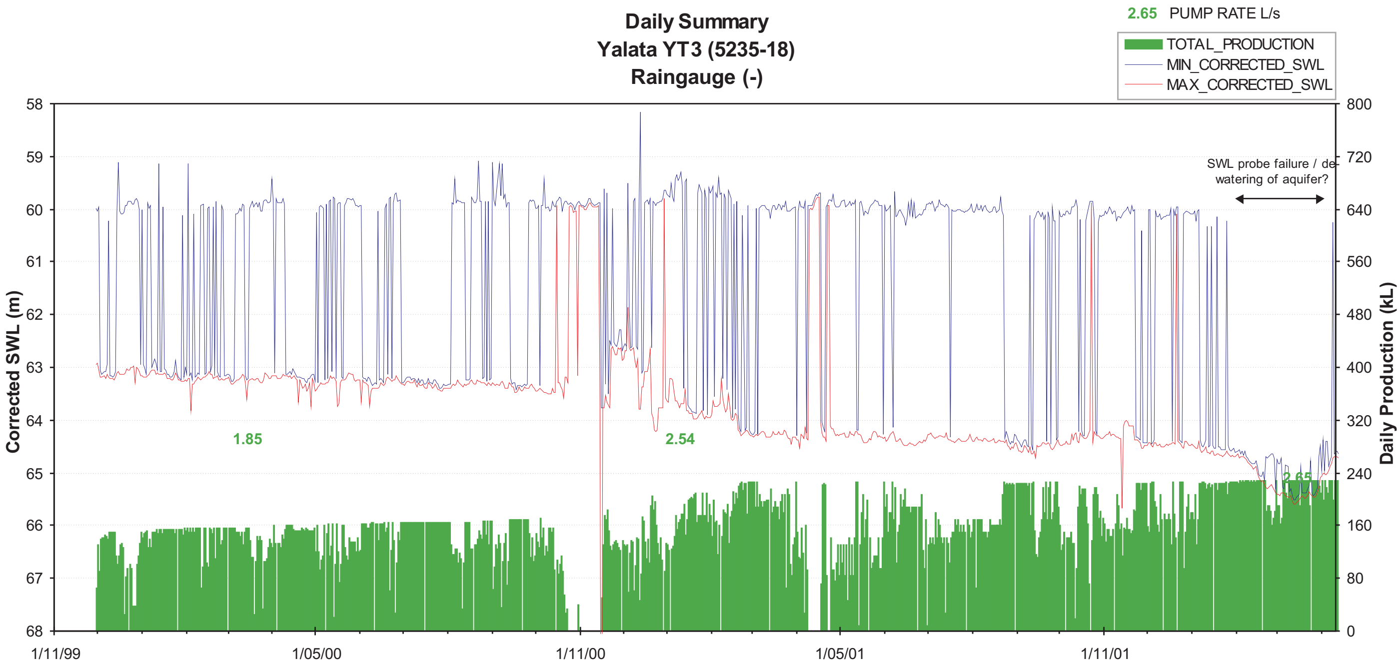


Figure 10.4 Daily Summary, Yalata YT 3

due to the influence of pumping. This could perhaps be clarified by testing other wells in the area such as Tallowan-1. An up-to-date download of the loggers in August 2002 shows the same pattern, but no indication of problems with water supply. Spreading the pumping load more evenly between YT-2 and YT-3 should alleviate the stress on the aquifer, and this change is recommended. Reducing the pump rate of YT-3 to 2 L/s or less would also decrease the likelihood of problems with this well. If the reduction of pump rates for both wells results in insufficient water supply for the community, even when pumping 24 hours a day, then the choice would seem to lie between improved water management and drilling additional wells to spread the production load.

We do not have any rainfall data for the Yalata area, so an assessment of recharge is not possible. All that can be said is that there are no indications of recharge in the SWL data and that there are indications of an overall decline in SWL as a result of natural drainage. Only recharge can reverse this decline in SWL, and without such recharge the life of these wells, and of any other shallow wells that are drilled in the general area, is limited. It seems probable, at present, that the wells can produce 3 L/s between them, pumping 24 hours per day, for a maximum yield of 260 kL/day. When the pumping SWL gets close to the water cut, in perhaps 10 years, these pumping rates will have to be decreased. Continued monitoring is required to refine these estimates.

11. OAK VALLEY

Monitoring equipment was installed in November 2001. The hourly pump rate figures are not accurate because of difficulty with measuring such low flow rates, and should mainly be used in a qualitative sense, to show whether the pump was working. Based on the accumulated flow figures total production averaged 8.56 kL/day, with average production rates for individual wells ranging from 1.17 kL/day (OV-10) to 2.12 kL/day (OV-8).

Total monthly production for Oak Valley ranged from a minimum of 41 kL in Nov 2001 to a maximum of 112 kL in March 2002 (Fig. 11.2).

Rainfall figures show little precipitation, the maximum daily figure being less than 16 mm over 2 hours – not enough to generate recharge.

These wells are solar-powered, so only operate on sunny days. The pumps operate automatically when power is availableand have cutout switches which activate when the supply tank is full or when the water level in the well drops below a critical level. If a well stops pumping during daylight hours there is no way of telling which of the three limits caused it.

All three monitored wells pumped for 10-12 hours on most days. The night-time non-pumping period of 12-14 hours was sufficient to allow the SWL to recover to close to its full level, with OV-9 recovering most quickly and OV-7 showing the slowest recovery rate. In all three wells there is little difference between SWL levels in November and those in April, indicating that the wells are coping satisfactorily, and that the pumping routine should be sustainable.

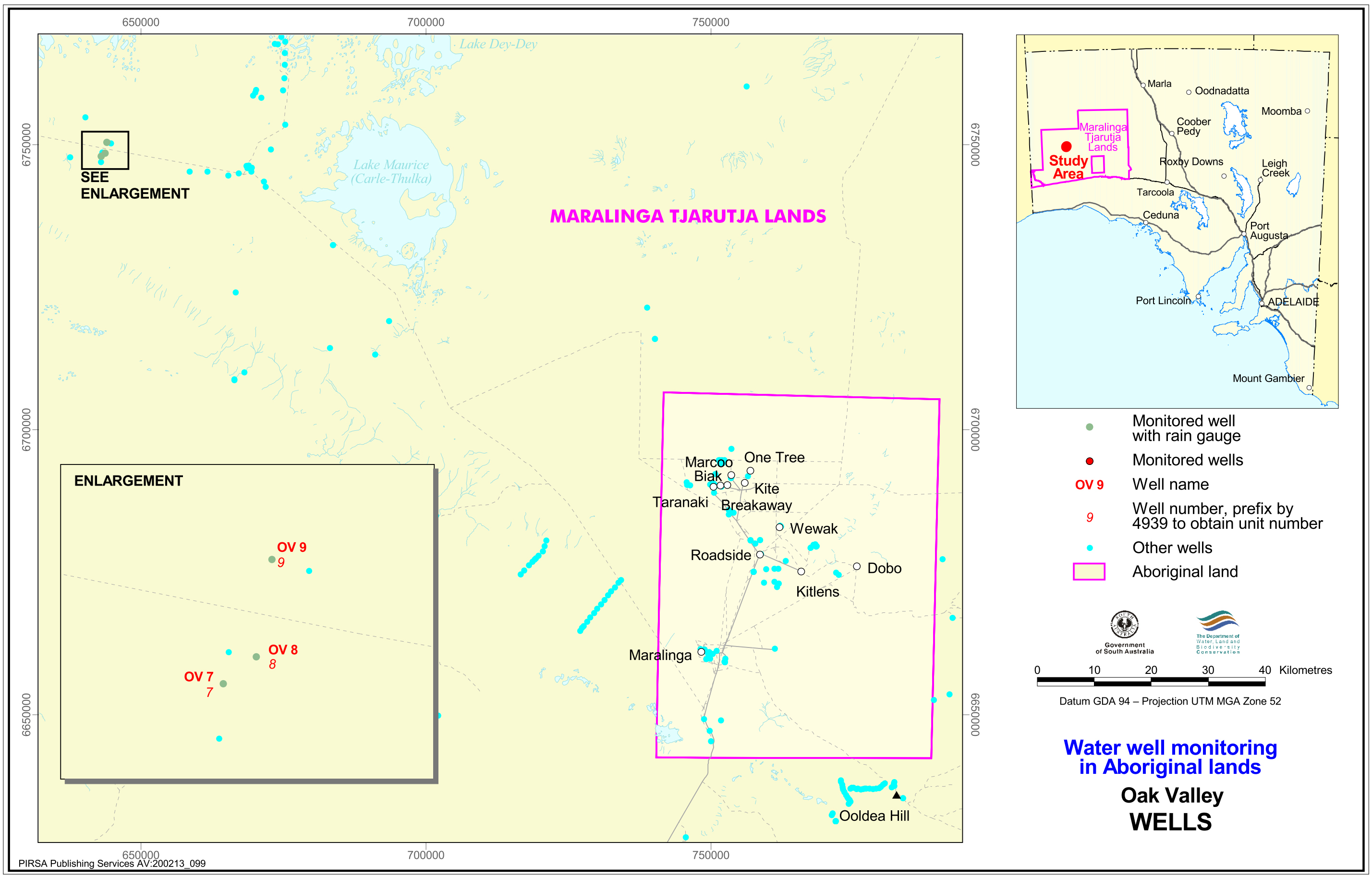
OV-7

Basic Data

Year drilled	1986	
Total Depth	33 m	
Geology	0-9 m	Calcrete
	9-33 m	Sandstone
Water Cuts	27-33 m	0.02 L/s
Yield	1987	0.05 L/s
SWL	1986	21 m
	2002	18.8 m
TDS	1987	735 mg/L
	1997	617 mg/L
Casing	0-33 m	150 mm ID PVC
Production Interval	Slotted ?	

Average water production was 1.54 kL/day. The non-pumping SWL was constant at ~19 m, with a 10 m drawdown occurring whilst pumping (Fig. 11.3).

A detailed study of the SWL variations during pumping (Fig. 11.4) shows that the measured SWL drops steadily for 4 hours after pumping commences, but is then constant at 29.4 m for 8-10 hours while pumping continues. This seems unlikely, and it is more



650000
700000
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6650000
Lake Dey-Dey
Lake Maurice (Carle-Thulka)
SEE ENLARGEMENT
MARALINGA TJARUTJA LANDS
ENLARGEMENT
OV 9
9
OV 8
8
OV 7
7
Marcoo
One Tree
Biak
Kite
Taranaki
Breakaway
Wewak
Roadside
Dobo
Kitlens
Maralinga
Ooldea Hill
Marla
Oodnadatta
Moomba
Coober Pedy
Maralinga Tjarutja Lands
Study Area
Roxby Downs
Leigh Creek
Tarcoola
Ceduna
Port Augusta
Port Lincoln
ADELAIDE
Mount Gambier
Monitored well with rain gauge
Monitored wells
OV 9 Well name
9 Well number, prefix by 4939 to obtain unit number
Other wells
Aboriginal land
Government of South Australia
The Department of Water, Land and Biodiversity Conservation
0 10 20 30 40 Kilometres
Datum GDA 94 – Projection UTM MGA Zone 52
Water well monitoring in Aboriginal lands
Oak Valley
WELLS
PIRSA Publishing Services AV:200213_099

Figure 11.1

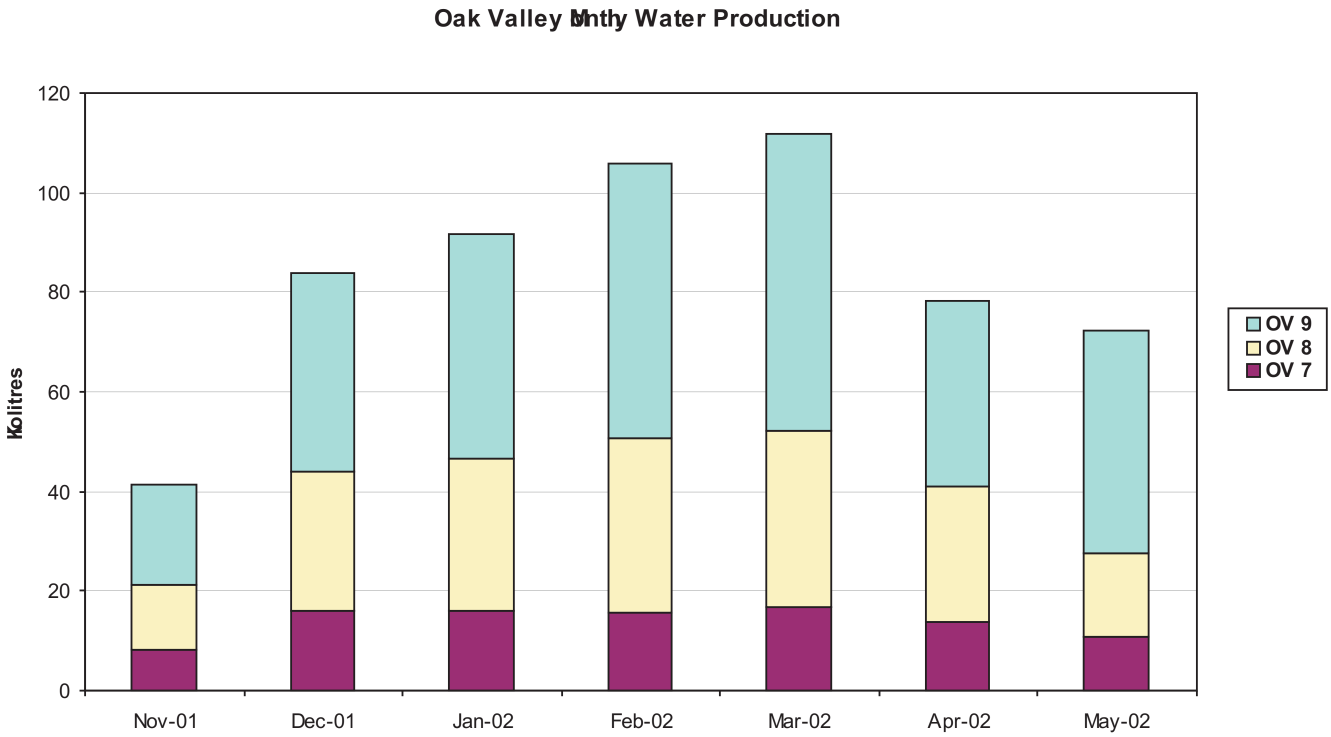

Figure 11.2 Community water production at Oak Valley

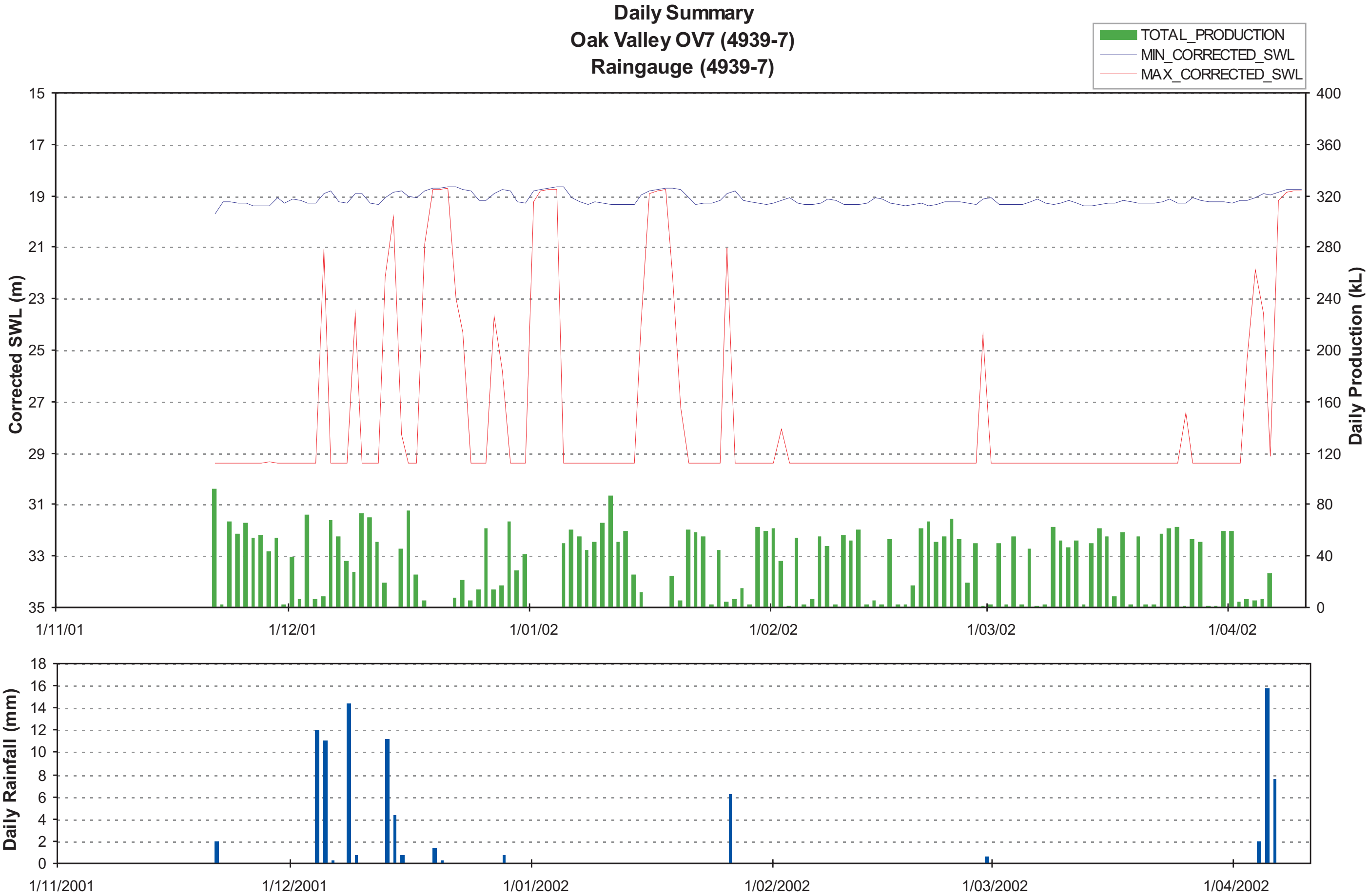

Figure 11.3 Daily Summary, Oak Valley OV 7

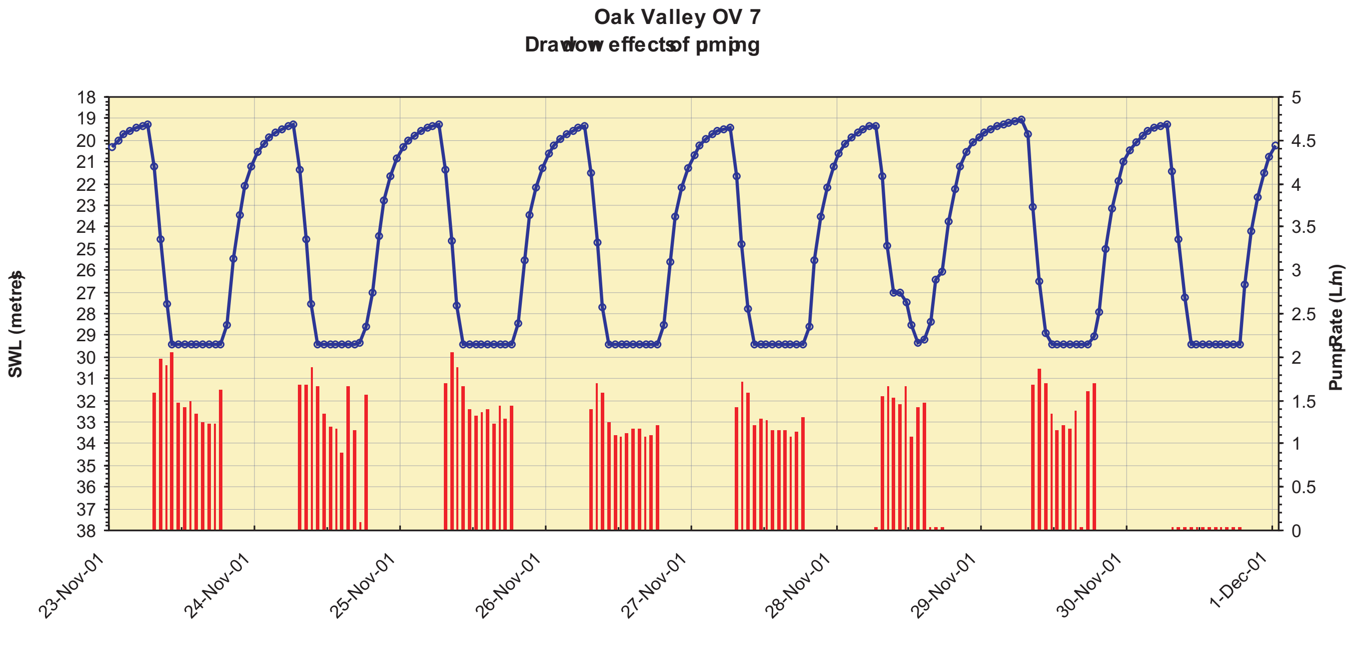

Figure 11.4 Detailed daily SWL variation, Oak Valley OV 7

probable that the sensor is located at this depth. The true SWL would drop lower. As this information is important to evaluating well performance efforts will be made to lower the sensor.

It is also significant that the SWL takes more than 12 hours to return to its non-pumping level after pumping ceases. This accounts for the ripple on the minimum SWL curve in Figure 11.3, since this level depends on how long the pump was switched off (hours without sunlight). The non-pumping SWL appears to be about 18.5 m.

OV-8

Basic Data

Year drilled	1987	
Total Depth	31 m	
Geology	0-2 m	Sand
	2-31 m	Sandstone/Siltstone
Water Cuts	21 m	0.07 L/s
	24 m	0.13 L/s
	30 m	0.2 L/s
Yield	1987	0.05 L/s
SWL	1987	19 m
2002	14.4 m	
TDS	1987	833 mg/L
	1997	717 mg/L
Casing	0-28 m	150 mm ID PVC
Cemented	28-31 m	
Production Interval	19-28 m	Slotted

The pumped aquifer at 21-24 m has a water quality of 800 mg/L TDS. A second aquifer was encountered at 31 m but was more saline (2500 mg/L) and was plugged off. As we have no knowledge of the efficiency of the aquitard between these aquifers it is wise to assume that there is a potential of upwards leakage of more saline water into the good aquifer if the well is stressed. It is recommended that the quality of the water produced by this well be checked regularly – at least every download and preferably monthly.

The well produces its quota of 2.12 kL/day. The non-pumping SWL was constant at ~14.5 m, with pumping causing a drawdown of about 6 m (Fig. 11.5). The shape of the drawdown curve (Fig. 11.6) indicates that the measured pumping SWL is correct and is 0.5 m above the water cut.

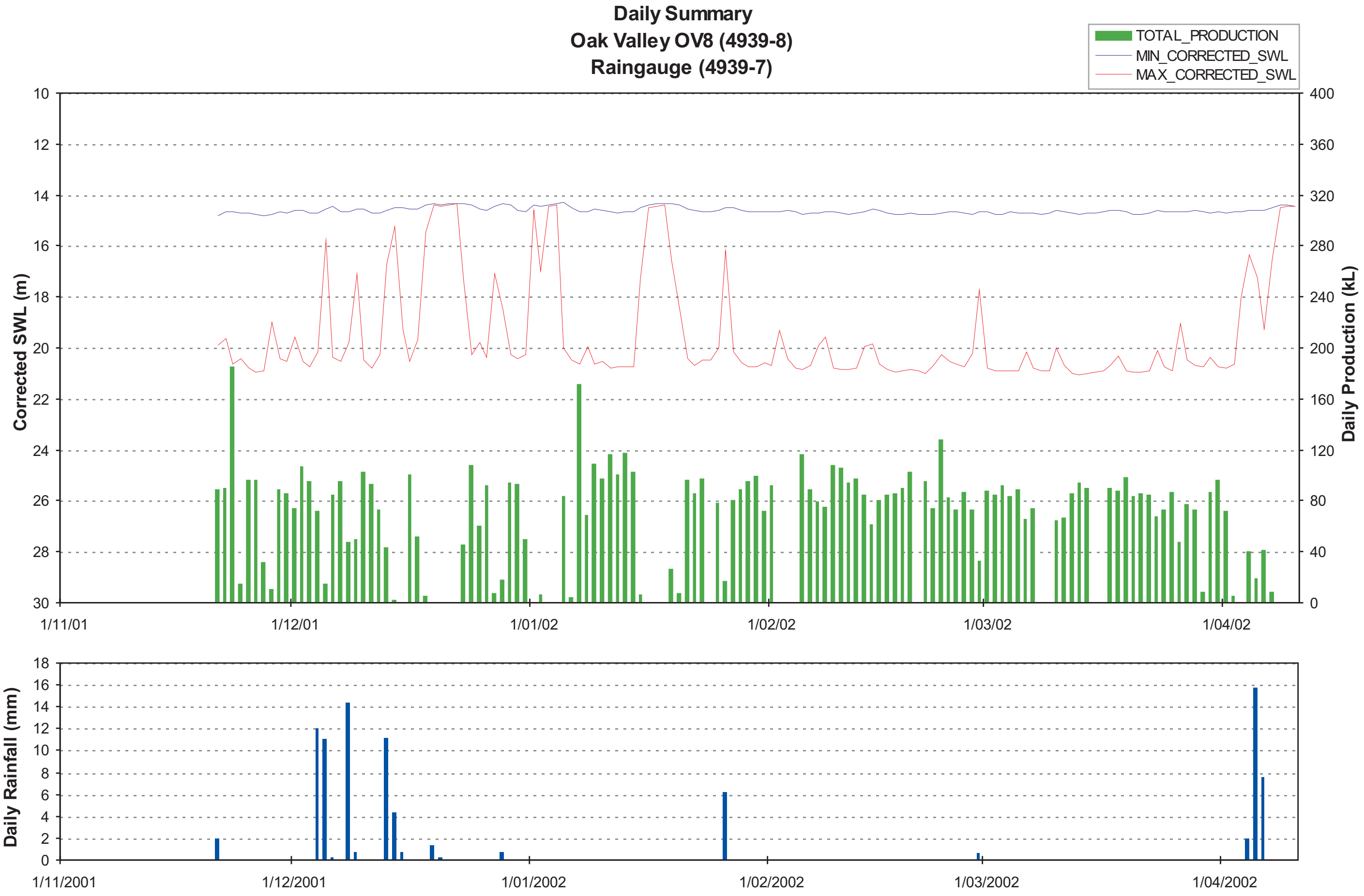

Figure 11.5 Daily Summary, Oak Valley OV 8

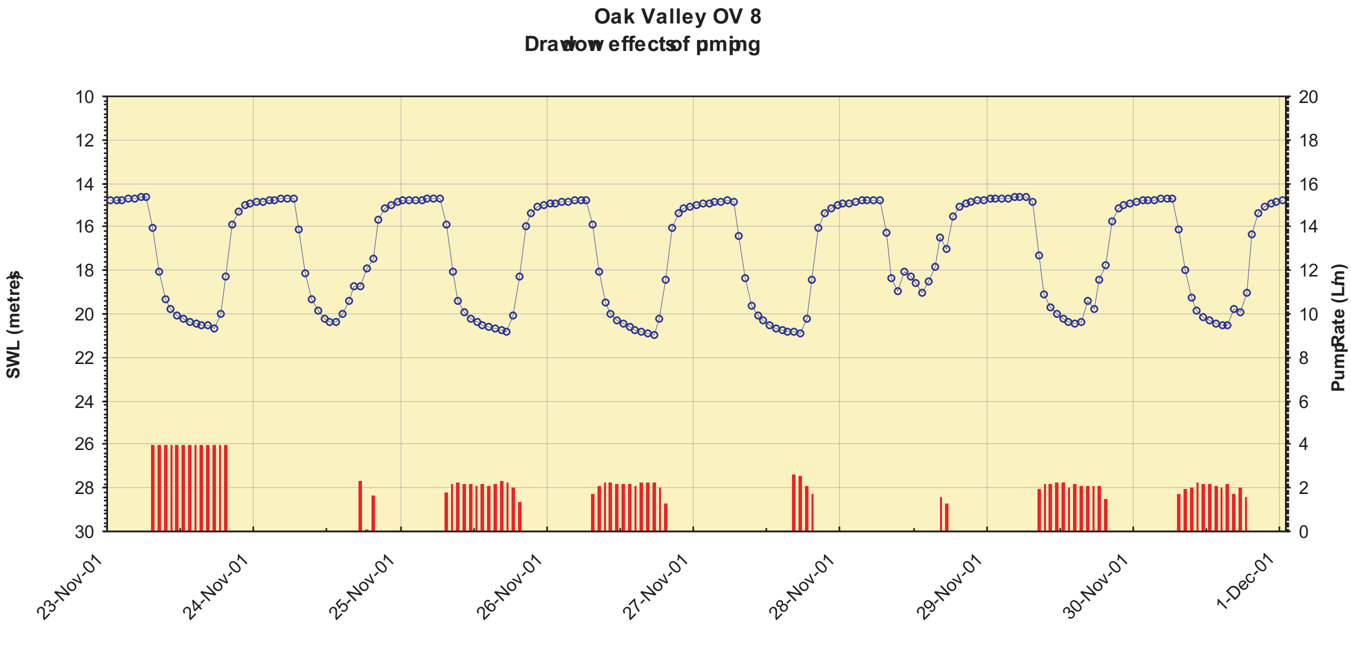

Figure 11.6 Detailed daily SWL variation, Oak Valley OV 8

OV-9

Basic Data

Year drilled	1987	
Total Depth	32 m	
Geology	0-2 m	Sand
	2-20 m	Sandstone
	20-28 m	Siltstone
	28-32 m	Sandstone
Water Cuts	20 m	0.02 L/s
	32 m	0.06 L/s
Yield	1987	0.05 L/s
SWL	1987	16.3 m
2002	16.4 m	
TDS	1987	630 mg/L
	1997	331 mg/L
Casing	0-32 m	150 mm ID PVC
Production Interval	20-32 m	Slotted

Water quality deteriorated with depth during drilling and with time during pump testing, in both cases ranging from ~300 mg/L to ~600 mg/L TDS.

The non-pumping SWL is steady at about 16.5 m with a drawdown of about 13 m (Fig. 11.7, see note below).

Like OV-7, the SWL curve shows a flat minimum at about 29.4 m for some 4 hours at the end of extended pumping (Fig. 11.8). The same cause is suspected and will be remedied if possible. This plot also shows that the recovery of the SWL after pumping is rather slow, so that a true non-pumping SWL is only achieved when, for one reason or another, the well is not pumped for a few days. This slow recovery does not appear to affect the functionality of the well.

Conclusions

The three monitored wells appear to be settled in a sustainable routine of pumping, with no sign of stress. There is no indication here of the failure of the wells which, apparently, occurred after the end of the period in July 2002 (Simon Wurst, DOSAA, pers. Comm.).

It is important to note that the wells are producing as much as they can, without extending pumping hours by using an external power source (which might overstress the wells). Thus there is no reserve for extra production to cover breakdown, extra demand, etc. Such reserves would have to come from other sources, such as shed-tanks or long distance transport, or be 'banked' from this production in additional storage tanks.

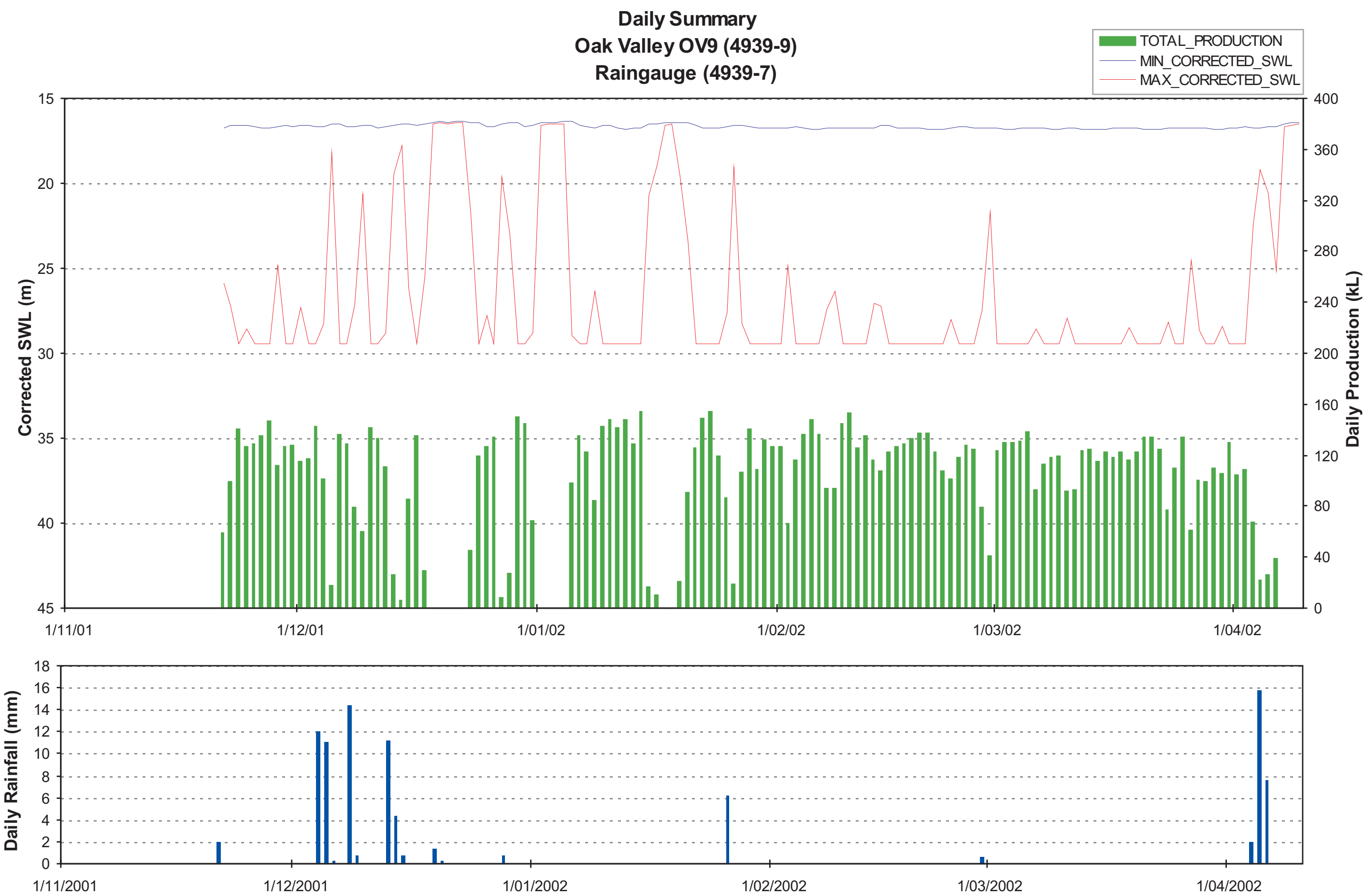

Figure 11.7 Daily Summary, Oak Valley OV 9

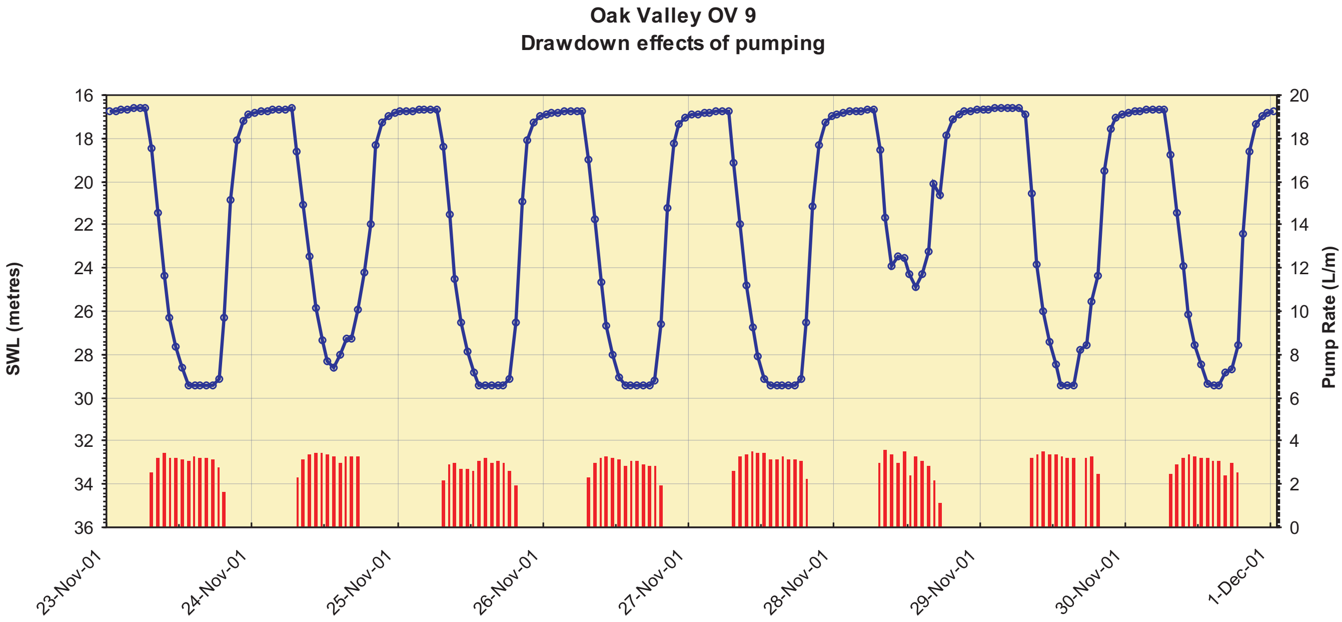

Figure 11.8 Detailed daily SWL variation, Oak Valley OV 9

CONCLUSIONS AND RECOMMENDATIONS

Indulkana

The water supply is satisfactory for the medium term.

The wells in the valleys, tapping the Mount Chandler Sandstone aquifer, all showed evidence of recharge and should be capable of higher production levels than was recently possible. The water quality may also have improved.

There is no evident recharge for the wells in the Indulkana Range which now provide most of Indulkana's supply. Moreover, the water levels have dropped steadily and currently anticipated life of the wells is reduced to 6 and15 years. A close watch on this situation is advisable.

Mimili

The two supply wells are coping satisfactorily with the current production, but are not capable or any increase, even temporarily. Two new wells tested this year should double the capacity. There are no indications of a finite life for any of these wells.

Fregon

All four wells are stable and the demand is distributed to minimise the stress on each well. There is no indication of limited life for any well. Two new wells drilled 3 km north of the community have rather better quality water, but have not been pump tested.

Kenmore Park

The water supply appears satisfactory for current demands, and there is evidence that the aquifers are being recharged. However, the usage of the wells is not optimal for well longevity or for well assessment. We advise that the load on KP-6, in particular, be decreased and that KP-98 is used to make up the deficit in supply.

Pukatja

Recharge has been occurring in all aquifers over the past two years and has restored all wells to their original state. Production capacity should be satisfactory and the supply appears to be sustainable.

Amata

Long term recharge has restored all wells. The capacity should now be satisfactory, with extra yield available for emergencies.

Kalka

The production wells have declining water levels and there is no evidence of recharge. This community has no reserve capacity for emergencies, such as well failure or extra demand. We advise that the new well, KA-137, be made operational as soon as possible in order to provide this reserve.

Pipalyatjara

Well supply is satisfactory and sustainable. Recharge has occurred.

Nepabunna

N-101 is stressed at current demands, but there are no signs in the monitoring data of any strain on the aquifer at N-149. Nevertheless, N-149 is pumped in a way that suggests difficulty in maintaining the output. The reason for this discrepancy should be ascertained. Monitoring is insufficient for further analysis and would be improved by additional observation wells. There is no evidence of recharge, but the water supply appears sustainable in the medium term.

Yalata

Although the wells are not stressed by current pumping levels the water level is declining, probably as a result of drainage. There is no evidence of recharge. The life expectancy of these wells is 10-15 years. Continued close monitoring of these wells is essential to confidence in the longevity of this water supply. Restricting the pump rates of both wells is more important than limiting the duration of pumping.

Oak Valley

While the wells appear to be in a sustainable pumping routine, their fragility must be kept in mind. The lack of any reserve supply requires close management of water usage and, preferably, maximisation of tank storage as a backup supply.

GLOSSARY

Flowback

This term describes a situation where a faulty non-return valve allows water from the distribution pipes to flow back into the well when the pump switches off, resulting in an elevated SWL. The water level characteristically takes a few hours to drop back to its natural non-pumping level.

Non-pumping SWL

The water level in a well when the pump is switched off and after the water level has stabilized.

Pumping SWL

The water level in a well while pumping. This is a function of the pump rate.

SI Units Commonly Used Within Text

Name of unit	Symbol	Definition in terms of other metric units	
Millimetre	mm	10^{-3} m	length
Metre	m		length
Kilometre	km	10^{3} m	length
Litre	L	10^{-3} m^{3}	volume
Kilolitre	kL	1 m^{3}	volume
Megalitre	ML	10^{3} m^{3}	volume
Gigalitres	GL	10^{6} m^{3}	volume
Microgram	µg	10^{-6} g	mass
Milligram	mg	10^{-3} g	mass
Gram	g		mass
Kilogram	kg	10^{3} g	Mass

Abbreviations Commonly Used Within Text

Abbreviation		Name	Units of measure
SWL	=	Standing Water Level	m
TDS	=	Total Dissolved Solids *(milligrams per litre)*	mg/L
EC	=	Electrical Conductivity *(micro Siemens per centimetre)*	µS/cm
pH	=	Acidity	

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APPENDIX A OPERATIONS REPORT ON WATER WELL MONITORING IN ABORIGINAL LANDS FOR THE PERIOD OCTOBER 2001 TO APRIL/MAY 2002

AP Lands - Water Supply Bores Download Trip Report

Amata, SWL/Flowrate Summary

Bore	**SWL Meas'd**	**SWL Logger**	**SWL Error**	**Flowrate** (L/sec)	**Acc. Flow** (m^3)	**Rain Gauge** (mm)
A-109	8.595	8.614	0.019	2.330	12,589.000	375.20
A-17	8.715	8.705	0.010	1.670	796.290	0.00
A-26	11.215	11.250	0.035	1.070	2,660.740	0.00

A-109 11/05/2002 Data down loaded and checked. Clean water trap and rain gauge. Check battery volts OK 12.15 under load. Reset flow totaliser, clear logger memory and restart. The flow meter fault reported by Bruce Hewitson was investigated but no fault was found. The flow rate may need to be checked during the next trip.

A-17 11/05/2002 Download data logger and check data. Reset flow accumulator, clean water trap and clear logger memory. There was some difficulty measuring the SWL. Logger restarted.

A-26 11/05/2002 Down load data logger and check. Clean water trap, reset flow totaliser and clear logger memory. Check battery volts 12.08 under load. Restart logger.

Ernabella, SWL/Flowrate Summary

Bore	**SWL Meas'd**	**SWL Logger**	**SWL Error**	**Flowrate** (L/sec)	**Acc. Flow** (m^3)	**Rain Gauge** (mm)
E-01	3.955	0.000	0.000	0.000	0.000	0.00
E-12	3.670	3.709	0.039	0.000	18,020.000	0.00
E-42	4.430	4.507	0.077	0.356	1,000.160	348.60
E-44	5.820	5.876	0.044	0.203	2,277.170	0.00
E-45	5.905	6.016	0.111	0.606	11,385.000	0.00
E-97B	9.220	9.299	0.079	3.090	17,493.000	0.00
E-97L	11.645	0.000	0.000	1.410	11,109.000	0.00

E-12 10/05/2002 Down load data and check. 2100P failing due to failed battery, replace battery charger and battery system. Clean water trap and reset flow totaliser. Restart logger. Flow rate check over looked.

E-42 10/05/2002 Down load data and check. Clean water trap and rain gauge. Reset flow totaliser and rain gauge totaliser. Check battery 12.6 volts under load. Replace leaking airline joiner. Clear logger memory and restart.

E-44 10/05/2002 Down load data and check. Clean water trap, reset flow totaliser and clear logger memory. Restart logger.

E-45 10/05/2002 Down load data and check, some obvious problems possibly since the lightning strike on 9/11/01. Replace the 2100P which had internal air leaks. Check battery 12.6 volts. Reset flow accumulator, clear logger memory. Restart logger.

E-97B 10/05/2002 Data down loaded and checked. Clean water trap, reset flow accumulator. The battery charger was very hot and the battery voltage down to 11.1 volts these items were removed and replaced with a new charger and battery system. The data logger memory cleared and then restarted.

E97-L 10/05/2002 Unable to communicate with data logger which was removed and replaced with S/N 311203. The battery charger and battery system was replaced due to excessive heat of the existing charger and low battery volts. Input channels of the data logger were calibrated and the logger restarted.

Fregon, SWL/Flowrate Summary

Bore	SWL Meas'd	SWL Logger	SWL Error	Flowrate (L/sec)	Acc. Flow (m^3)	Rain Gauge (mm)
FRG-1	10.090	10.110	0.020	1.780	3,728.000	0.00
FRG-14	10.300	10.295	0.005	2.530	9,114.15	268.60
FRG-7	11.025	11.009	0.016	2.330	12,562.000	0.00
FRG-E4	9.930	9.888	0.042	1.840	4,758.590	0.00

FRG-1 9/05/2002 Down load data, clean water trap, reset flow accumulator, clear memory and restart the logger.

FRG-14 9/05/2002 Data down loaded and checked. Clean water trap and raingauge. Reset flow meter accumulator and clear logger memory. Restart logger.

FRG-7 9/05/2002 Down load data and check. Reset flow meter accumulator, clean water trap, clear logger memory and restart.

FRG-E4 9/05/2002 Some difficulty was encounted communicating with the logger data was down loaded and checked. Battery voltages were checked and found OK. Water trap cleaned, flow meter accumulator reset and memory cleared. Logger restarted.

Indulkanna, SWL/Flowrate Summary

Bore	SWL Meas'd	SWL Logger	SWL Error	Flowrate (L/sec)	Acc. Flow (m^3)	Rain Gauge (mm)
I-19	14.570	14.484	0.014	0.393	132.501	247.40
I-19A	24.545	24.581	0.036	0.000	158.159	0.00
I-25	8.760	7.733	0.027	0.000	0.000	0.00
I-27	8.870	8.847	0.023	0.000	0.000	0.00
I-R1	0.000	0.000	0.000	0.000	18,704.000	0.00
I-R2	56.600	56.600	0.000	1.215	4,566.740	0.00
I-R3	51.780	0.000	0.000	0.000	0.000	0.00
I-R4	55.760	0.000	0.000	0.000	0.000	0.00

I-19 8/05/2002 Down load data, clean water trap and raingauge, clear logger memory and flow meter accumulator. Battery volts were checked 12.79 volts under load. The logger was then restarted.

I-19A 8/05/2002 Down load data. Replace the 2100P S/N 210367 removed by the ESO replace all damaged air line connectors. Install new battery charger and upgrade the battery system. Reset the flow meter accumulator and clear the logger memory, restart logger. The flowmeter was unable to be checked as the pump was not working. Note the 2100P is now over ranged by 3.09 meters. The down hole air tube needs to be shortened and a 20 mm conduit should be installed to assist in obtaining SWL measurements.

I-25 8/05/2002 Bore has not been used and the pump has been removed. Data down loaded memory cleared, battery checked and logger restarted after cleaning water trap. Flow meter could not be checked.

I-27 8/05/2002 Bore is not used and the pump is not installed. Data was down loaded, memory cleared and the logger restarted. The 2100P is the old style not modified. The flow meter could not be checked and should possibly be removed from the site.

I-R1 8/05/2002 Data down loaded. Isolate pump to allow bore to recover. Reset flow accumulator and check battery volts 11.9V. Water level probe broken off down hole, SWL could not be measured, the logger was restarted and SWL corrections will need to be adjusted later. Flow rate check was over looked.

I-R2 8/05/2002 Data down loaded, water trap cleaned, flow meter accumulator reset and logger memory cleared. Battery checked 12.45 volts under load. It was found that the data logger channel 3 had failed and a replacement logger was installed S/N 311170 The new logger input channels were calibrated and started.

I-R3 8/05/2002 Geo Tech Systems logger was installed at a depth of 53.500 meters. I expect that there will be a minor variation as the weight of the logger straightens the mounting cable. The logger is set up to log every hour.

I-R4 8/05/2002 SWL measured to top of casing.

Kalka, SWL/Flowrate Summary

Bore	**SWL Meas'd**	**SWL Logger**	**SWL Error**	**Flowrate** (L/sec)	**Acc. Flow** (m^3)	**Rain Gauge** (mm)
KA-1	29.465	27.541	1.924	0.221	1,196.740	0.00
KA-2	0.000	28.189	0.000	0.199	1,286.230	0.00
KA-3	20.100	20.030	0.070	0.893	5,762.510	358.40

KA-1 11/05/2002 Data logger down loaded and data checked. Clean water trap and reset flow accumulator. Clear logger memory and restart.

KA-2 11/05/2002 Down load logger and check data. Clean water trap and reset flow totaliser. Unable to measure SWL as water level probe stuck down hole and broken off with 30 meters loss of cable. The logger was restarted with existing datum. This bore should have the pump removed water level probe cable removed and a 20 mm conduit installed.

KA-3 11/05/2002 Down load data and check. Clean water trap and rain gauge. Check battery voltage 12.2 volts under load. Reset flow accumulator and clear logger memory. Restart logger.

Kenmore Park, SWL/Flowrate Summary

Bore	**SWL Meas'd**	**SWL Logger**	**SWL Error**	**Flowrate** (L/sec)	**Acc. Flow** (m^3)	**Rain Gauge** (mm)
KP-6	8.960	0.000	0.000	0.677	0.000	0.00
KP-7	8.895	8.897	0.000	0.702	1,155.950	295.20
KP-98	4.770	4.853	0.083	0.536	595.240	0.00

KP-6 10/05/2002 Data down loaded and checked, an anomaly between the 2100P and flow meter data was noted at approximately 1 April. Flow meter was showing FATAL ERROR and was replaced with S/N A97 79251. Data logger input channel 3 replacement fuse. Due to site faults SWL correction could not be measured and the accumulated flow could not be obtained.

KP-7 10/05/2002 Down load data and checked, an anomaly found in the SWL data. An air leak was found in the adaptor fitting between the 1/4" and 5/16" air tubes which was replaced. Clean water trap and rain gauge, flow meter accumulator reset clear the logger memory. Restart the logger. When the pump is next removed the down hole air tube should be replaced with 1/4" tube to be standard with other sites.

KP-98 10/05/2002 Data down loaded and checked. Water trap cleaned, flow meter accumulator reset and logger memory cleared. Battery voltage checked 11.52 volts under load. Logger restarted.

Mimilli, SWL/Flowrate Summary

Bore	**SWL Meas'd**	**SWL Logger**	**SWL Error**	**Flowrate** (L/sec)	**Acc. Flow** (m^3)	**Rain Gauge** (mm)
M-1	15.565	15.590	0.025	1.020	7,603.670	0.00
M-3	11.340	11.356	0.016	1.763	9,245.390	0.00

M-1 9/05/2002 Logger was found to be NOT LOGGING and that the logger had stopped at the time of the radio equipment being installed 18/4/02. Data was able to be down loaded and various checks made. Flow meter accumulator was reset and the logger memory cleared. The logger was restarted. To prevent this failure occurring again an independent battery charger would be required for the logging equipment instead of sharing the radio supply.

M-3 9/05/2002 Down load data was inspected and looked OK except that no rainfall had been recorded. Water trap and rain gauge was cleaned, logger memory cleared and flow meter accumulator was reset. Rewired connections to the rain gauge and restart the logger. The rain gauge was checked with a 1 mm test.

Nepabunna, SWL/Flowrate Summary

Bore	SWL Meas'd	SWL Logger	SWL Error	Flowrate (L/sec)	Acc. Flow (m^3)	Rain Gauge (mm)
N-101	47.330	47.370	0.040	0.844	5,393.400	0.00
N-149	52.600	52.678	0.078	0.214	4,621.500	85.20

N-101 12/05/2002 Down load data logger and check data. Reset flow accumulator, clean water trap and clear logger memory. Restart data logger.

N-149 12/05/2002 Data logger down loaded and data checked. Clean rain gauge and water trap. Check battery voltage 12.15 volts under load. Reset flow totaliser, clear logger memory and restart.

Oak Valley, SWL/Flowrate Summary

Bore	SWL Meas'd	SWL Logger	SWL Error	Flowrate (L/sec)	Acc. Flow (m^3)	Rain Gauge (mm)
OV-10	12.120	0.000	0.000	0.000	1,583.000	0.00
OV-2	9.000	0.000	0.000	0.000	1,699.000	0.00
OV-7	18.820	18.797	0.023	0.000	1,466.000	90.40
OV-8	14.420	14.442	0.022	0.000	1,953.000	0.00
OV-9	16.445	16.459	0.014	0.000	0.00	

OV-10 10/04/2002 Measure SWL after allowing bore to recover, note accumulated flow.

OV-2 10/04/2002 Measure SWL after allowing the bore to recover, note accumulated flow. Pump solar panels loose on mounting.

OV-7 10/04/2002 Down load data and check, clean water trap and rain gauge, check battery volts 13.28V, clear memory and restart logger. All systems working OK

OV-8 10/04/2002 Download data and check validity, clean water trap, checked battery volts 13.15v clear logger memory and restart. All working OK.

OV-9 10/04/2002 Down load data, clean water trap, check battery volts, clear logger memory and restart. All working OK.

Pipilyatjara, SWL/Flowrate Summary

Bore	SWL Meas'd	SWL Logger	SWL Error	Flowrate (L/sec)	Acc. Flow (m^3)	Rain Gauge (mm)
MD-13	12.170	0.000	0.000	0.000	0.000	0.00
PMB-95	16.620	16.729	0.109	1.449	4,944.680	749.20
PMB-96	20.505	20.689	0.184	1.464	5,163.520	0.00

MD-13 11/05/2002 SWL measured but hours of use not noted.

PMB-95 11/05/2002 Data down loaded and checked. Clean rain gauge and water trap. Check battery voltage, reset flow totaliser and clear logger memory. Restart logger.

PMB-96 11/05/2002 Data logger down loaded and data checked. Battery voltage checked, water trap cleaned and flow accumulator reset. Clear logger memory and restart.

Yalata, SWL/Flowrate Summary

Bore	SWL Meas'd	SWL Logger	SWL Error	Flowrate (L/sec)	Acc. Flow (m^3)	Rain Gauge (mm)
YMBT-2	60.390	60.378	0.013	1.177	0.000	0.00
YMBT-3	60.245	60.257	0.012	2.680	28,992.000	0.00

YMBT-2 9/04/2002 Down load data, reset flow accumulator, clean water trap, check data, clear memory, Restart logger after replacing battery charger and 2100P battery to new system

YMBT-3 9/04/2002 Faulty 2100P battery Replace charger and battery to new system Down load data, clean water trap, check battery volts cleared memory and reset flow accumulator. Restarted data logger.

CONCLUSIONS AND OBSERVATIONS

The down load trips were generally successful in that all sites were down loaded and data was retrieved for the period November'01 to April/May'02.

The upgraded 2100P Water Level transducers were not installed at I27 and I25 as both sites were functioning without problems, these sites will be modified as required.

Repairs included :

- E-12, 2100P battery had failed, requiring replacement of both battery and charger.
- E-45, 2100P had internal air leaks and is returned to Mindata for repair.
- E-97B, replace battery charger and change to upgraded battery system.
- E-97L, replace data logger and return for repair, replace battery charger and change to upgraded battery system.
- I-19A, reinstate 2100P and replace battery charger and change to upgraded battery system.
- I-R2, replace failed data logger returned for repair.
- KP-6, Flow meter replaced returned for repair, data logger repaired on site.
- YMBT-2, replace battery charger and change to upgraded battery system.
- YNBT-3, replace battery charger and change to upgraded battery system.

The majority of failures again related to battery failures and battery chargers. This will be addressed by systematically upgrading the battery systems followed by regular battery replacement.

At the request of Mr. Sandy Dodds a new logger has been installed at IR3 to monitor SWL only, this is to assist with the study of aquifer characteristics. It was intended that 4 more loggers would have been installed during the trip, but the bores targeted had been modified with welded steel covers making the installation impossible.

RECOMMENDATIONS

Kalka bore KA-2, this bore now has 30 plus meters of water level probe cable down the bore as a result of becoming entangled and stuck. At the time of removal a 20 mm conduit should be installed in a similar manner to KA-1.

The recommendation for action at Indulkanna I-19A has not been attempted and is repeated below.

At Indulkanna I-19A, it would be greatly appreciated if DOSAA could instruct B. Hewitson to install a 20 mm conduit in this bore for the purpose of obtaining SWL measurements, the present situation is very difficult to obtain a reliable measurement. In addition the air tube used by the 2100P transducer should be reduced in length by 3.5 meters, because in a recovered state the SWL over pressures the 2100P input. This means that although the full extent of the draw down may not be seen, a more reliable recovered state can be recorded.

APPENDIX B WATER WELLS AND EQUIPMENT IN ABORIGINAL LANDS

Dates and Locations of Well monitoring equipment - Anangu Pitjantjatjara Lands

Area	Well Identification	Unit Number	Depth (metres)	Latitude (South)	Longitude	Flowmeter	SWL transducer and logger	Logger Format	Comments
						Date of Installation			
Indulkana	IMB-19	5544-101	68	26.9848	133.2898	Dec-1997	Dec-1997	2	Also raingauge
	IMB-19A	5544-132	79	26.986	133.2927	Dec-1997	Dec-1997	2	
	IMB-25	5544-157	30	26.9903	133.293	pre-97	pre-97	2	
	IMB-26	5544-158	48	26.9863	133.287	Dec-1997	Dec-1997	2	
	IMB-27	5544-159	40	26.9837	133.2762	Dec-1997	Dec-1997	2	Not monitored to Apr 2000
	IR-1	5544-172	72	26.988	133.2811	Oct-1999	Oct-1999	2	
	IR-2	5544-169	90.7	26.9892	133.2764	Oct-1999	Oct-1999	2	
	IR-3	5544-170		26.9921	133.2729				Not monitored
Pukatja	E-01	5345-06	18.3	26.2738	132.1358	Dec-1997	Dec-1997	2	
	E-12	5345-12	22.9	26.2725	132.1265	Dec-1997	Oct-1998	2	
	E-42	5345-33	21	26.2703	132.1257	Dec-1997	Dec-1997	2	Raingauge
	E-44	5345-85	16.5	26.2585	132.124	Dec-1997	Dec-1997	2	
	E-45	5345-84	30	26.2593	132.125	pre-97	pre-97	2	Transducer replaced 12/97
	E97B	5345-114	42.5	26.3291	132.1104	Apr-1998	Apr-1998	2	
	E97 L	5345-124	31	26.33	132.1031	Apr-1998	Apr-1998	2	
Kenmore Park	KP-6	5345-67	30	26.3225	132.4393	pre-97	pre-97	2	
	KP-7	5345-68	36	26.322	132.4375	Dec-1997	Dec-1997	2	Raingauge
	KP-98	5345-98	30	26.3007	132.4242				Pump hours recorded
Mimili	M-1	5443-25	35	27.0235	132.6733	Jan-1998	Jan-1998	2	
	M-3	5443-28	60	27.1422	132.6925	pre-97	pre-97	2	Transducer replaced 12/97

Area	Well Identification	Unit Number	Depth (metres)	Latitude (South)	Longitude	Flowmeter	SWL transducer and logger	Logger Format	Comments
						Date of Installation			
Fregon	FRG-01	5344-09	18.6	26.7668	132.0378	pre-97	pre-97	2	Transducer replaced 12/97
	FRG-07	5344-31	48	26.7573	132.0387	Jan-1998	Jan-1998	2	
	FRG-14	5344-47	30	26.7593	132.0402	Jan-1998	Jan-1998	2	Raingauge
	FRG-E4	5344-19	35	26.7545	132.036	Jan-1998	Jan-1998	2	
Amata	A-15	5145-55	35.8	26.1422	131.135	pre-97	pre-97	1	Raingauge. Well ABN and replaced by A-109
	A-17	5145-84	34.5	26.1425	131.1387	Jan-1998	Jan-1998	2	
	A-26	5145-19	39	26.1343	131.1387	Jan-1998	Jan-1998	2	
	A-109	5149-109	55	26.146753	131.1375	Nov-2001	Nov-2001	2	
Pipalyatjara	PIP-95	4745-95	36.8			Jan-1998	Jan-1998	2	Raingauge
	PIP-MD13	4745-92	43	26.1587	129.1698	Jan-1998	NONE		Rarely used - run for 31 hours Mar-Oct/98
	PIP-96	4745-96	36.8			pre-97	pre-97	2	
Kalka	KA-1	4745-78	40.5	26.1085	129.1507	Jan-1998	Jan-1998	2	
	KA-2	4745-94	60	26.1167	129.1528	Jan-1998	Jan-1998	2	
	KA-3	4745-85	40	26.1182	129.1668	Jan-1998	Jan-1998	2	Raingauge
Nepabunna	N-101	6636-101	64	30.5842	138.9764	Dec-1999	Dec-1999	2	
	N-149	6636-149	120	30.578	138.9585	Dec-1999	Dec-1999	2	Raingauge
Yalata	YT-2	5235-15	72	31.4564	131.8012	Dec-1999	Dec-1999	2	
	YT-3	5235-18	73	31.4534	131.8047	Dec-1999	Dec-1999	2	
Oak Valley	OV-7	4939-7	33	29.390246	130.47395	Nov-2001	Nov-2001		Raingauge
	OV-8	4939-8	31	29.385445	130.48051	Nov-2001	Nov-2001		
	OV-9	4939-9	32	29.368259	130.48336	Nov-2001	Nov-2001		