MWH

BUILDING A BETTER WORLD

FINAL REPORT

Gingin Aquifer Trend Review

Prepared for Department of Water

April 2010

EXECUTIVE SUMMARY

MWH Australia Pty Ltd was engaged by the Department of Water to conduct a review of groundwater monitoring data within the Gingin groundwater area (GWA). Data was supplied by the Department of Water and consisted of the state network monitoring bores and a selection of bores associated with private abstraction.

Monitoring bore data presented in this report demonstrates trends within the groundwater aquifers of the Gingin GWA.

Regionally, groundwater levels within the Superficial aquifer have been in decline since 1992, apart from adjacent to the coast, where levels have been steady. There are isolated regions of water level increases in the central zone of the Superficial aquifer, while the southern sub-area of Eclipse Hill demonstrates both rises and falls in groundwater levels. Available data within the Yarragadee aquifer also suggests groundwater decline in the central and north western districts since 2002, although this followed increases between 1997 and 2002. The Leederville aquifer's data limits widespread analysis, although monitoring bores demonstrate gradually declining water levels between 1997 and 2007. The Leederville-Parmelia system appears to be experiencing rising groundwater levels in the north and a significant decline in the south. Insufficient data was available for the Lesueur and Mirrabooka aquifers to allow objective analysis.

Individual bore hydrographs within this review reflect the findings of the regional analysis. Instances where the hydrographs indicate unusual patterns or anomalies have been identified as potential subjects for further investigation.

In line with our Quality System, this document has been prepared by Michael Carroll, reviewed by Jim Campbell and signed off by Jim Campbell.

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1 Introduction

MWH Australia was commissioned by the Department of Water (DoW) to conduct a review of available groundwater monitoring data for the Gingin Groundwater Allocation Area (GWA). This report contains the results of this review, contributing to Phase A of the DoW's allocation process.

The information contained herein is structured according to two major aspects of an allocation plan:

- Groundwater Allocation Sub-areas
- Groundwater Aquifers

The Gingin GWA consists of two sets of sub-areas. The first, illustrated in Figure 1-1, is used for the unconfined aquifer systems. Figure 1-2 illustrates the second set of sub-areas, which is used for the confined and semi-confined aquifer systems, namely the Yarragadee, Leederville, Leederville-Parmelia, Lesueur and Mirrabooka systems. Other aquifers present in the Gingin Groundwater area but not included in this report are the Surficial, Fractured Rock West, Poison Hill and Cattamarra Coal Measures aquifers. These aquifers are not included due to the lack of monitoring data available.

Table 1 and Table 2 below indicate the extent of each aquifer within the sub-areas, as well as an indication of the monitoring data coverage available. The nomenclature used within these two tables will be used consistently throughout the report.

Table 1: Aquifer extent and data coverage for the Gingin GWA unconfined sub-areas

Sub-area	Aquifer Extent	Data Coverage
Wedge Island	Major	Good
Victoria Plains	None	n/a
Moora	None	n/a
Lancelin	Complete	Adequate
Namming Lake	Major	Adequate
Karakin Lakes	Complete	Good
North Moore River Park	Complete	Poor
Seabird	Complete	Good
South Moore River Park	Complete	Poor
Red Gully	Minor	None
Guilderton North	Complete	Adequate
Beermullah Plain North	Complete	Adequate
Deepwater Lagoon North	Complete	None
Gingin Townsite	Minor	Poor
Bindoon	None	n/a
Eclipse Hill	Minor	Adequate

Table 2: Aquifer extent and data coverage for the Gingin GWA confined/semi-confined aquifers by sub-area

Aquifer	SA 1		SA 2		SA 3 North	
	Aquifer Extent	Data Coverage	Aquifer Extent	Data Coverage	Aquifer Extent	Data Coverage
Mirrabooka	n/a	n/a	n/a	n/a	n/a	n/a
Lesueur	Minor	Poor	n/a	n/a	n/a	n/a
Leederville	Moderate	Marginal	Complete	Poor	Complete	Poor
Leederville-Parmelia	n/a	n/a	n/a	n/a	n/a	n/a
Yarragadee	Major	Marginal	Complete	Poor	Complete	None

Aquifer	SA 4		SA 5		SA 6	
	Aquifer Extent	Data Coverage	Aquifer Extent	Data Coverage	Aquifer Extent	Data Coverage
Mirrabooka	Minor	None	Major	Poor	Major	Marginal
Lesueur	n/a	n/a	n/a	n/a	n/a	n/a
Leederville	n/a	n/a	n/a	n/a	n/a	n/a
Leederville-Parmelia	Major	Poor	Major	Marginal	Major	Marginal
Yarragadee	Major	Poor	Major	Poor	Major	none

Section 2 presents the results of a regional aquifer analysis of the data. Initial figures demonstrate the availability of data in 5 year intervals, combining data where possible from all the bores across the Gingin GWA in a certain aquifer. A second set of figures for each aquifer qualitatively illustrates the trends in water levels observed in the bore data.

Section 3 of this report contains all the available hydrographs for each aquifer type and groundwater sub-area across the region. Location maps are presented before the hydrographs to allow a spatial reference for the hydrographs.

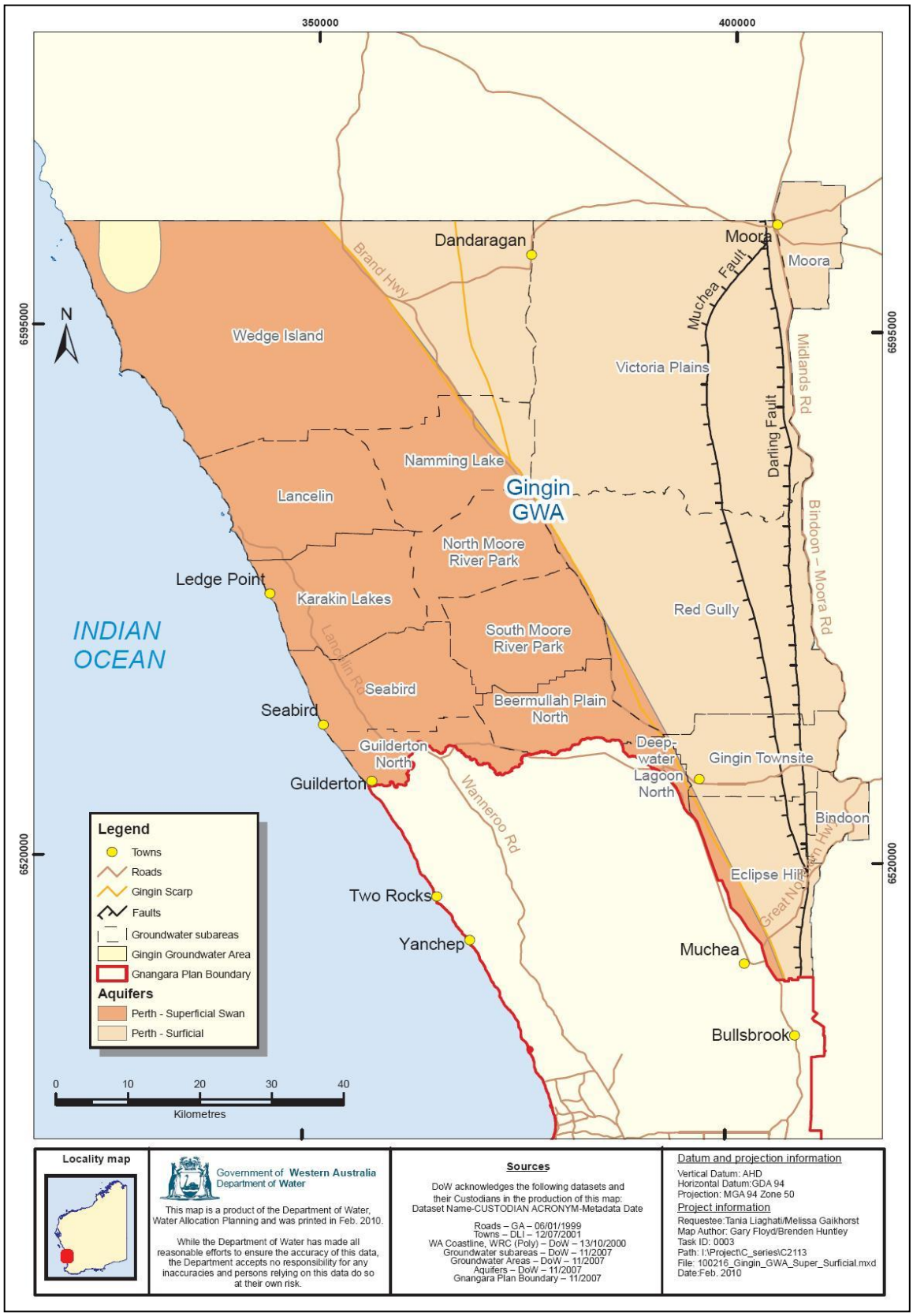


Figure 1-1: Location plan of the Gingin GWA displaying the Superficial aquifer sub-areas. Figure courtesy of the DoW

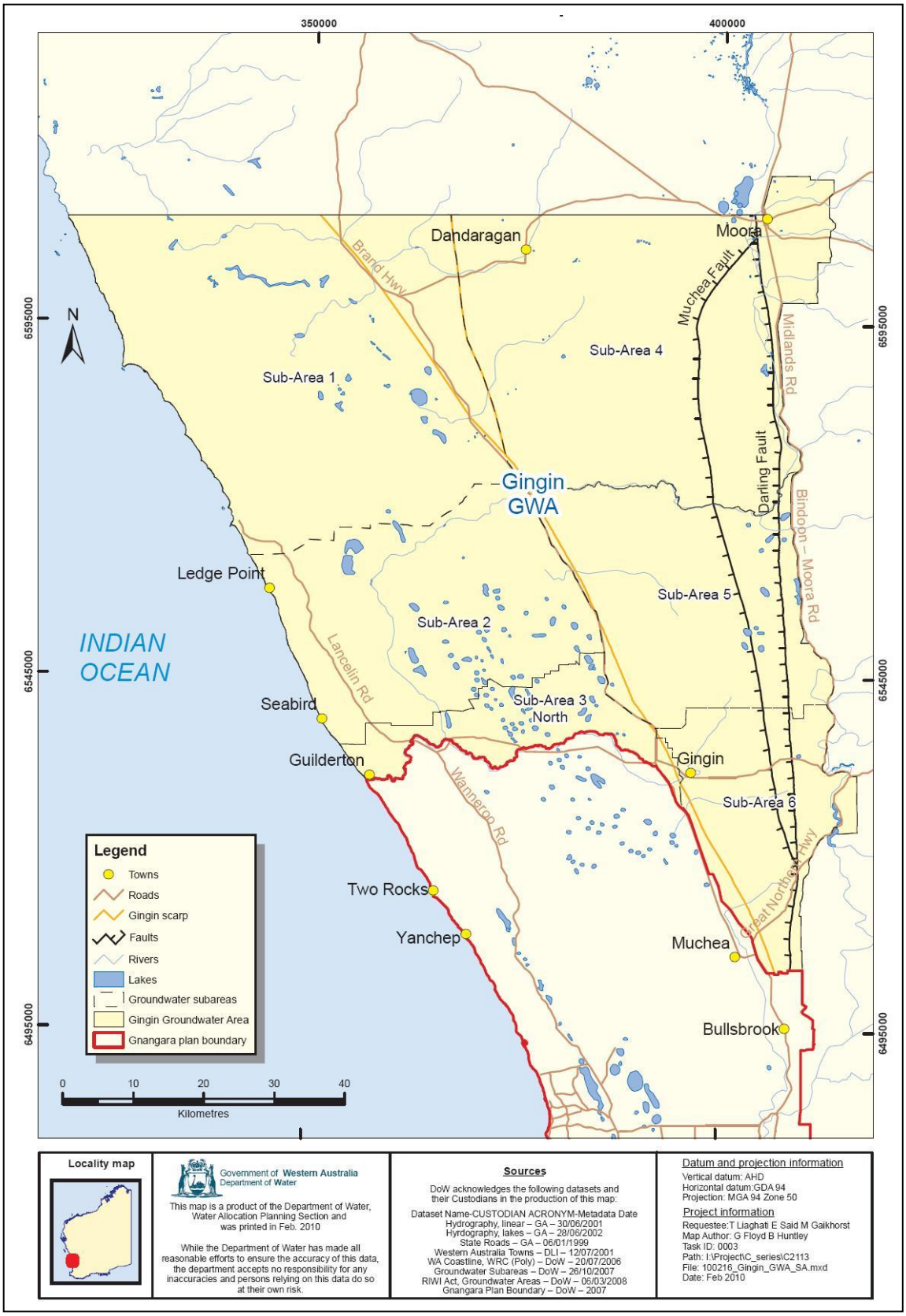


Figure 1-2: Location plan of the Gingin GWA displaying the confined/semi-confined system sub-areas. Figure courtesy of the DoW

2 Regional Aquifer Trends

The following section contains the results of a trend analysis conducted across the Gingin GWA. The available data for each aquifer was sorted and selected, where available, at 5 yearly intervals starting from 1977. To account for seasonal groundwater variation, only monitoring data obtained in the autumn months of March and May was selected for the study.

2.1 Historical Data Availability

The series of diagrams from Figure 2-1 to Figure 2-4 below demonstrates the availability of data in each aquifer for the selected time periods. In general, the number of monitoring points increases over time as more monitoring bores were added during various drilling programs conducted by the authorities. However, there are periods of time following bore construction where monitoring has not taken place. This is particularly apparent in the Superficial aquifer, where no monitoring of the northern bores took place between 2007 and 2009

Throughout all the aquifers, only the period from 1997 to 2007 contains any consistent monitoring of available bores. This period was therefore selected for a regional analysis of groundwater trends. As mentioned above, data was only selected from autumn months to minimise seasonal effects.

2.2 Qualitative Trend Analysis

A qualitative method of displaying changes in measured groundwater levels was developed for each aquifer for the two periods from 1997 to 2002, and 2002 to 2007. As described, the common period and seasonal selection of data allows for comparison across the Gingin GWA and between aquifers.

The results of the analysis are illustrated in Figure 2-5 through to Figure 2-8, and utilise a method of increasing symbol size and colour intensity to demonstrate the trends observed. A yellow symbol is used where private bores screened over two or more intervals of unknown depth show different trends. In cases where State monitored bores with multiple screen depths have displayed conflicting values, the following methodology was employed:

- Use of the shallower screen for bores within the Superficial aquifer to best demonstrate changes in the water table
- Use of the shallower screen for bores within the confined/semi confined aquifers, unless the screened interval is near to an aquifer interface.

Construction details of the State monitoring bores used in this study are included in Appendix A. Screen details for the private bores were unavailable and are not contained within this report. It is acknowledged that different construction techniques for private bores may result in monitoring data that is inconsistent with the State monitoring network. The extent of this potential difference cannot be verified.

2.2.1 Superficial aquifer

Regionally, the Superficial aquifer has a good network of monitoring bores with a notable gap existing in land owned by the Department of Defence north of Ledge Point (Figure 2-5).

In the period between 1997 and 2002, groundwater levels appeared to have declined by less than 1 m in the Guilderton North, Beermullah Plain North, South Moore River Park, North Moore River Park and eastern Lancelin sub-areas. The decreasing trend also extends into the central Wedge Island sub-area, with an isolated 4 m decrease measured. Water levels appear to have been steady along the coastline, in the centre of the Seabird sub-area and in the south of the Karakin Lakes sub-area. Some apparent regions of water level increases are evident along the Lancelin and Karakin Lakes boundary, and towards the east of the Namming Lake sub-area. The Eclipse Hill sub-area has an unclear regional pattern, with declining water levels on the northern and southern boundaries and stable to increases water levels in the centre.

The data from 2002 to 2007 suggests a regional decline in water levels of less than 1 m, but with stability of water levels evident along the coastline of the Guilderton North, Seabird, Karakin Lakes and Lancelin sub-areas due to higher transmissivity in the Tamala Limestone and the proximity of the Indian Ocean. There is an apparent recovery in the centre of the Wedge Island sub-area during this time, including the area of significant decline between 1997 and 2002. Declining trends of 1-2 m are evident in the Eclipse hill sub-area and isolated locations within the Lancelin and Karakin Lakes sub-areas.

2.2.2 Lesueur aquifer

The single data point available for the Lesueur aquifer limits the scope of the analysis, although water levels appear to be slightly declining, particularly since 2002 (Figure 2-7)

2.2.3 Leederville aquifer

Analysis of the groundwater level trends displayed in Figure 2-6 for the Leederville aquifer is limited by the number and spatial extent of the monitoring bores. Apart from isolated recovery along the southern border of Sub-area 1 and the southern coastline of Sub-area 2, there appears to be a slight decline throughout the aquifer between 2002 and 2007.

2.2.4 Mirrabooka aquifer

Due to the limited number of bores available in the Mirrabooka aquifer (Figure 2-7, it is not possible to determine a regional trend. Additional bores were installed in 2008, which may improve future analysis.

2.2.5 Leederville-Parmelia aquifer

The data for the Leederville-Parmelia aquifer suggests similar regional trends for both periods from 1997 to 2002 and 2002 to 2007 (Figure 2-6). Groundwater levels have been rising slightly in the northern half of the aquifer (Sub-area 4 and Sub-area 5), with a larger increase in the east of Sub-area 5. There is a strong declining trend of up to 4 m in both periods in Sub-area 6, although this appears to be levelling off slightly between 2002 and 2007.

2.2.6 Yarragadee aquifer

Analysis of the Yarragadee aquifer is limited to the northern section of the Gingin GWA (Figure 2-8). A slight increase throughout the region between 1997 and 2002 was followed by a general decline in groundwater levels between 2002 and 2007. There was a fluctuation in excess of 4 m along the northern boundary of Sub-area 1 during the period studied. This appears to have been limited in extent as adjacent bores display more subdued changes.

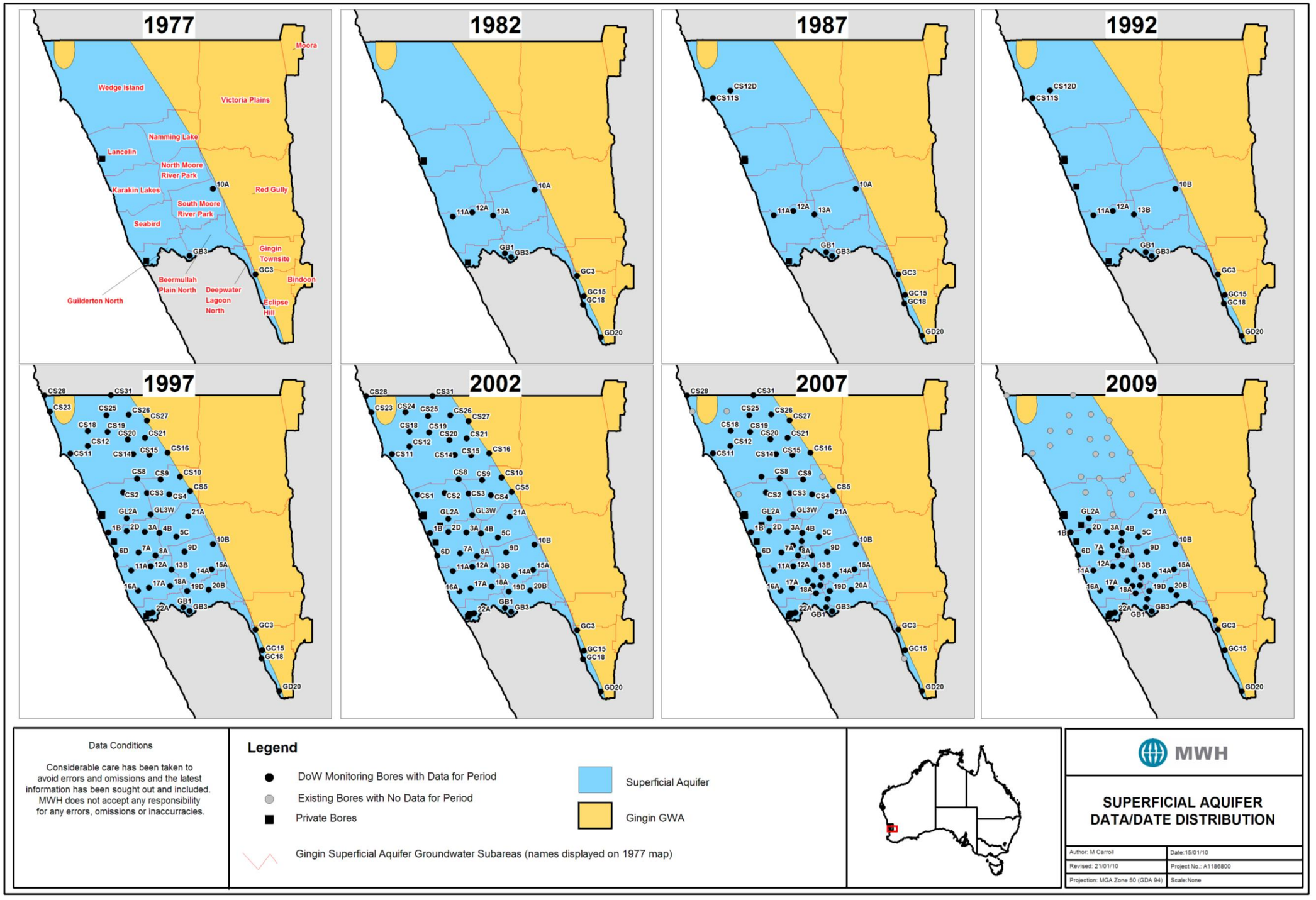


Figure 2-1: Temporal distribution of data in the Superficial aquifer for the Gingin GWA

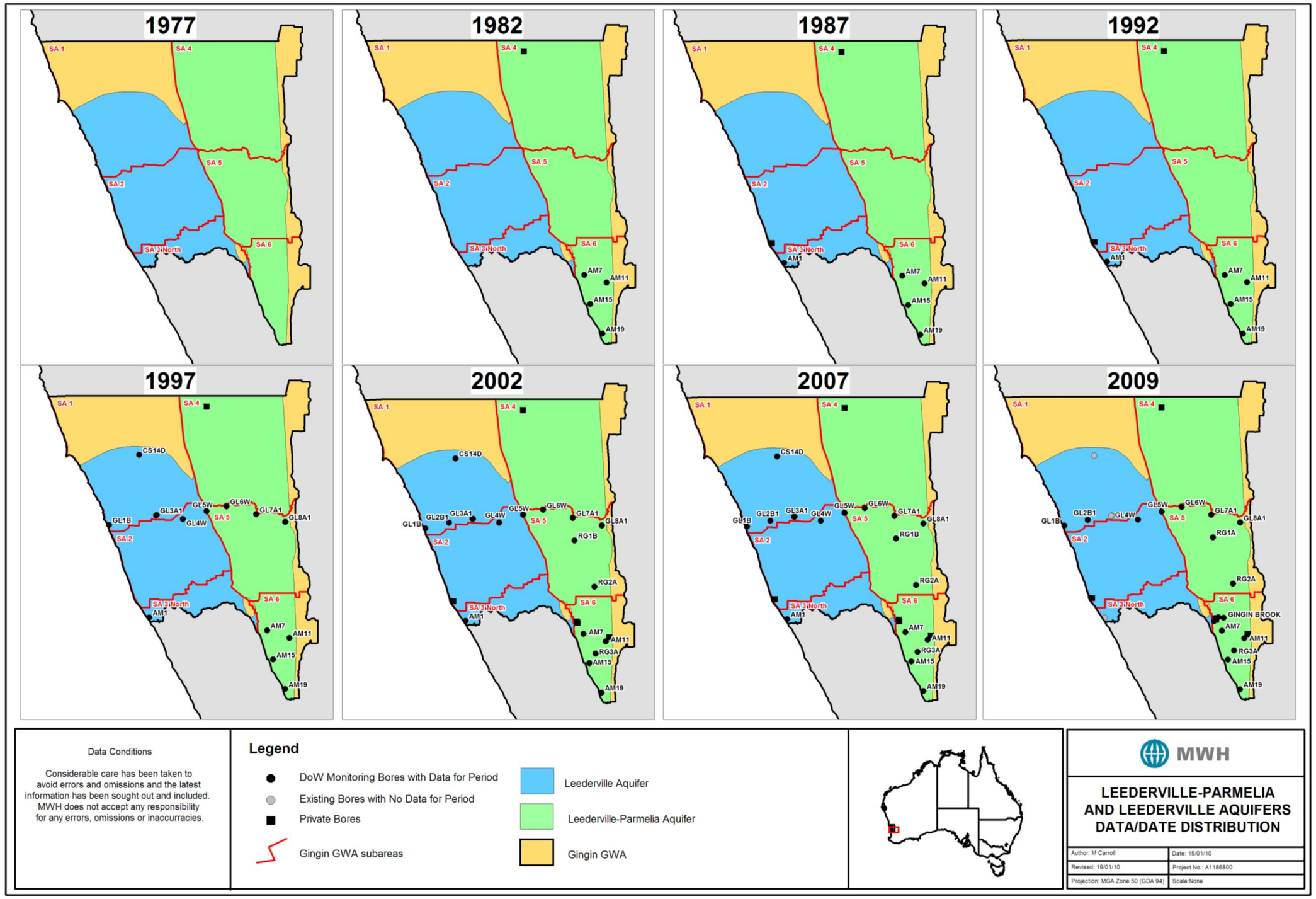


Figure 2-2: Temporal distribution of data in the Leederville-Parmelia and Leederville aquifers for the Gingin GWA

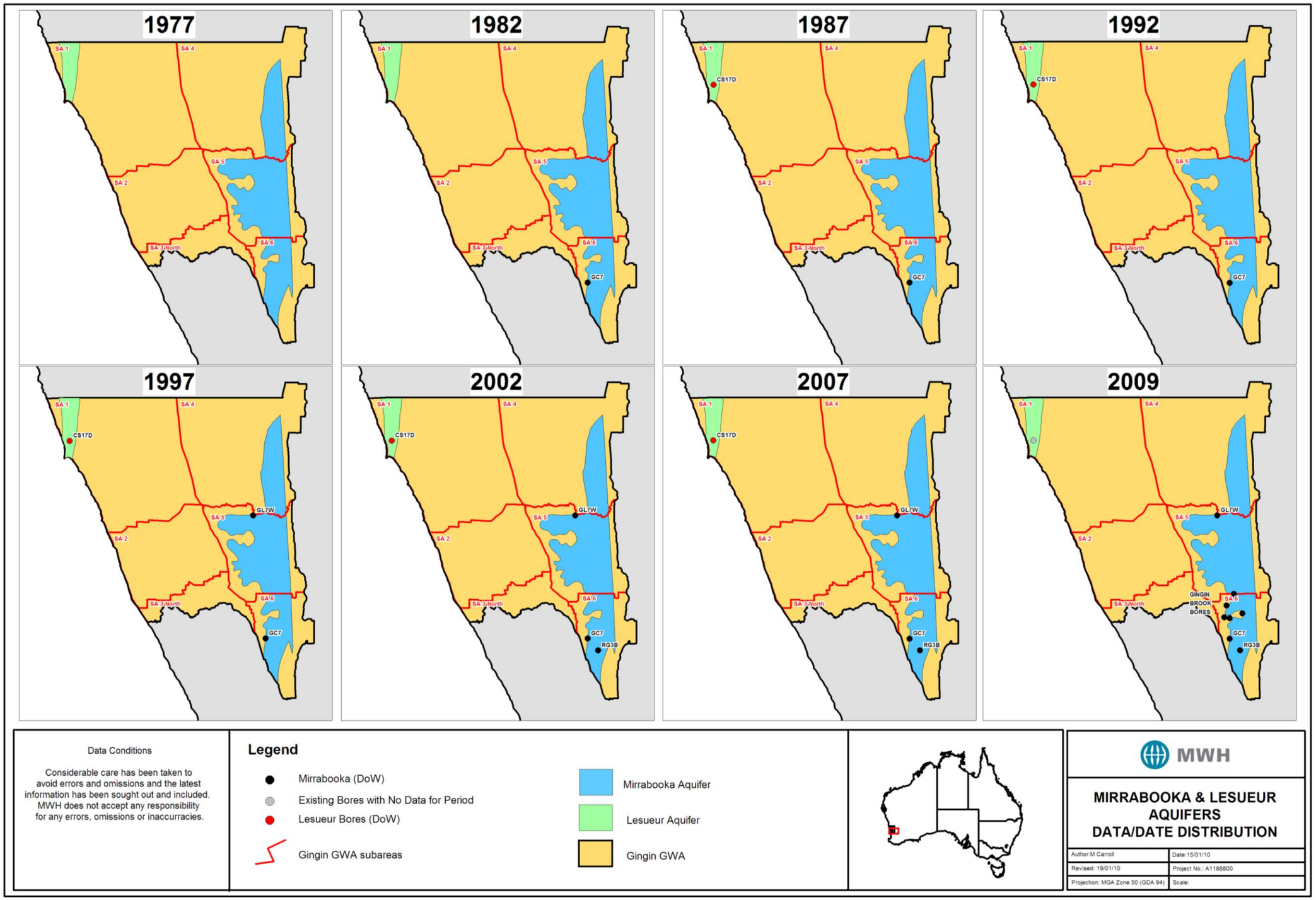


Figure 2-3: Temporal distribution of data in the Mirrabooka and Lesueur aquifers for the Gingin GWA

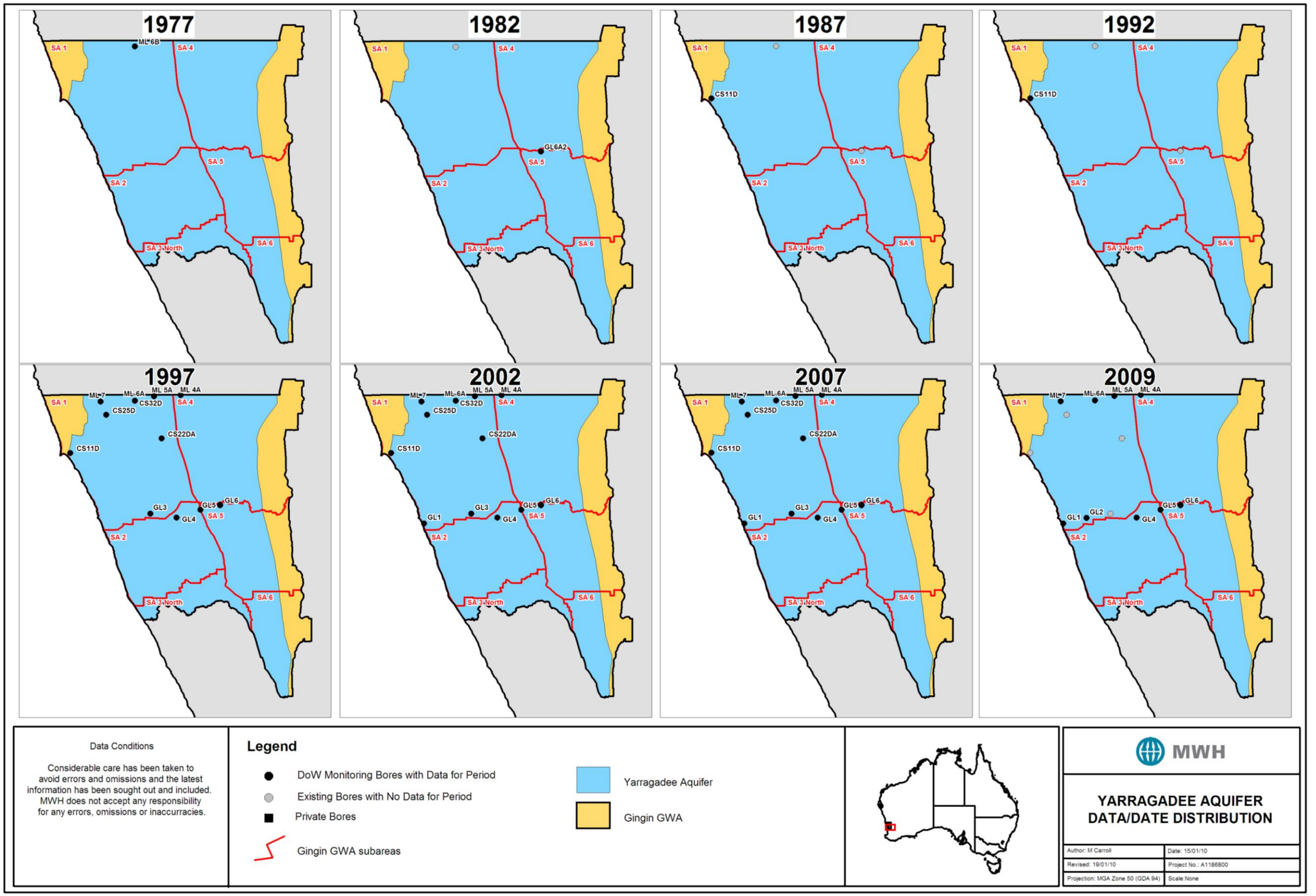


Figure 2-4: Temporal distribution of data in the Yarragadee aquifer for the Gingin GWA

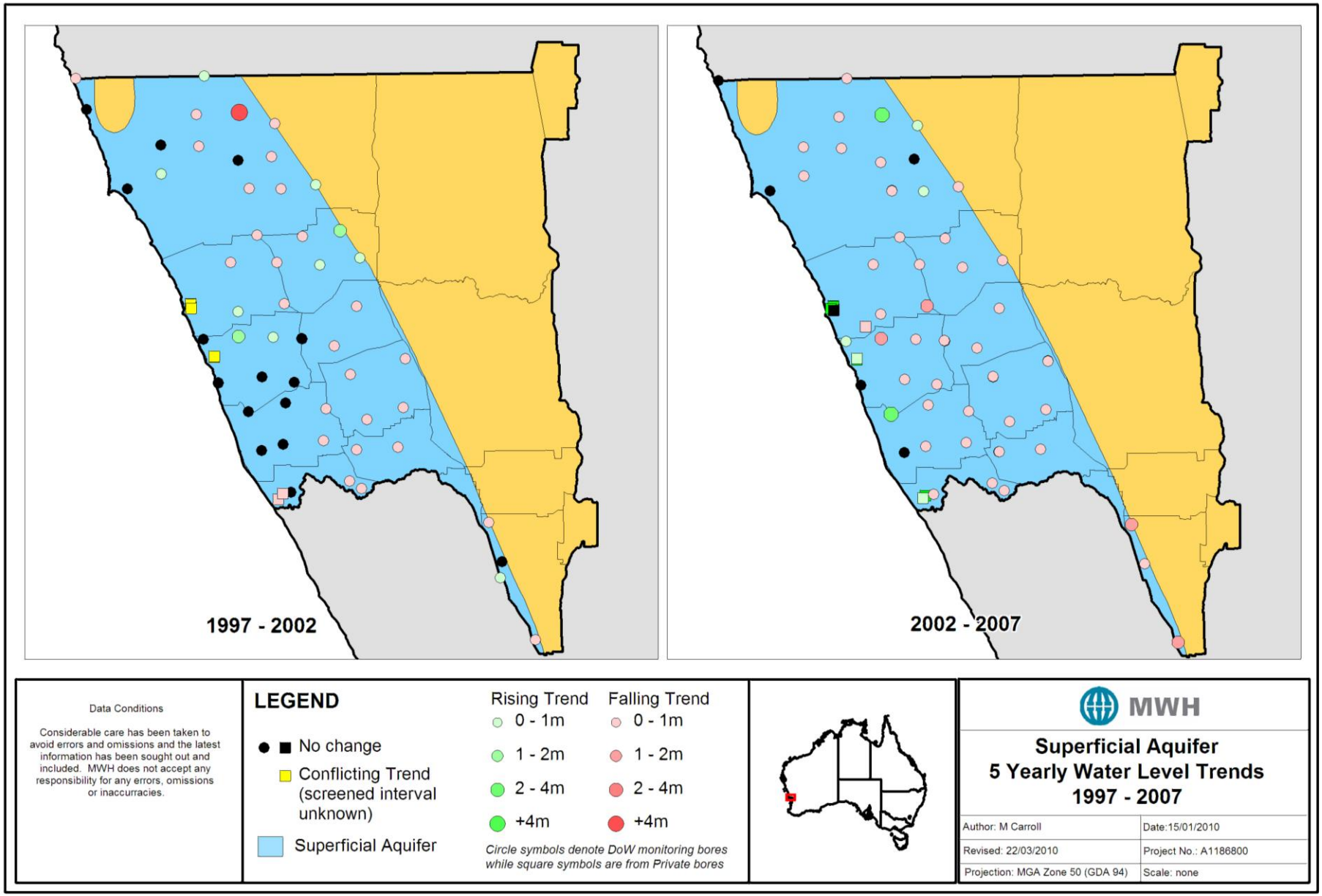


Figure 2-5: Qualitative changes in water levels between 1997 and 2007 for the Superficial aquifer

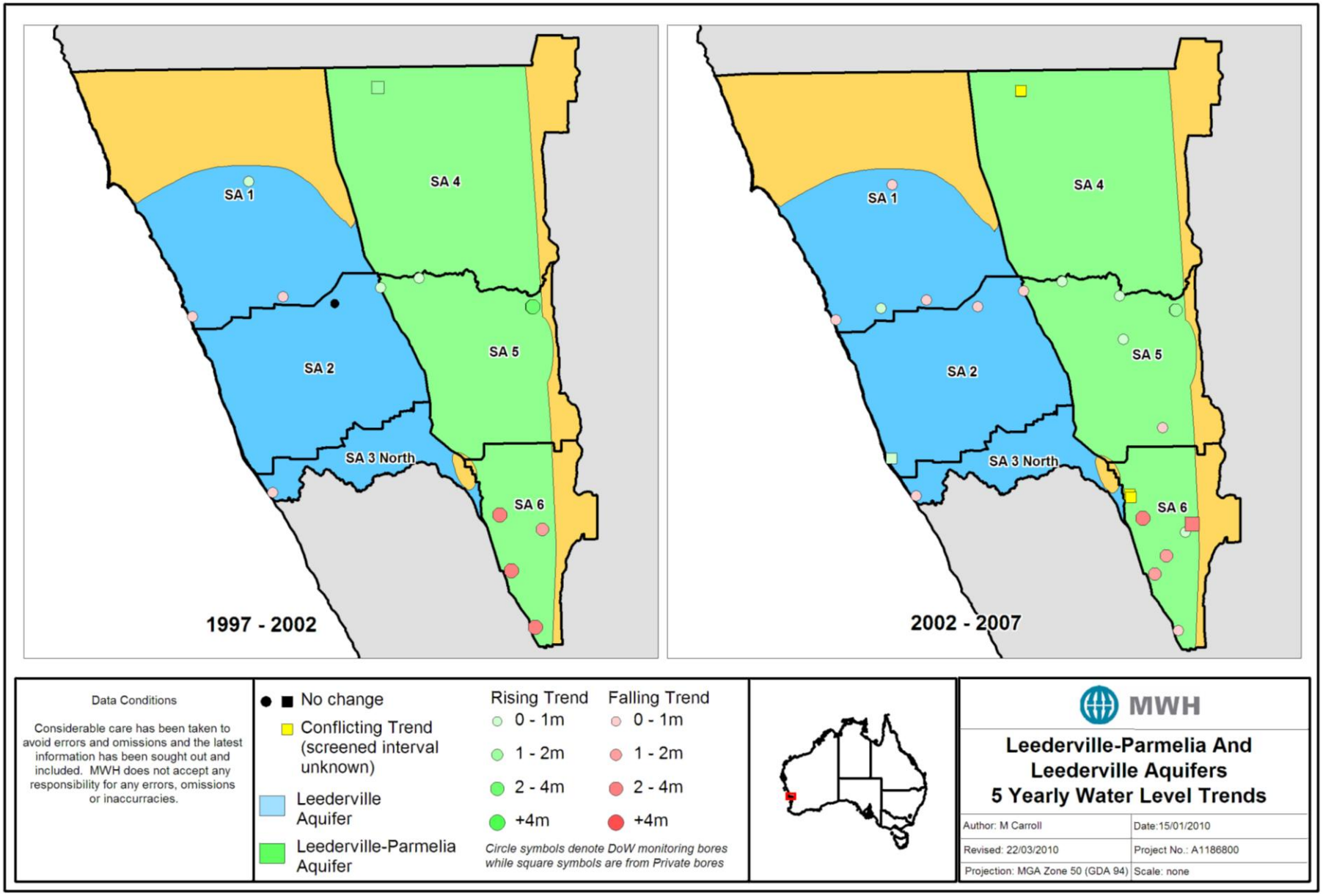


Figure 2-6: Qualitative changes in water levels between 1997 and 2007 for the Leederville and Leederville-Parmelia aquifers

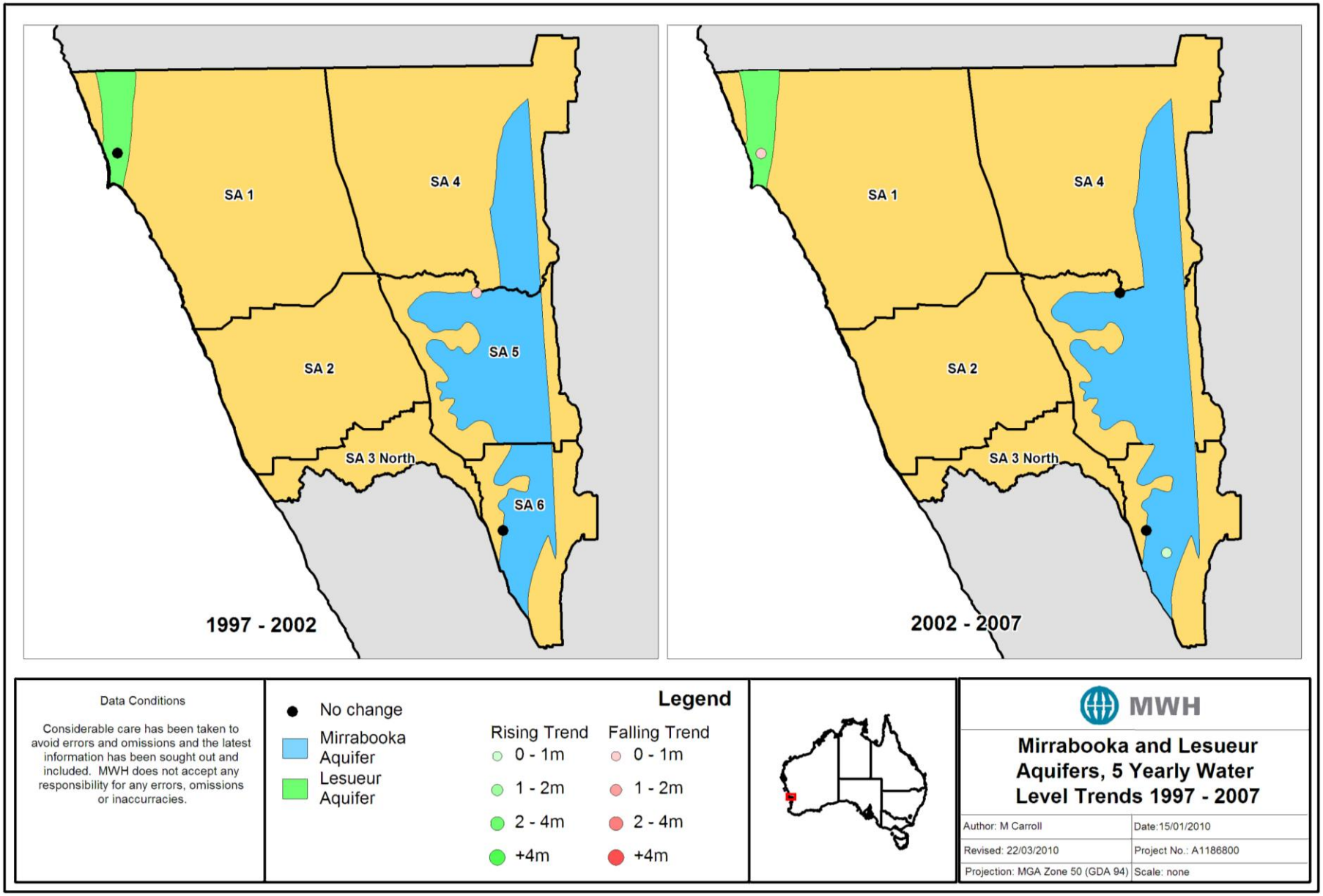


Figure 2-7: Qualitative changes in water levels between 1997 and 2007 for the Mirrabooka and Lesueur aquifers

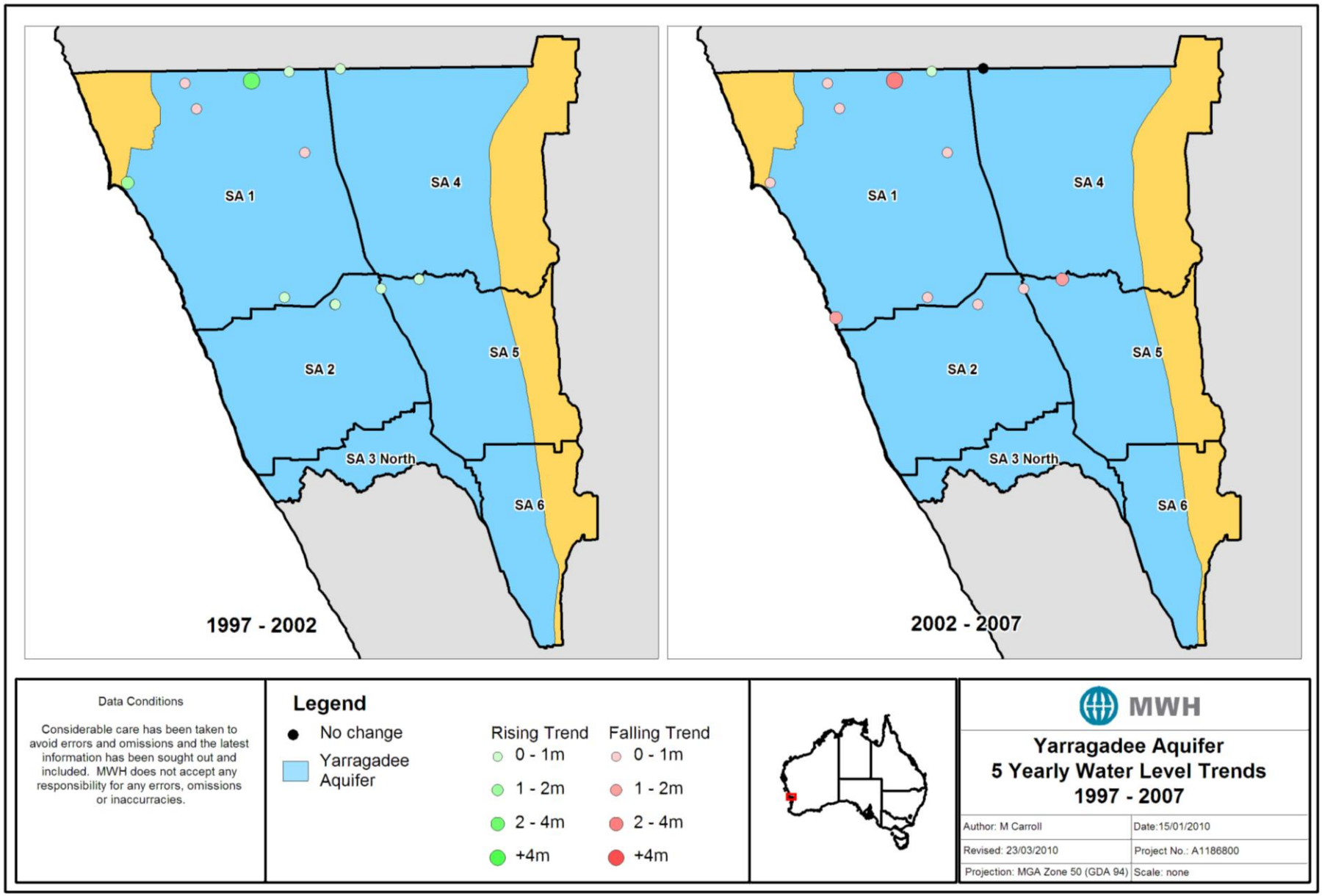


Figure 2-8: Qualitative changes in water levels between 1997 and 2007 for the Yarragadee aquifer

3 Monitoring bore hydrographs

Hydrographs are graphical representations of the groundwater level observed over time in a particular bore. Data is most often recorded as a depth below ground level or other reference point. These measurements have been converted into the Australian Height Datum (AHD). Wherever possible, the hydrographs are plotted with a common 20m elevation range and date scale for ease of comparison. However, in the larger sub-areas where there is greater variation in water level elevation, additional scales have been used.

3.1 Superficial aquifer

As outlined in Table 1, the Superficial aquifer is present and monitored within the following sub-areas:

- Wedge Island (29 hydrographs)
- Lancelin (5 hydrographs)
- Namming Lake (10 hydrographs)
- Karakin Lakes (11 hydrographs)
- North Moore River Park (5 hydrographs)
- Seabird (13 hydrographs)
- South Moore River Park (6 hydrographs)
- Guilderton North (5 hydrographs)
- Beermullah Plain North (9 hydrographs)
- Gingin Townsite (1 hydrograph)
- Eclipse Hill (5 hydrographs)

No monitoring data coverage exists in Red Gully and Deepwater Lagoon North, although the aquifer is present within these regions.

3.1.1 Wedge Island

Monitoring from the Wedge Island sub region consists of bores drilled as part of the Cataby Shallows program. Data extends as far back as 1985, although consistent data is available only from 1994 onwards for the majority of bores.

There are no uniform trends throughout the region, although there does appear to have been a peak in water levels between 2000 and 2002, followed by a more recent decline in water levels. This is largely reflected in Figure 2-5, although some examples of steady water levels near the coast and increased values near the eastern border are observed. The latter trend, observed in Bore CS26S and Bore CS26D, may require further clarification. It is driven by a sharp rise in water levels between 2005 and 2007, after an equally rapid decline in 2002.

3.1.2 Lancelin

The Lancelin sub region contains 5 bores drilled as part of the Cataby Shallows program in the north, and the Gillingarra Line in the south. Data collection extends as far back as 1982, although consistent monitoring data is available only after 1994. Data also exists since 1976 from monitoring bores drilled as part of a licensed abstraction program.

Overall, water levels appear to be steady with a slight decline since around 2006. Bore GL3W, near the eastern edge of the sub-area, displays a steady decline in water levels; current levels are almost 5 m lower than in 1991.

3.1.3 Namming Lake

Monitoring in this sub region consists of 10 monitoring points drilled as part of the Cataby Shallows program. As with previous sub regions, data collection began upon bore completion in 1985, although consistent monitoring data is available from 1994 onwards.

Where data extends to the present, the sub region appears to have experienced a historic rise in water levels, peaking between 2002 and 2004. In most cases water levels have declined slightly since then; this is reflected in Figure 2-5.

3.1.4 Karakin Lake

Monitoring bores within the Karakin Lake sub-area were established by the Salvado and Gingin Superficial drilling programs. Data availability is sporadic, with consistent monitoring taking place since 1996 for the Salvado Line bores and 2006 for the Gingin superficial bores. An additional hydrograph is presented for a private production bore, with water level data collection from 1992 onwards.

Water levels have been steadily declining, following an apparent peak between 2002 and 2003. The magnitude of the decline appears to increase in proportion to distance from the coast.

3.1.5 North Moore River Park

The 5 monitoring locations in the North Moore River Park sub-area were drilled as part of the Salvado Line program, with monitoring commencing in 1980 in some cases. Consistent monitoring has taken place since 1996 and reveals a steady decline in water levels of less than 1 m over 13 years.

3.1.6 Seabird

Monitoring bores within the Seabird sub-area were established by the Salvado and Gingin superficial drilling programs. As with the Karakin Lakes sub-area, consistent data is available from 1996 and 2006 for the Salvado Line and Gingin superficial bores respectively. Two vertical scales have been used for the hydrographs due to the wide range of water level elevations within this subarea.

The overall trend observed in the hydrographs is a slight, steady decline in water levels. The magnitude of the decline increases from less than 0.1 m by the coast to 0.3 m at the eastern extent of the sub-area. The sudden 3m increase in water levels observed in Bore 11a is currently under investigation, and will be reported separately.

3.1.7 South Moore River Park

South Moore River Park sub-area consists of 6 monitoring locations, drilled as part of the Salvado Line program. Consistent monitoring data is available since 1996, and shows a steady decrease in water levels between 0.1 m and 0.3 m in that time.

3.1.8 Guilderton North

The 5 monitoring locations within this sub-area originate from the Salvado Line, Gnangara Mound and Gingin Brook programs, the latter of which was commenced in late 2008. Additionally, two sets of monitoring data are presented from a private abstraction borefield, although the validity of recent fluctuations in this data cannot be verified.

Data from the Gnangara Mound Monitoring bores (GB1 and GB3) commences in 1978, and displays a slight rise in water levels until 1992, followed by a steady decrease of almost 2 m to the present. Closer to the coast, Bore 22A displays a smaller decline, and water levels may be considered steady. There is not enough data from the recently drilled Gingin Brook program to firmly establish any long term trends.

3.1.9 Beermullah Plain North

Data from the Beermullah Plain North sub-area consists of bores drilled as part of the Salvado Line, Gingin superficial and Gingin Brook programs. Salvado Line data is regularly available from 1996, Gingin superficial data commences in 2006, and the recent Gingin Brook data extends back to 2008.

Water levels in this sub-area appear to have been steady until 2000. More recently, levels have declined up to 1 m.

3.1.10 Gingin Townsite

There is a single monitoring bore present in the Gingin Townsite sub-area, and monitoring only commenced at the end of 2008. Therefore no long term trends can be identified for this location.

3.1.11 Eclipse Hill

Monitoring bores within the Eclipse Hill subarea were constructed as part of the Gnangara Mound Monitoring program, and data extends back to 1977 for all the bores.

There is no consistent trend observed in the data, although trend analysis suggests a decline. Bore GC15 and GC18 displays steady, yet fluctuating water levels throughout the period of 1977 to 2009, however, Bore GC3 has experienced a steady 5 m decline in water levels over the same period, while GD20 demonstrates an approximate 3 m decline in water levels since 1992. The true extent of this is masked by fluctuations in the order of 4 m.

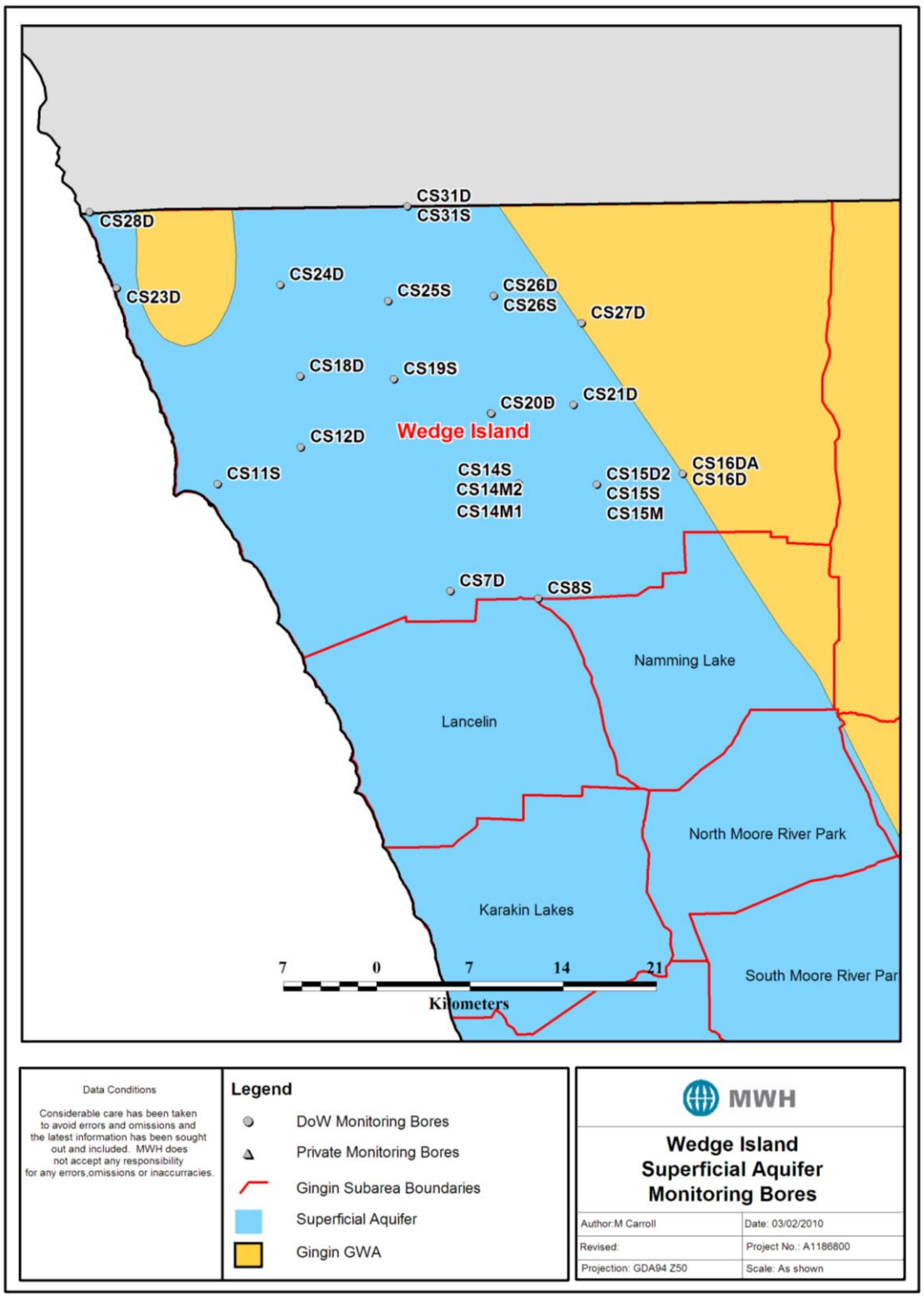
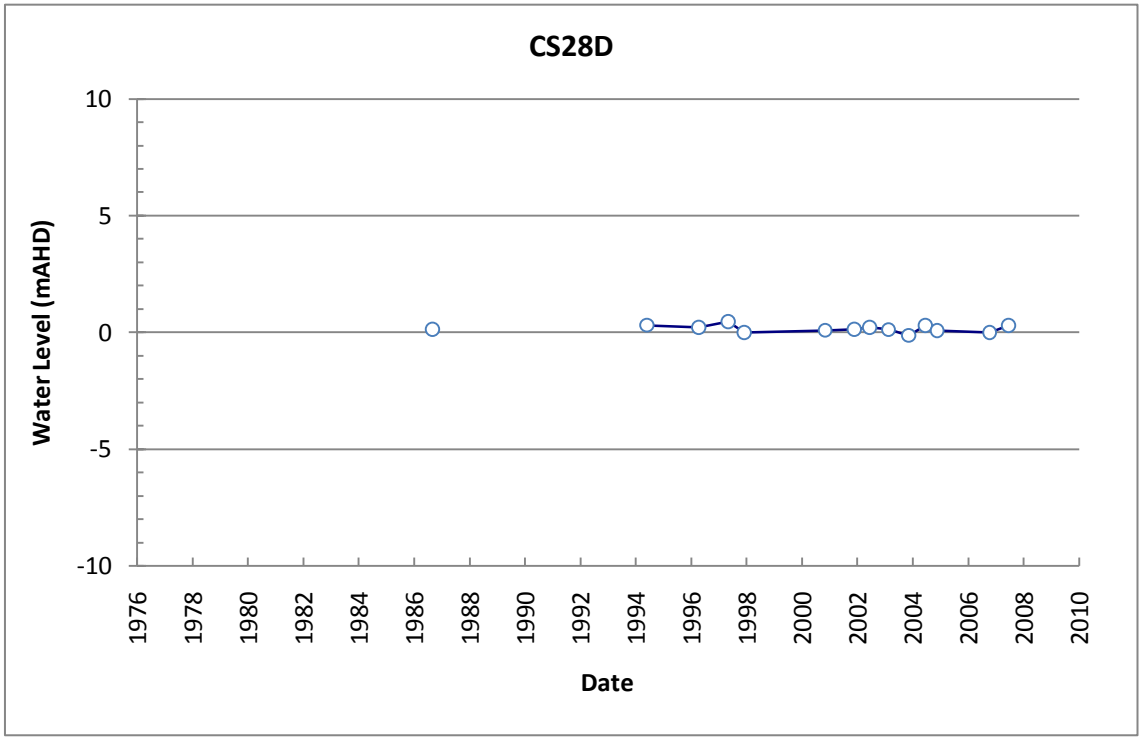


Figure 3-1: Wedge Island sub-area - monitoring bores within the Superficial aquifer


CS28D
Water Level (mAHD)
10
5
0
-5
-10
1976
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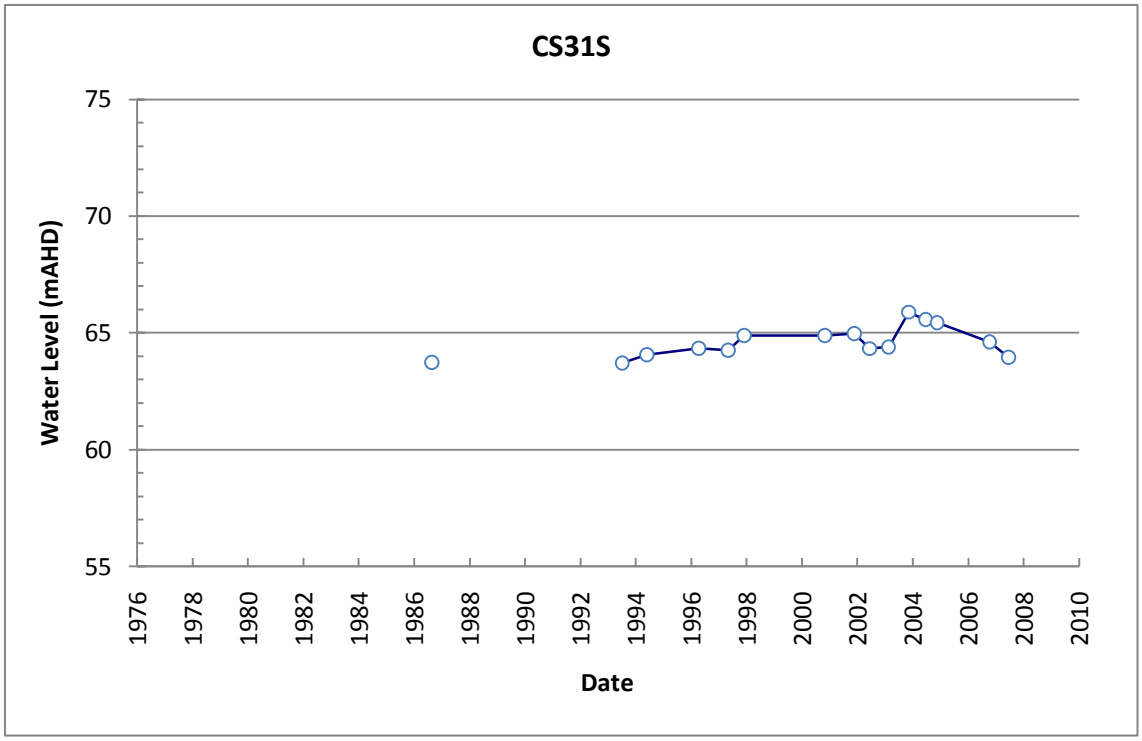
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


CS31S
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
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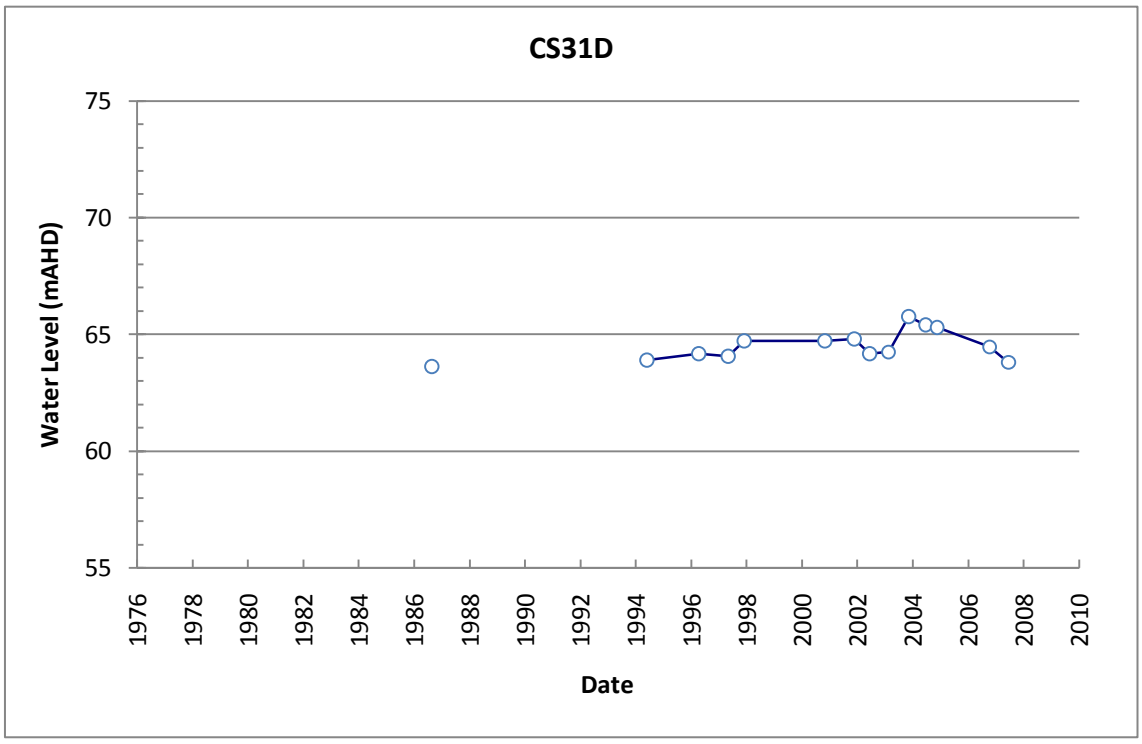
Date


CS31D
Water Level (mAHD)
75
70
65
60
55
1976
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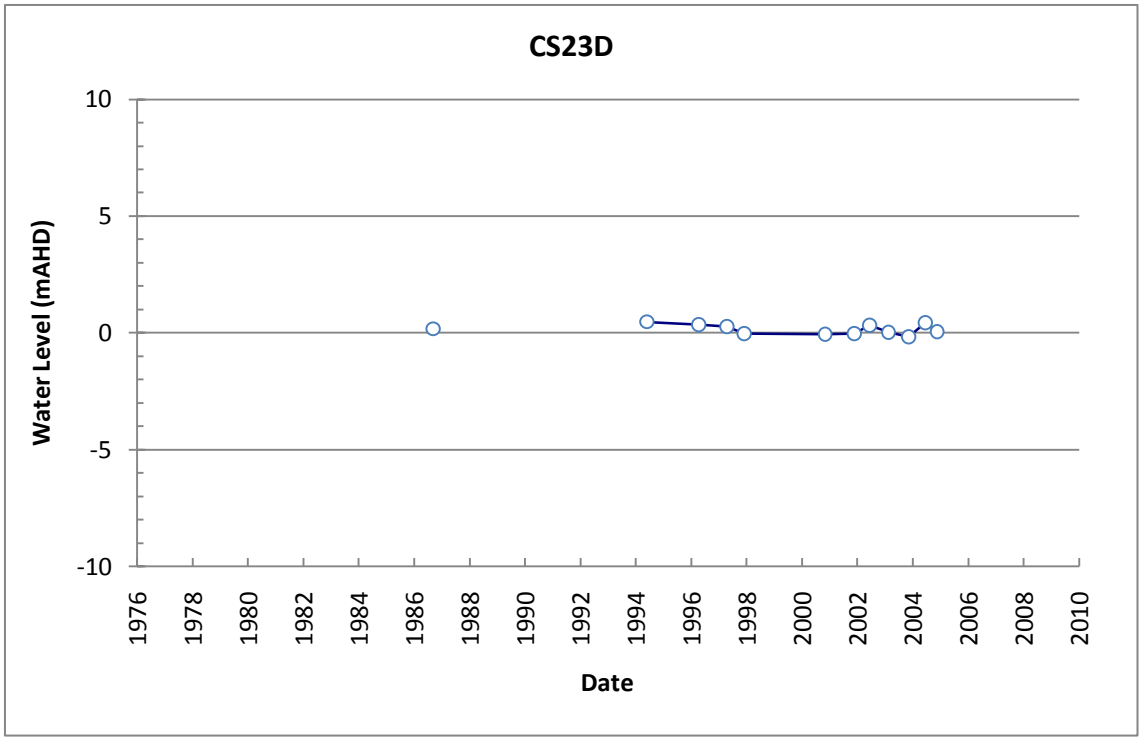
CS23D
Water Level (mAHD)
10
5
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-5
-10
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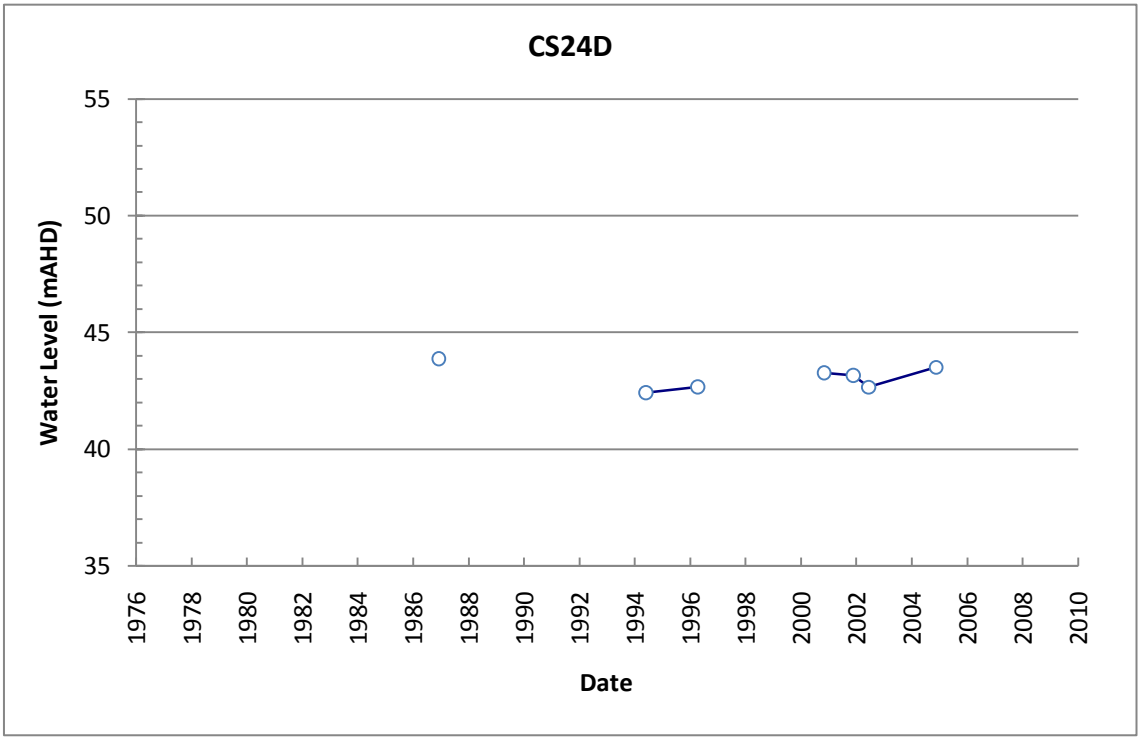
CS24D
Water Level (mAHD)
55
50
45
40
35
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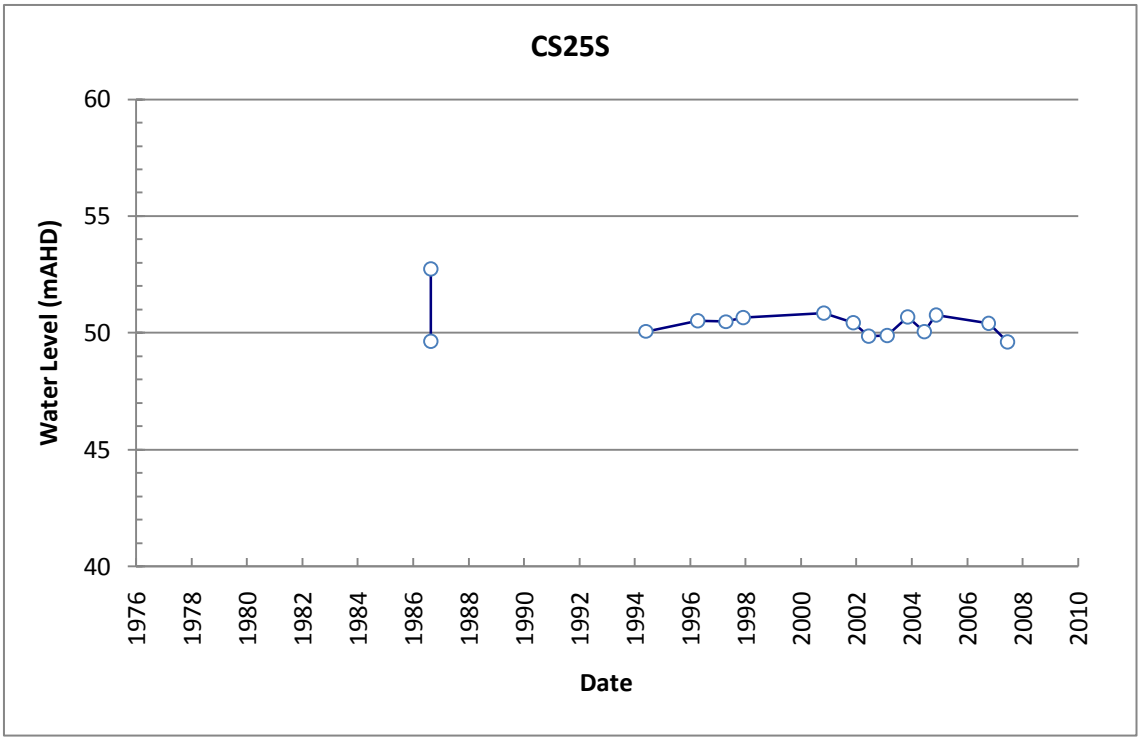
CS25S
Water Level (mAHD)
60
55
50
45
40
1976
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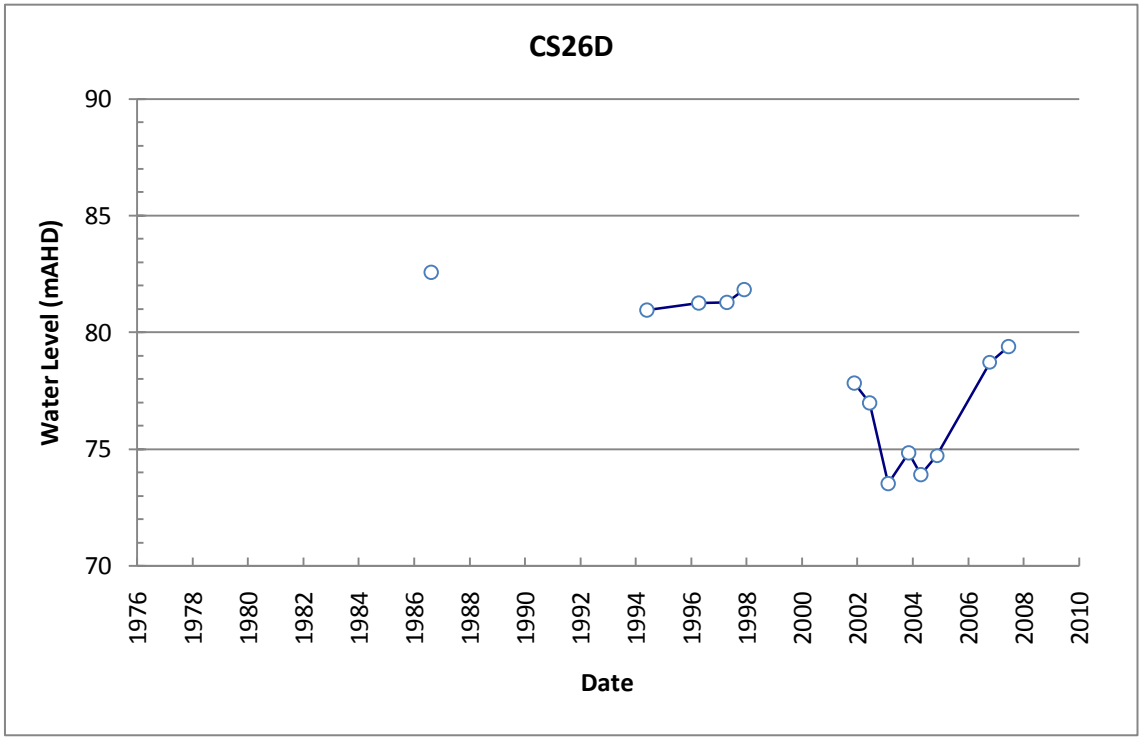
CS26D
Water Level (mAHD)
90
85
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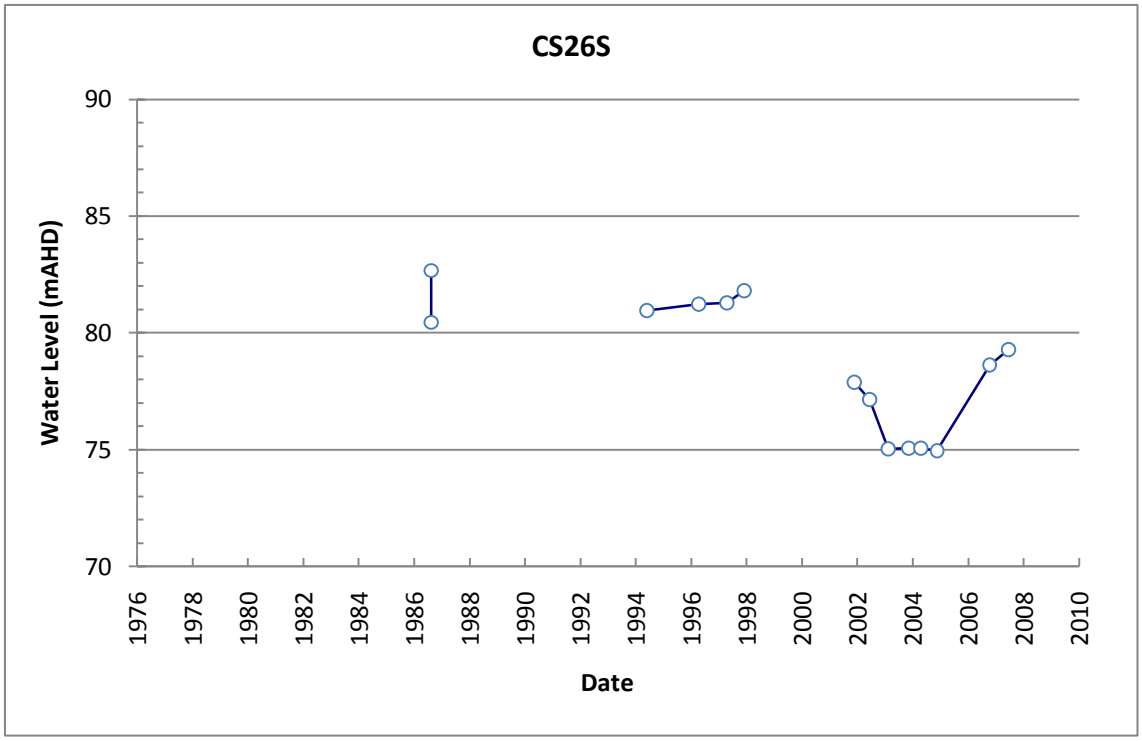
CS26S
Water Level (mAHD)
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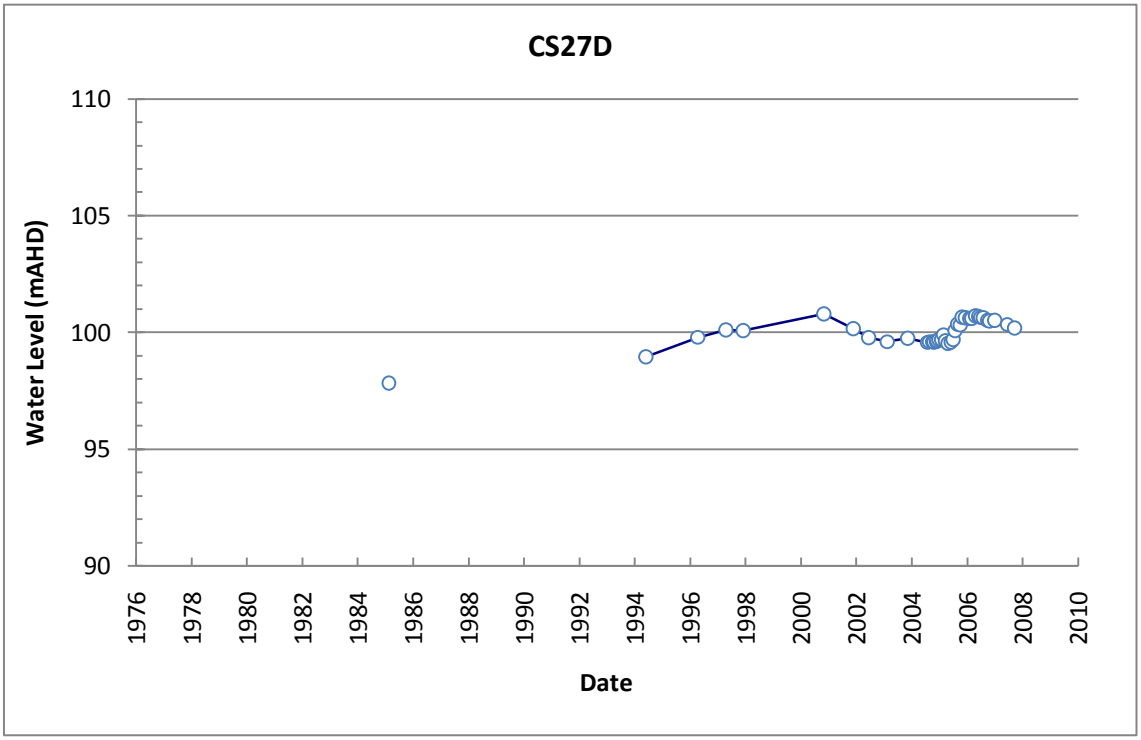
Date


CS27D
Water Level (mAHD)
110
105
100
95
90
1976
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1980
1982
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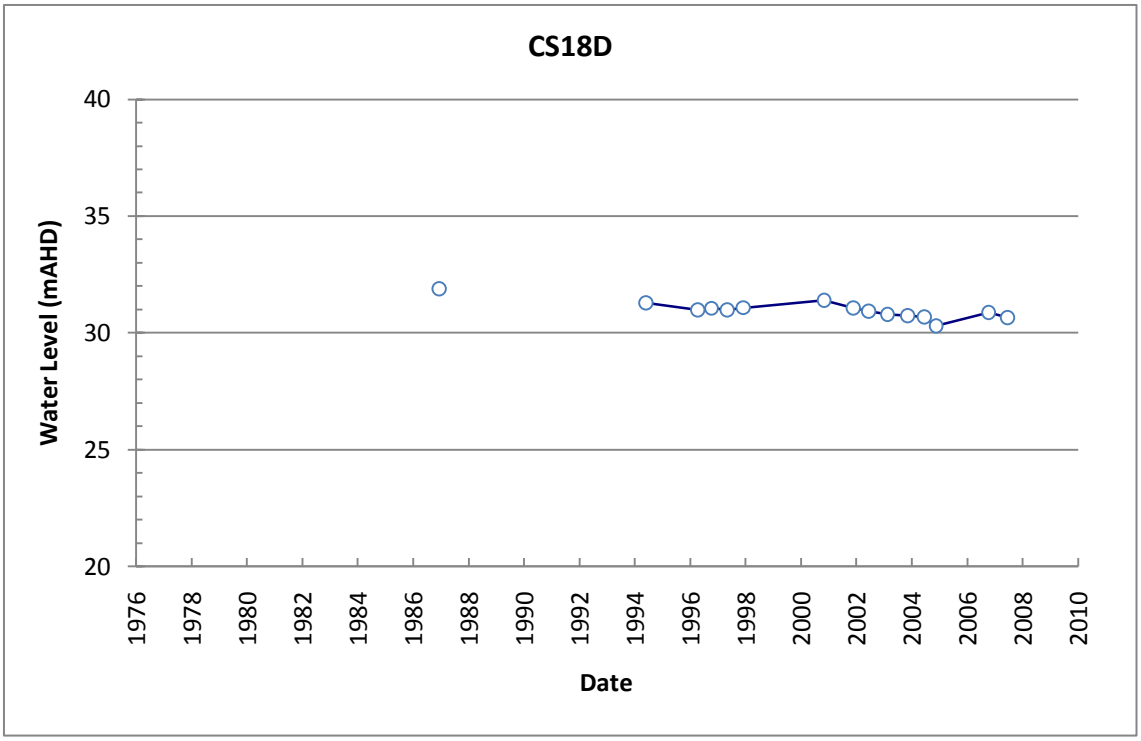
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


CS18D
Water Level (mAHD)
40
35
30
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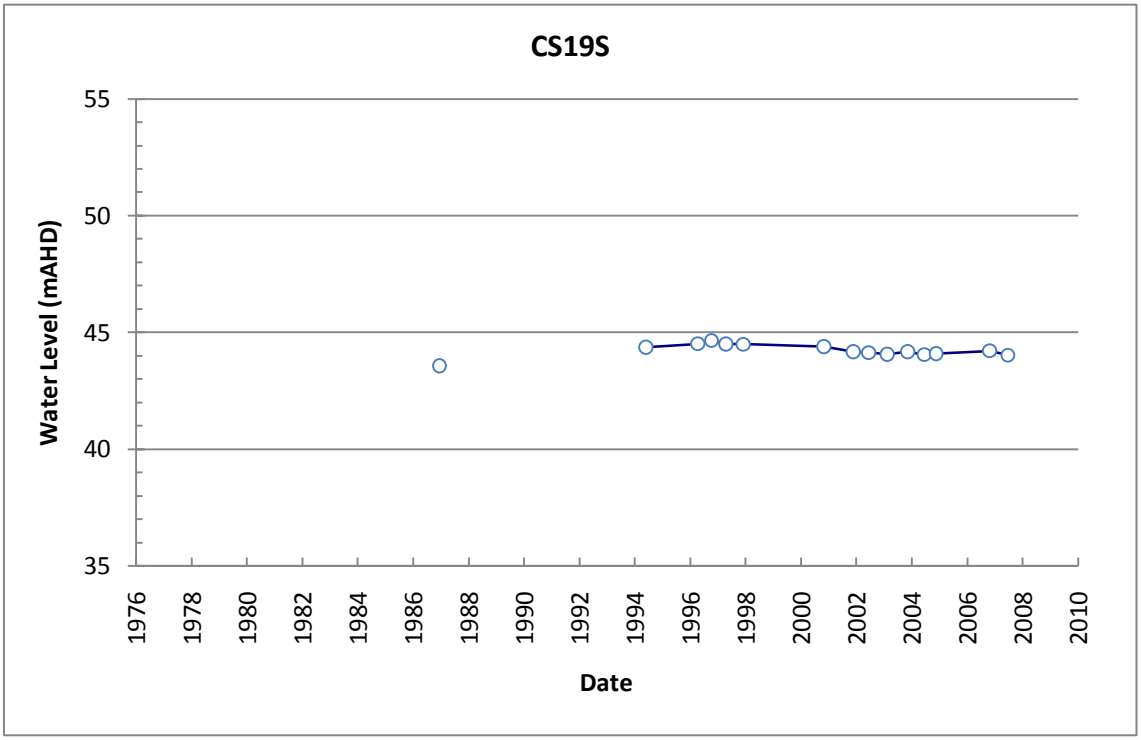
Date


CS19S
Water Level (mAHD)
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45
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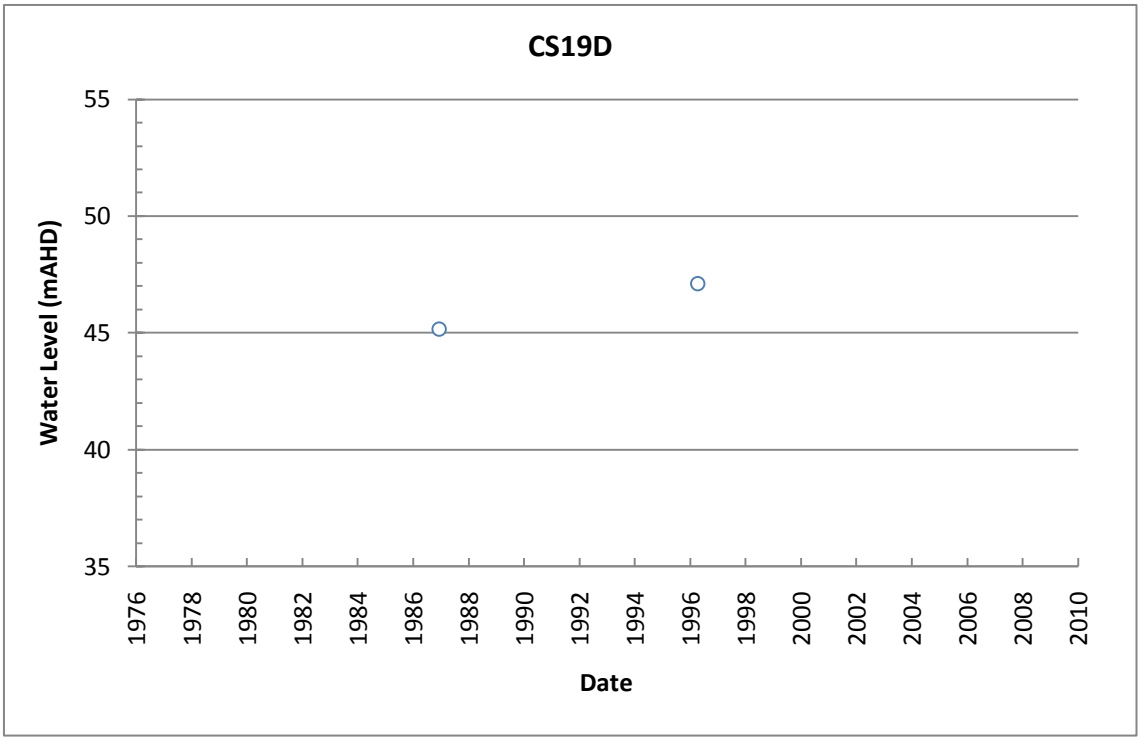
CS19D
Water Level (mAHD)
55
50
45
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2006
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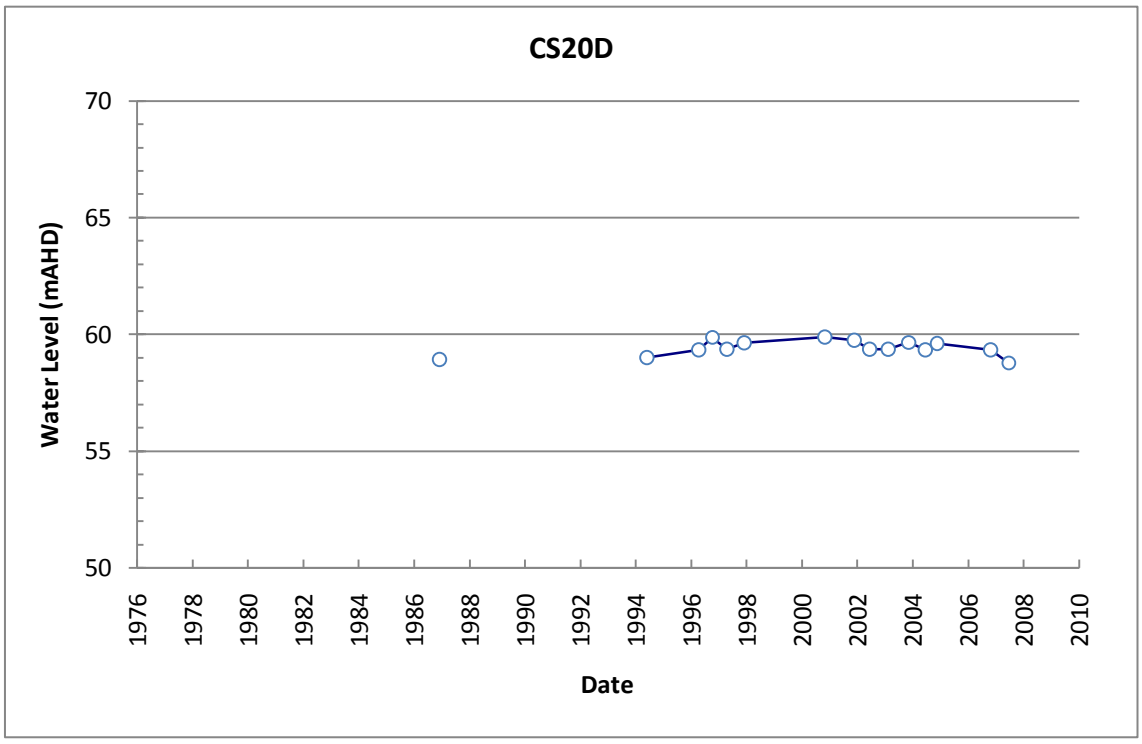
Date


CS20D
Water Level (mAHD)
70
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60
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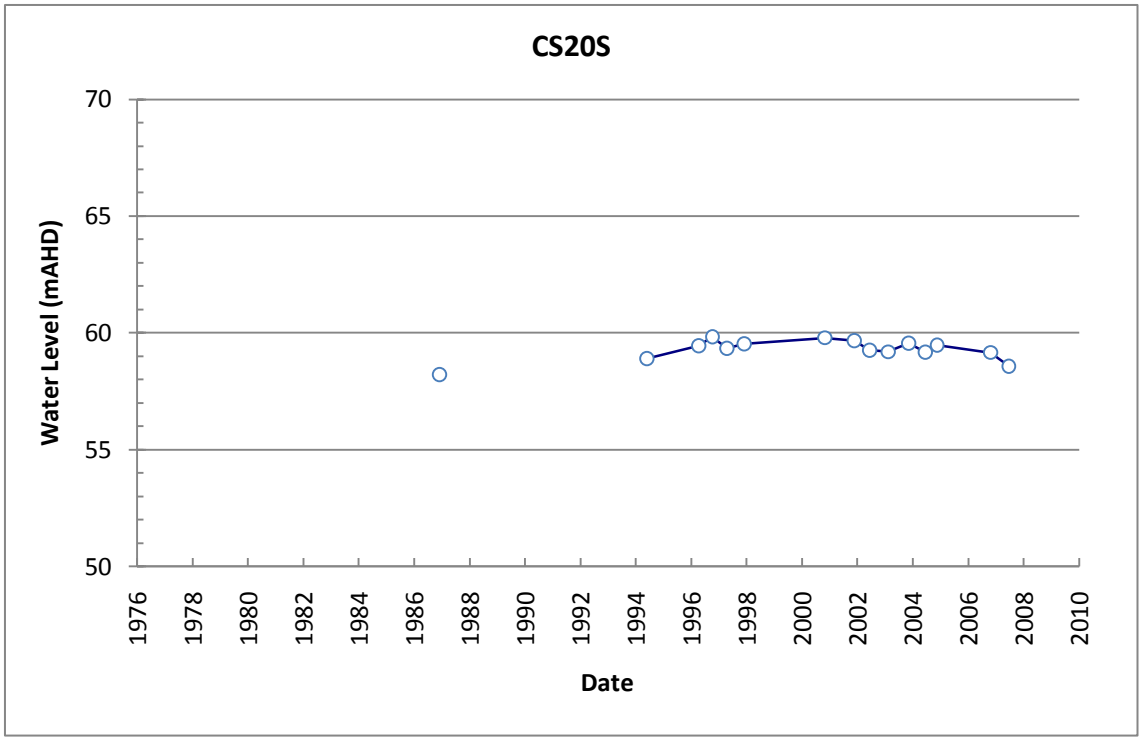
CS20S
Water Level (mAHD)
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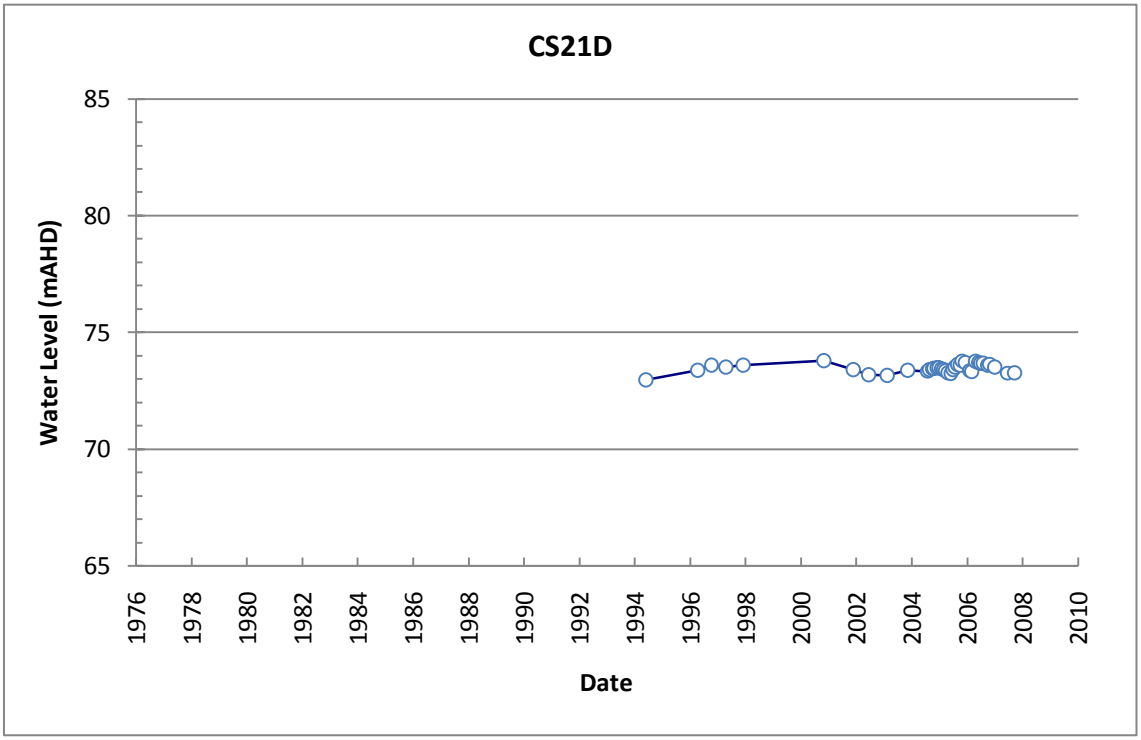
CS21D
Water Level (mAHD)
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75
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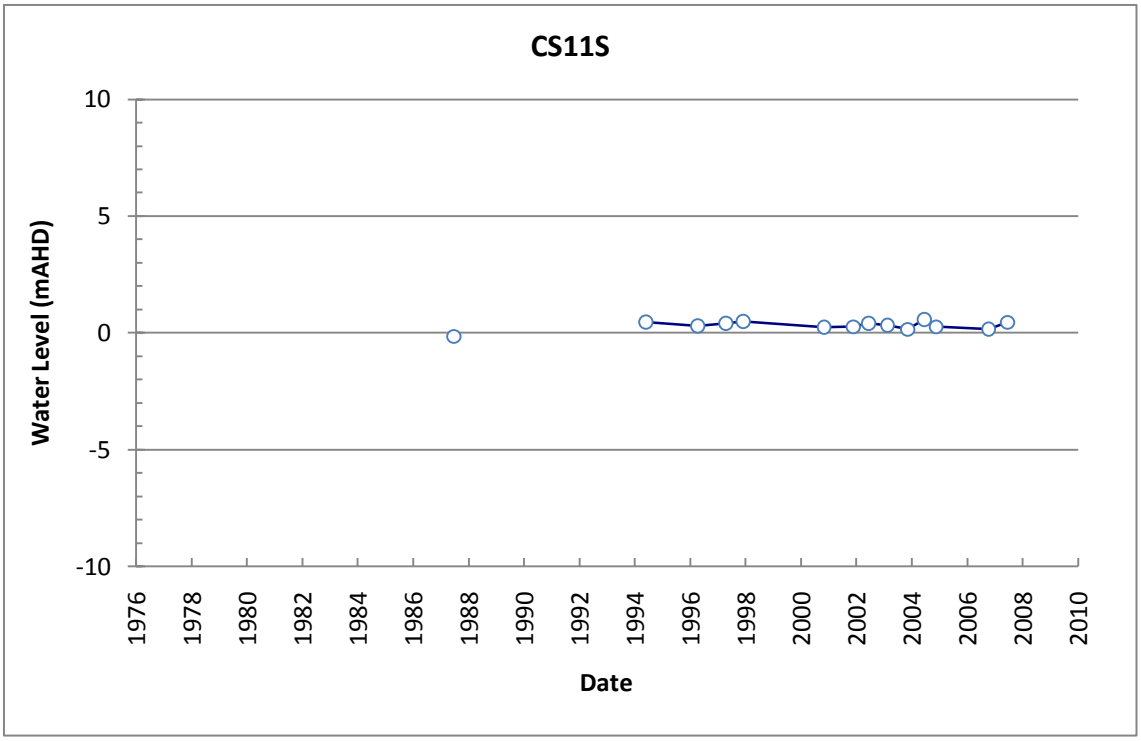
CS11S
Water Level (mAHD)
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-5
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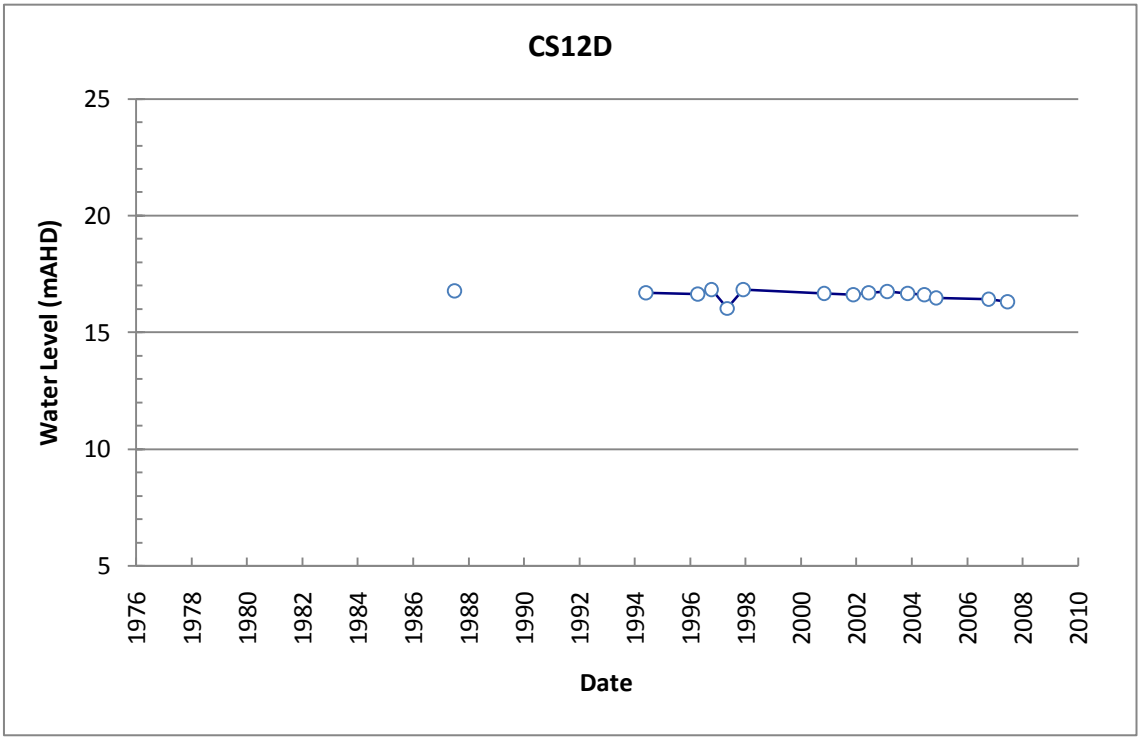
Date


CS12D
Water Level (mAHD)
25
20
15
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2002
2004
2006
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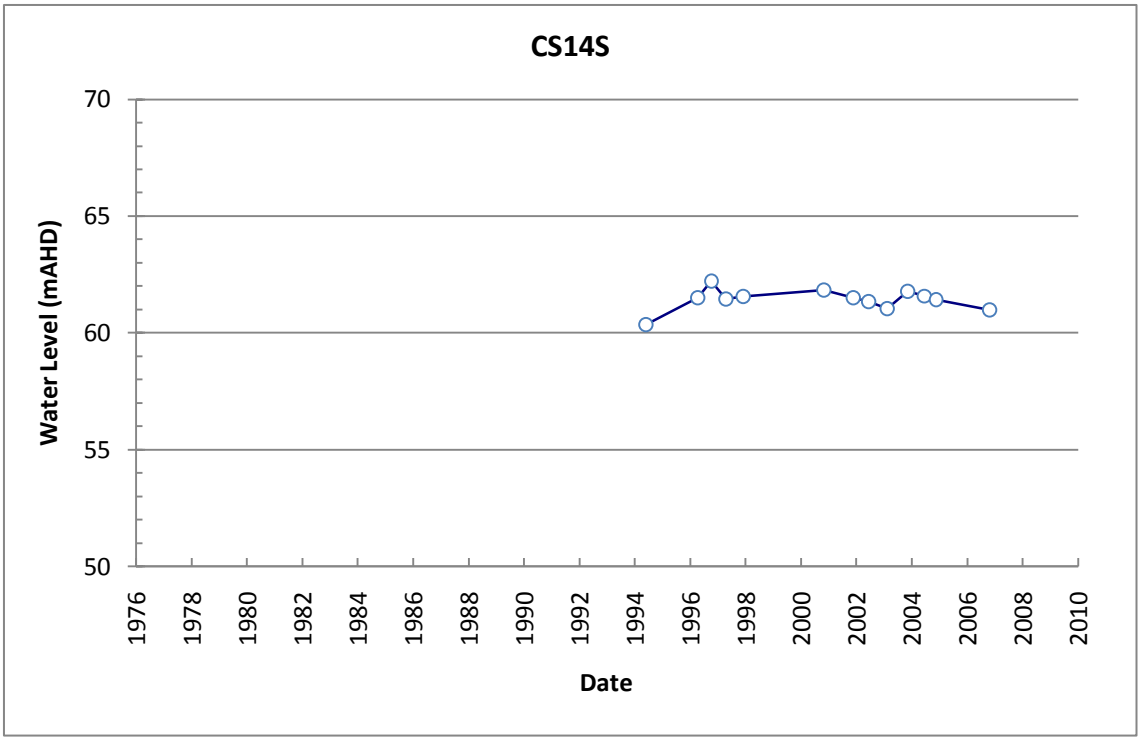
2010
Date


CS14S
Water Level (mAHD)
70
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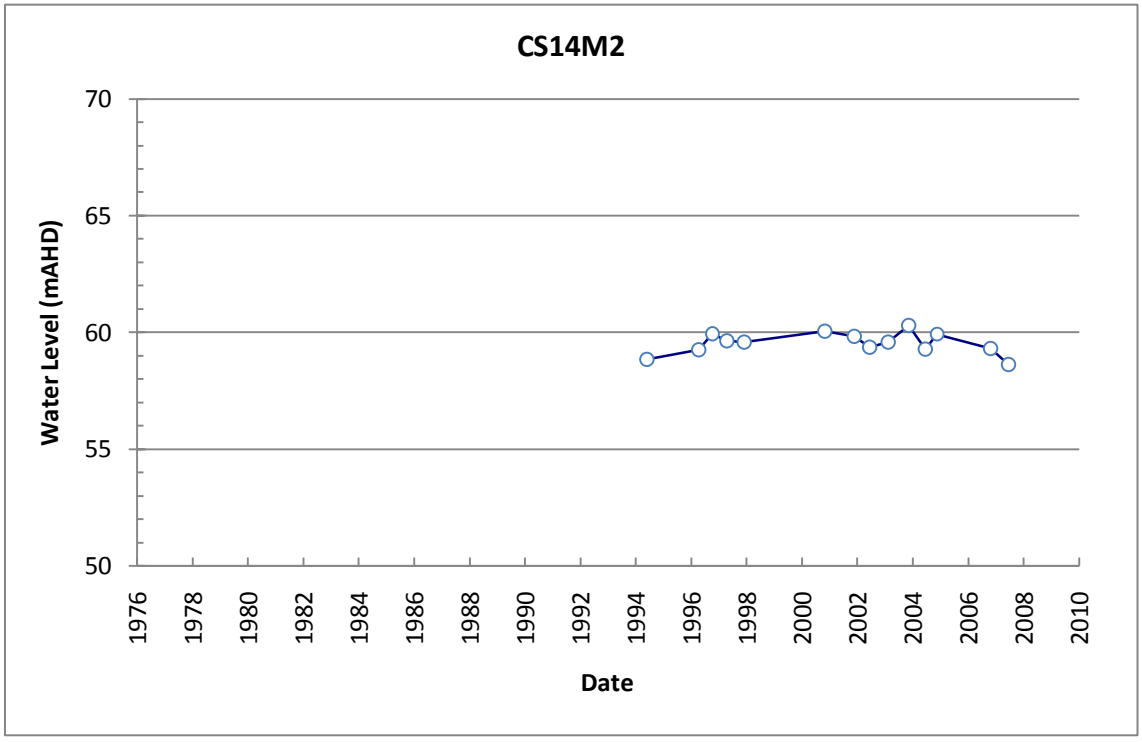
CS14M2
Water Level (mAHD)
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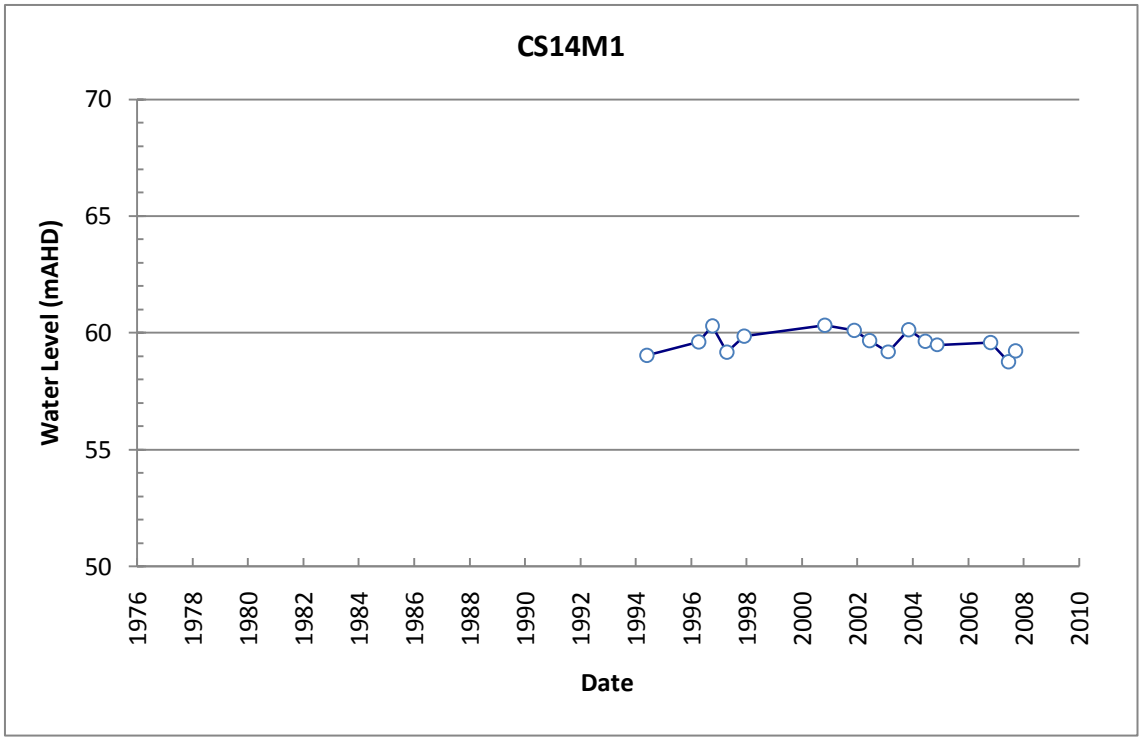
CS14M1
Water Level (mAHD)
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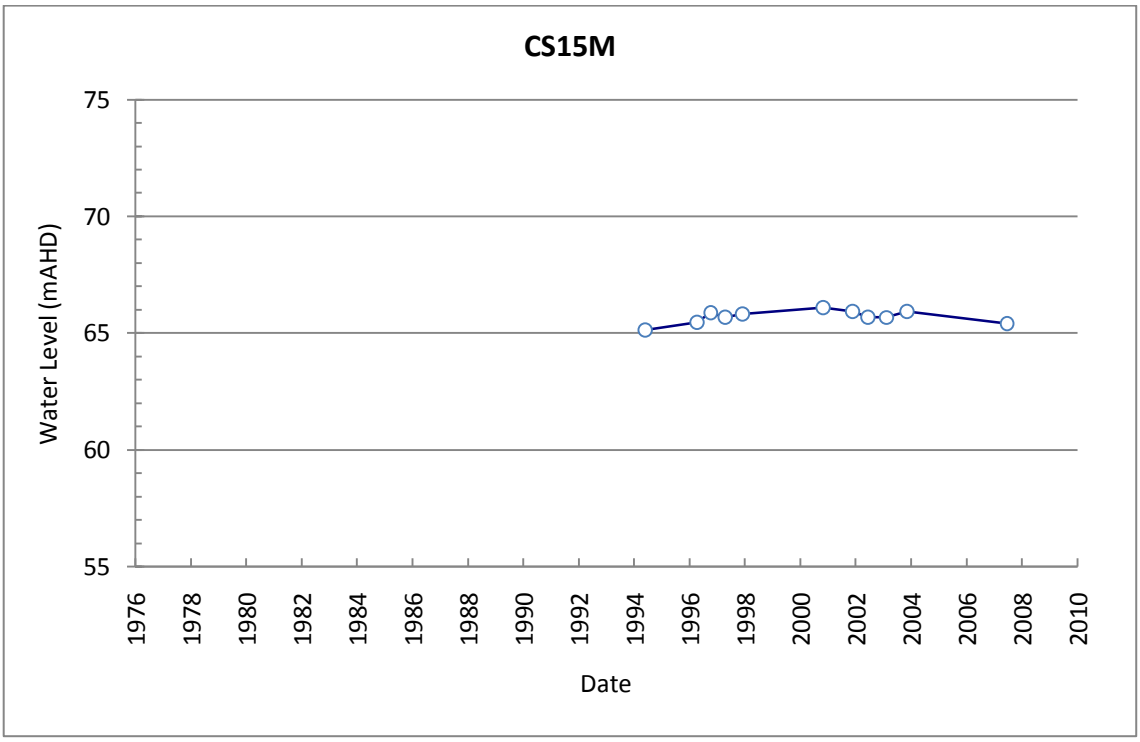
Date


CS15M
Water Level (mAHD)
75
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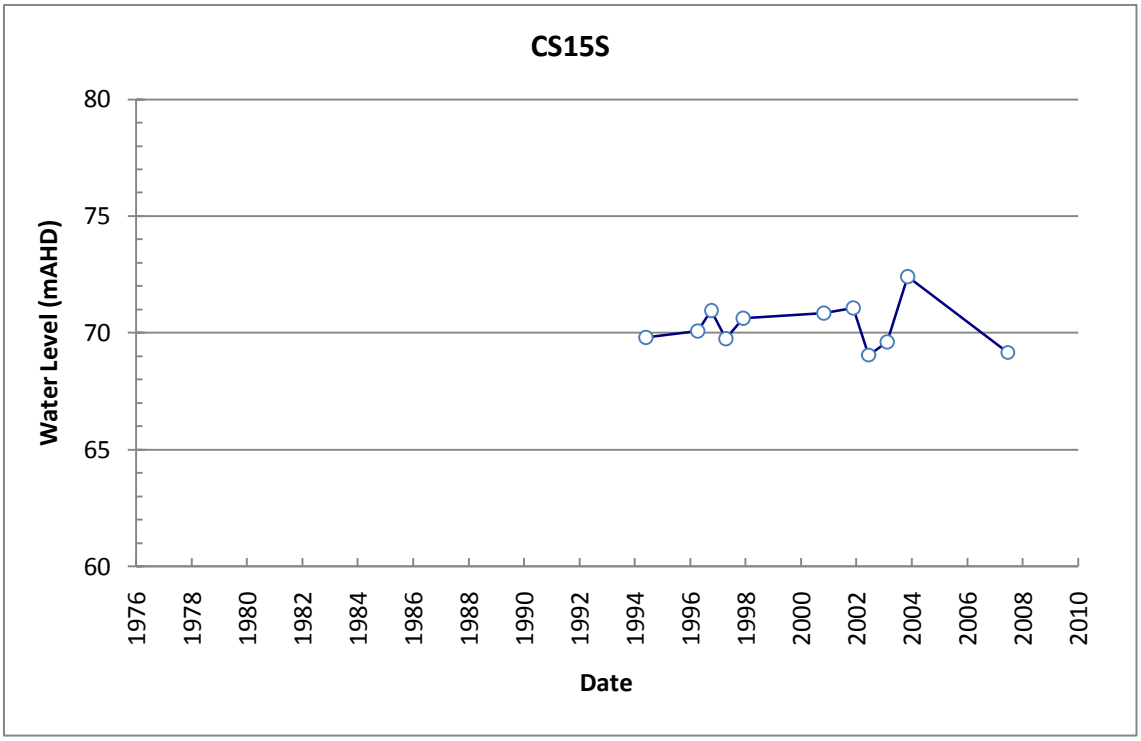
Date


CS15S
Water Level (mAHD)
80
75
70
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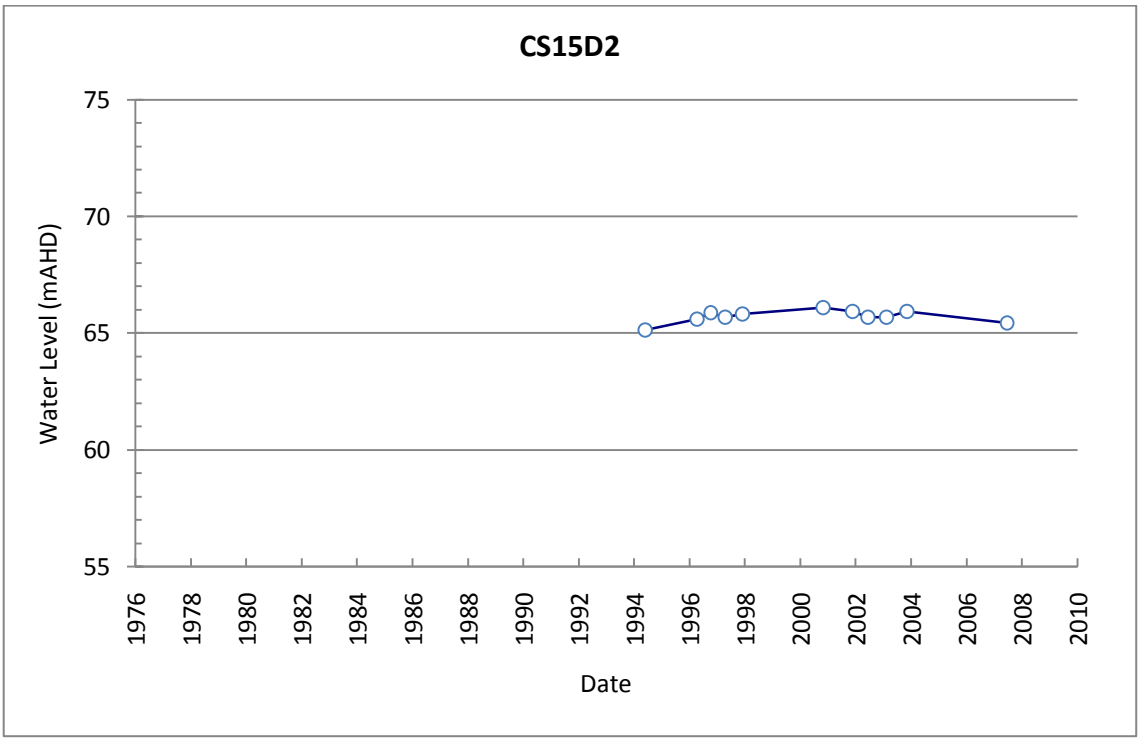
Date


CS15D2
Water Level (mAHD)
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65
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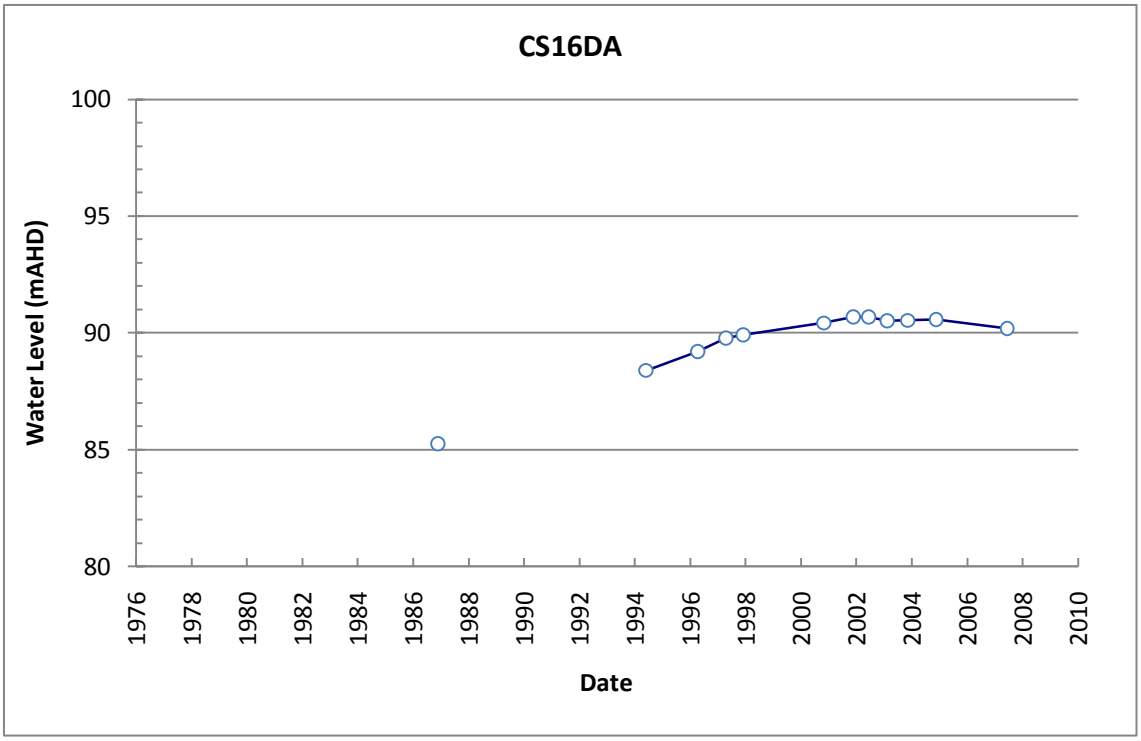
Date


CS16DA
Water Level (mAHD)
100
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90
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2006
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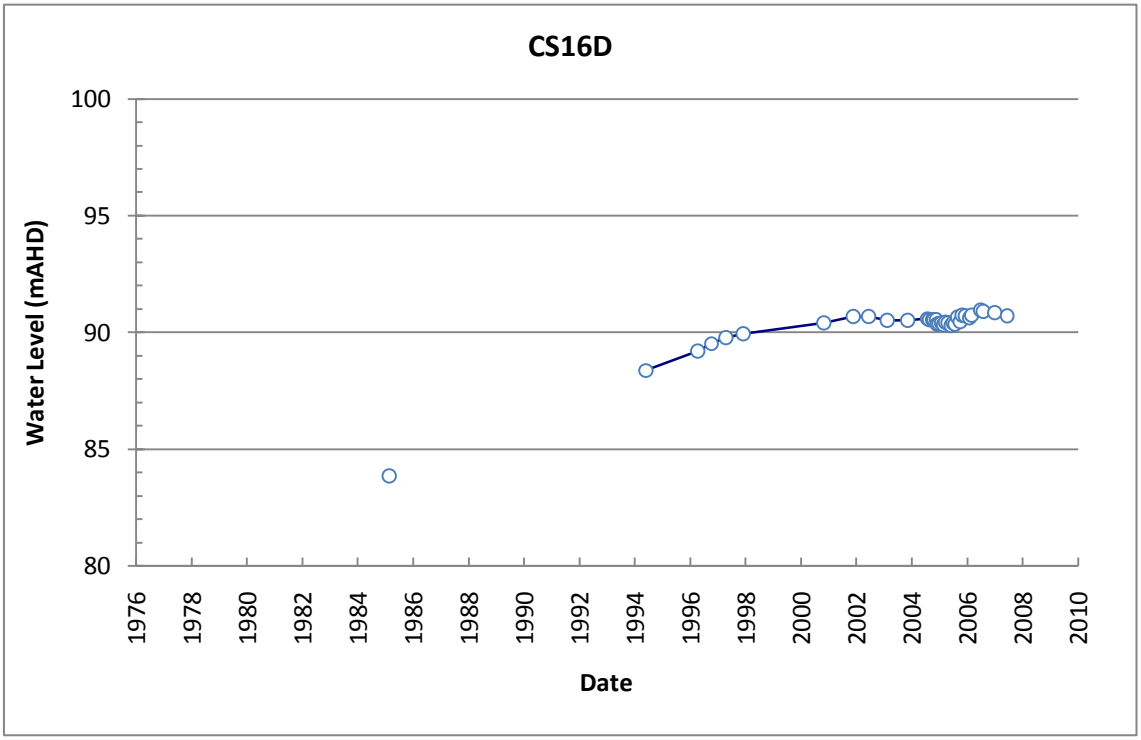
Date


CS16D
Water Level (mAHD)
100
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90
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2006
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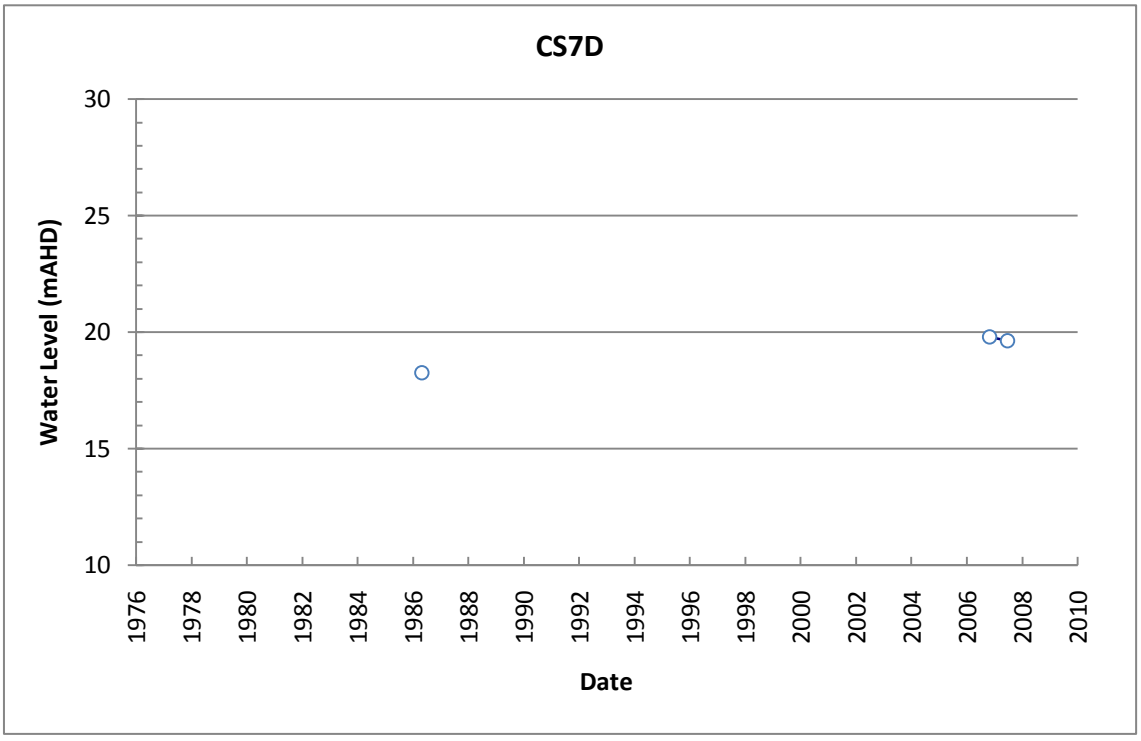
Date


CS7D
Water Level (mAHD)
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25
20
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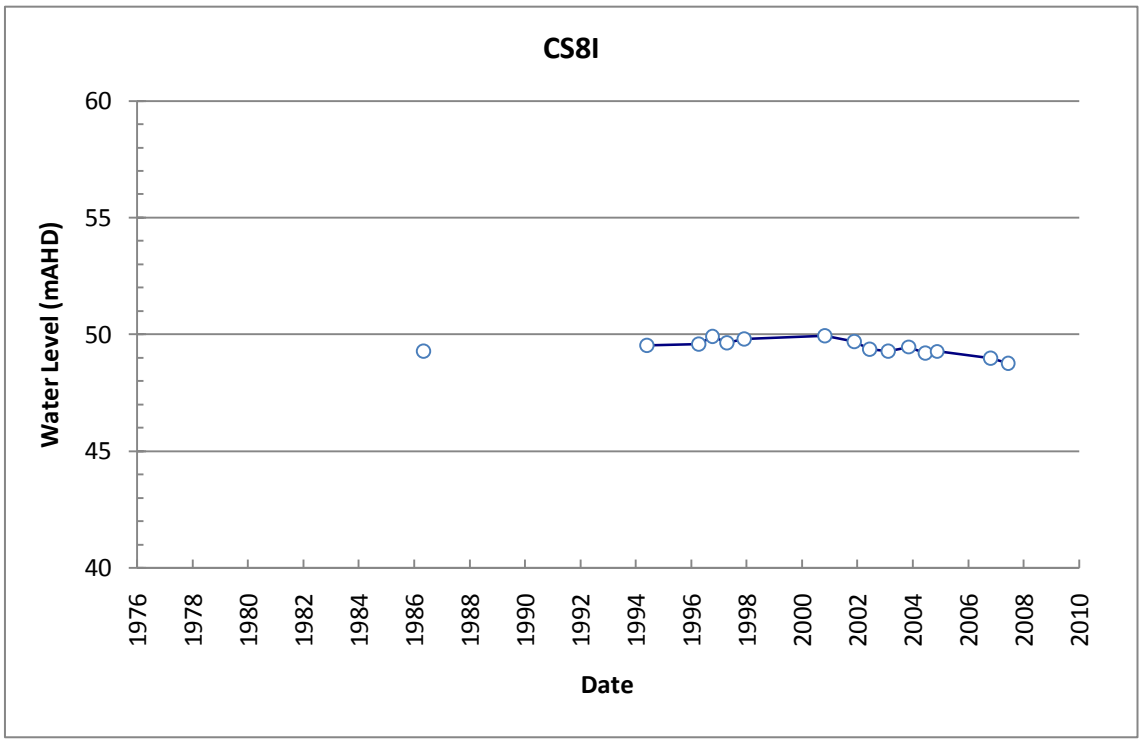
Date


CS8I
Water Level (mAHD)
60
55
50
45
40
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1982
1984
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1998
2000
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2006
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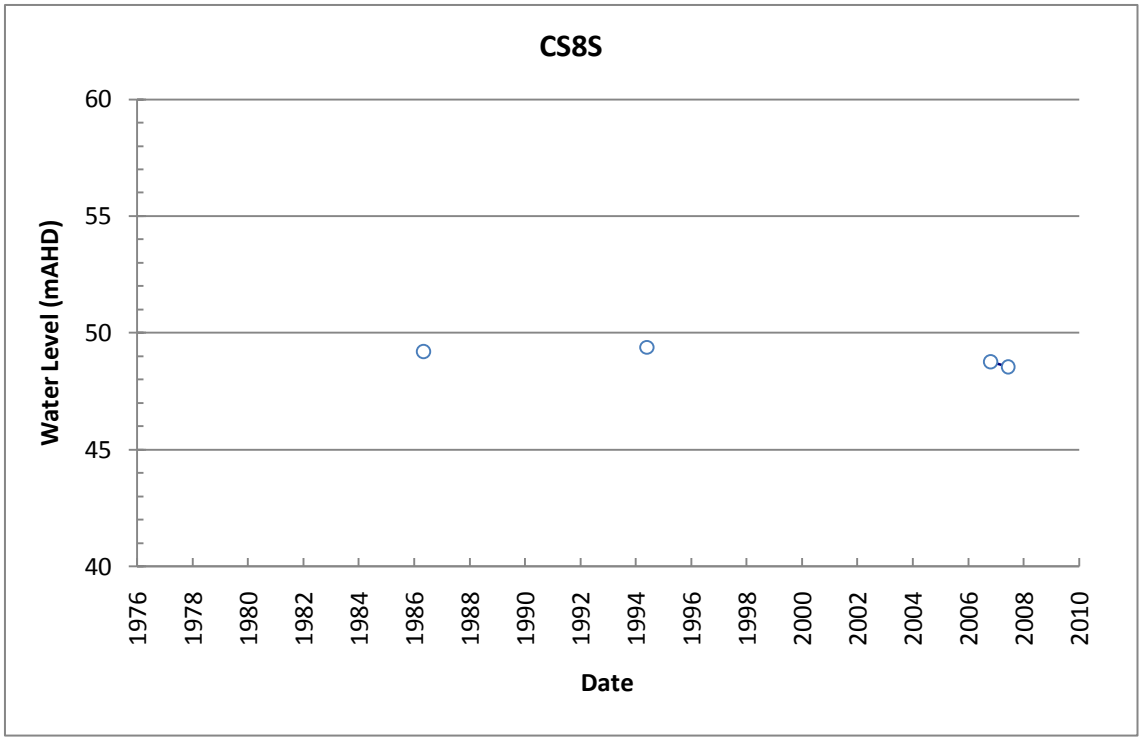
Date


CS8S
Water Level (mAHD)
60
55
50
45
40
1976
1978
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1982
1984
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1998
2000
2002
2004
2006
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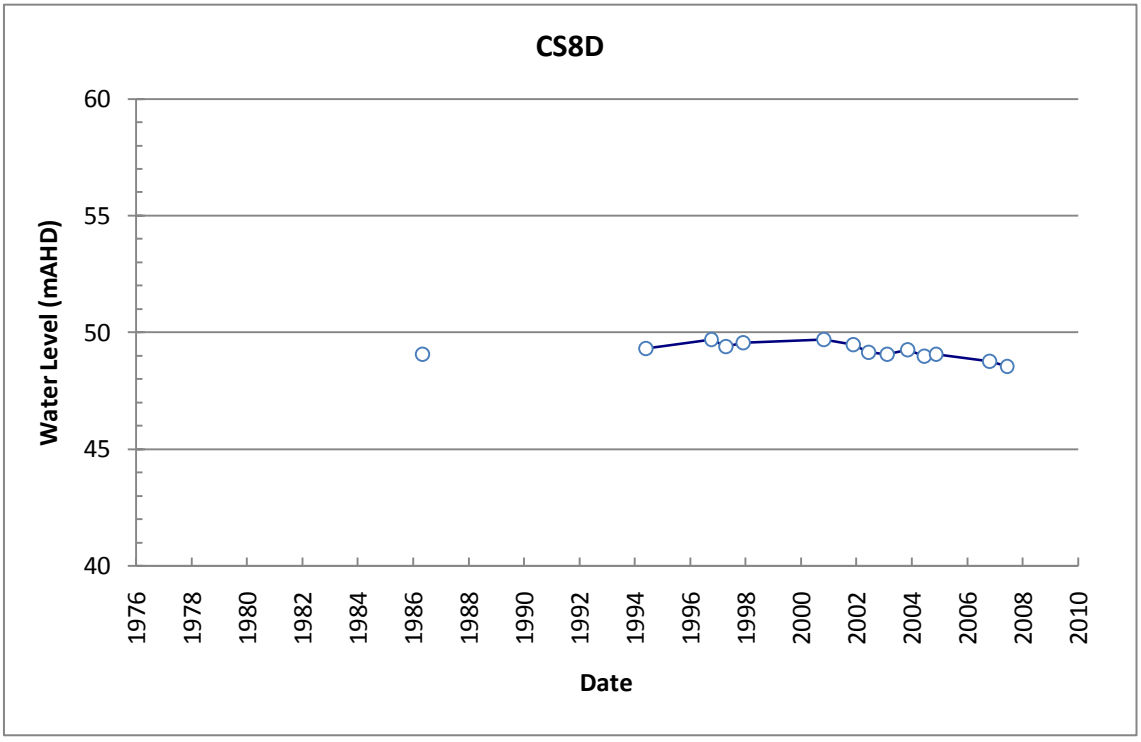
Date


CS8D
Water Level (mAHD)
60
55
50
45
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1998
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2002
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Date

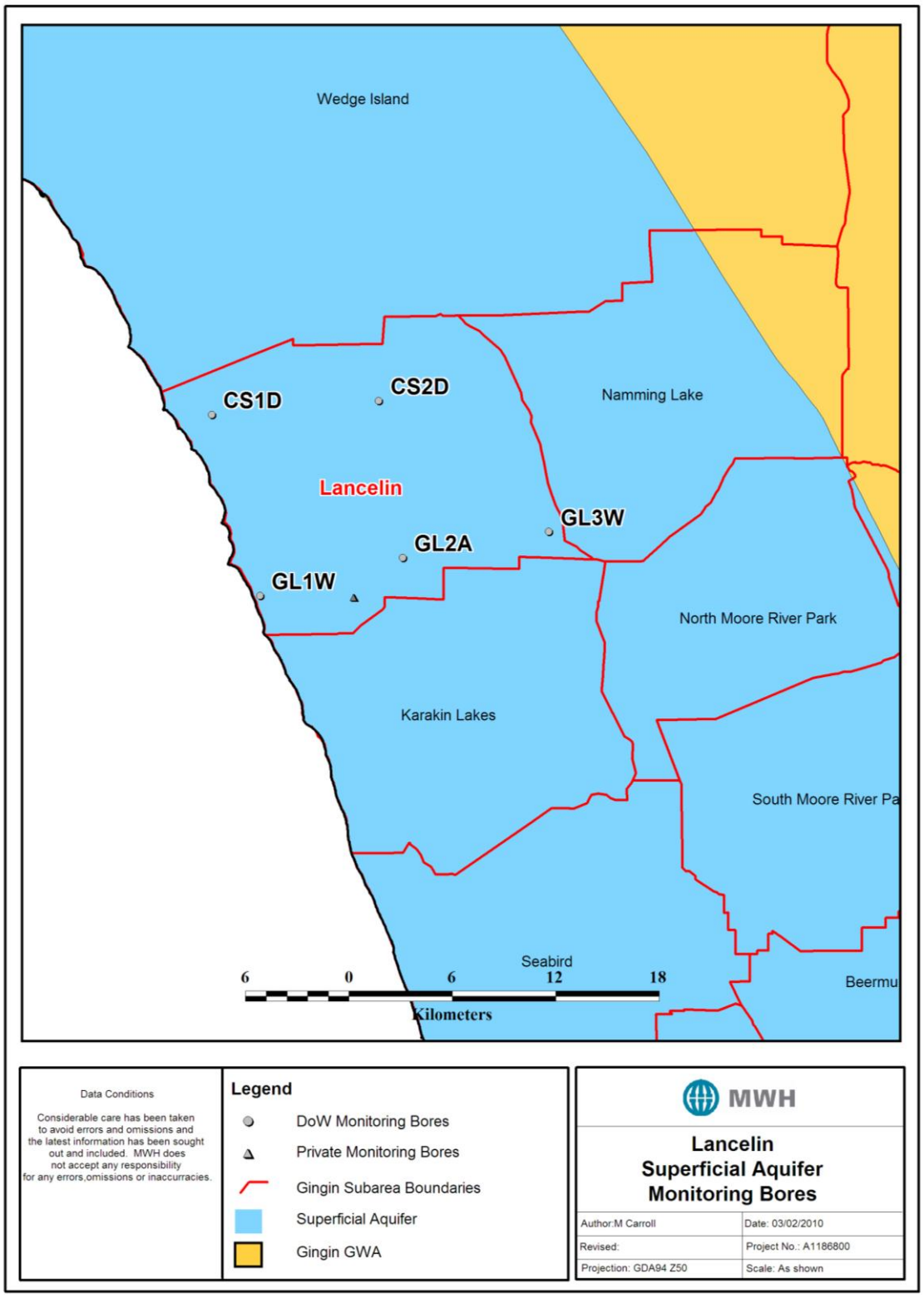
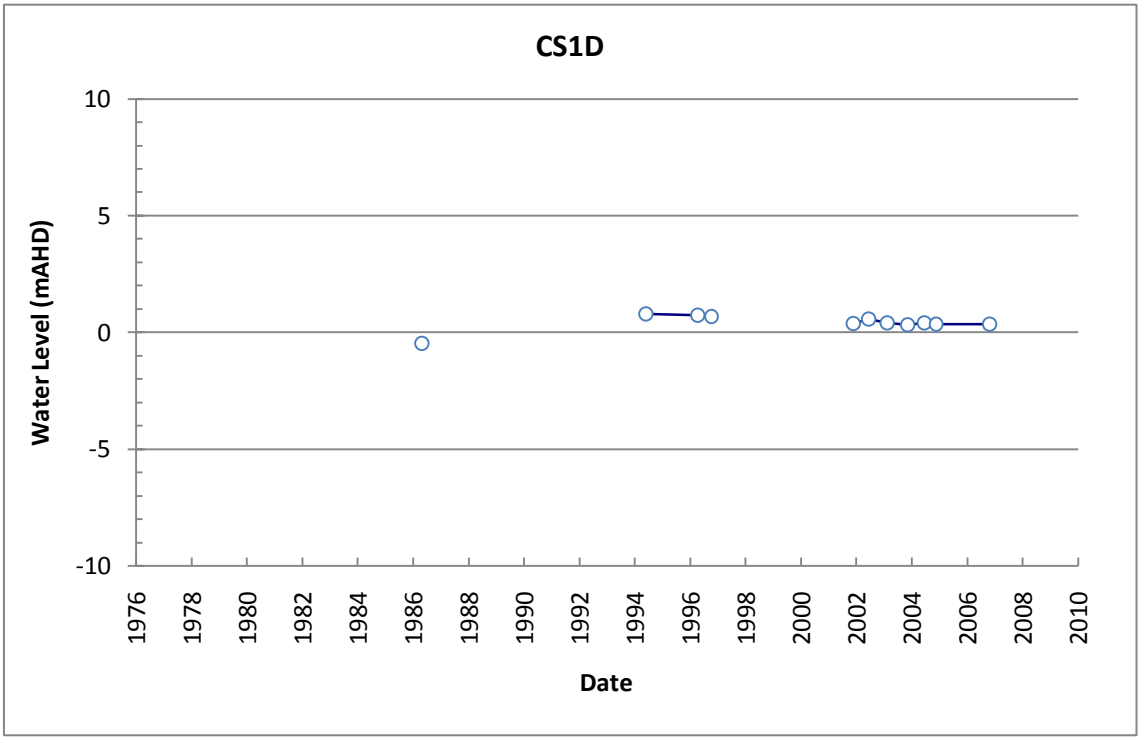


Figure 3-2: Lancelin sub-area - monitoring bores within the Superficial aquifer


CS1D
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
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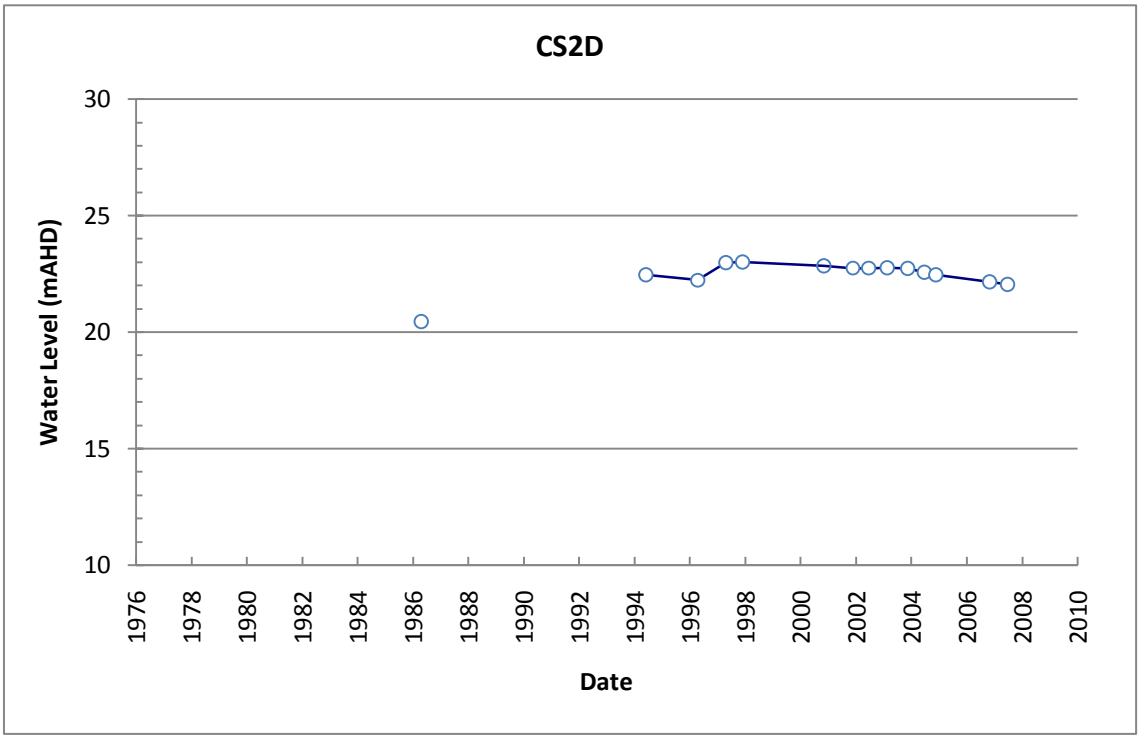
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


CS2D
Water Level (mAHD)
30
25
20
15
10
1976
1978
1980
1982
1984
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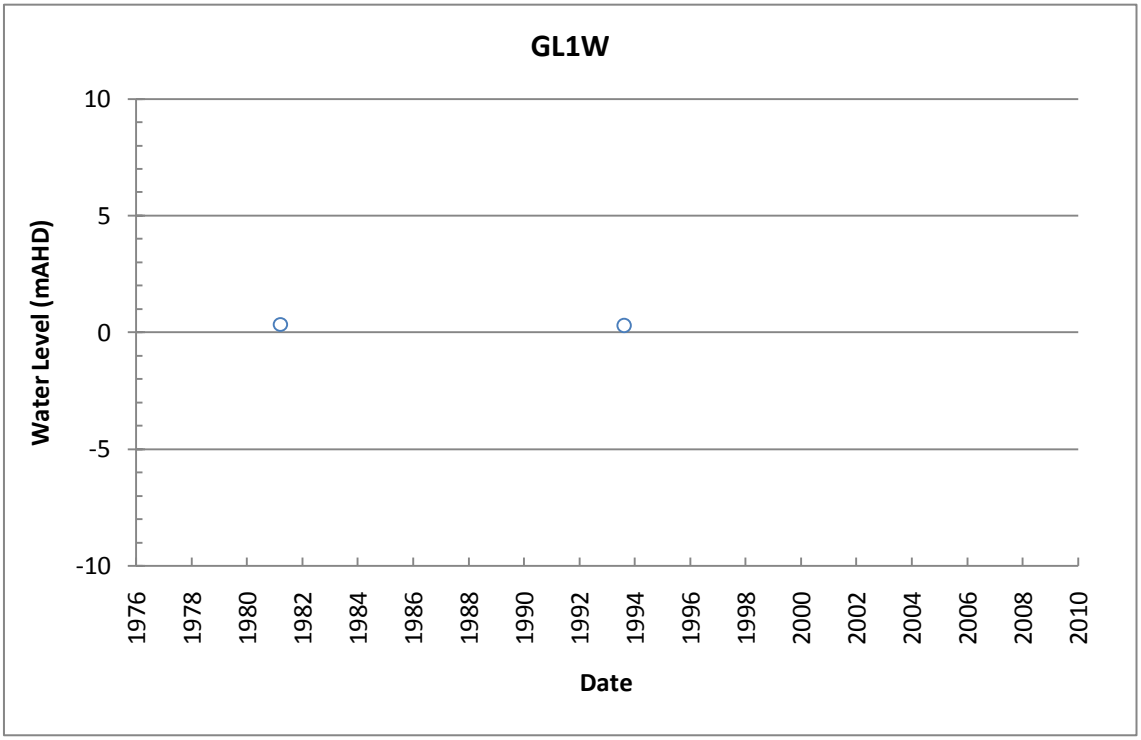
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL1W
Water Level (mAHD)
10
5
0
-5
-10
1976
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1982
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1994
1996
1998
2000
2002
2004
2006
2008
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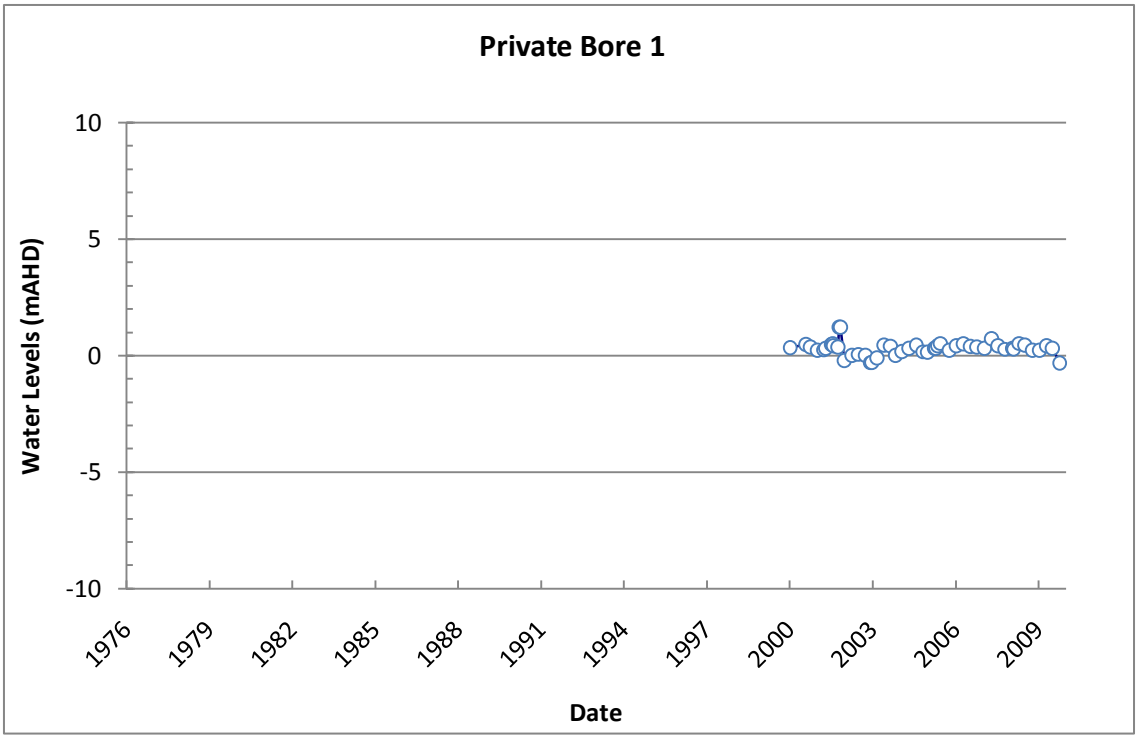
Date


Private Bore 1
Water Levels (mAHD)
10
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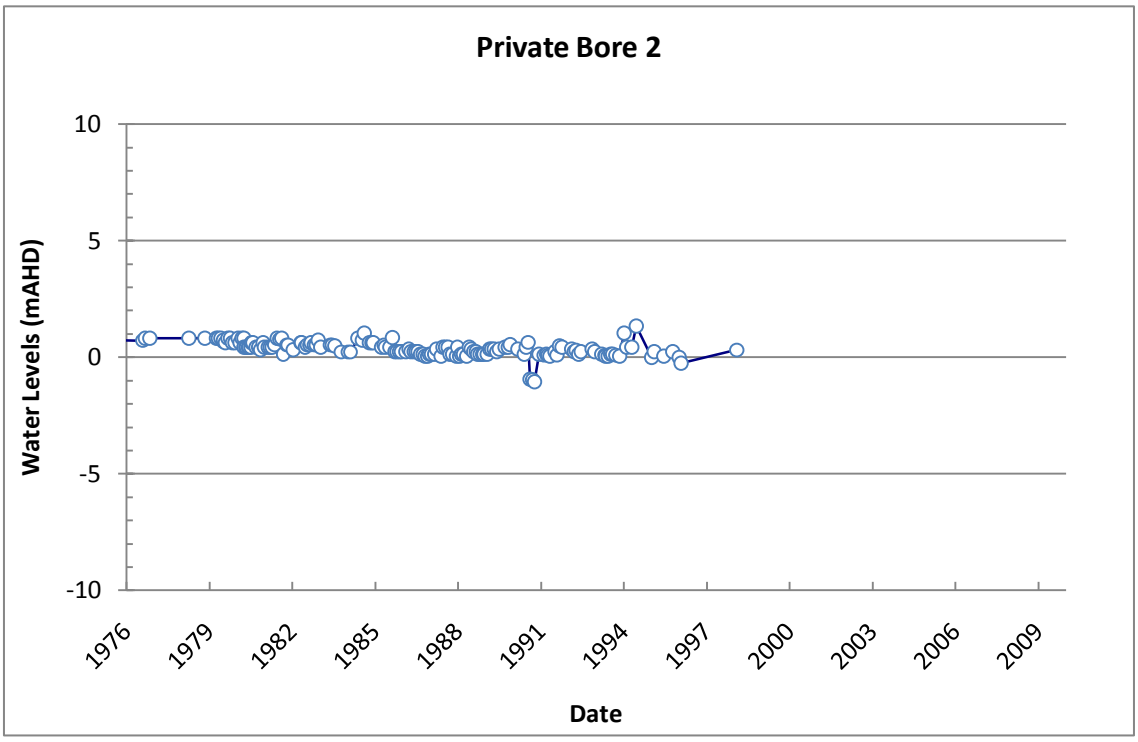
0
-5
-10
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Date


Private Bore 2
Water Levels (mAHD)
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-5
-10
1976
1979
1982
1985
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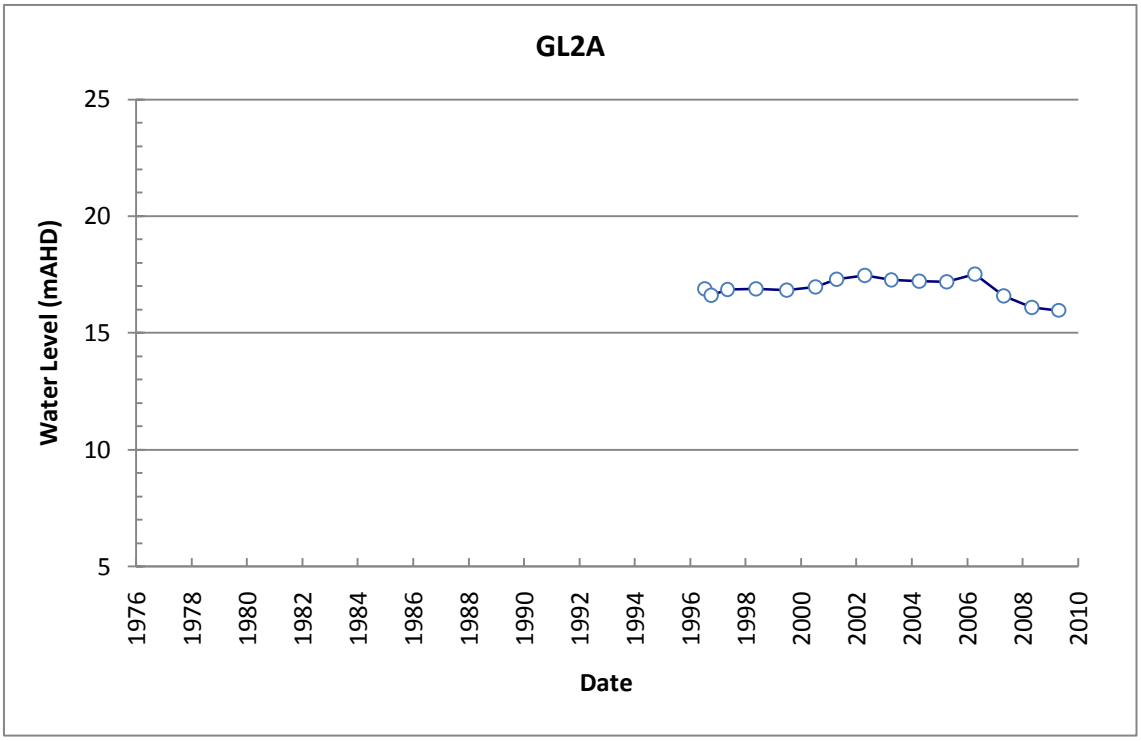
1991
1994
1997
2000
2003
2006
2009
Date


GL2A
Water Level (mAHD)
25
20
15
10
5
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2002
2004
2006
2008
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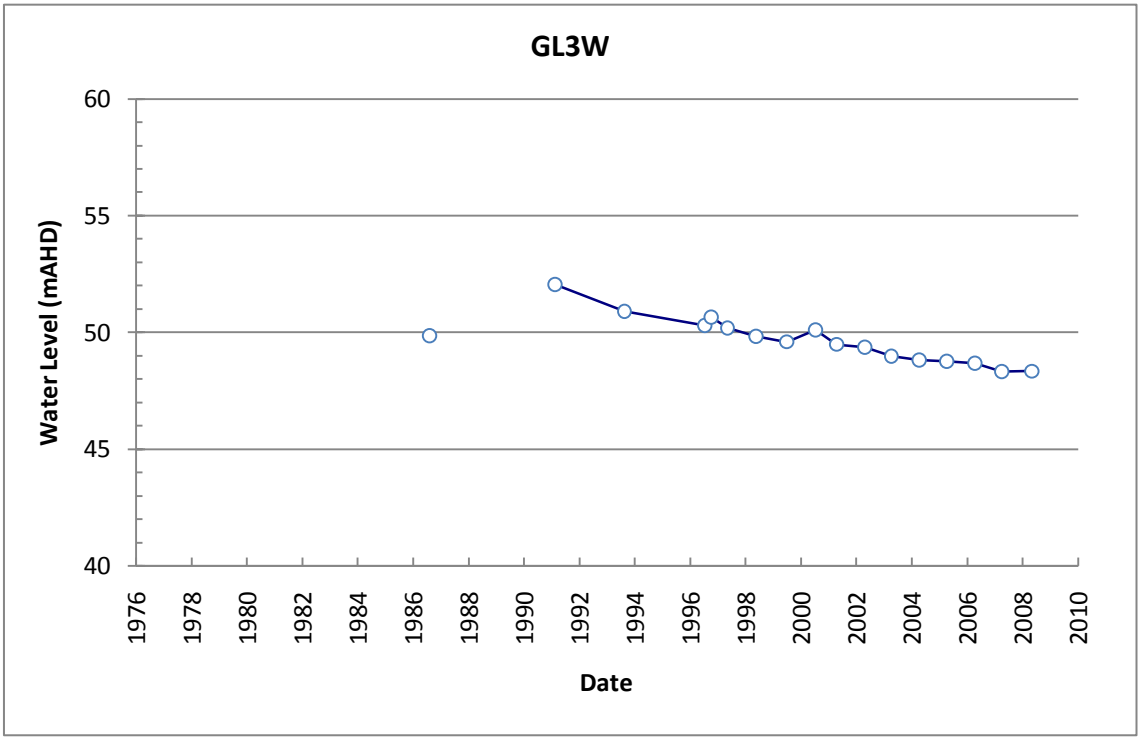
Date


GL3W
Water Level (mAHD)
60
55
50
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Date

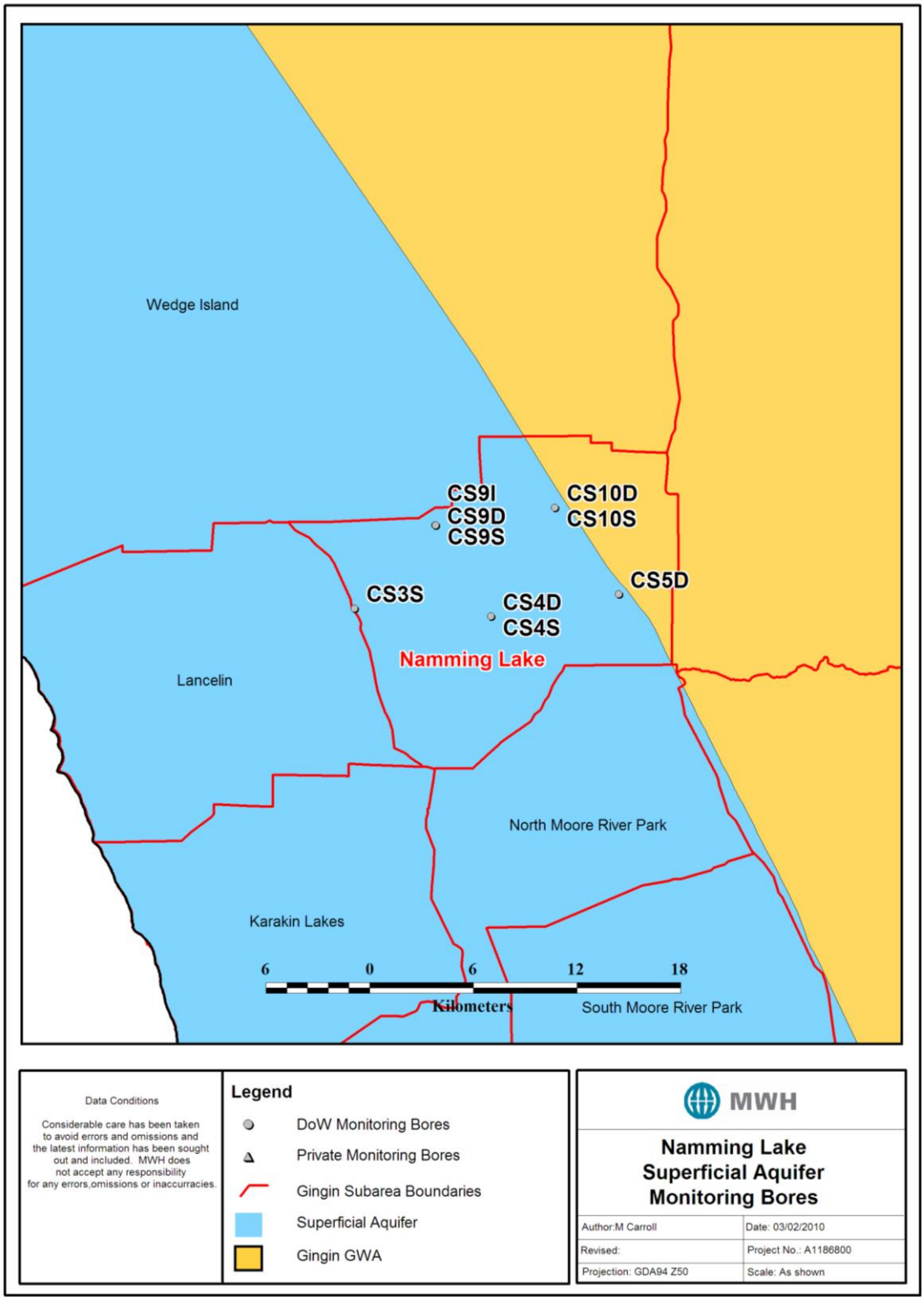
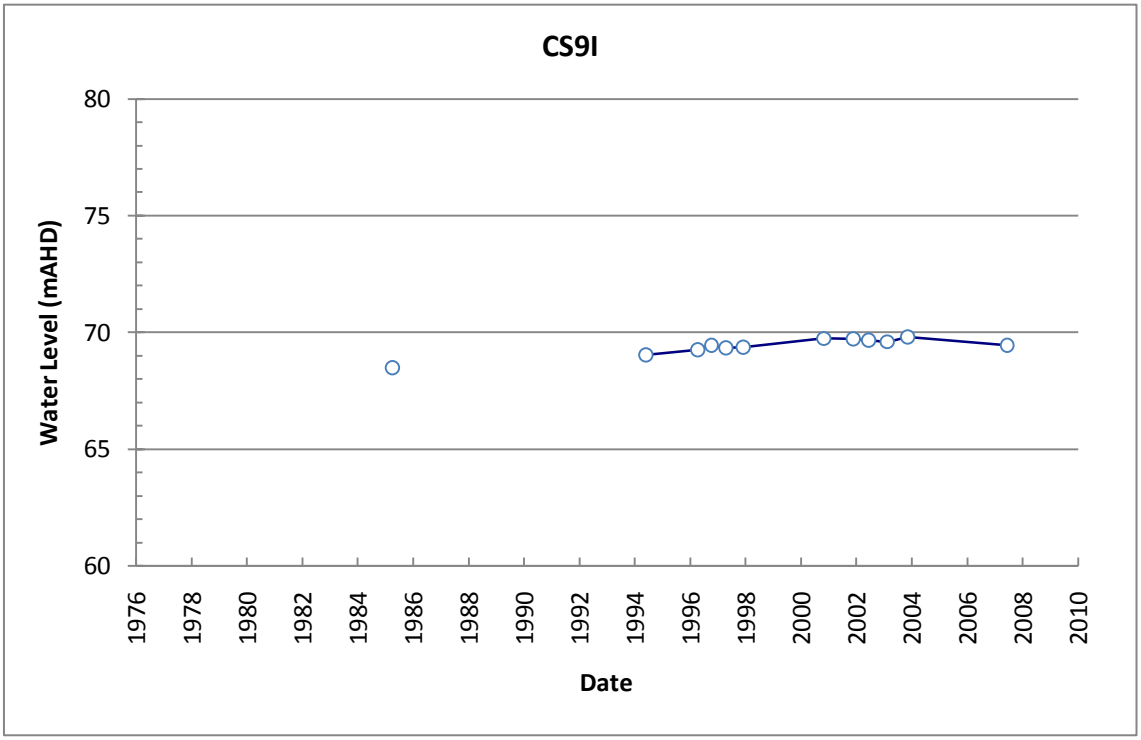


Figure 3-3: Namming Lakes sub-area - monitoring bores within the Superficial aquifer


CS9I
Water Level (mAHD)
80
75
70
65
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2006
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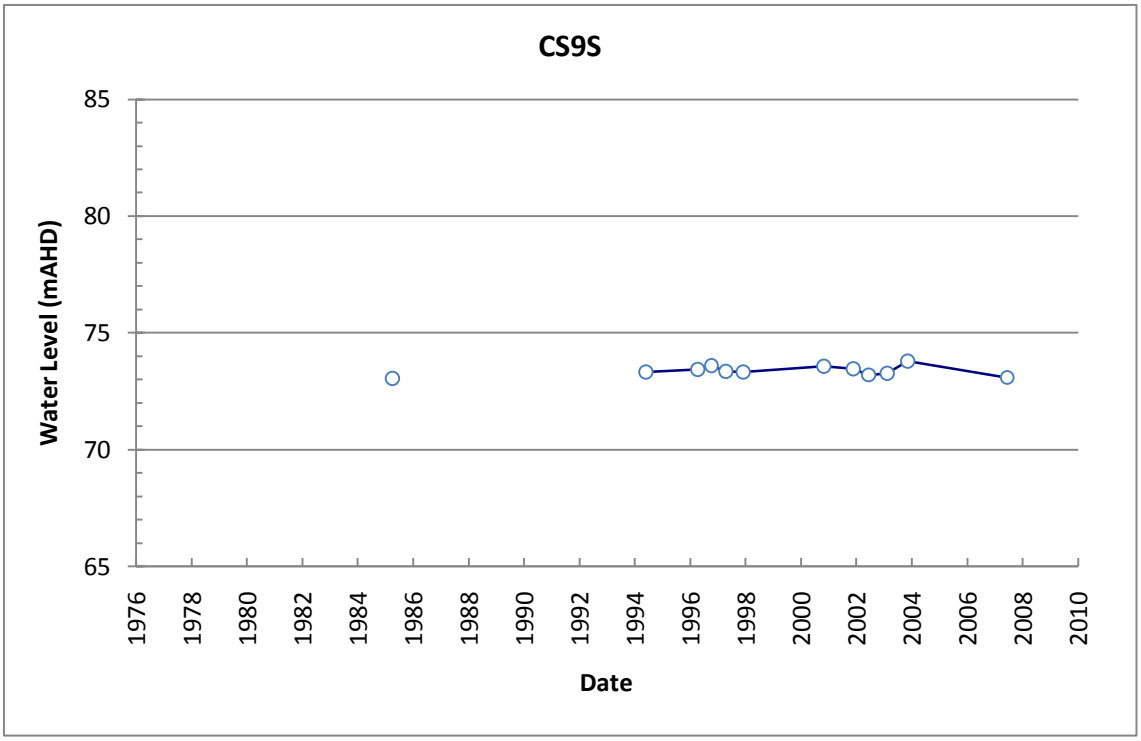
Date


CS9S
Water Level (mAHD)
85
80
75
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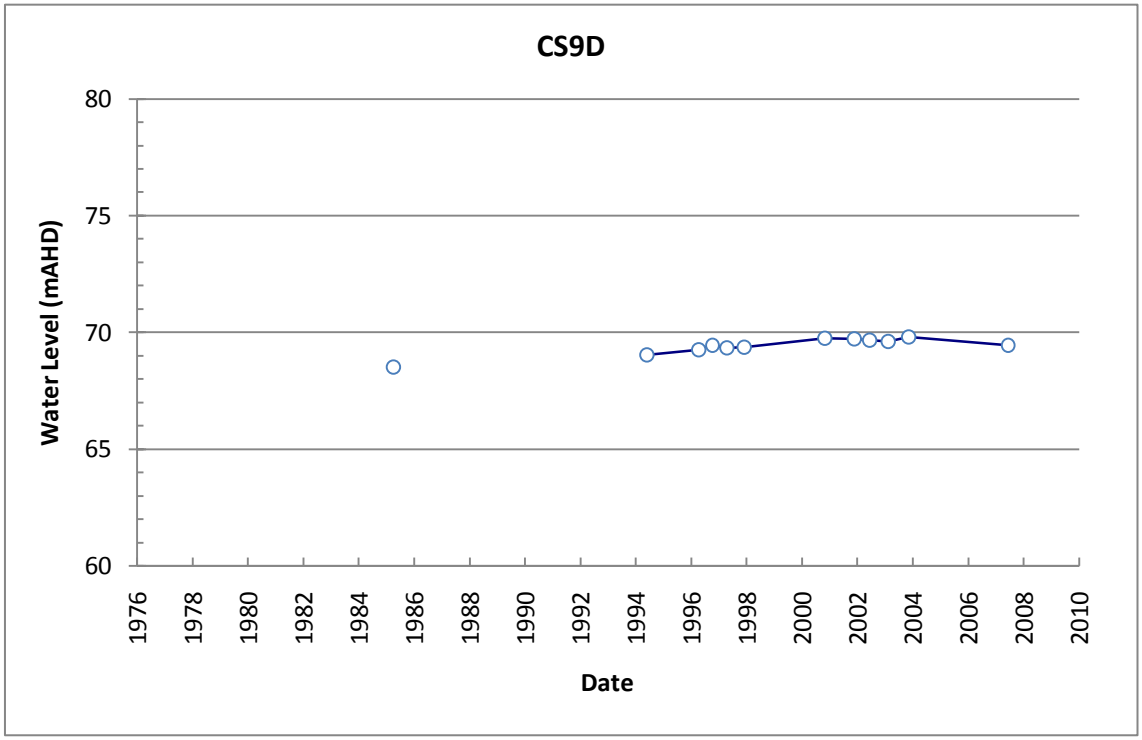
Date


CS9D
Water Level (mAHD)
80
75
70
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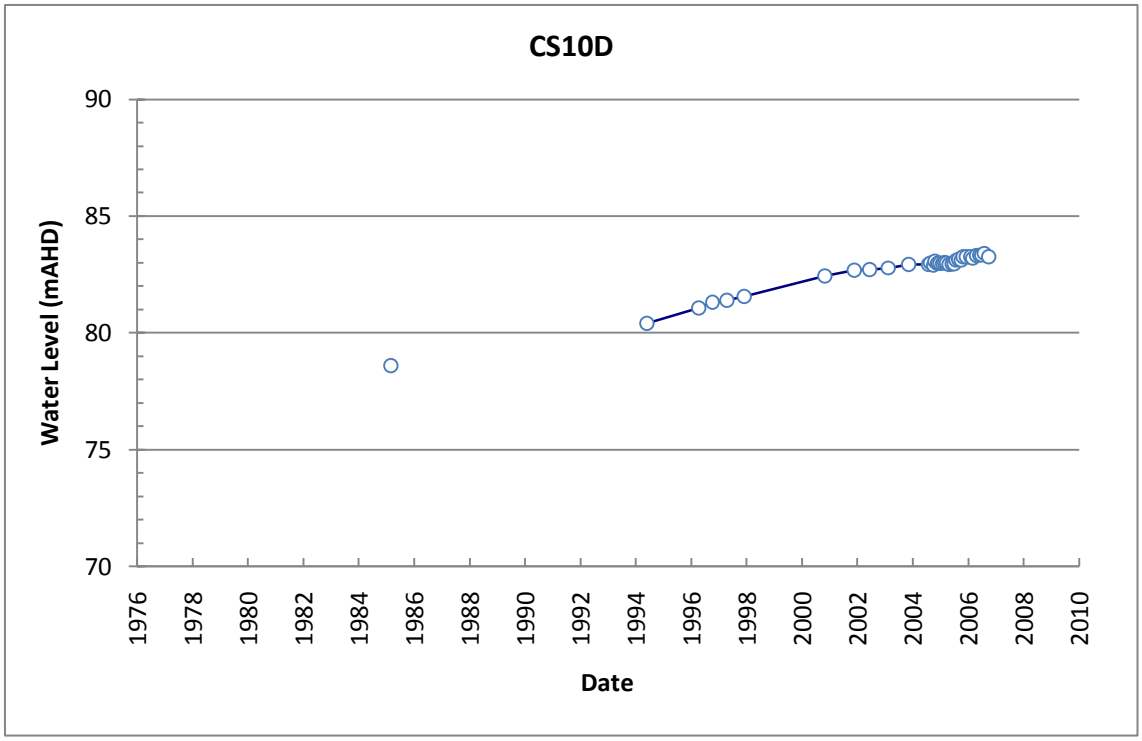
CS10D
Water Level (mAHD)
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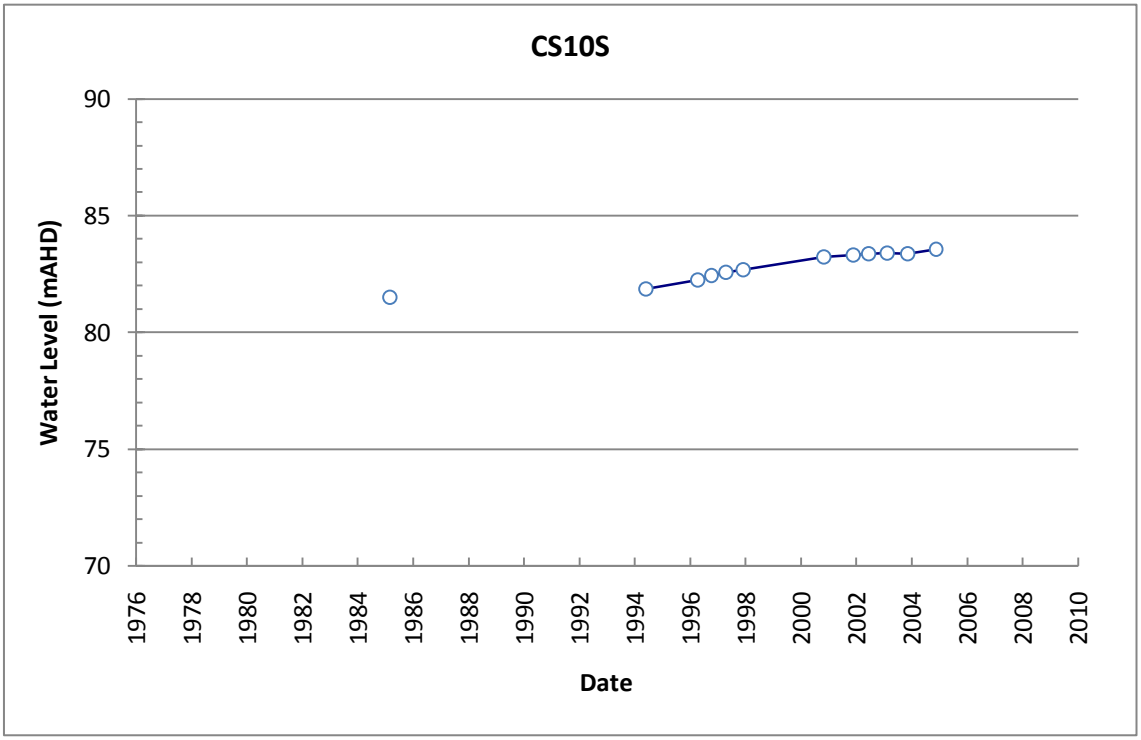
CS10S
Water Level (mAHD)
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2002
2004
2006
2008
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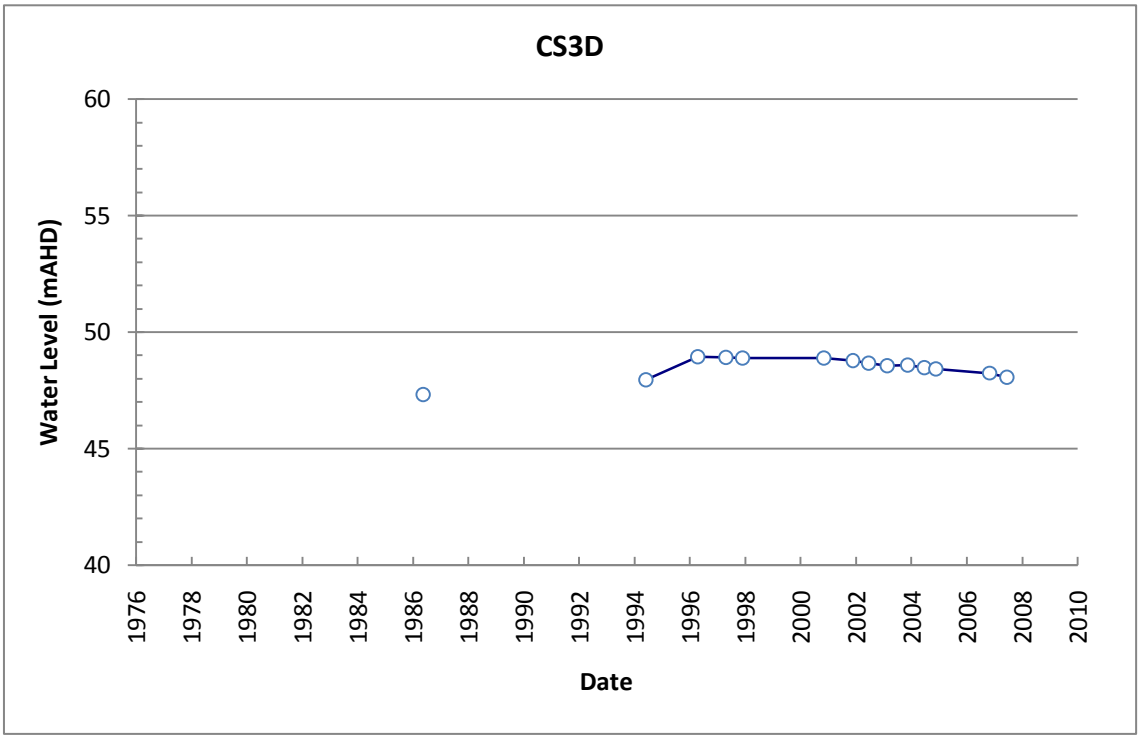
Date


CS3D
Water Level (mAHD)
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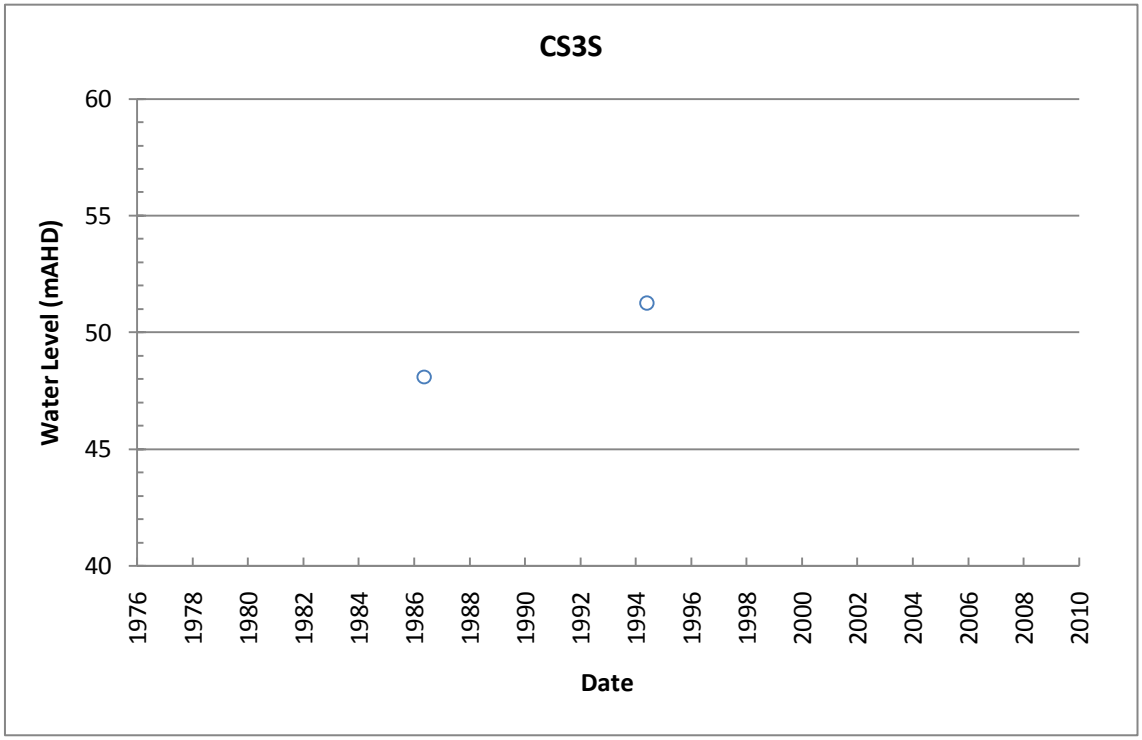
CS3S
Water Level (mAHD)
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50
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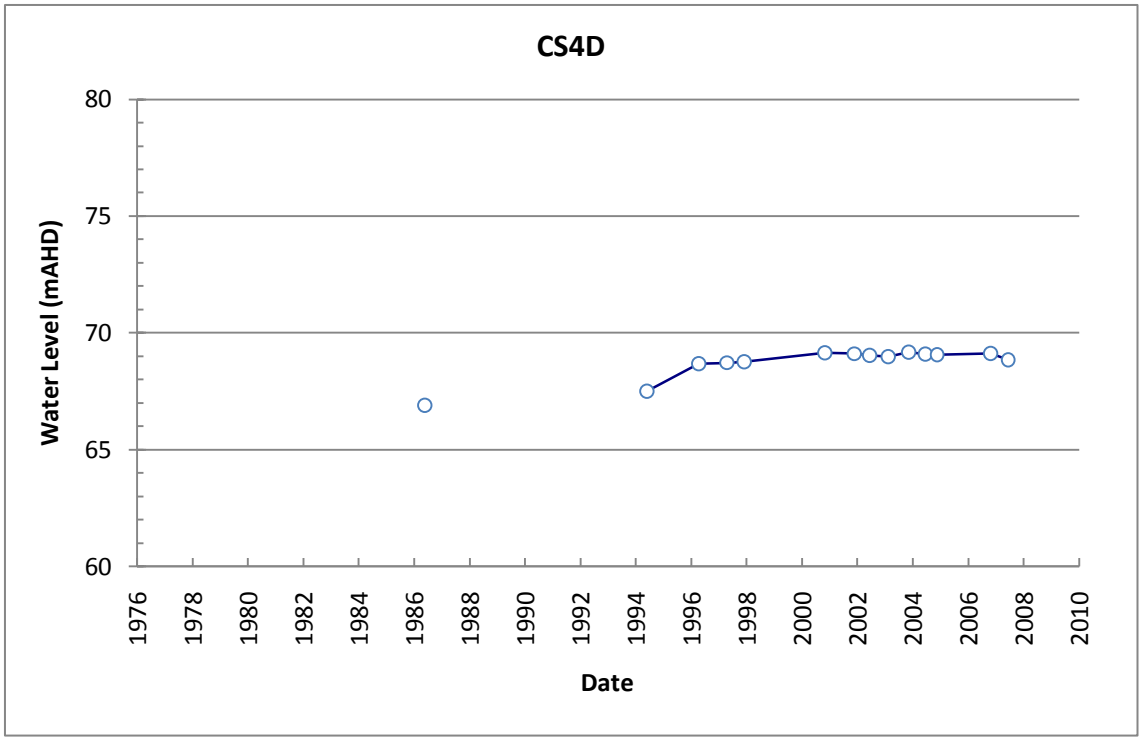
Date


CS4D
Water Level (mAHD)
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2006
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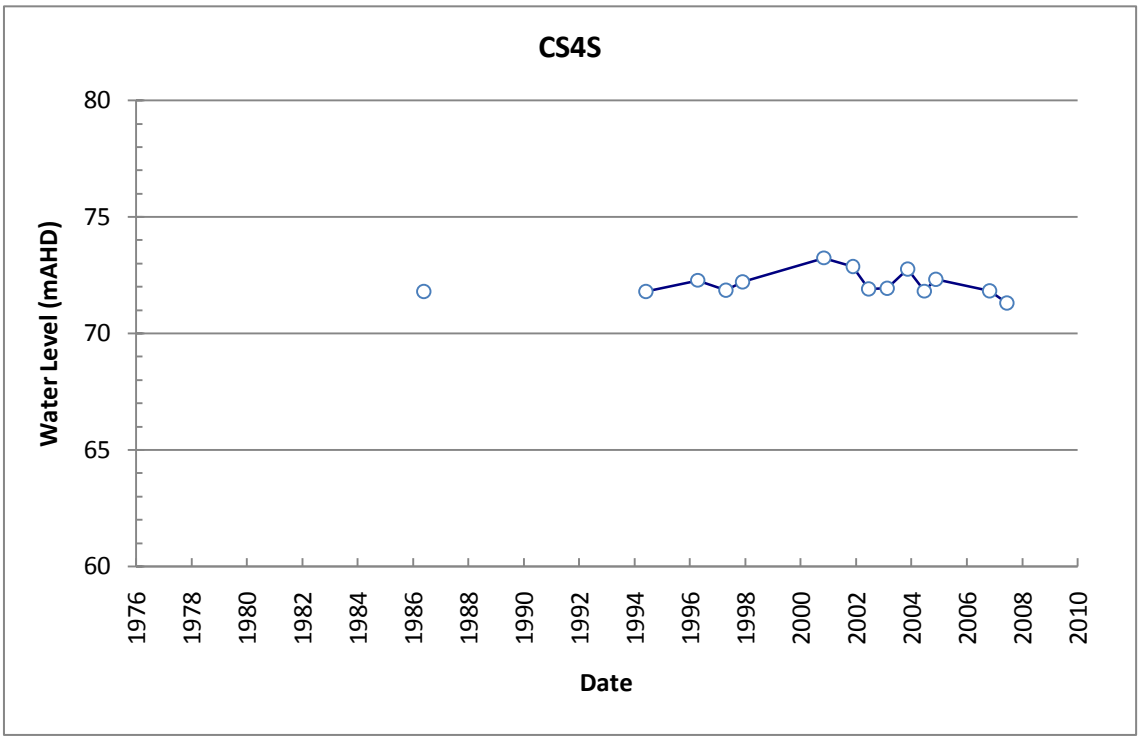
Date


CS4S
Water Level (mAHD)
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1992
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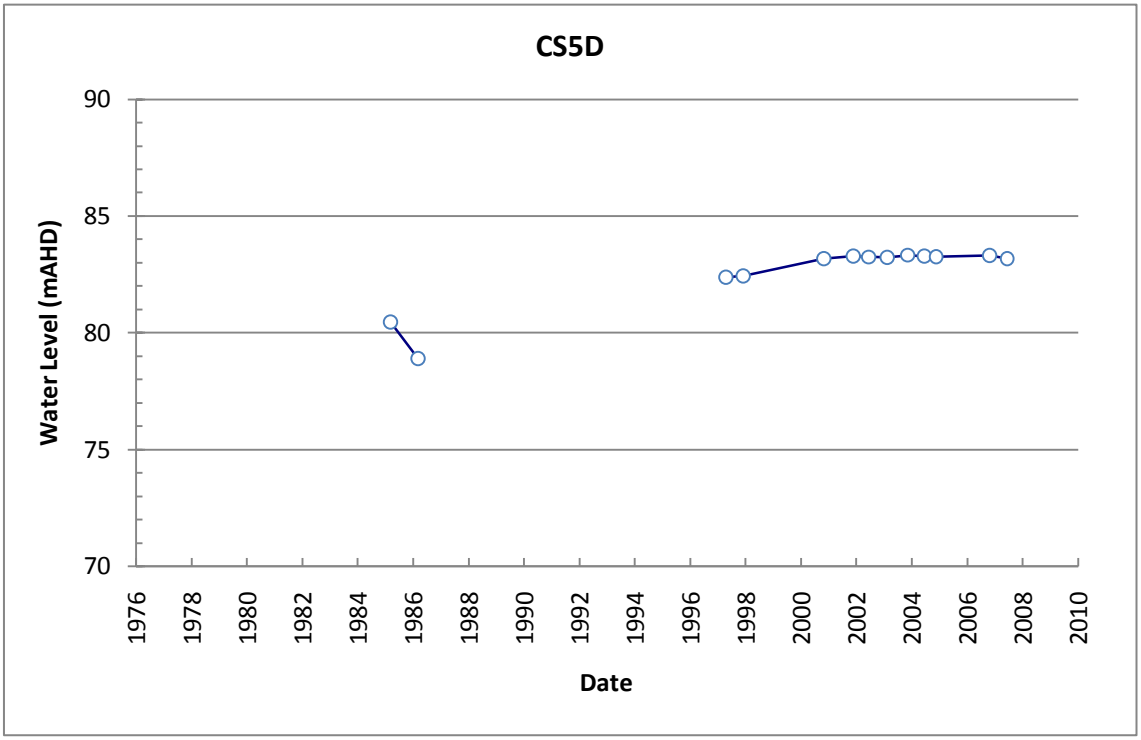
1996
1998
2000
2002
2004
2006
2008
2010
Date


CS5D
Water Level (mAHD)
90
85
80
75
70
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

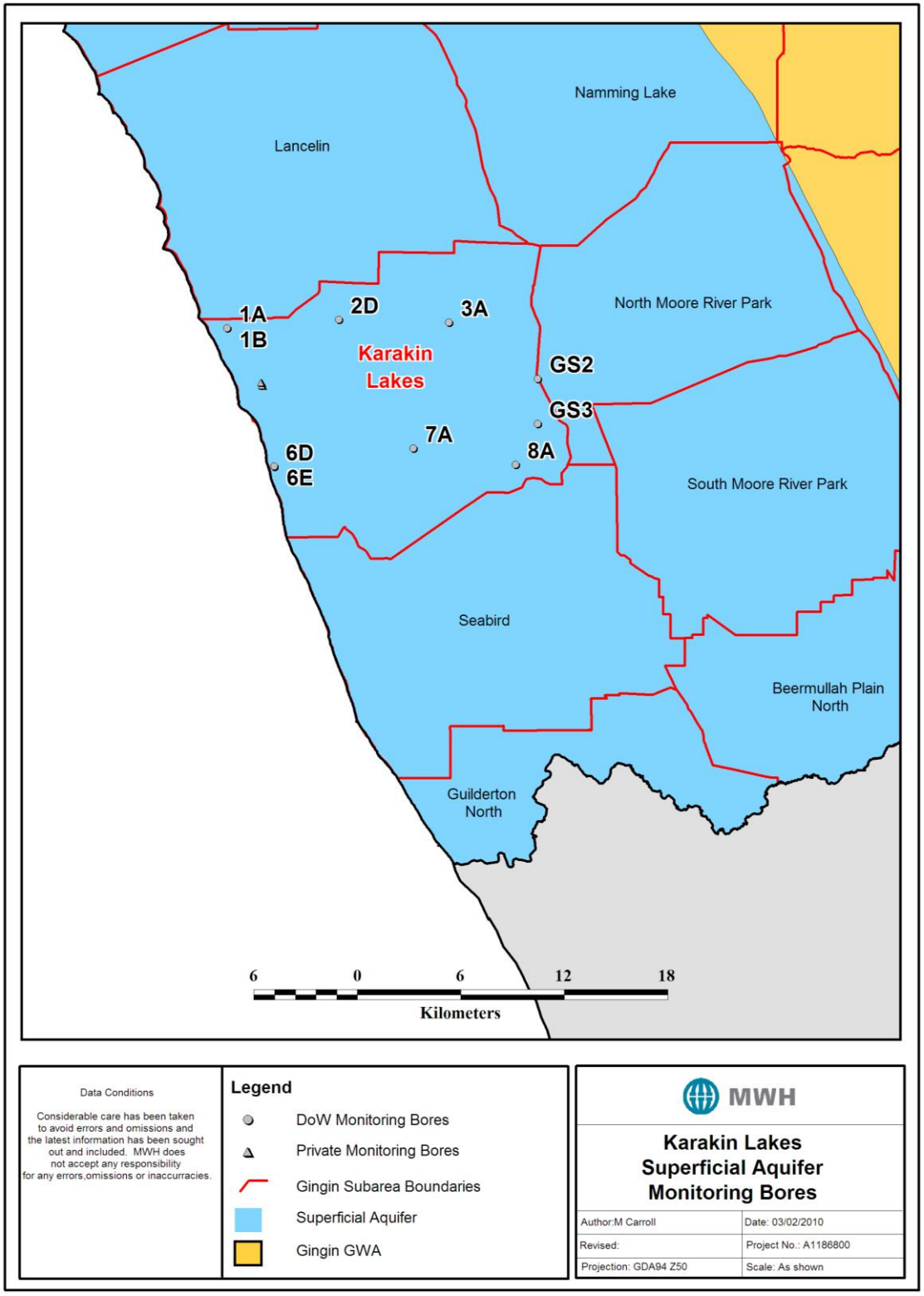
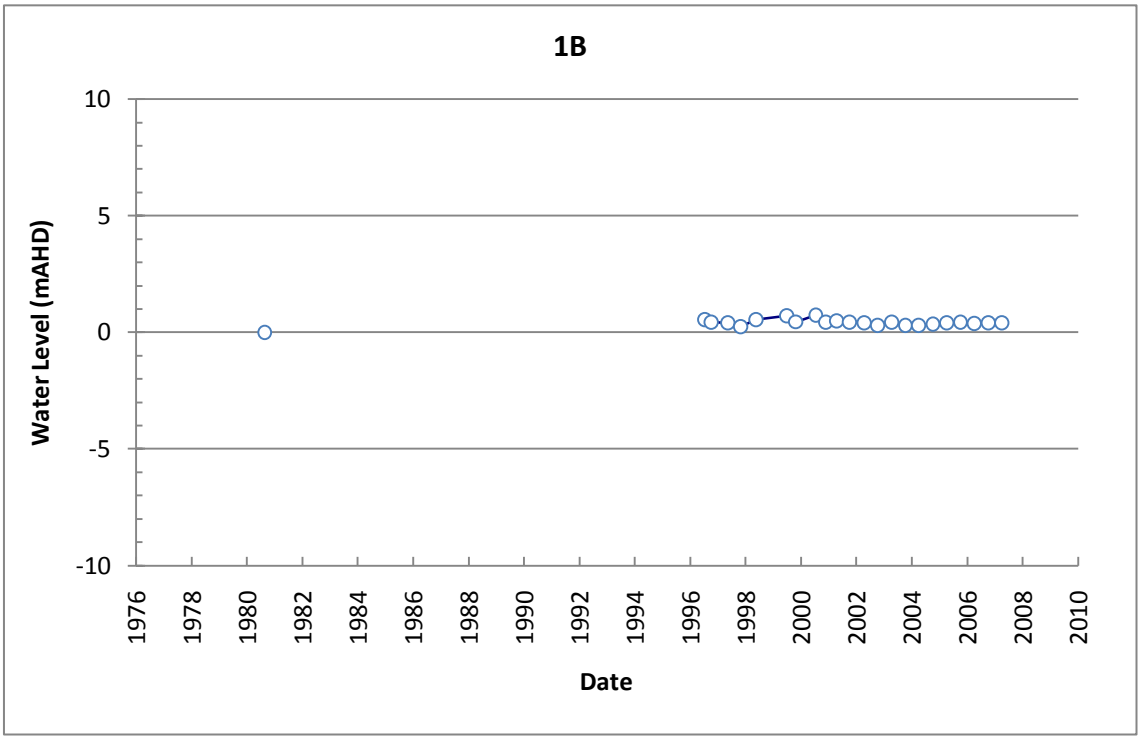
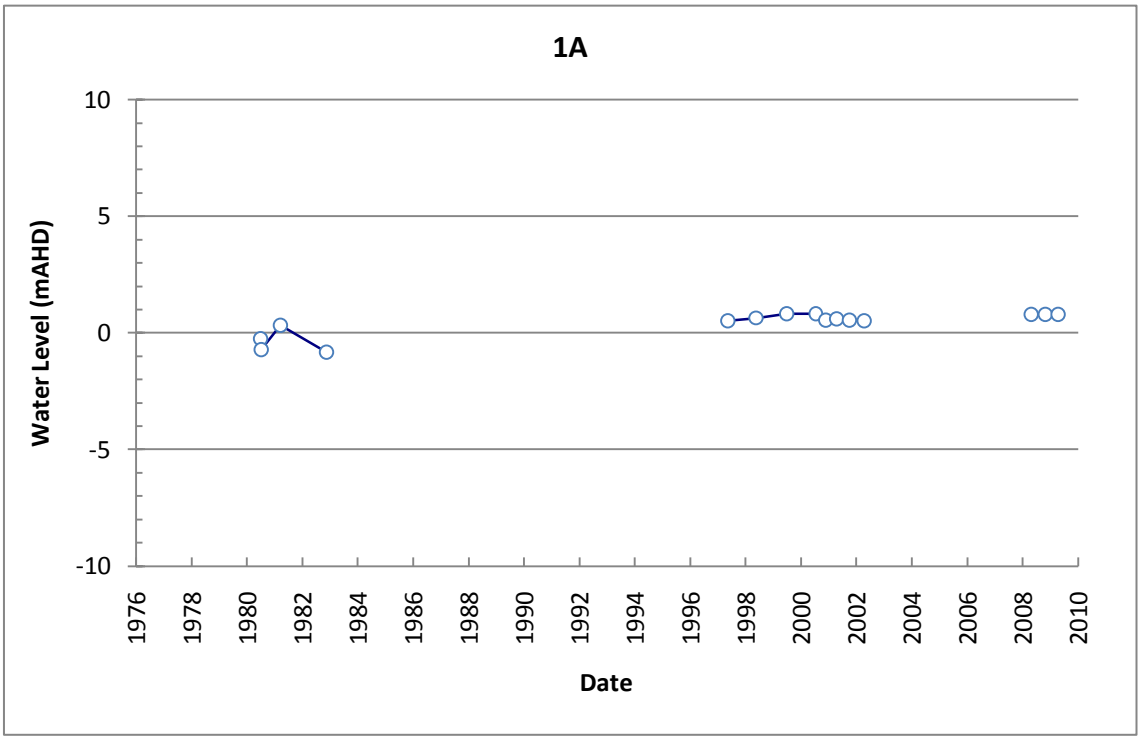
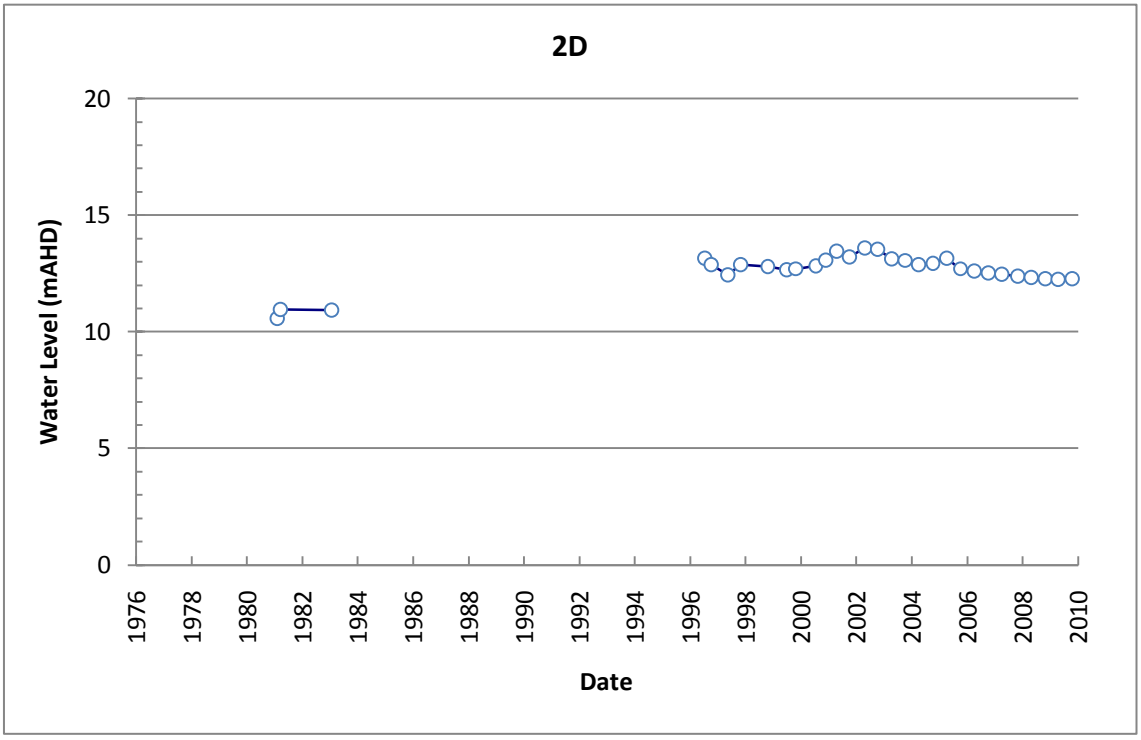
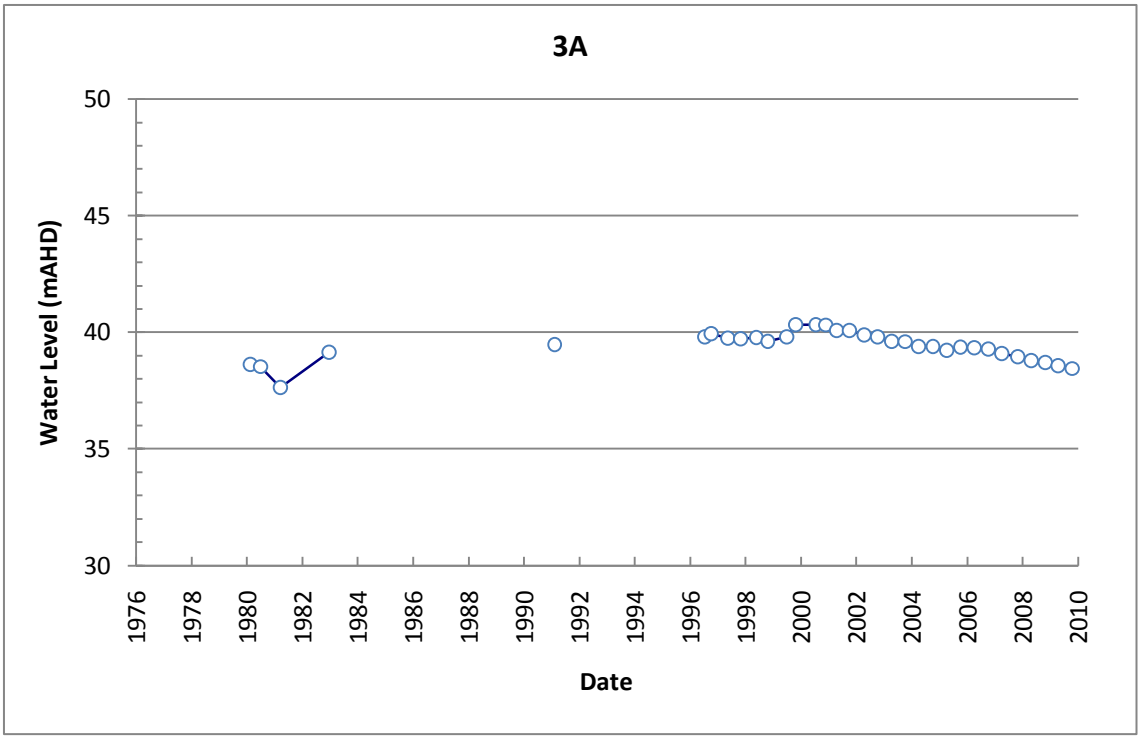


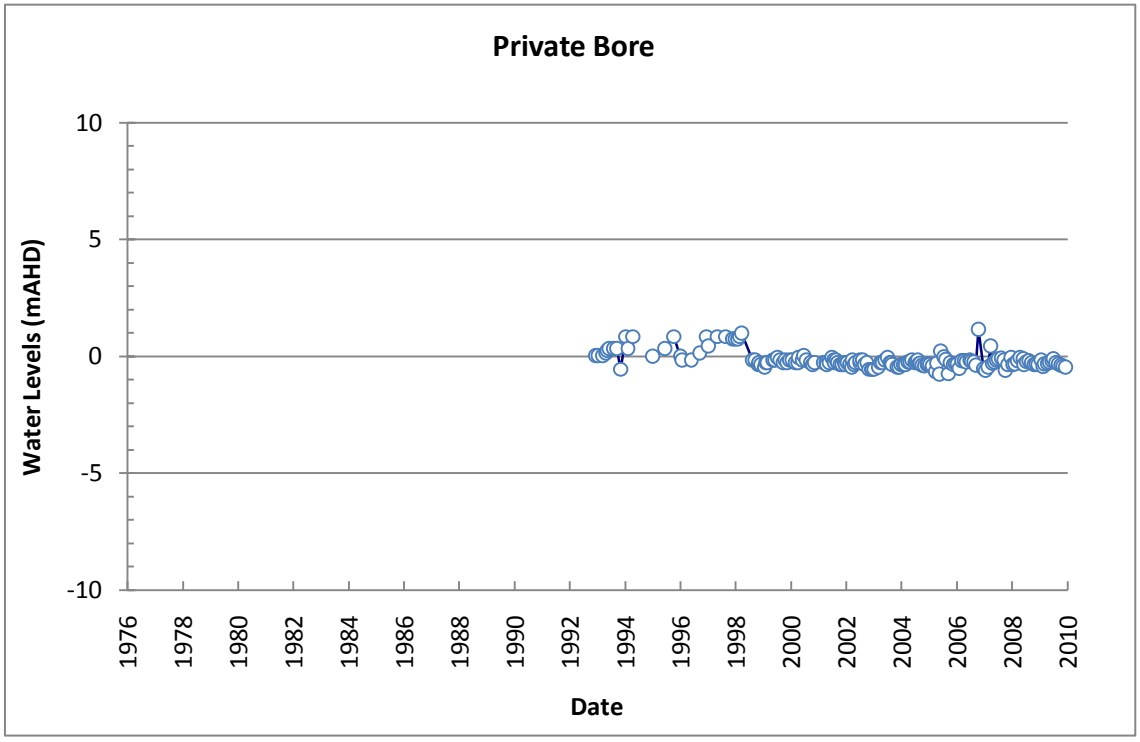
Figure 3-4: Karakin Lakes sub-area - monitoring bores within the Superficial aquifer

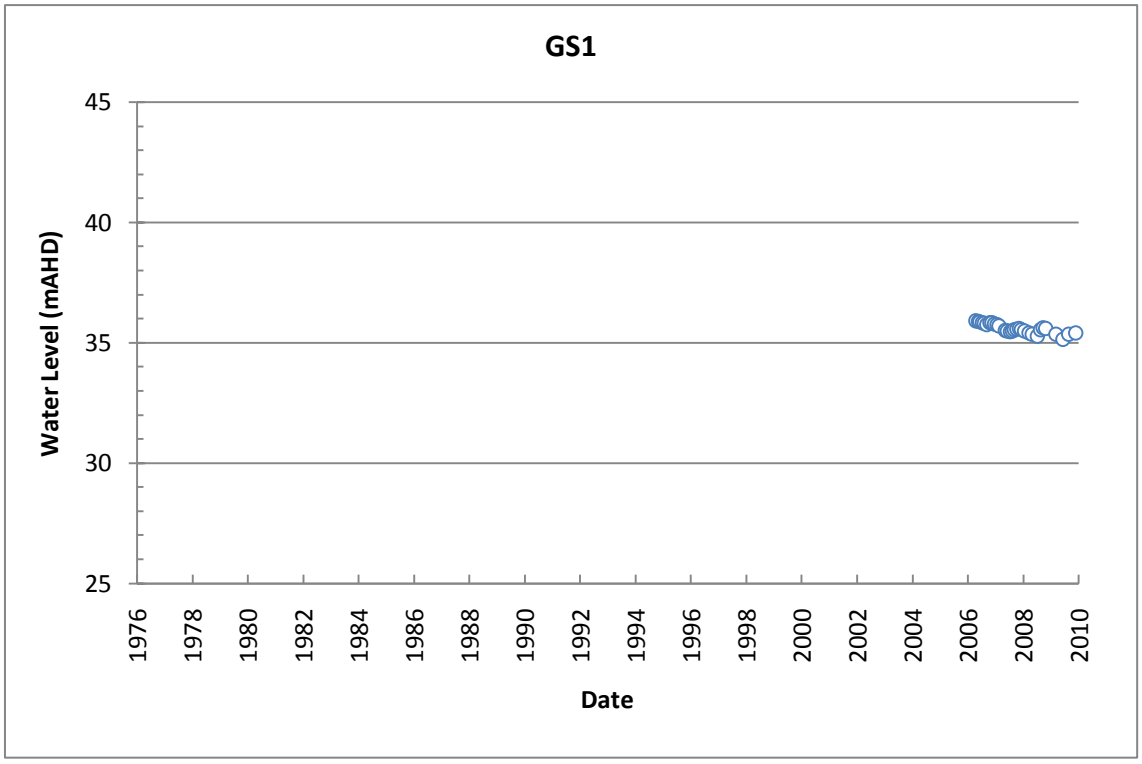

1B
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

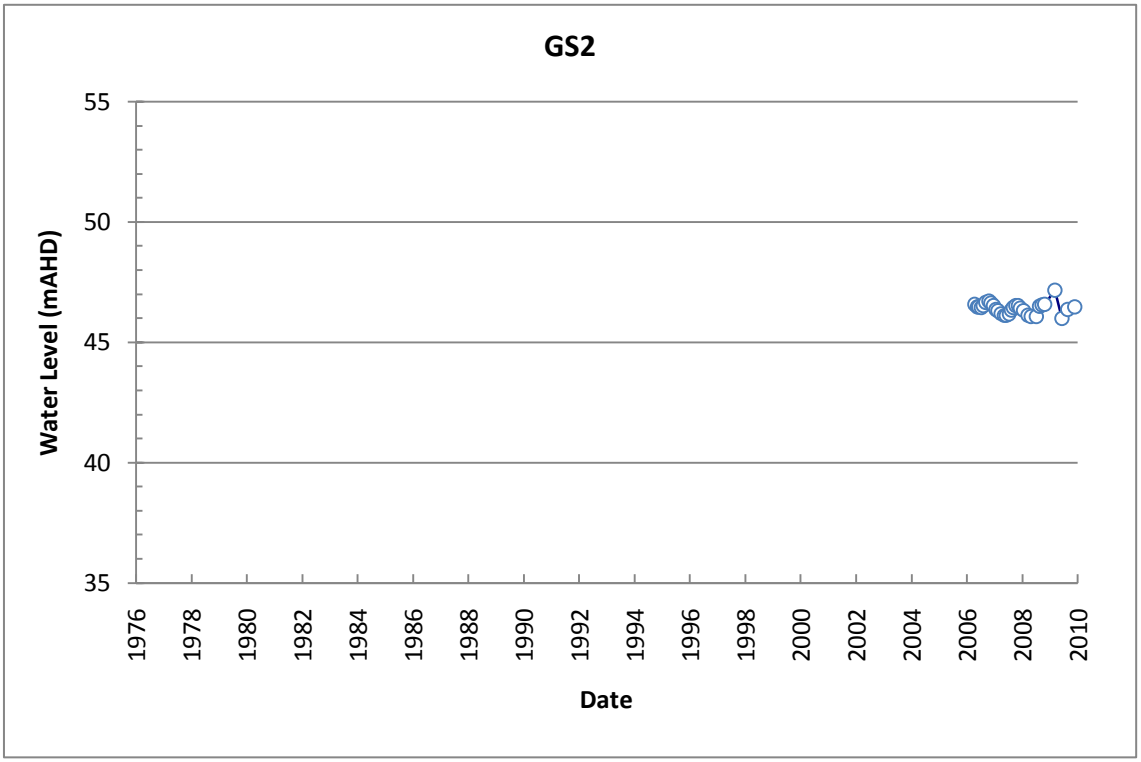

1A
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

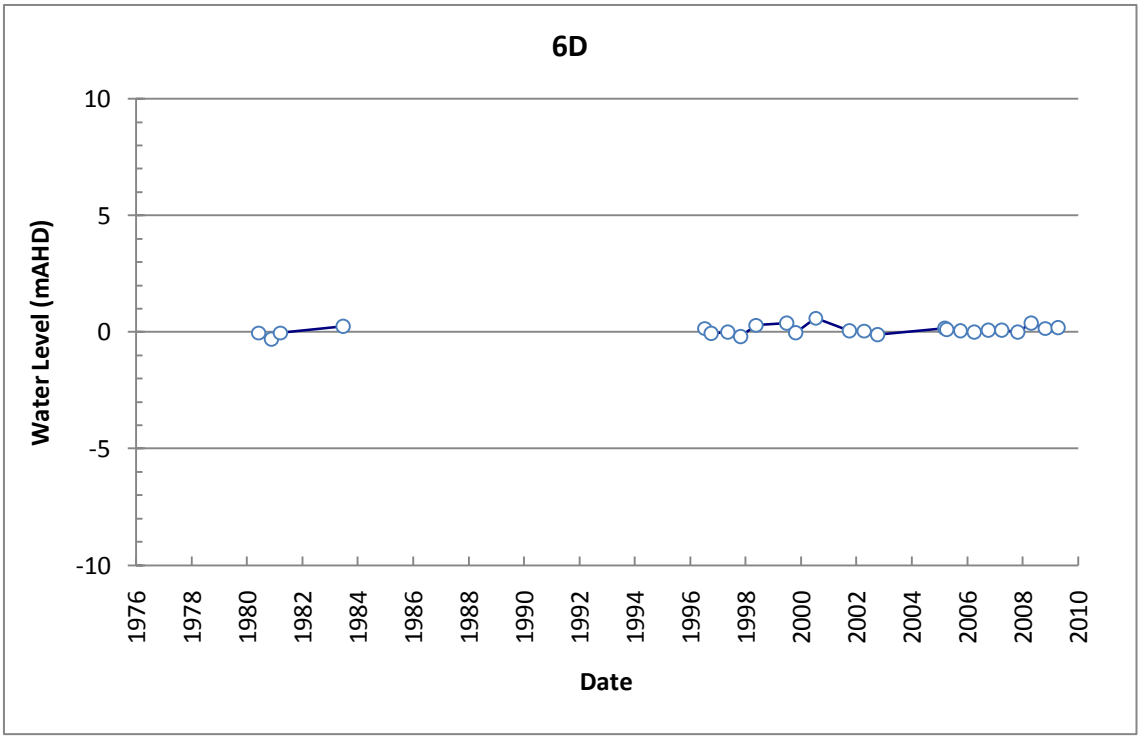

2D
Water Level (mAHD)
20
15
10
5
0
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

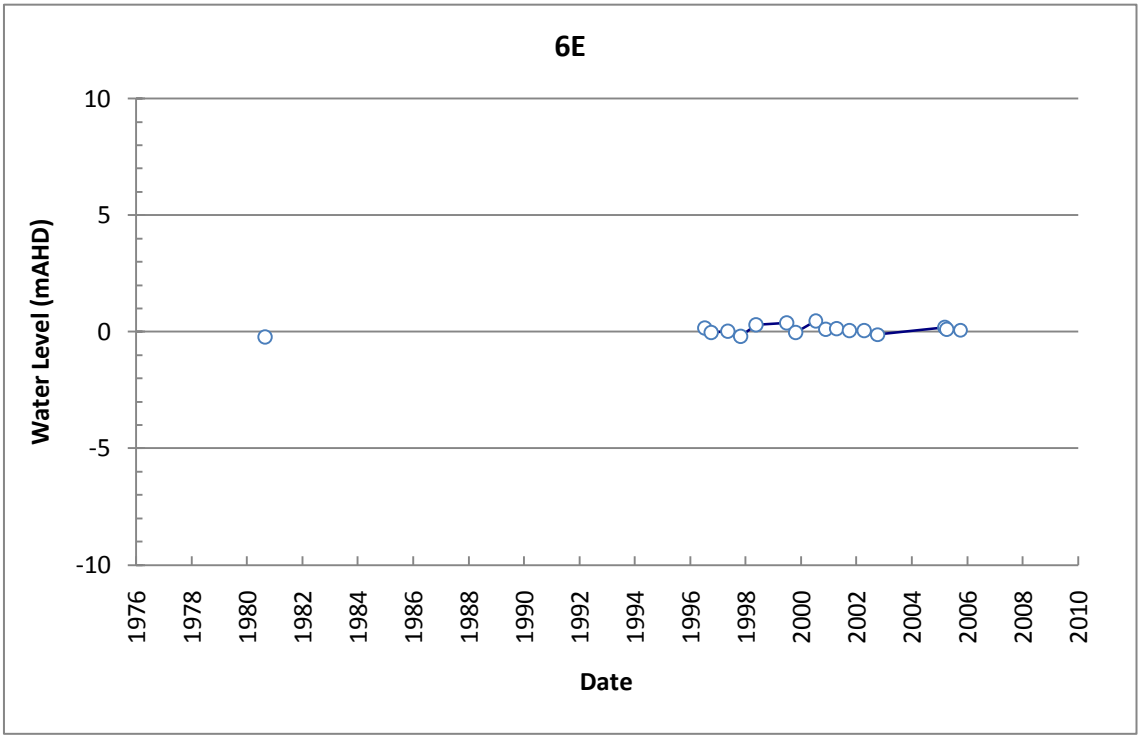

3A
Water Level (mAHD)
50
45
40
35
30
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

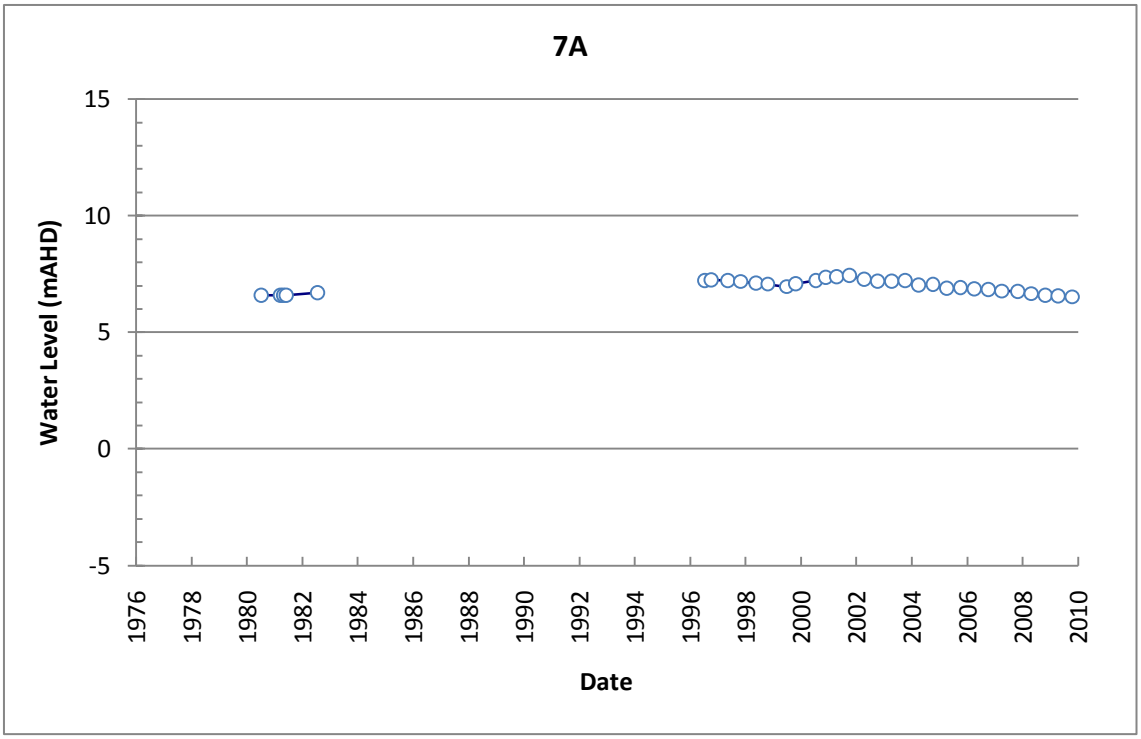

Private Bore
Water Levels (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

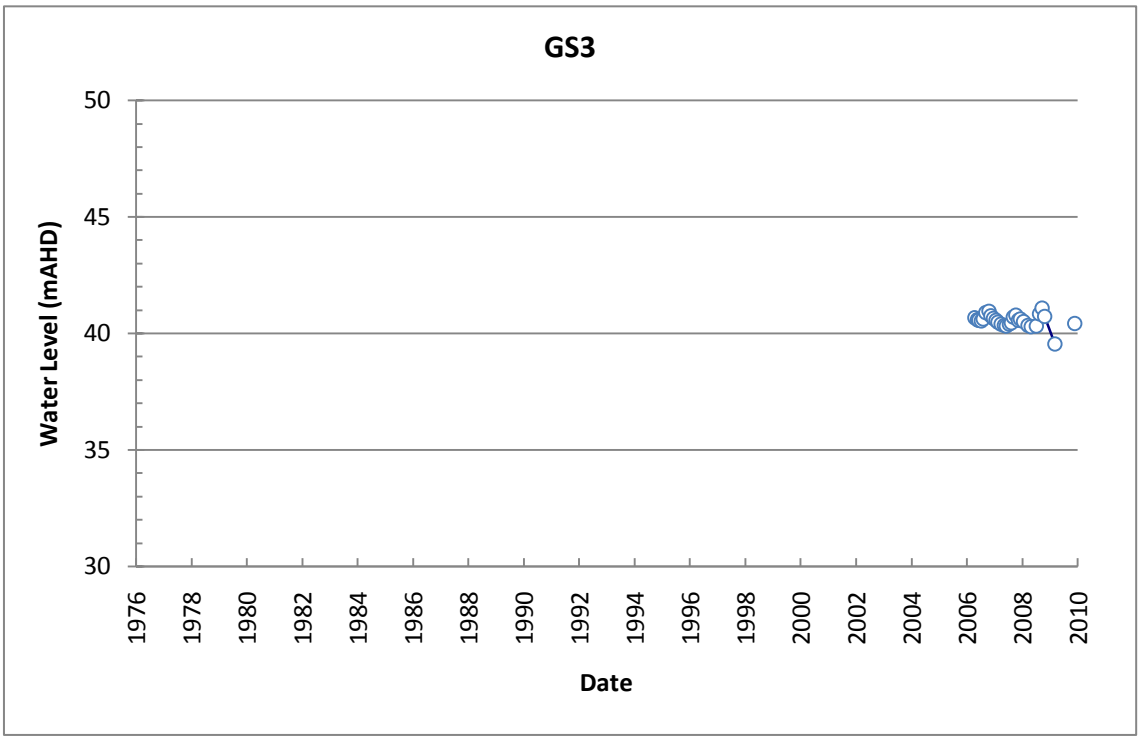

GS1
Water Level (mAHD)
45
40
35
30
25
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

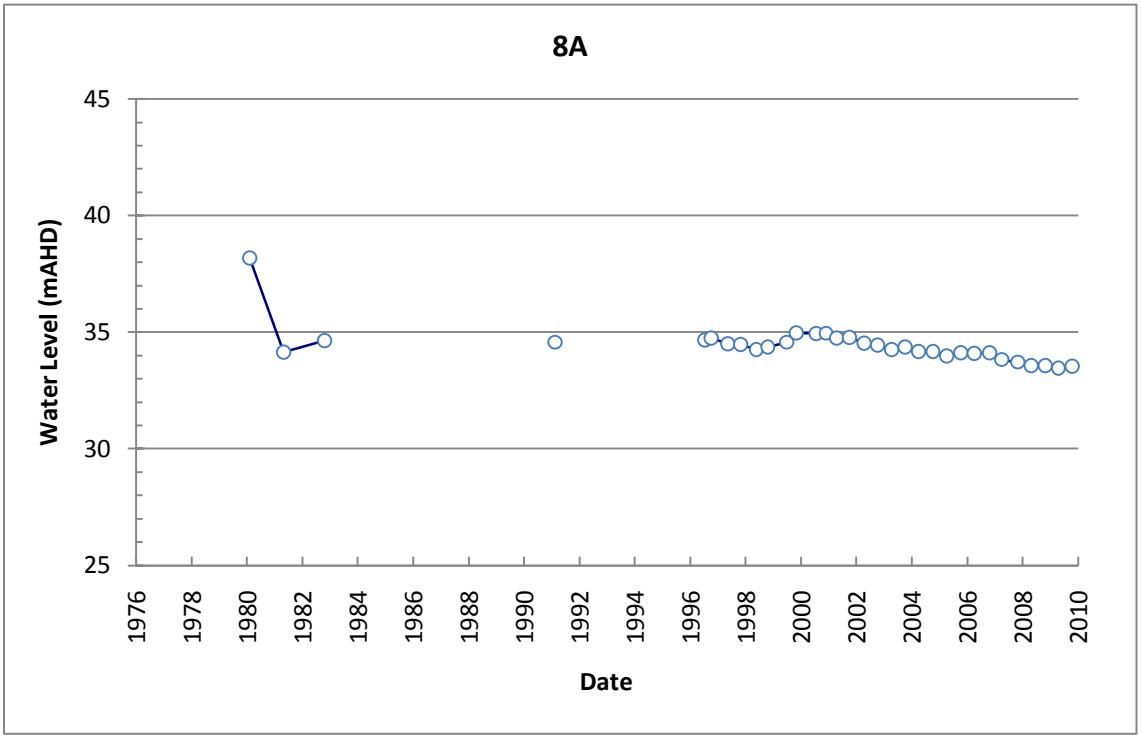

GS2
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


6D
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


6E
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


7A
Water Level (mAHD)
15
10
5
0
-5
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GS3
Water Level (mAHD)
50
45
40
35
30
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


8A
Water Level (mAHD)
45
40
35
30
25
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

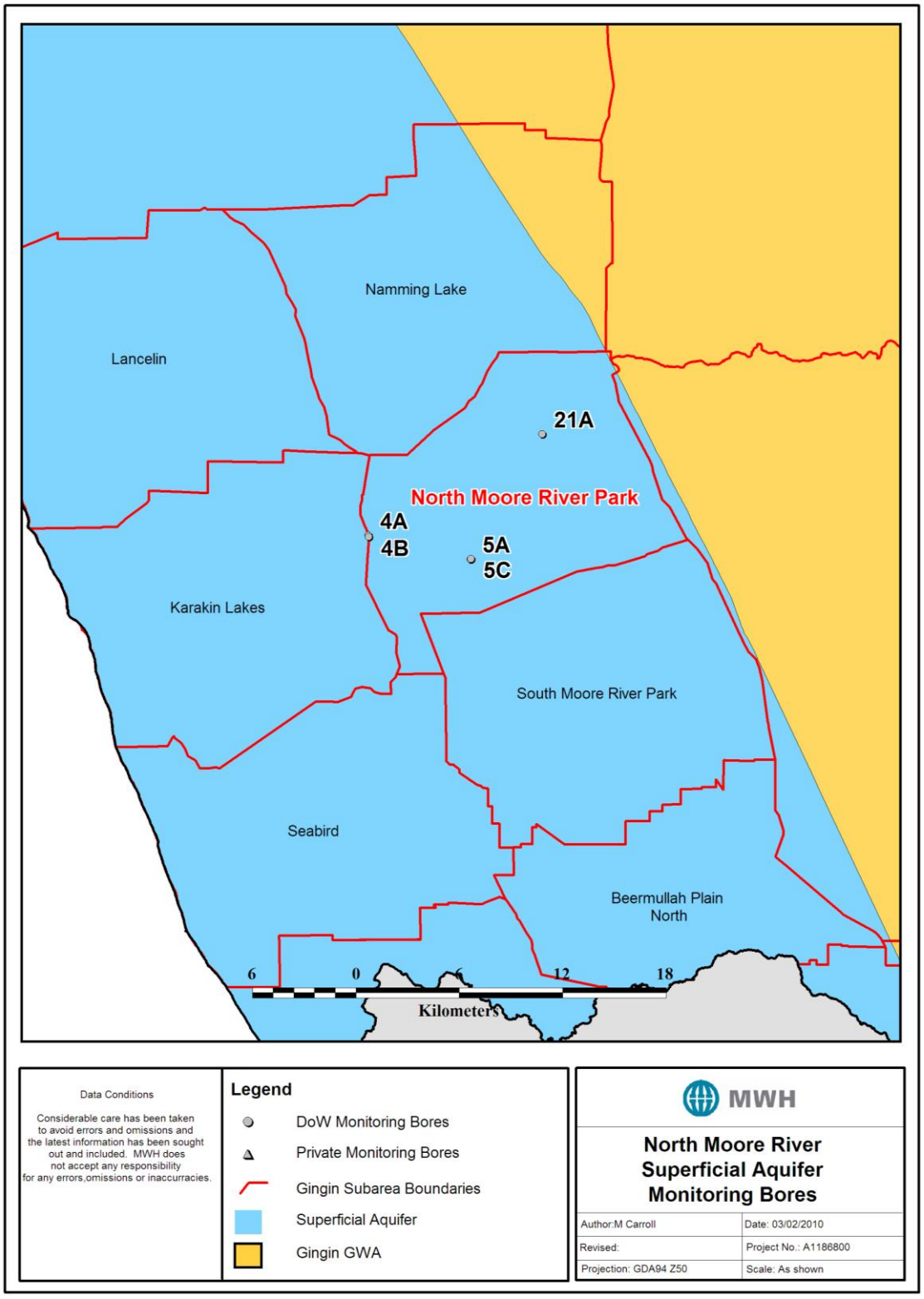
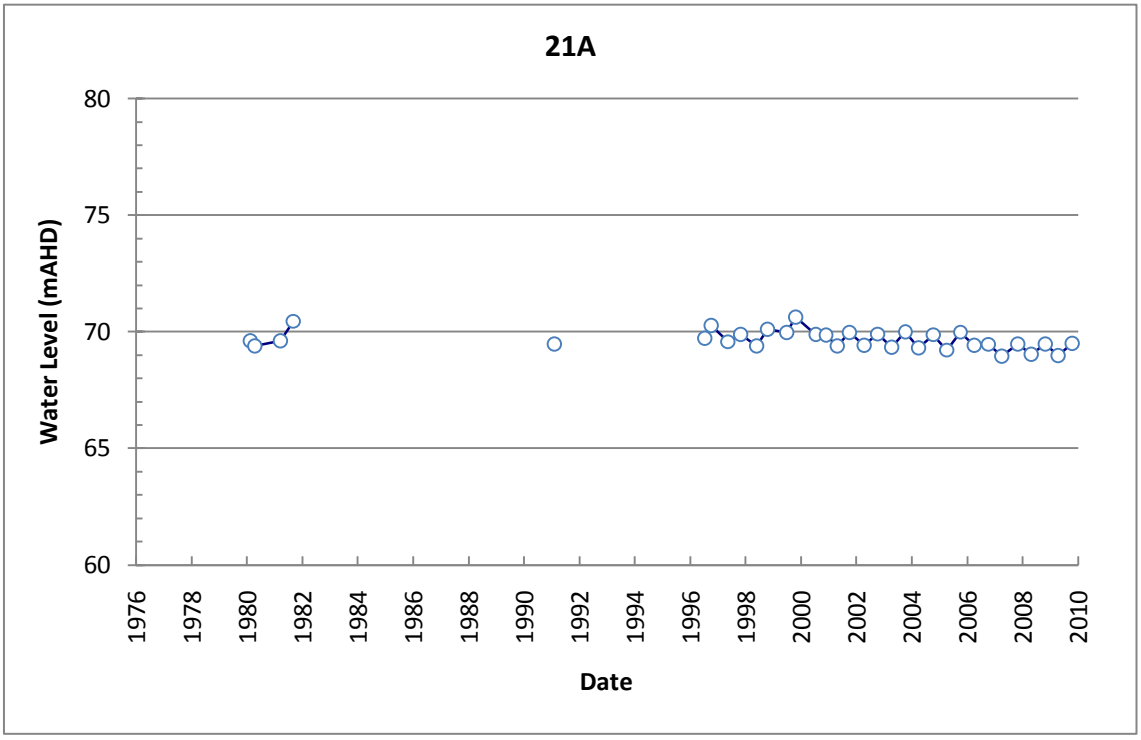
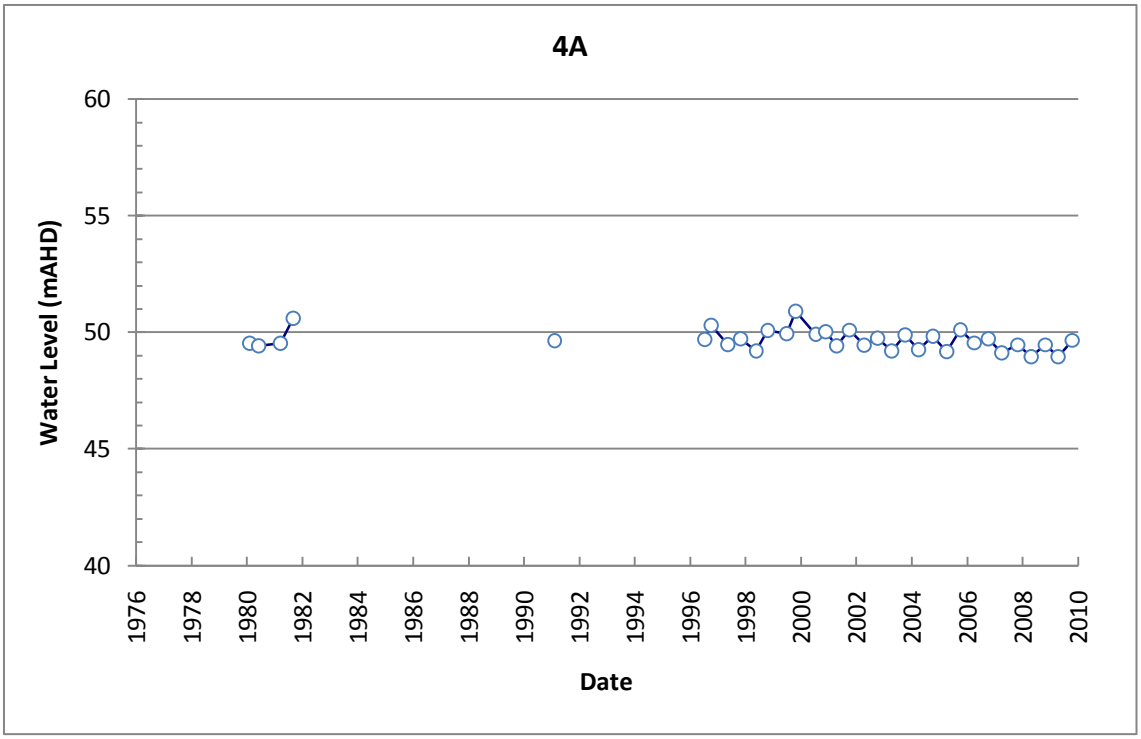
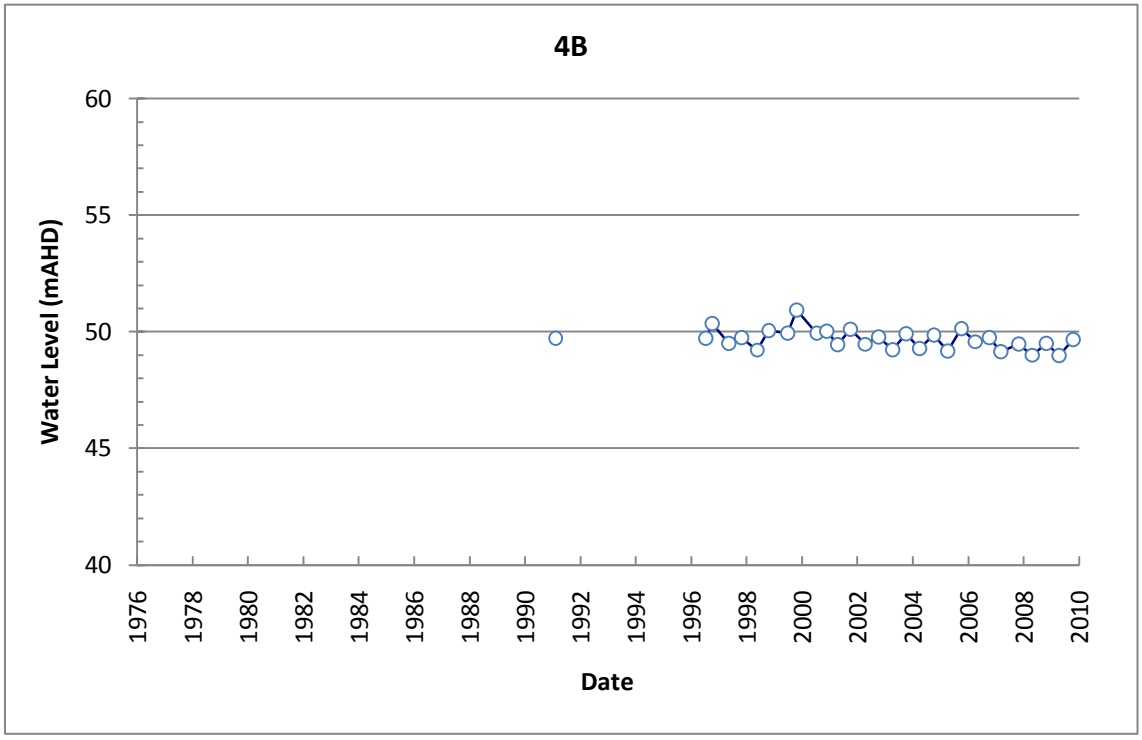
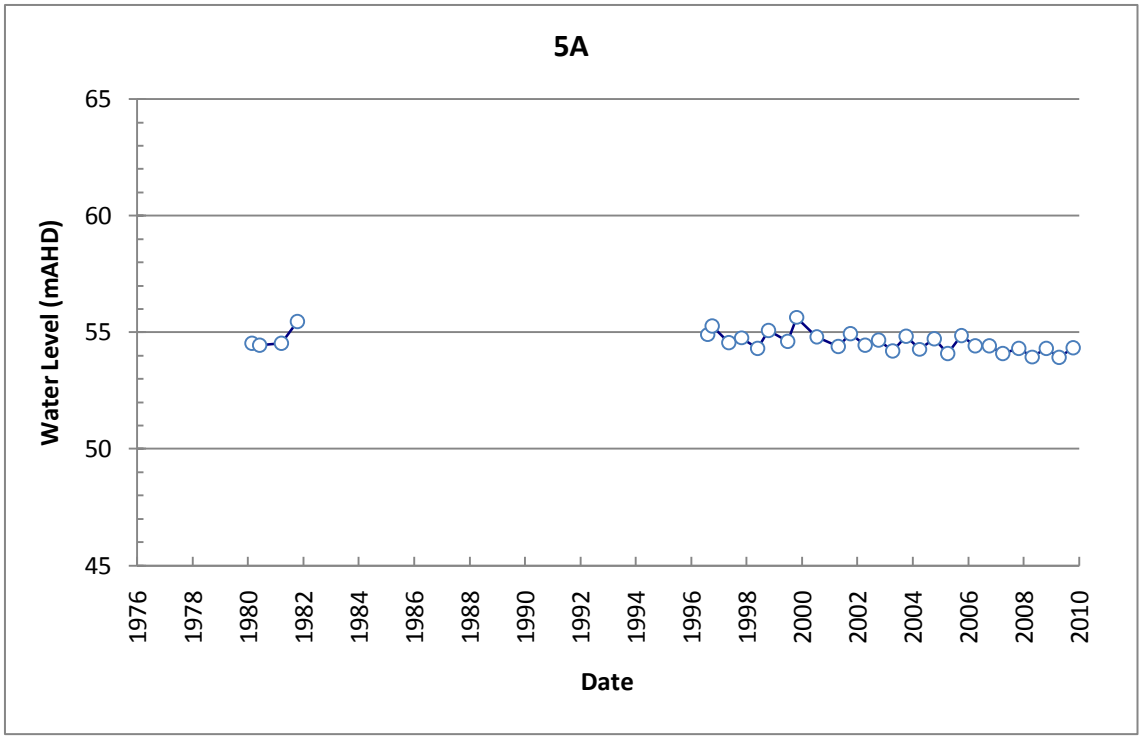


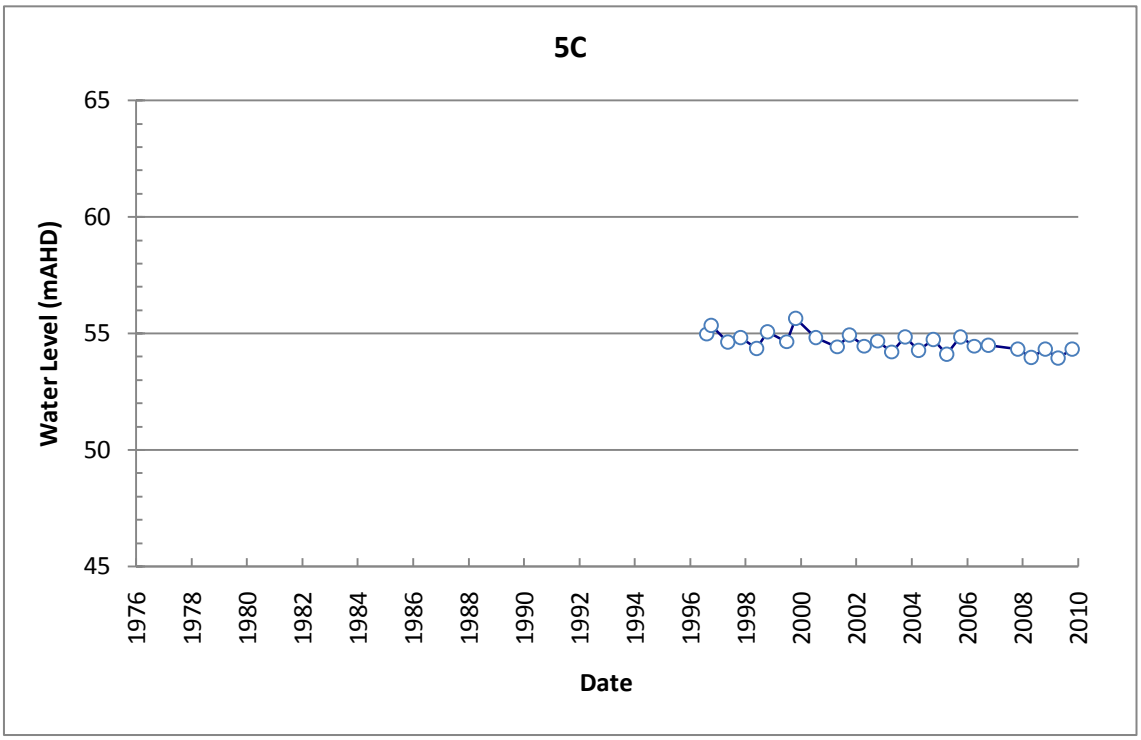
Figure 3-5: North Moore River Park sub-area - monitoring bores within the Superficial aquifer


21A
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


4A
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


4B
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


5A
Water Level (mAHD)
65
60
55
50
45
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


5C
Water Level (mAHD)
65
60
55
50
45
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

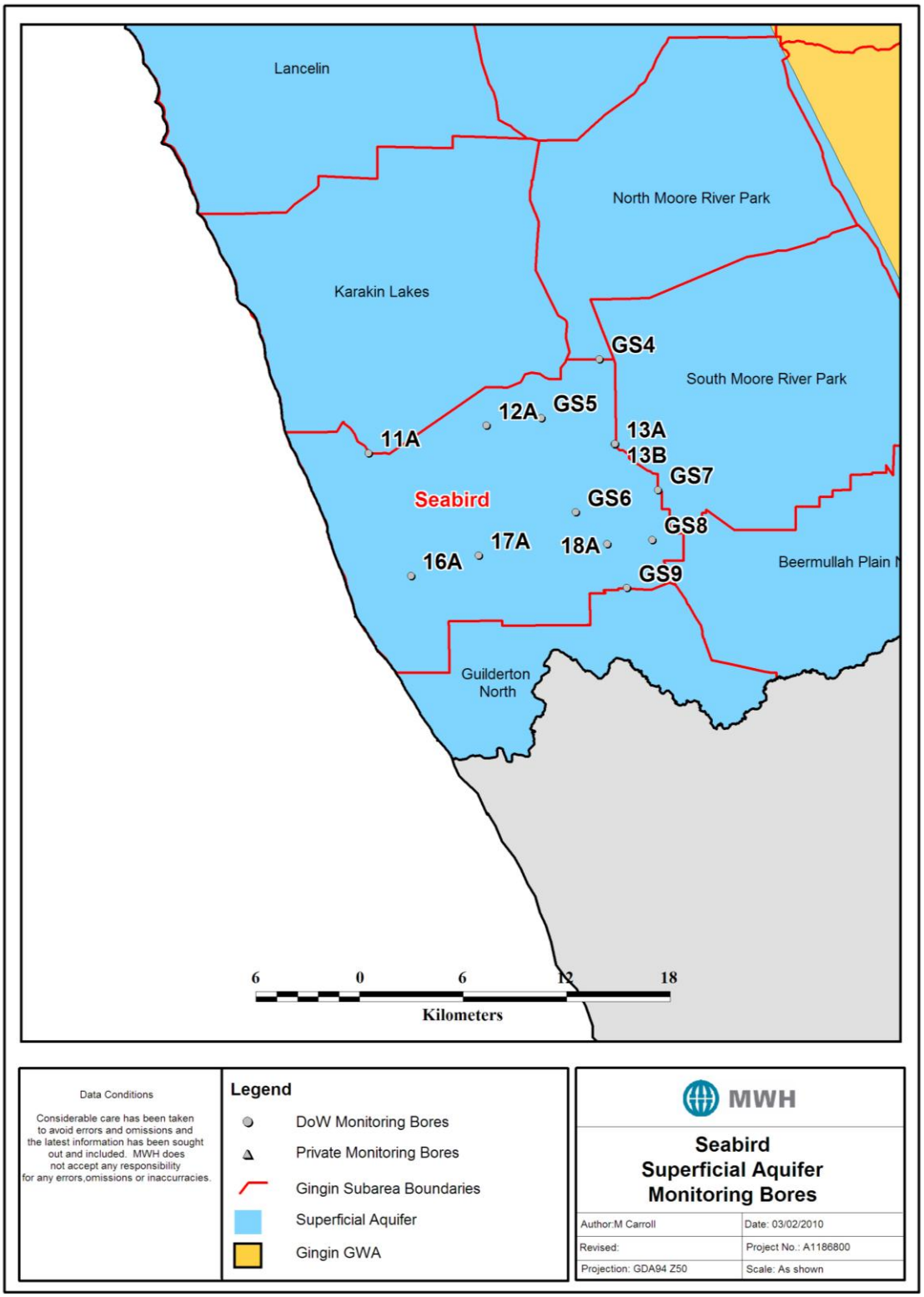
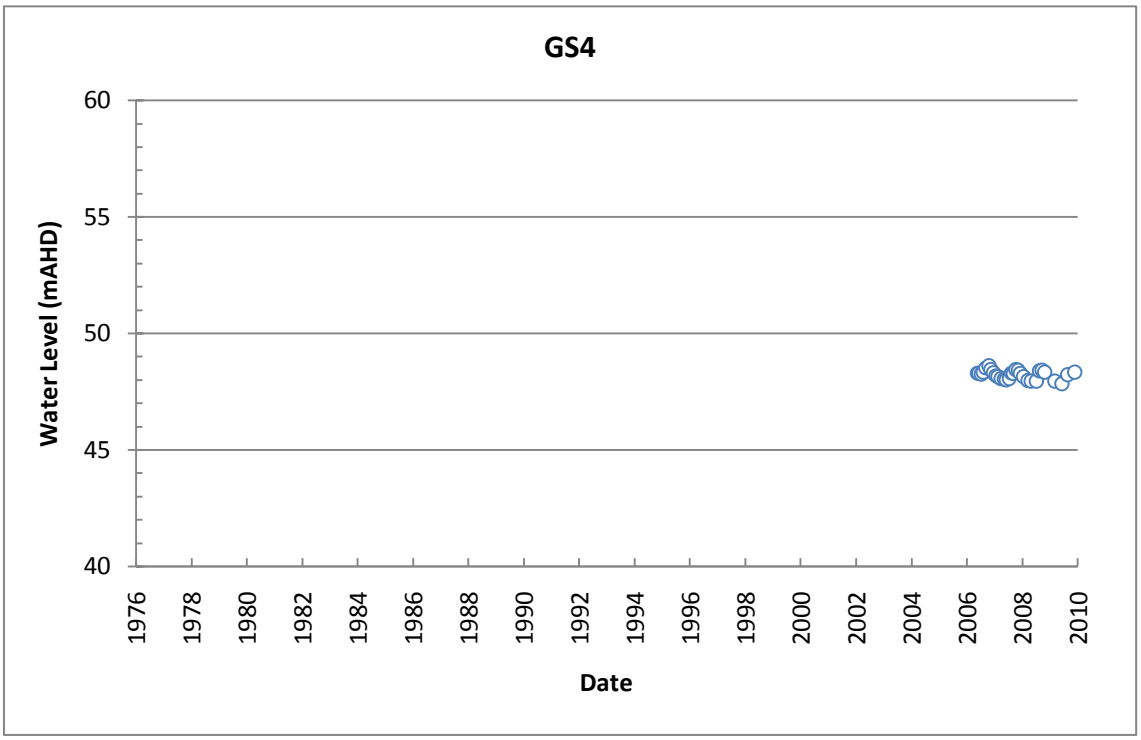
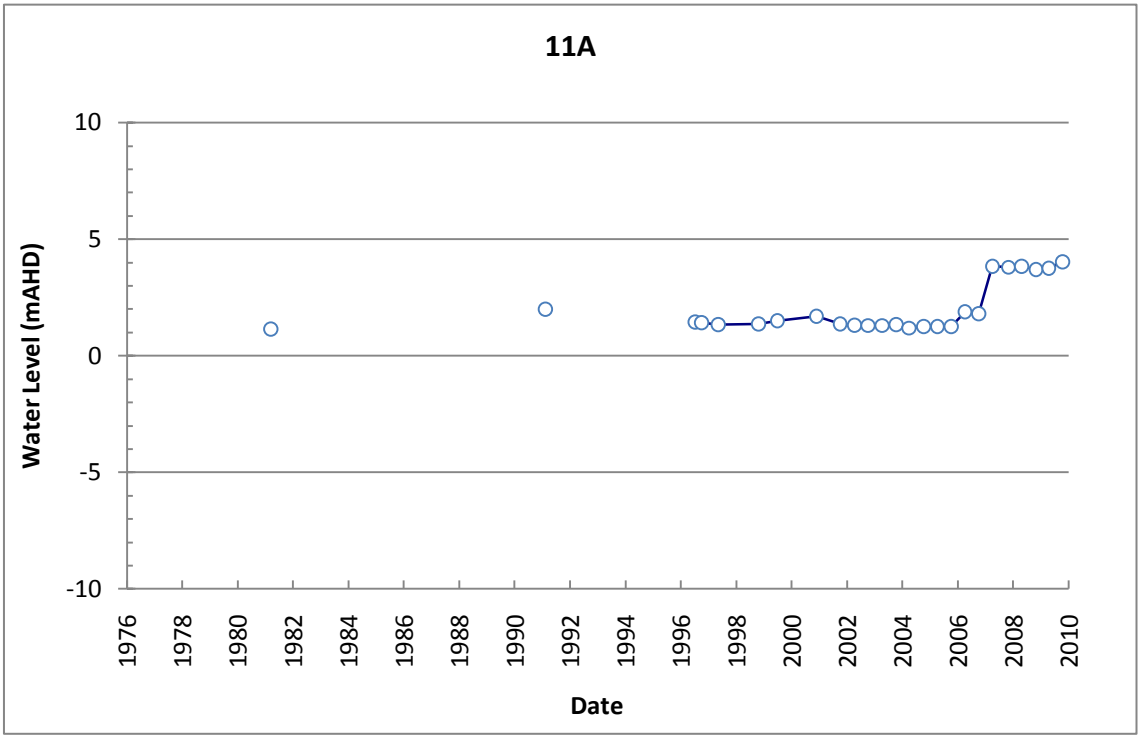
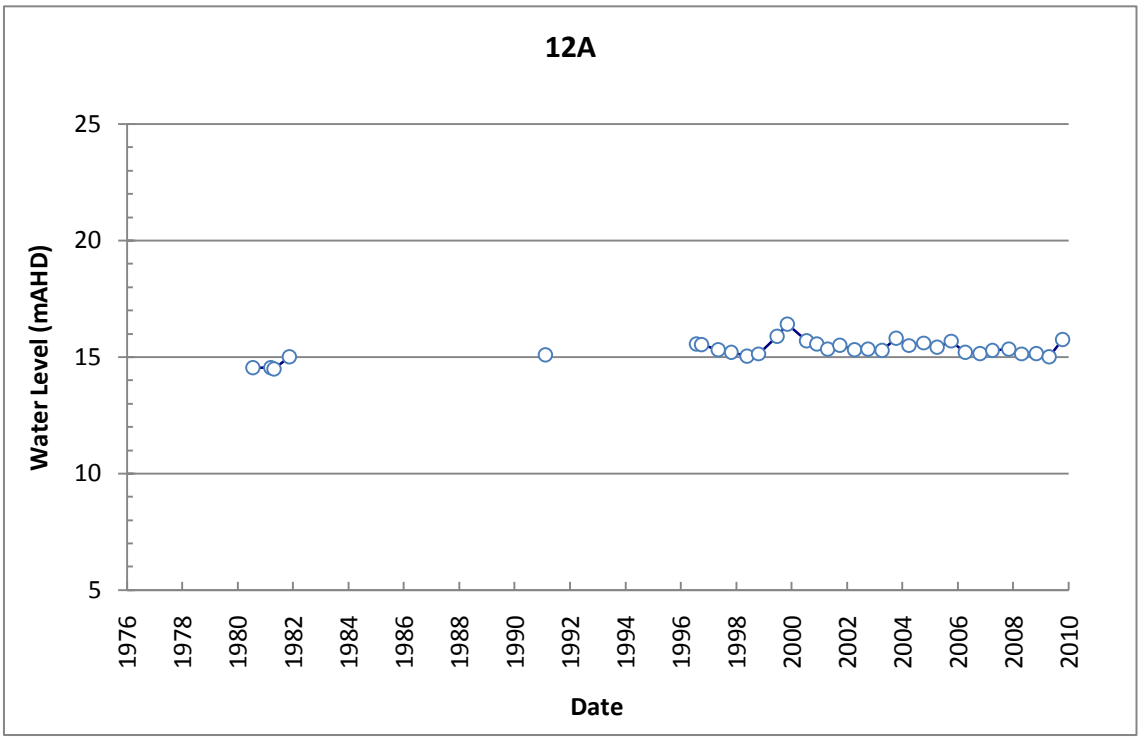
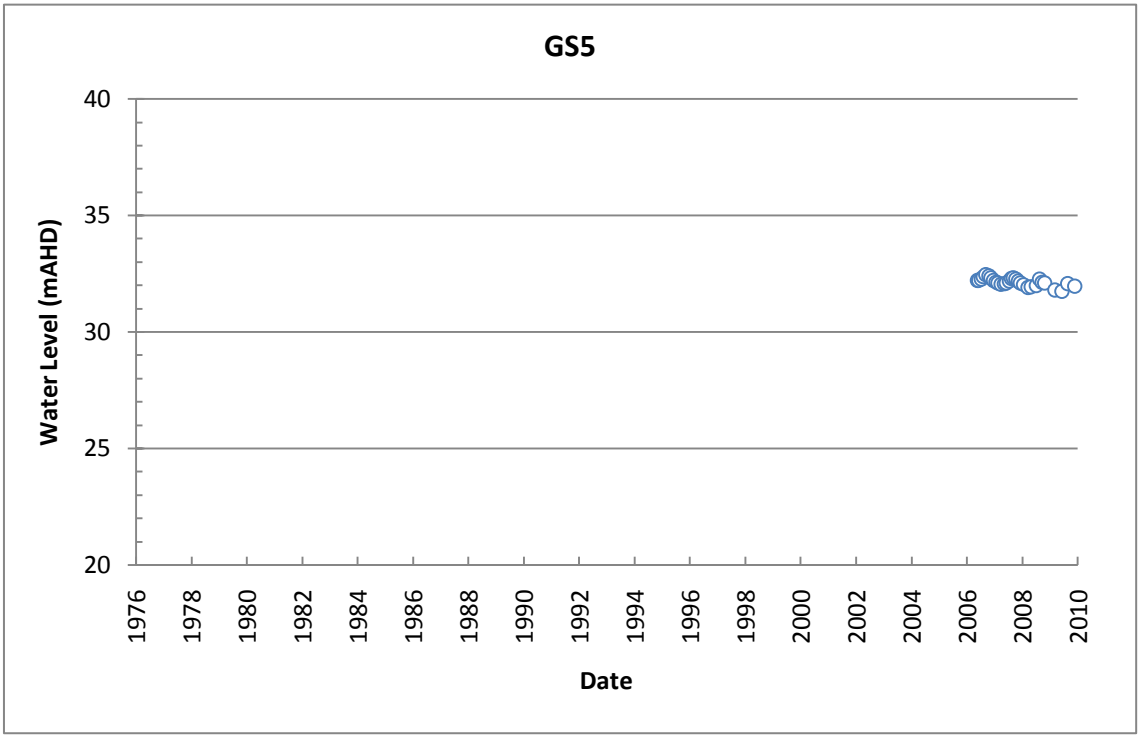


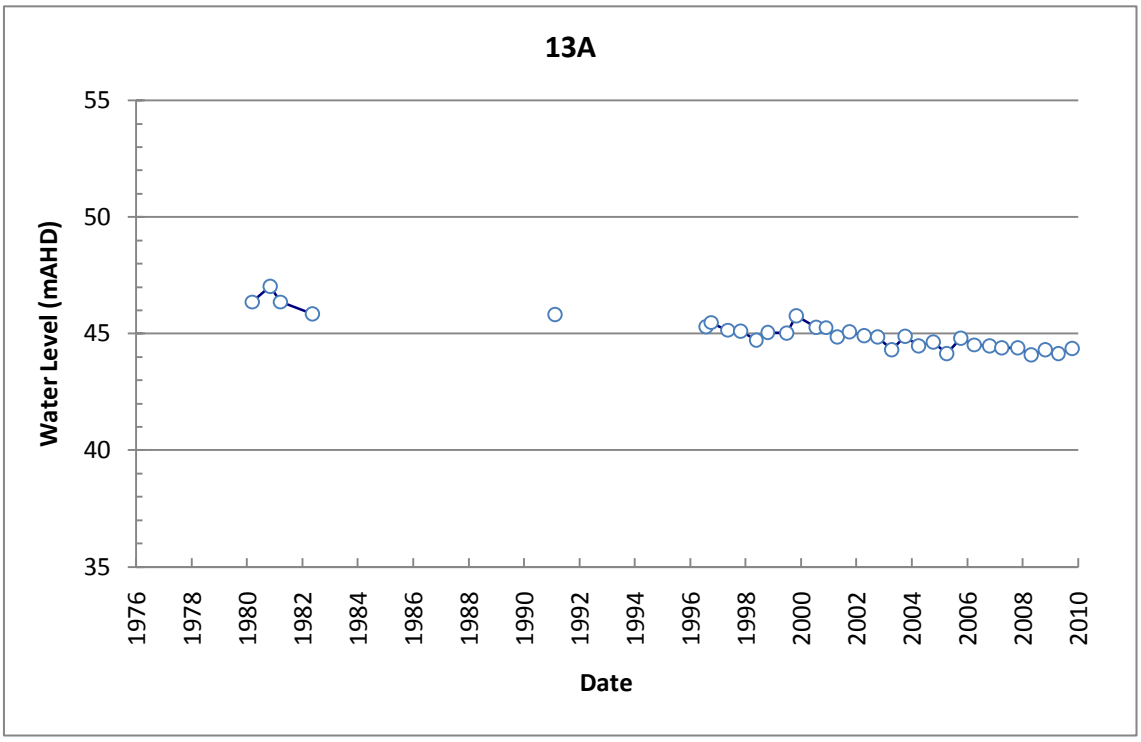
Figure 3-6: Seabird sub-area - monitoring bores within the Superficial aquifer

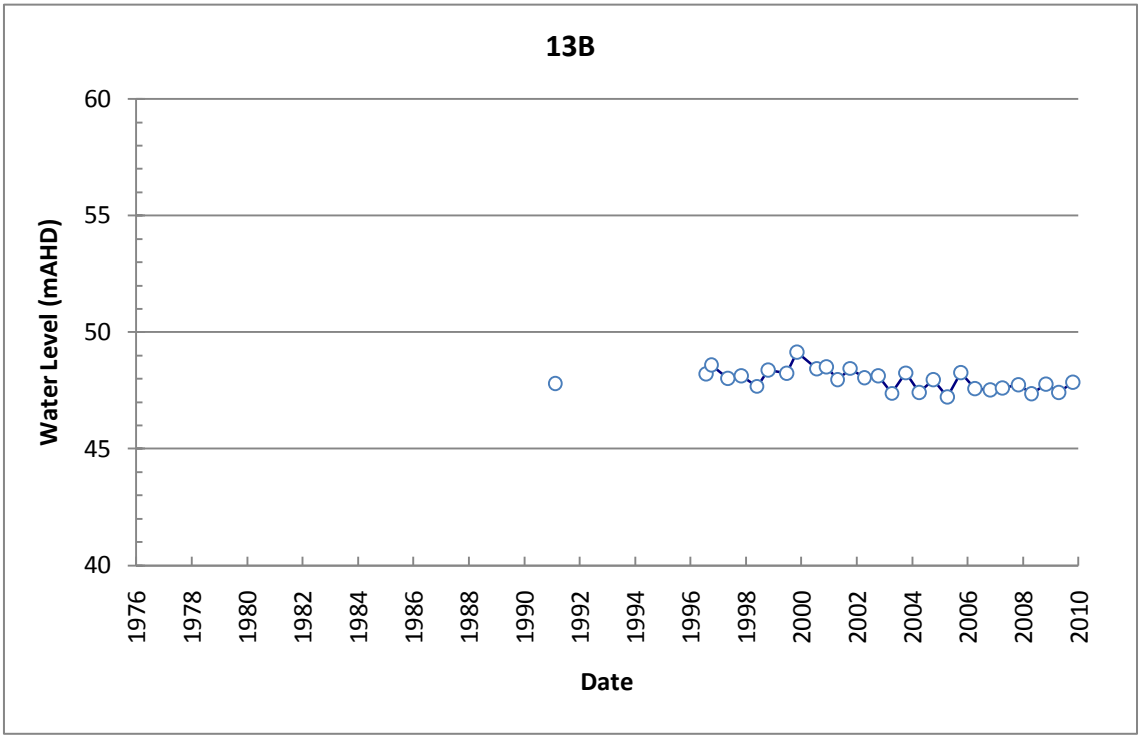

GS4
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

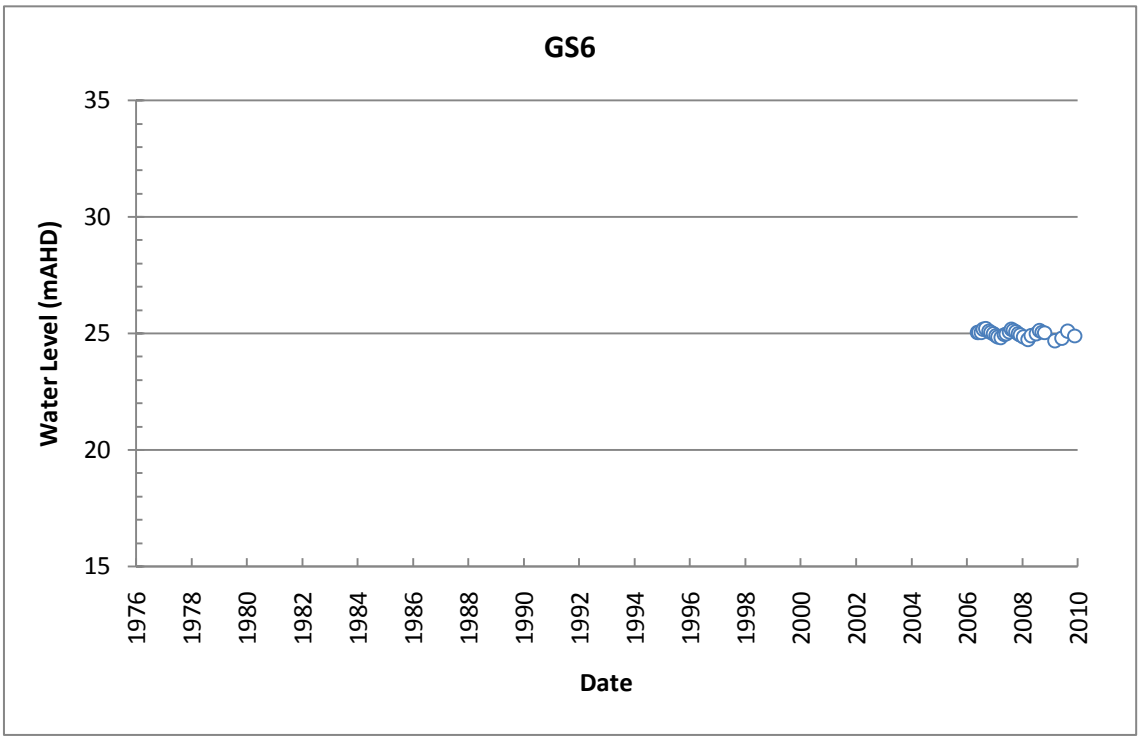

11A
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

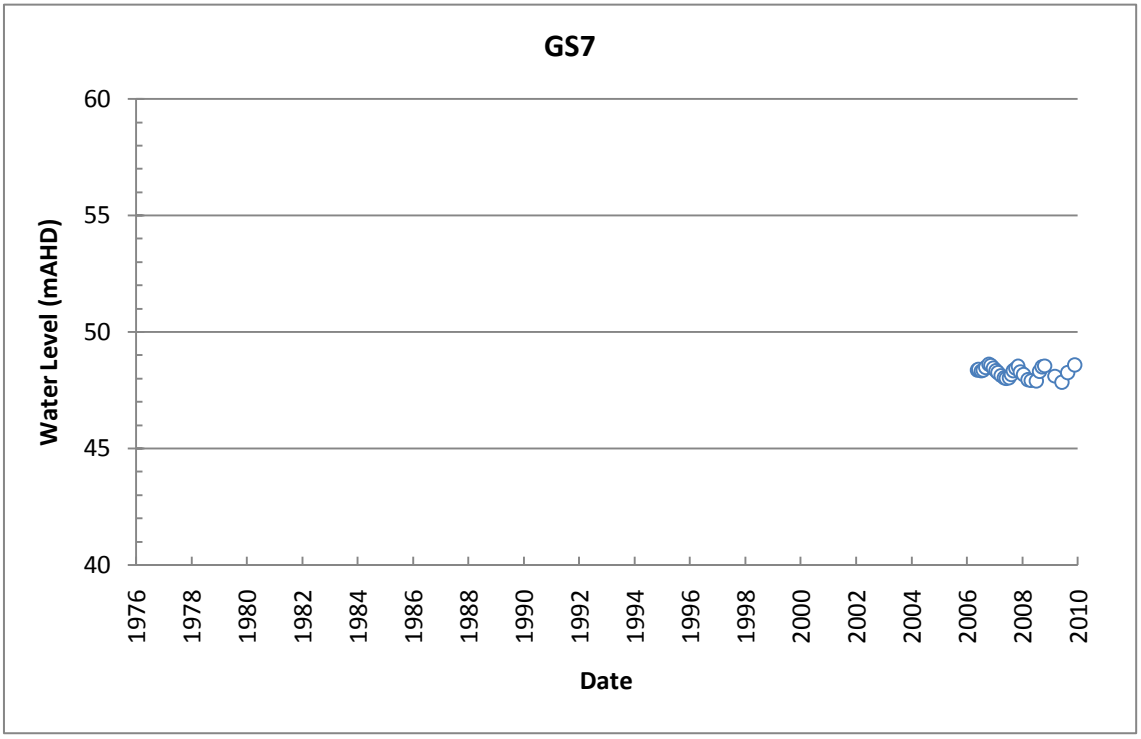

12A
Water Level (mAHD)
25
20
15
10
5
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

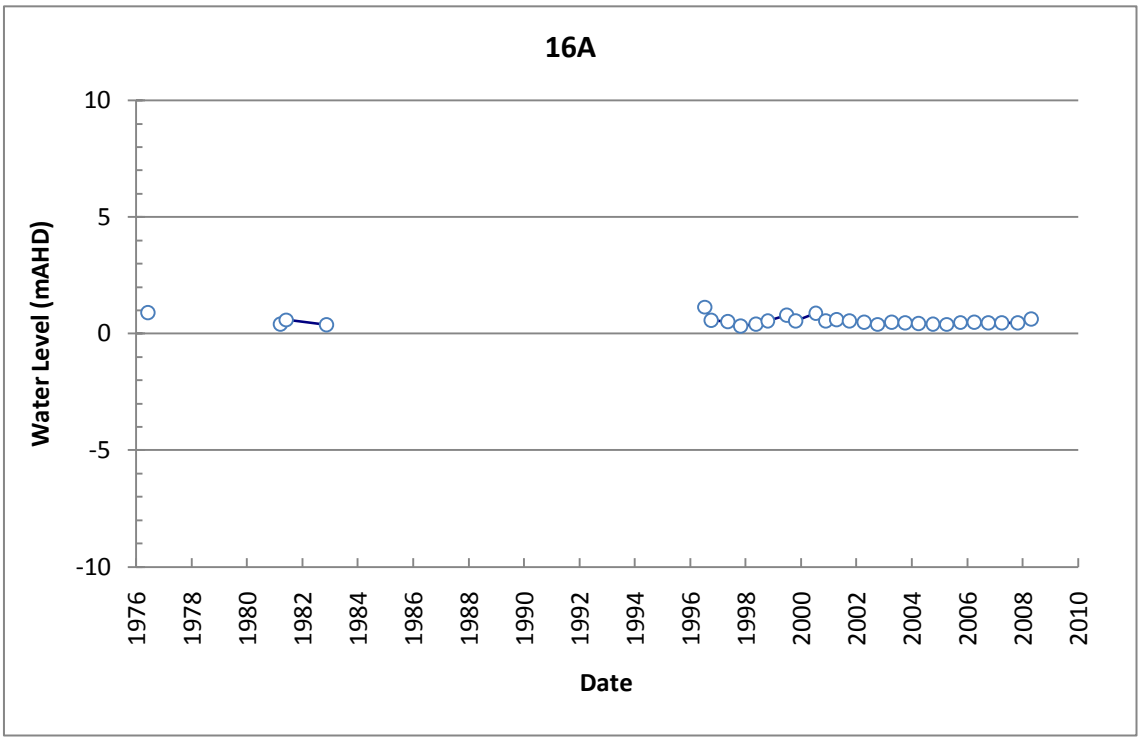

GS5
Water Level (mAHD)
40
35
30
25
20
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

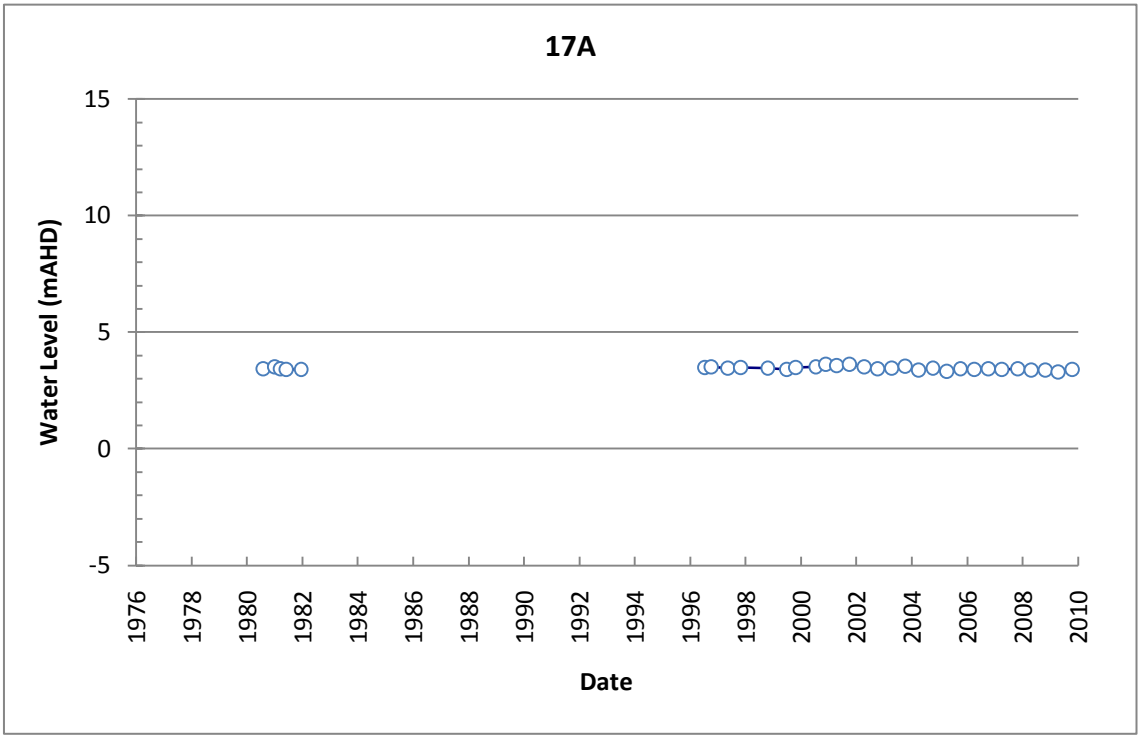

13A
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

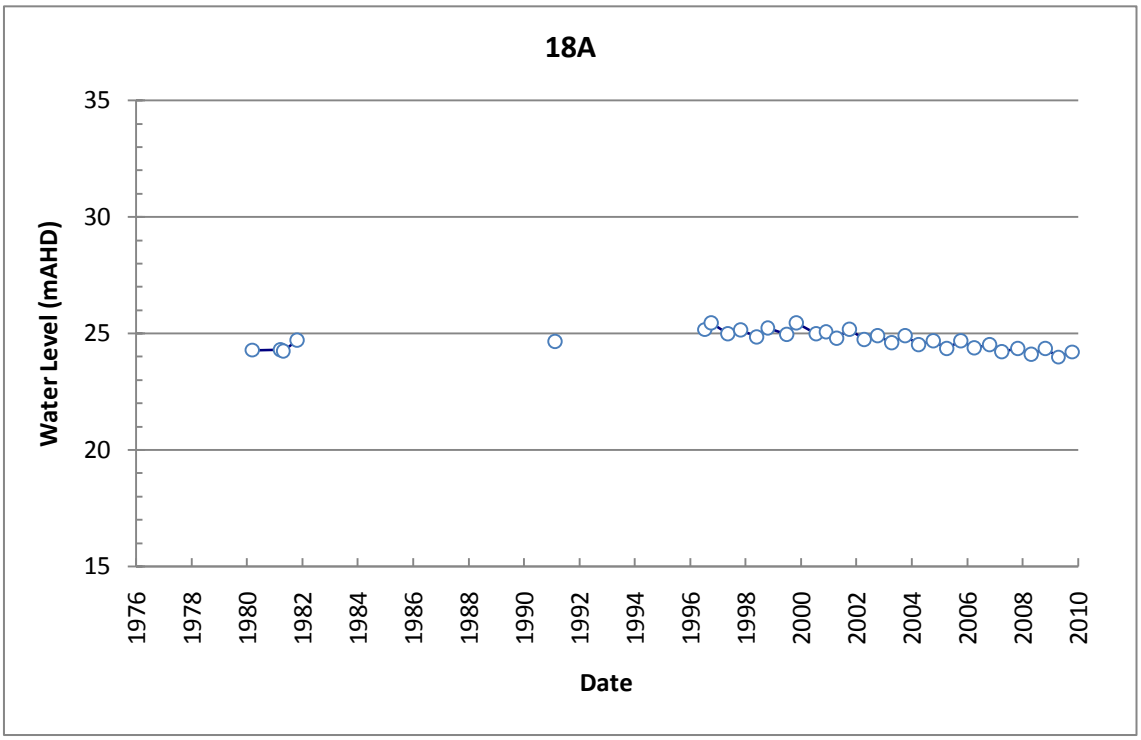

13B
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

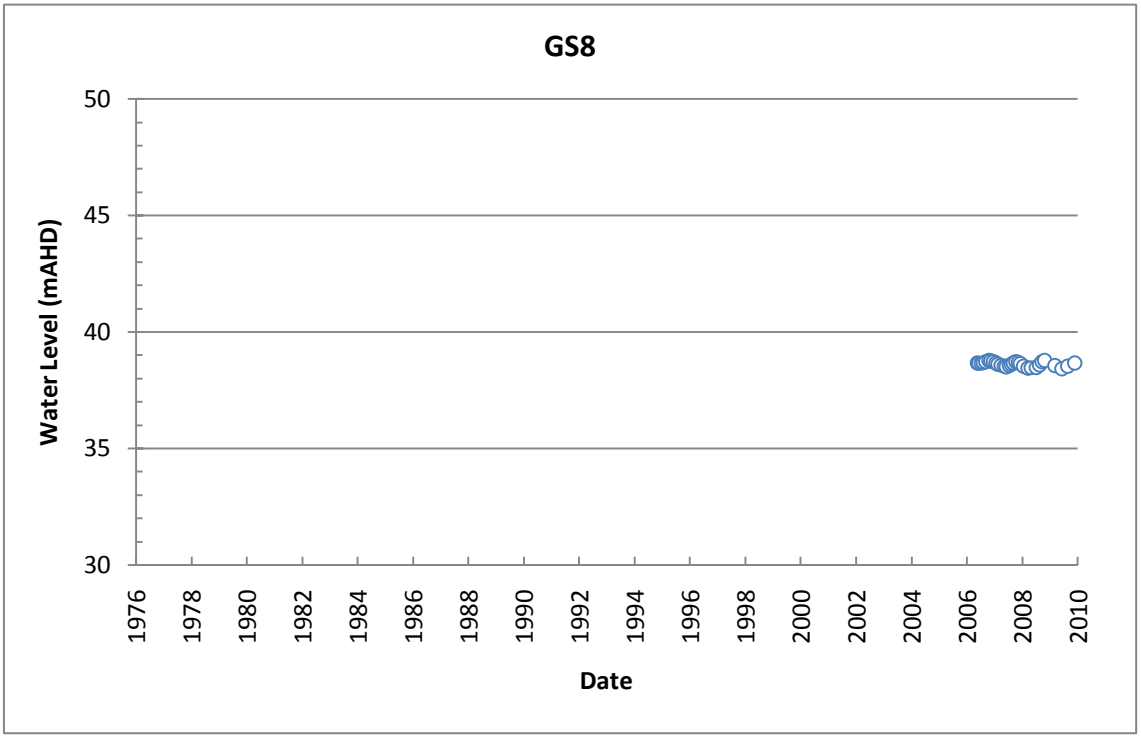

GS6
Water Level (mAHD)
35
30
25
20
15
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

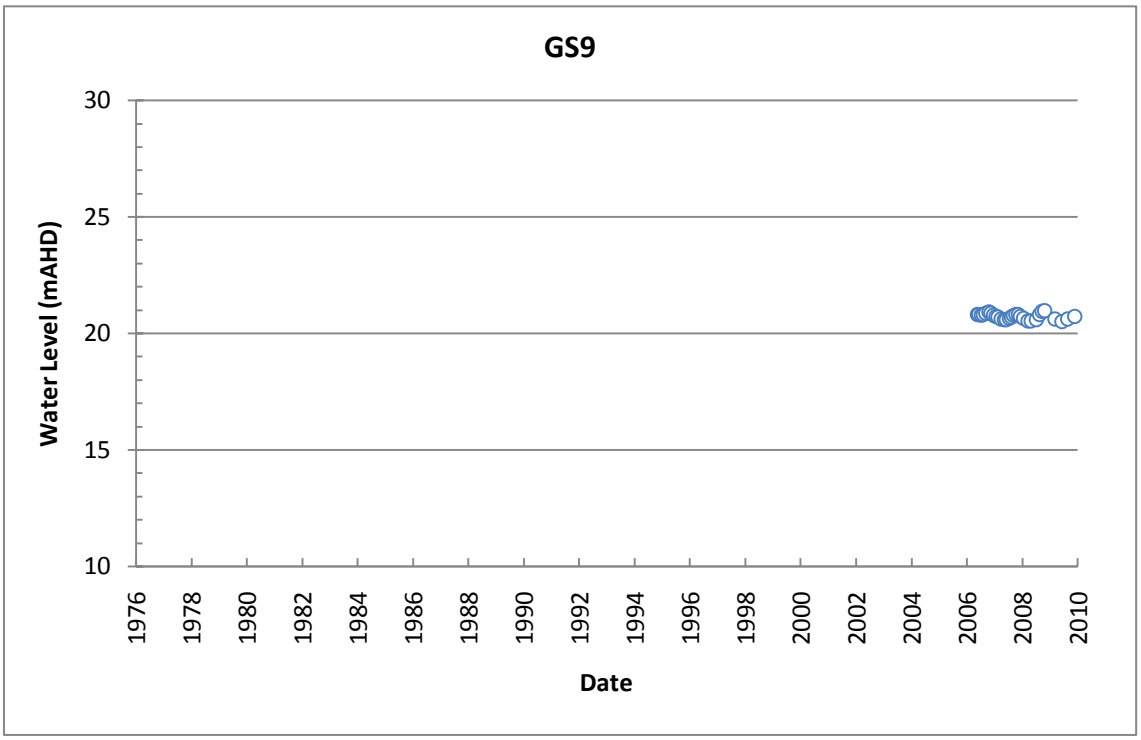

GS7
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


16A
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


17A
Water Level (mAHD)
15
10
5
0
-5
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


18A
Water Level (mAHD)
35
30
25
20
15
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GS8
Water Level (mAHD)
50
45
40
35
30
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GS9
Water Level (mAHD)
30
25
20
15
10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

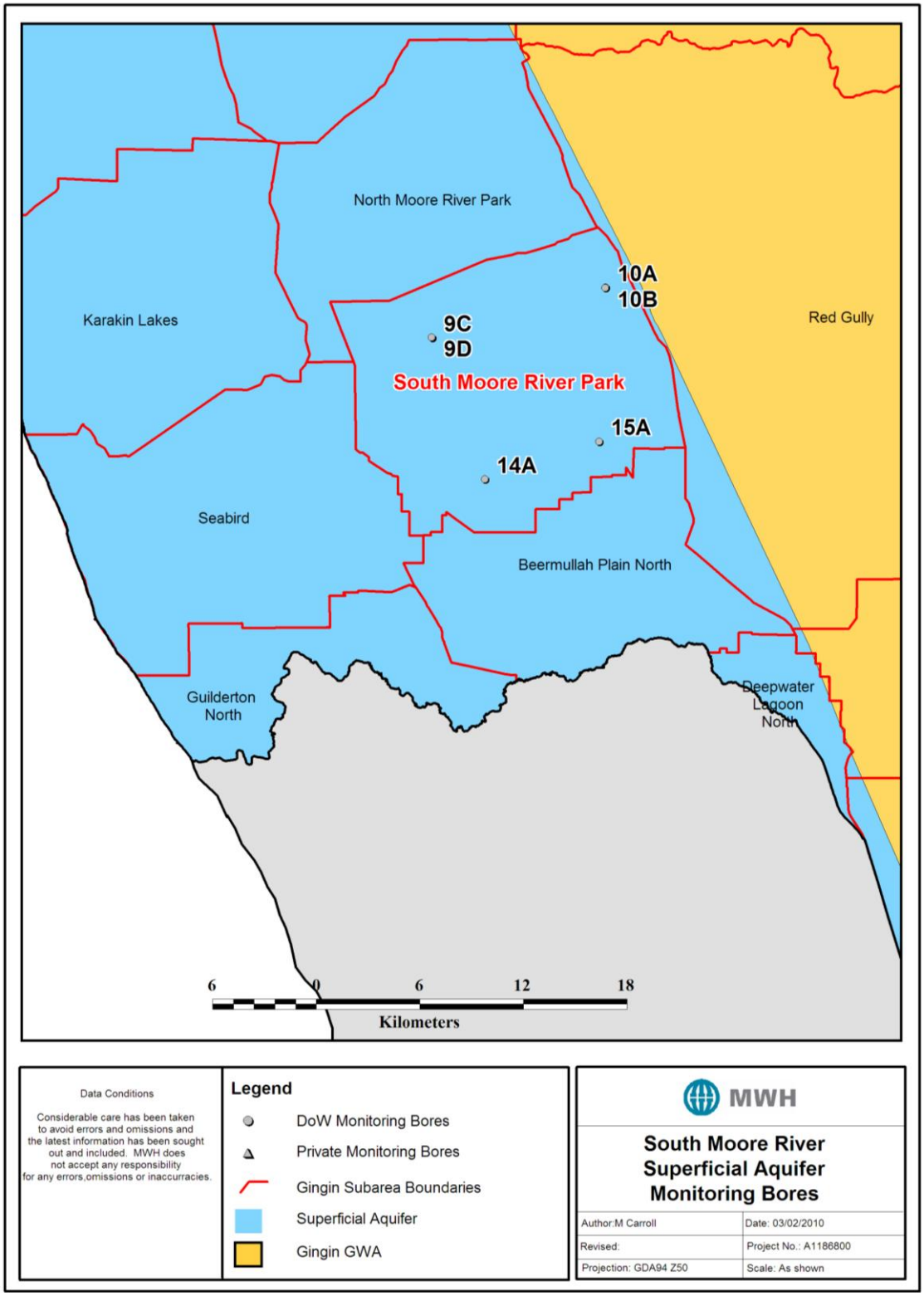
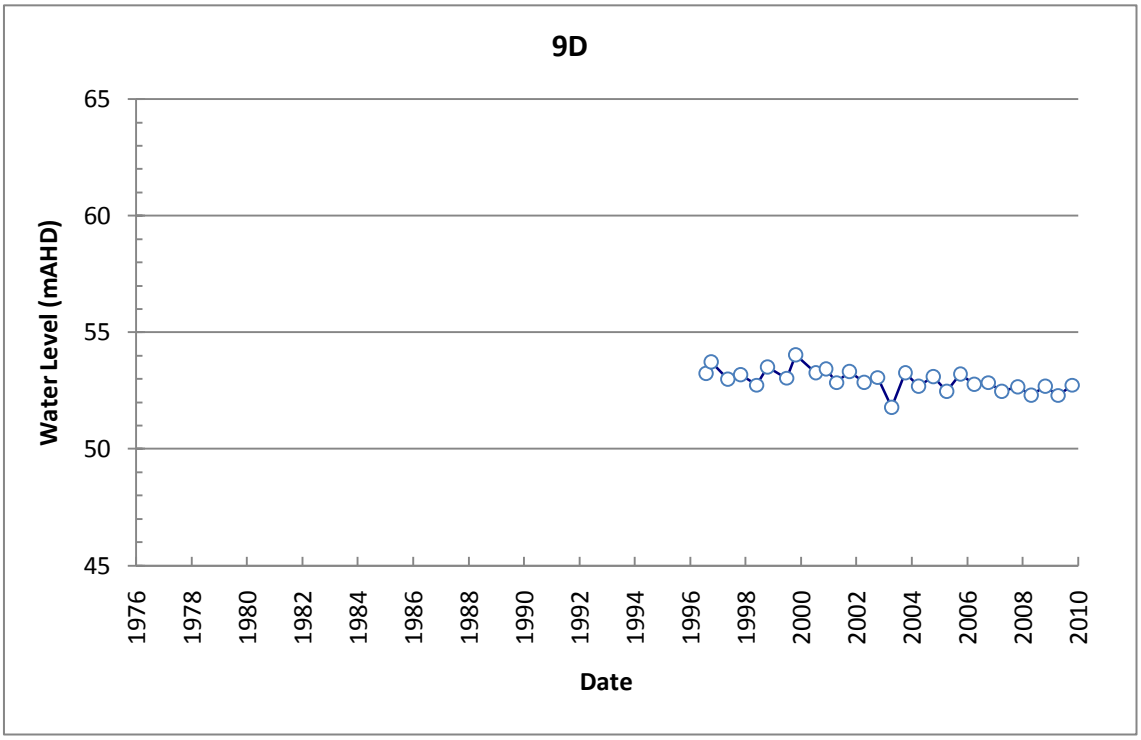
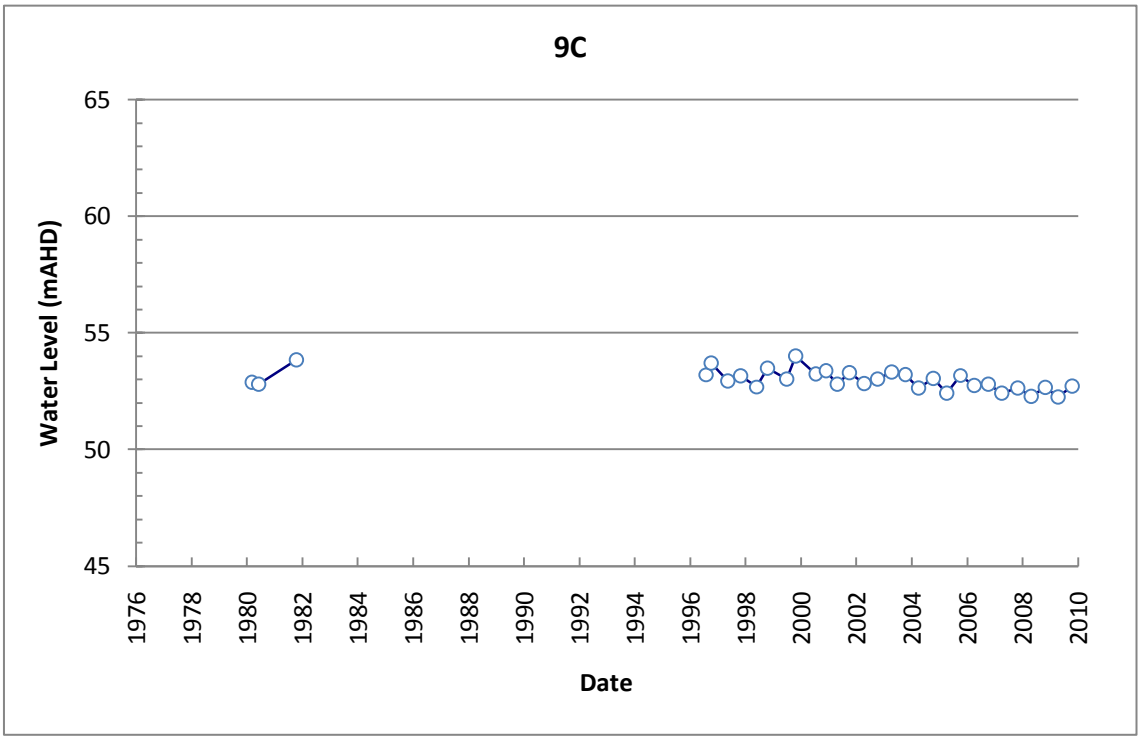
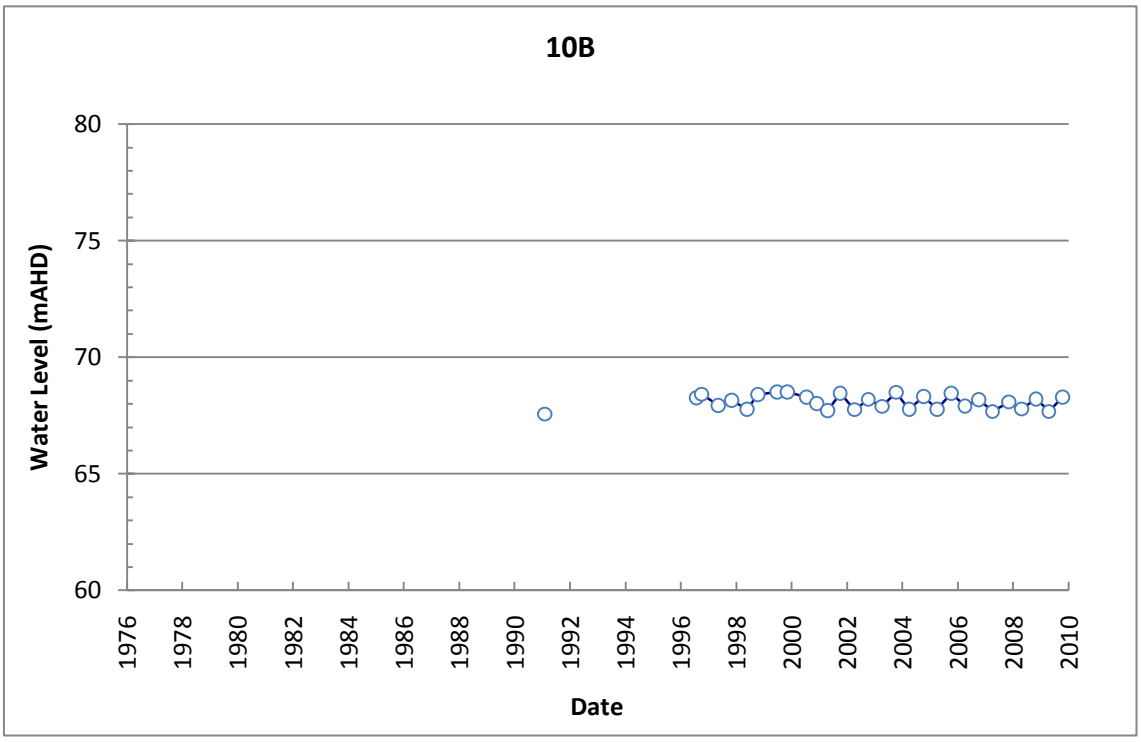
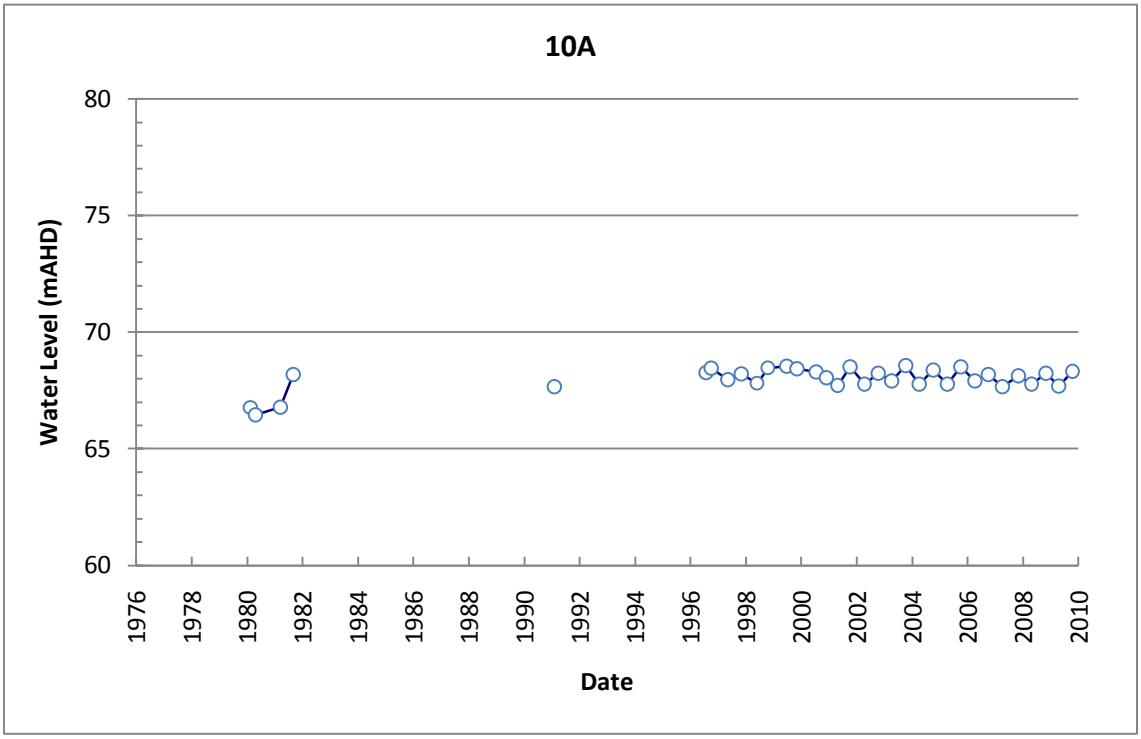


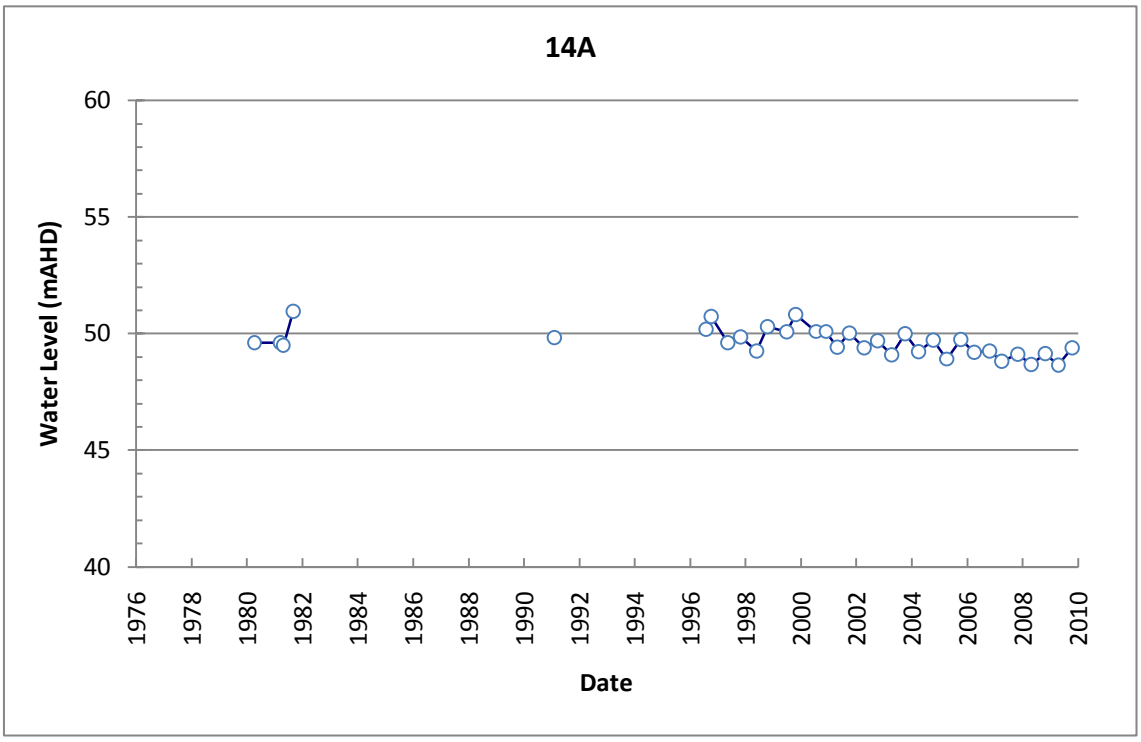
Figure 3-7: South Moore River Park sub-area - monitoring bores within the Superficial aquifer

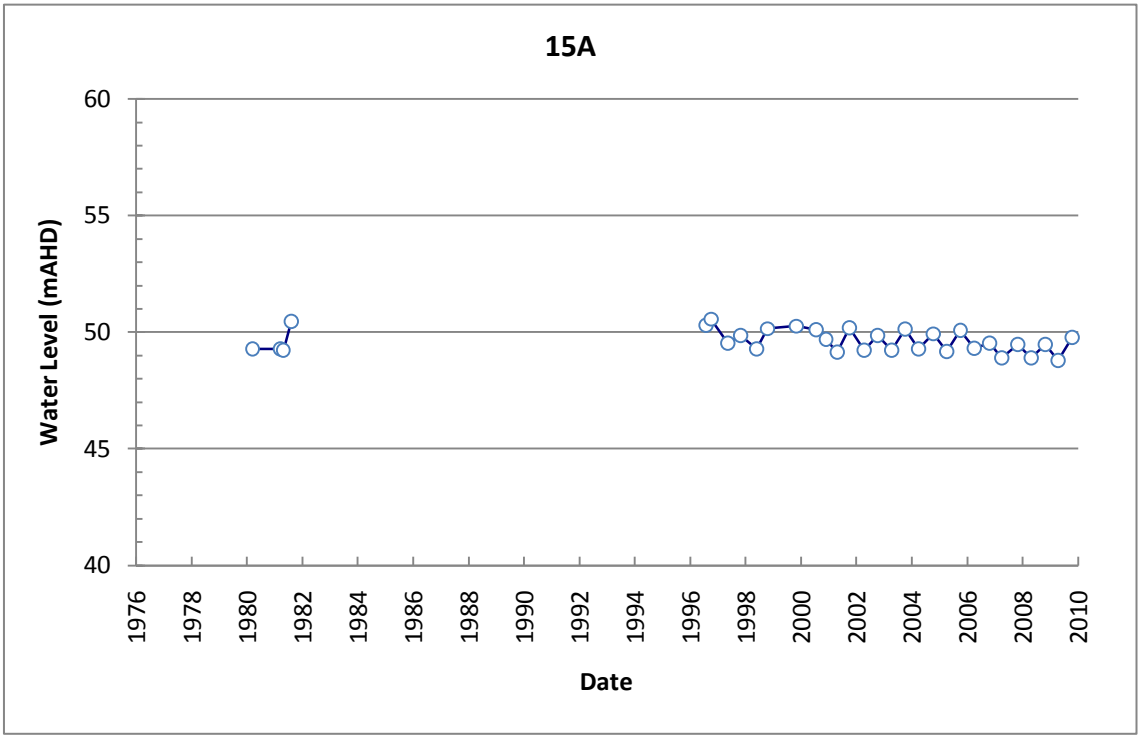

9D
Water Level (mAHD)
65
60
55
50
45
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


9C
Water Level (mAHD)
65
60
55
50
45
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


10B
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


10A
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


14A
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


15A
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

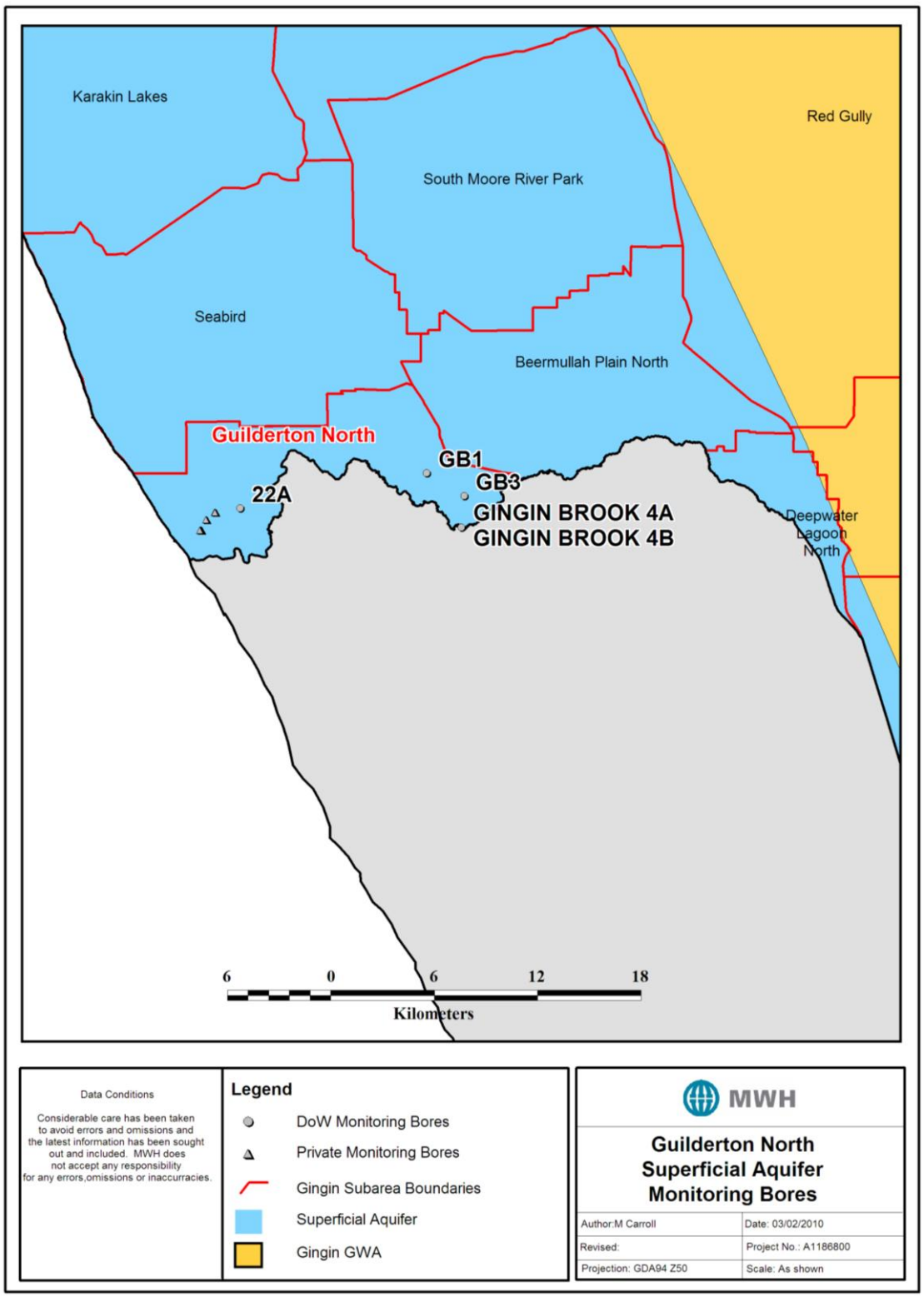
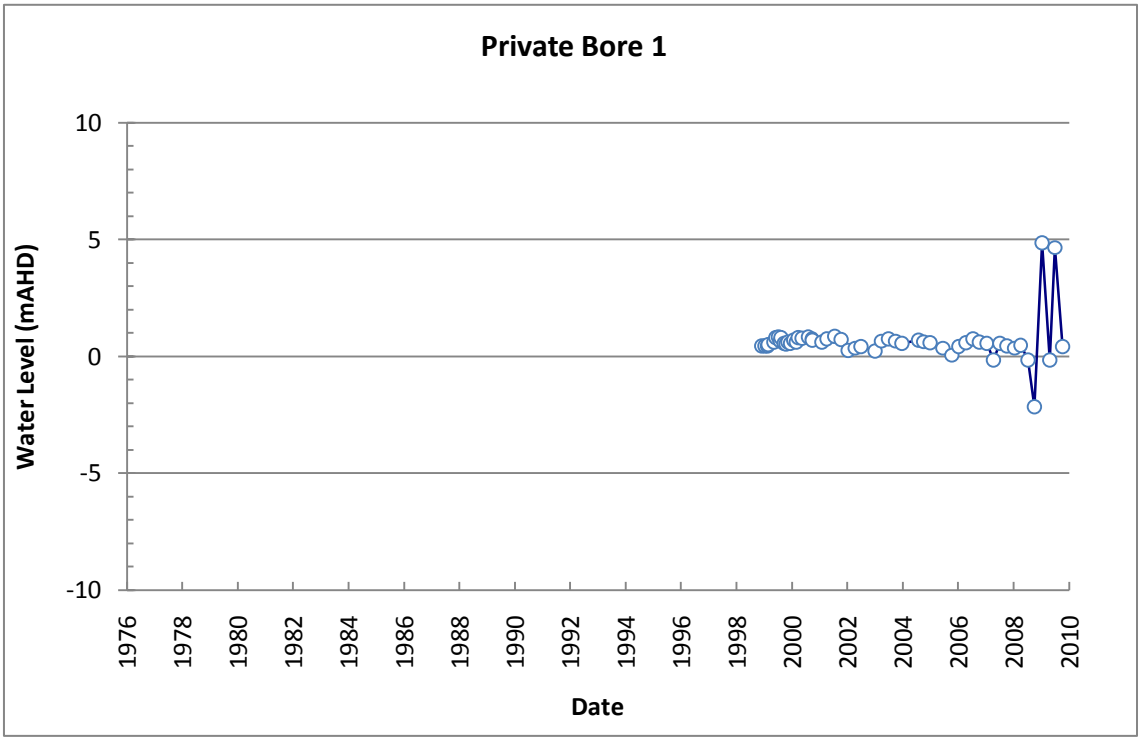
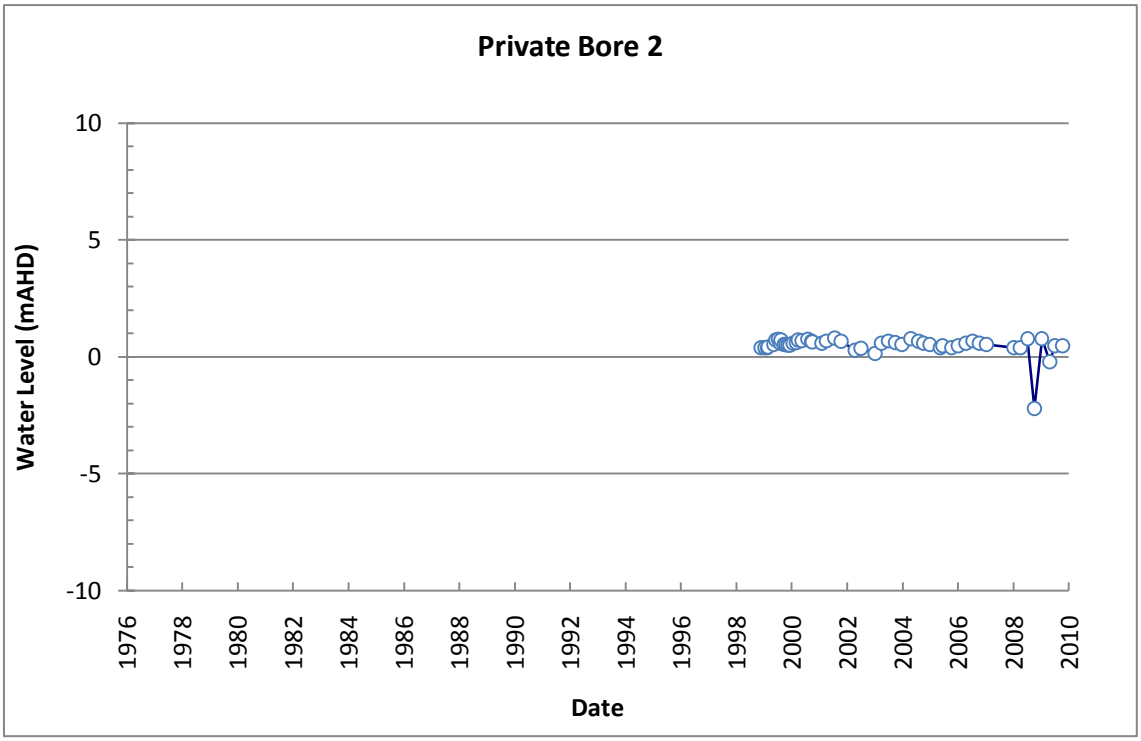
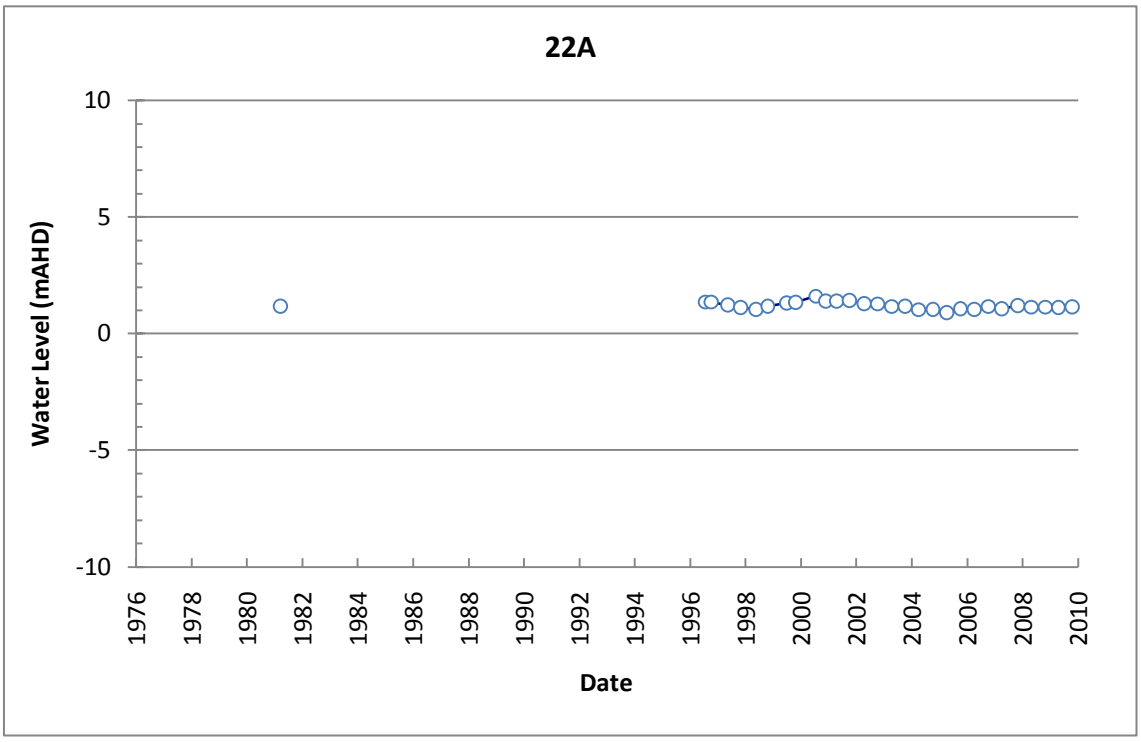
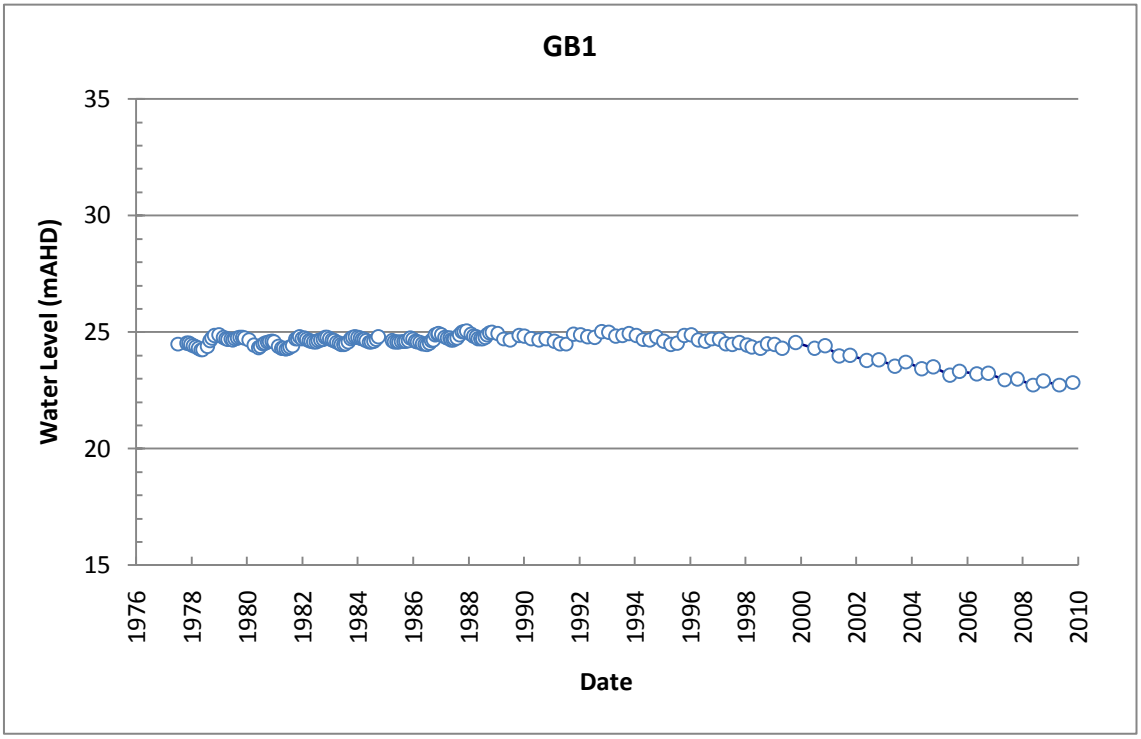


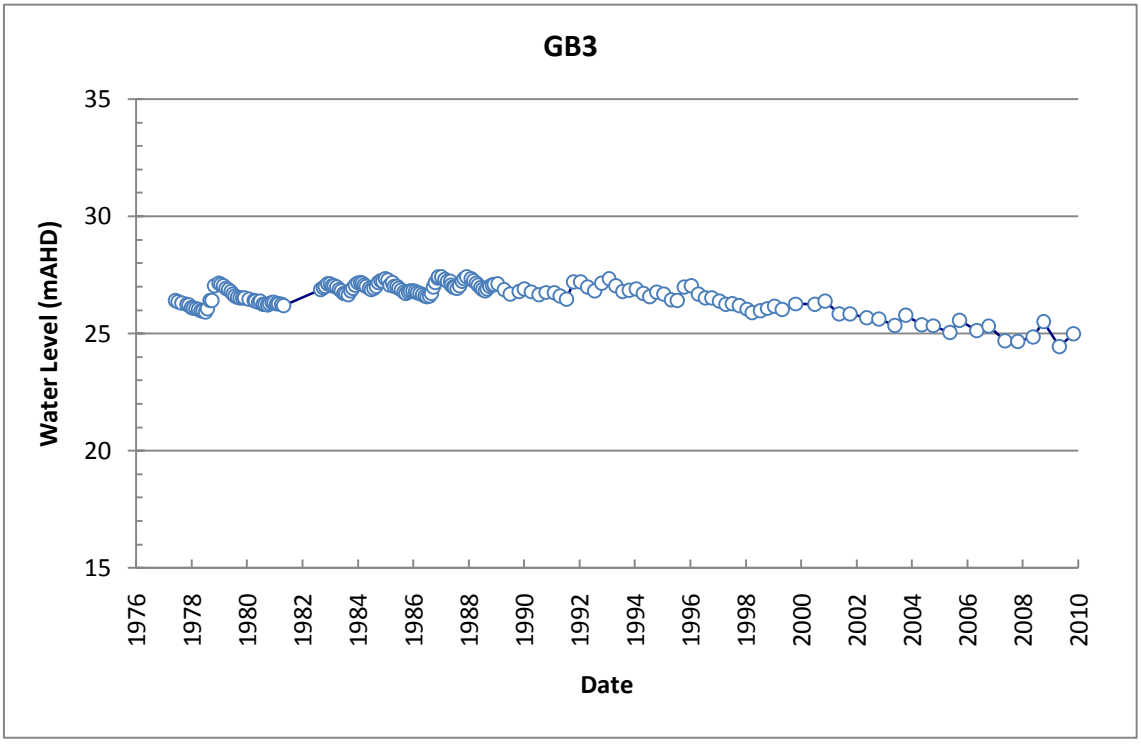
Figure 3-8: Guilderton North sub-area - monitoring bores within the Superficial aquifer

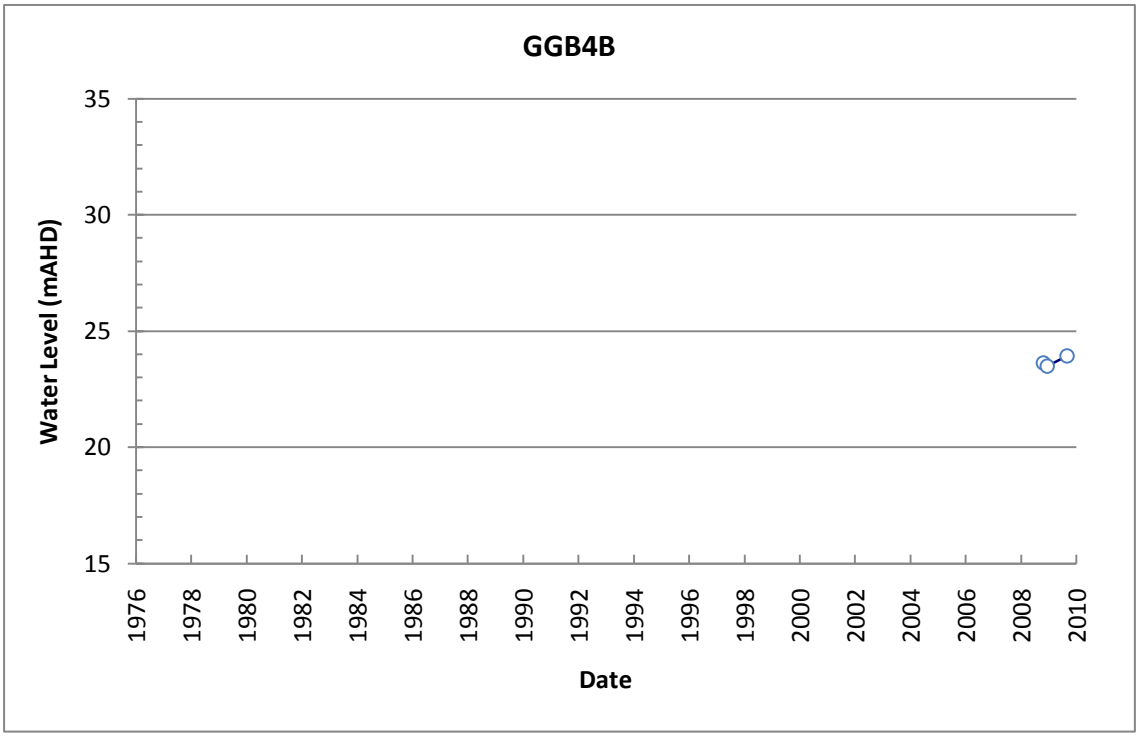

Private Bore 1
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

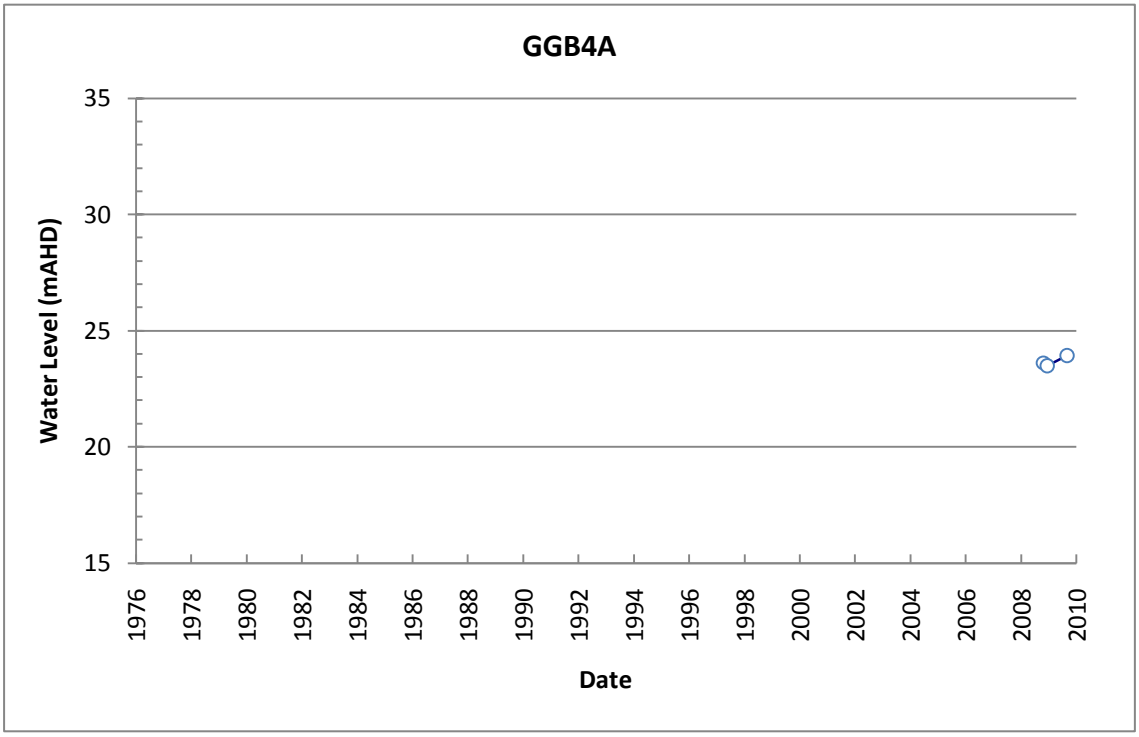

Private Bore 2
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


22A
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GB1
Water Level (mAHD)
35
30
25
20
15
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GB3
Water Level (mAHD)
35
30
25
20
15
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB4B
Water Level (mAHD)
35
30
25
20
15
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB4A
Water Level (mAHD)
35
30
25
20
15
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

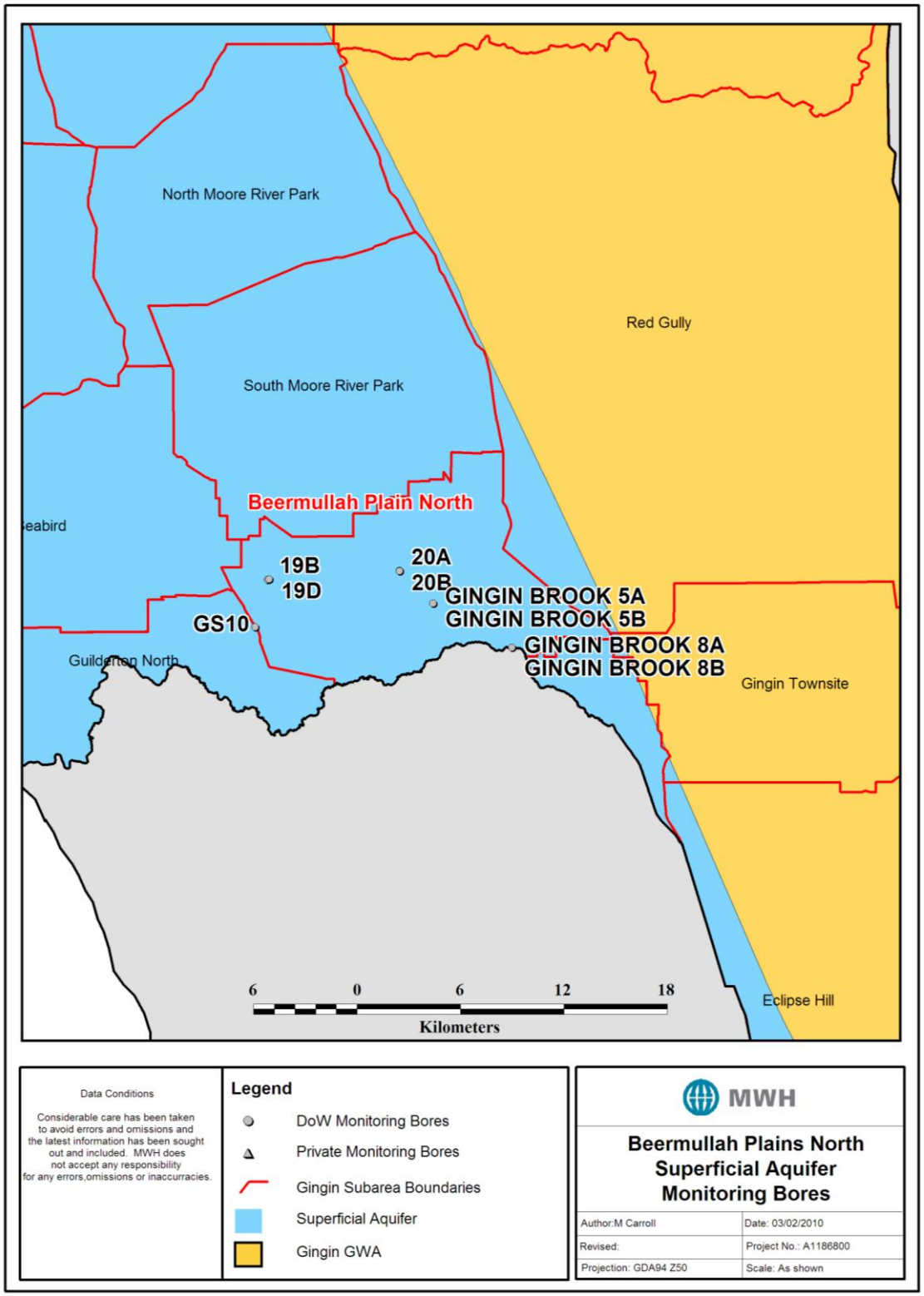
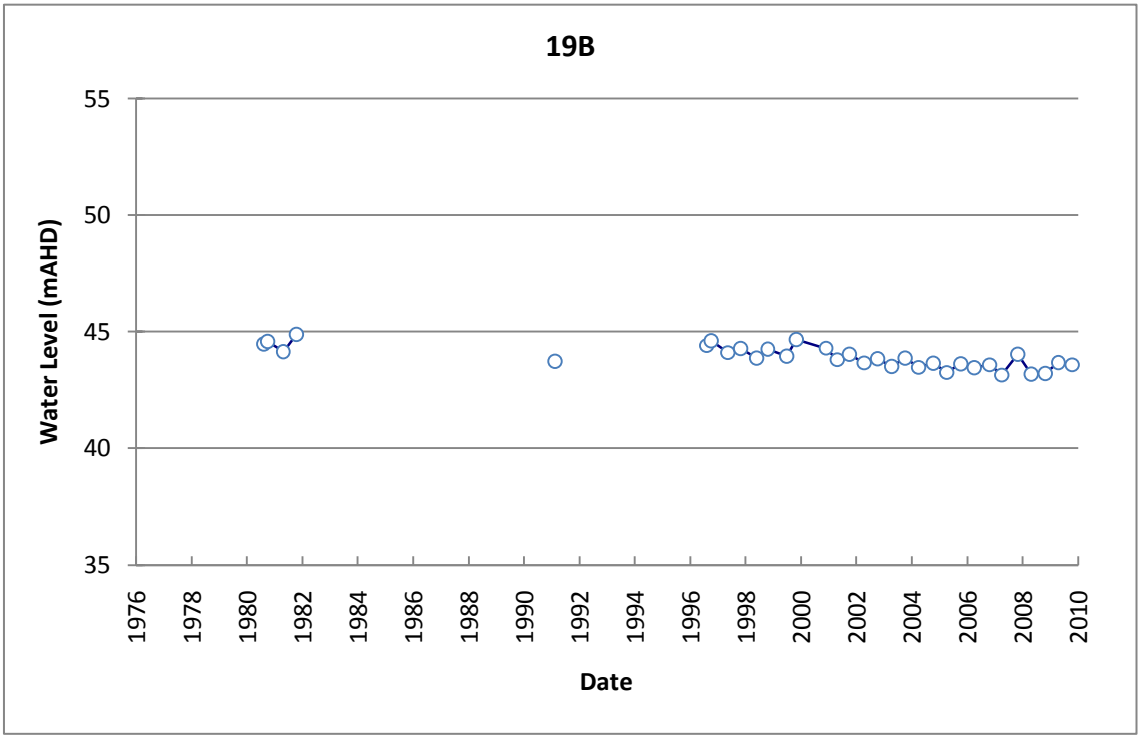
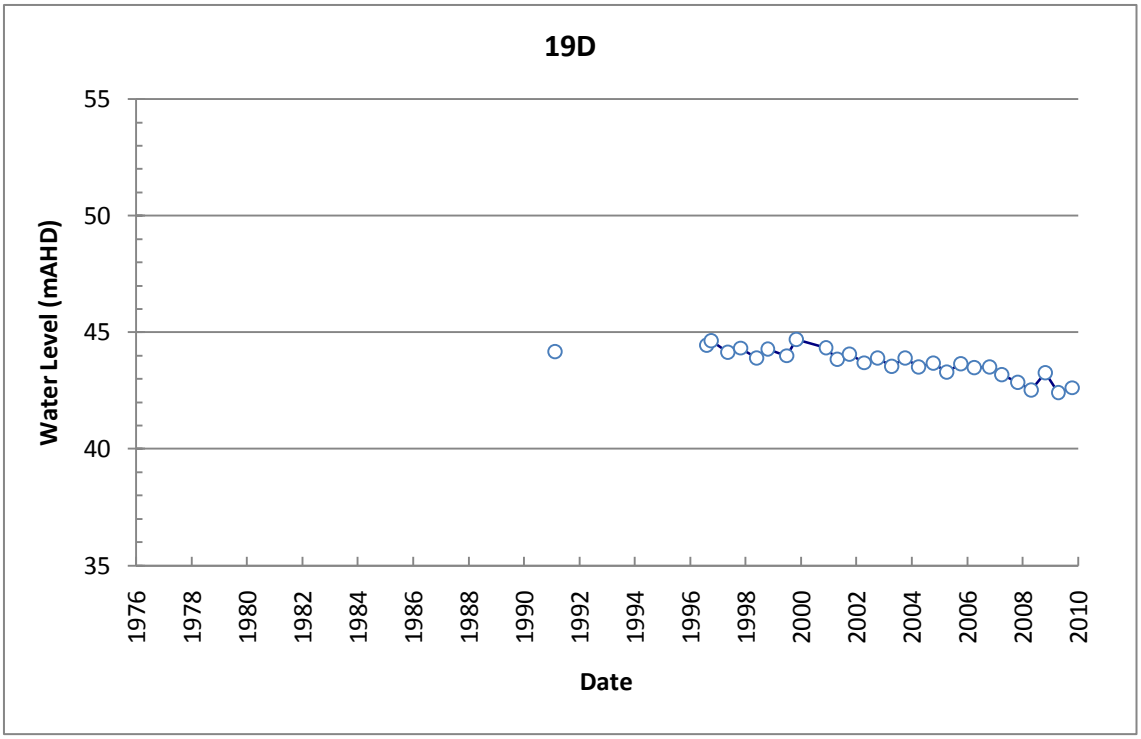
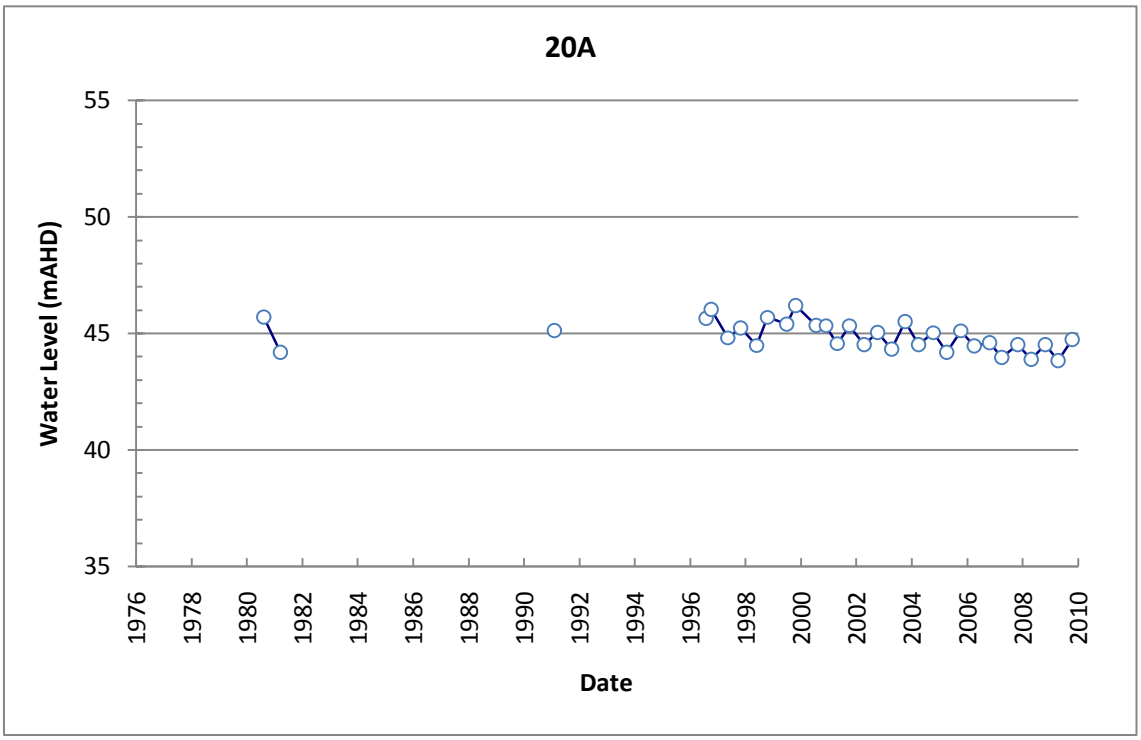
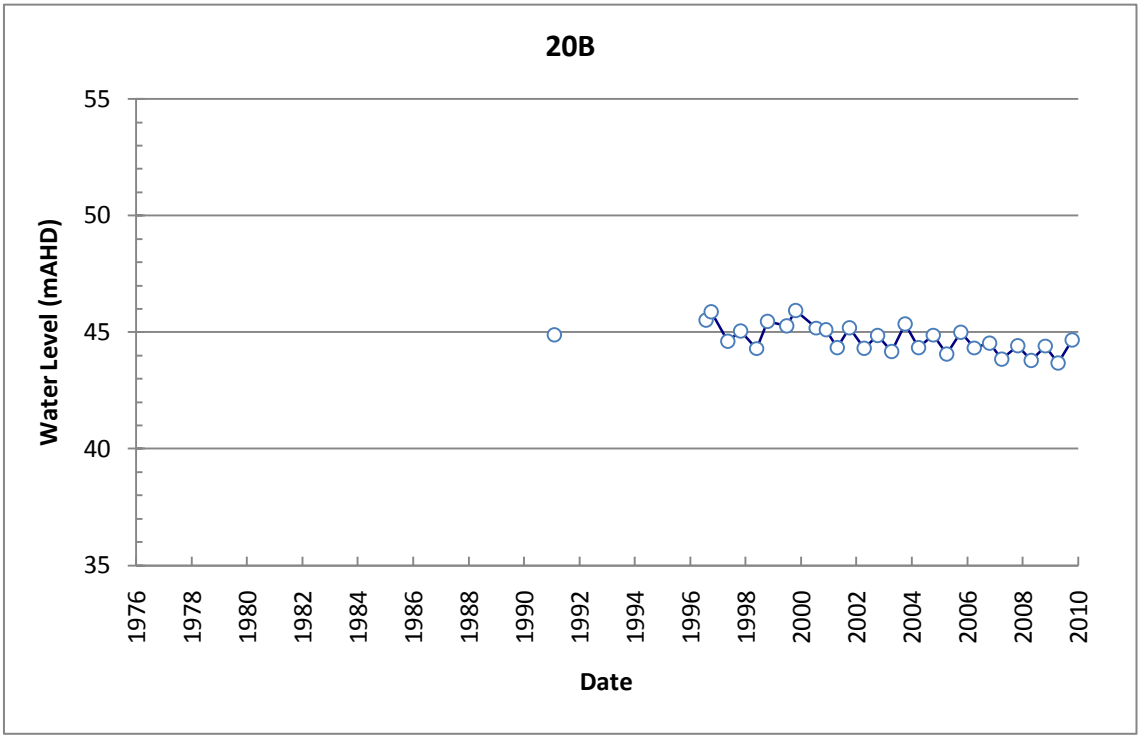


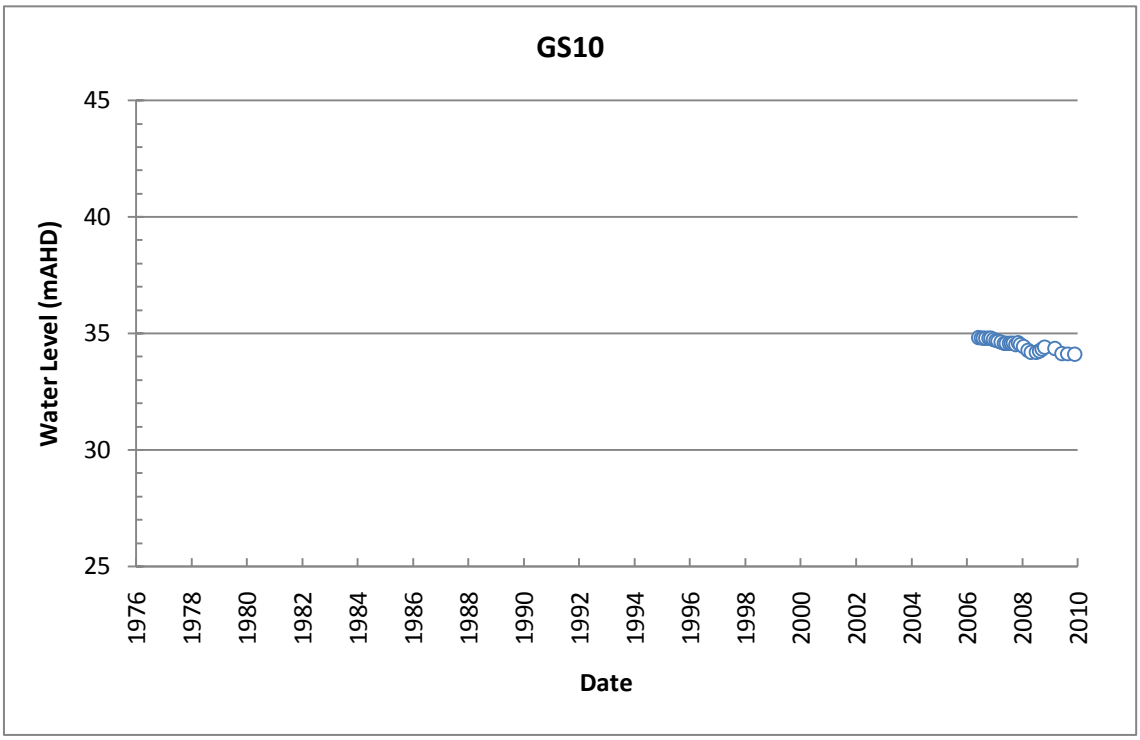
Figure 3-9: Beermullah Plain North sub-area - monitoring bores within the Superficial aquifer

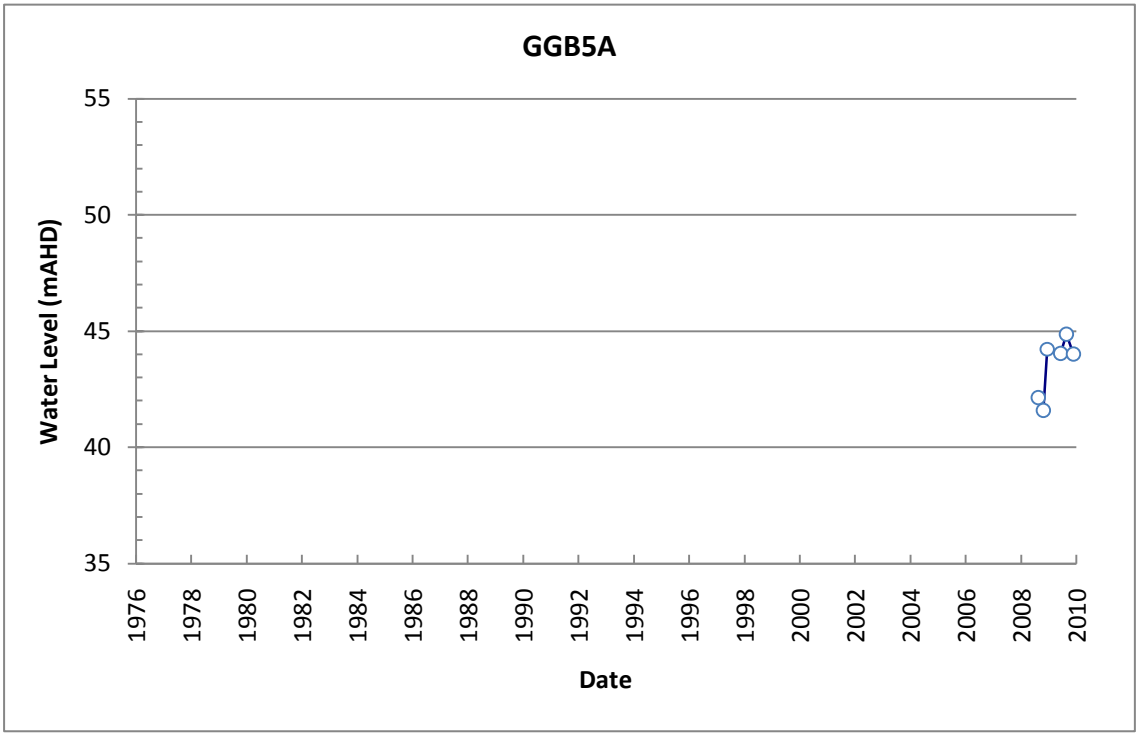

19B
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

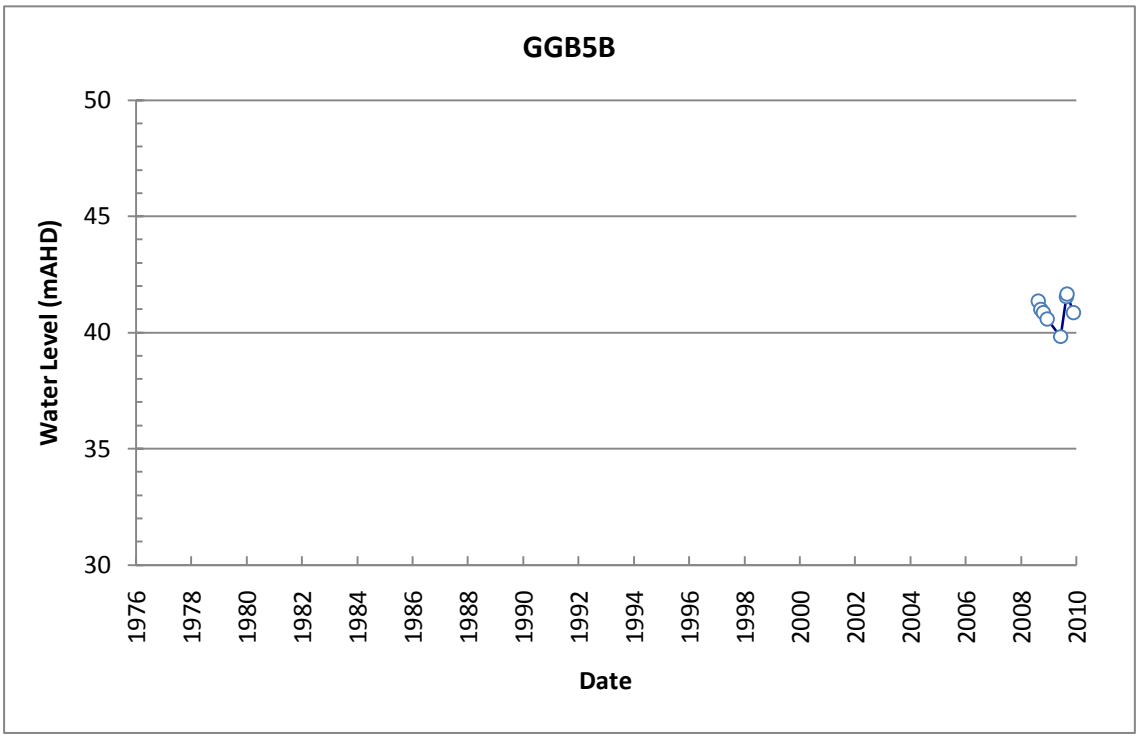

19D
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

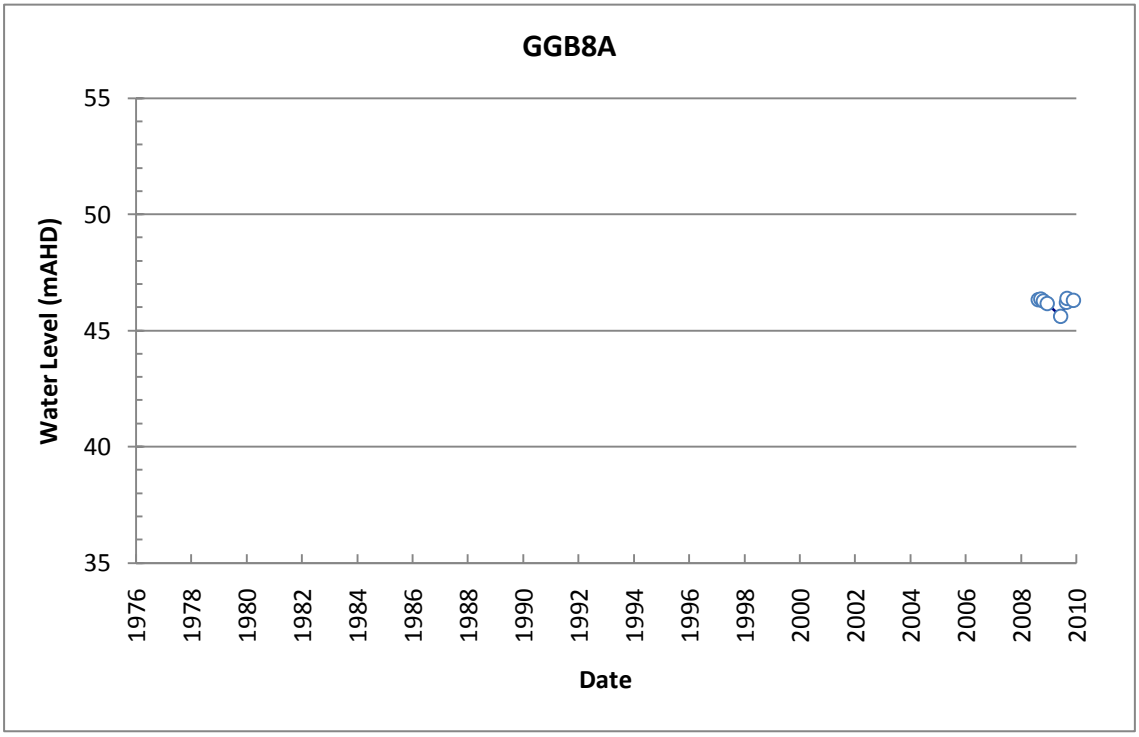

20A
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

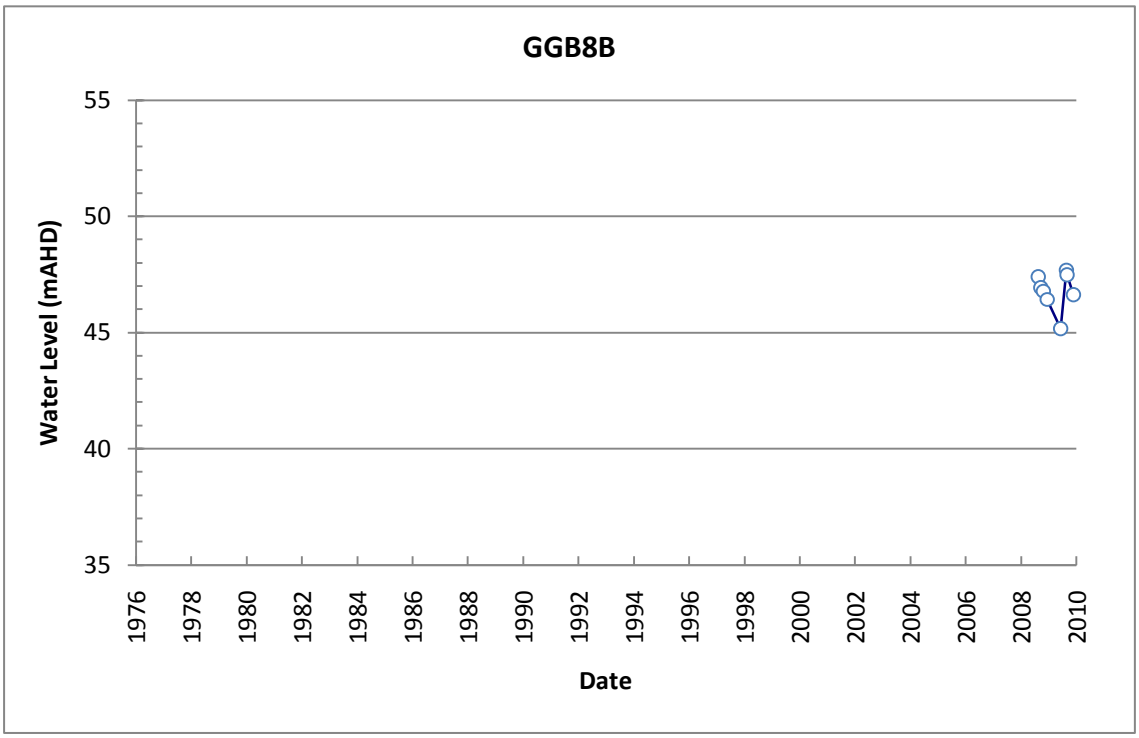

20B
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GS10
Water Level (mAHD)
45
40
35
30
25
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB5A
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB5B
Water Level (mAHD)
50
45
40
35
30
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB8A
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB8B
Water Level (mAHD)
55
50
45
40
35
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

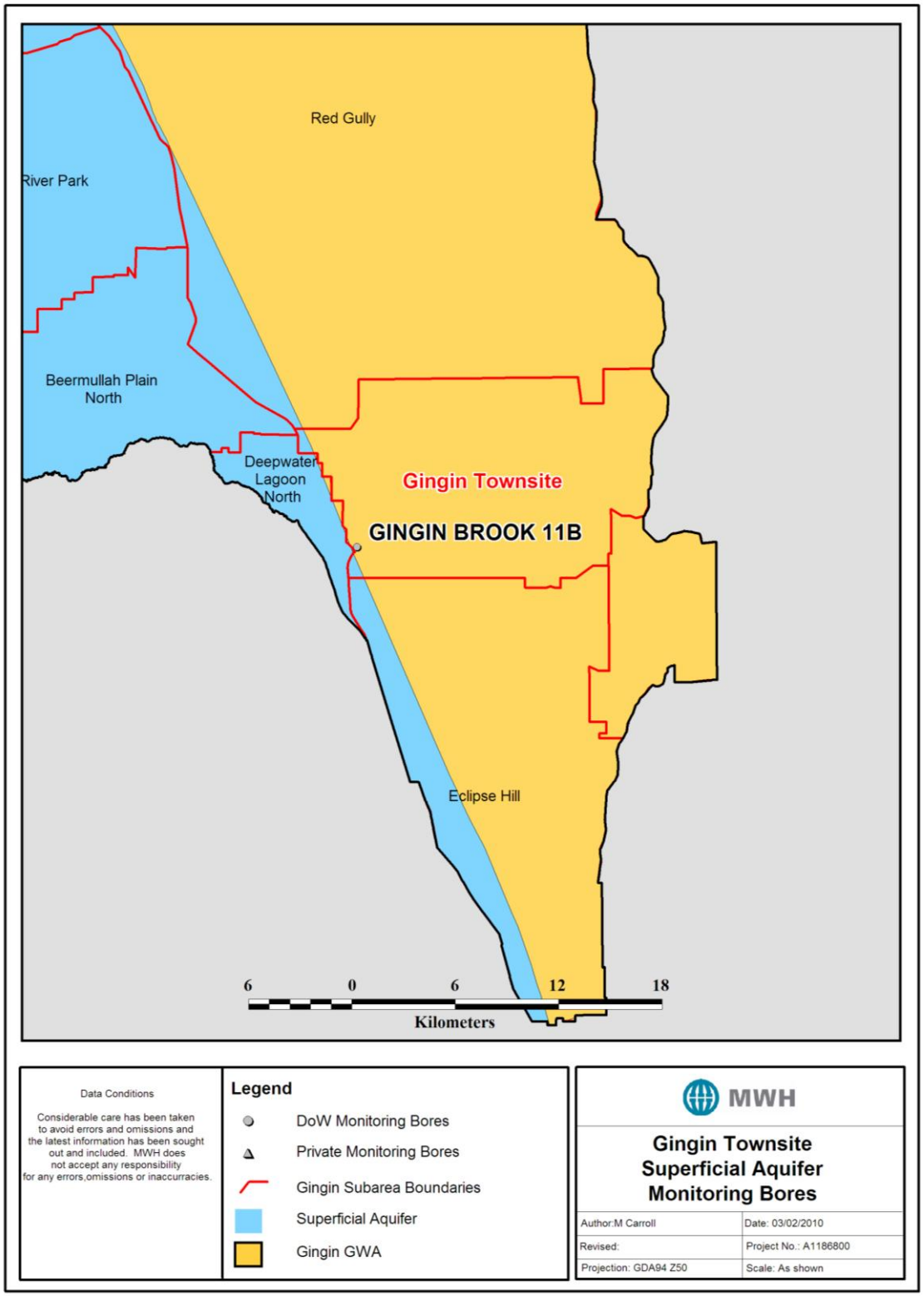
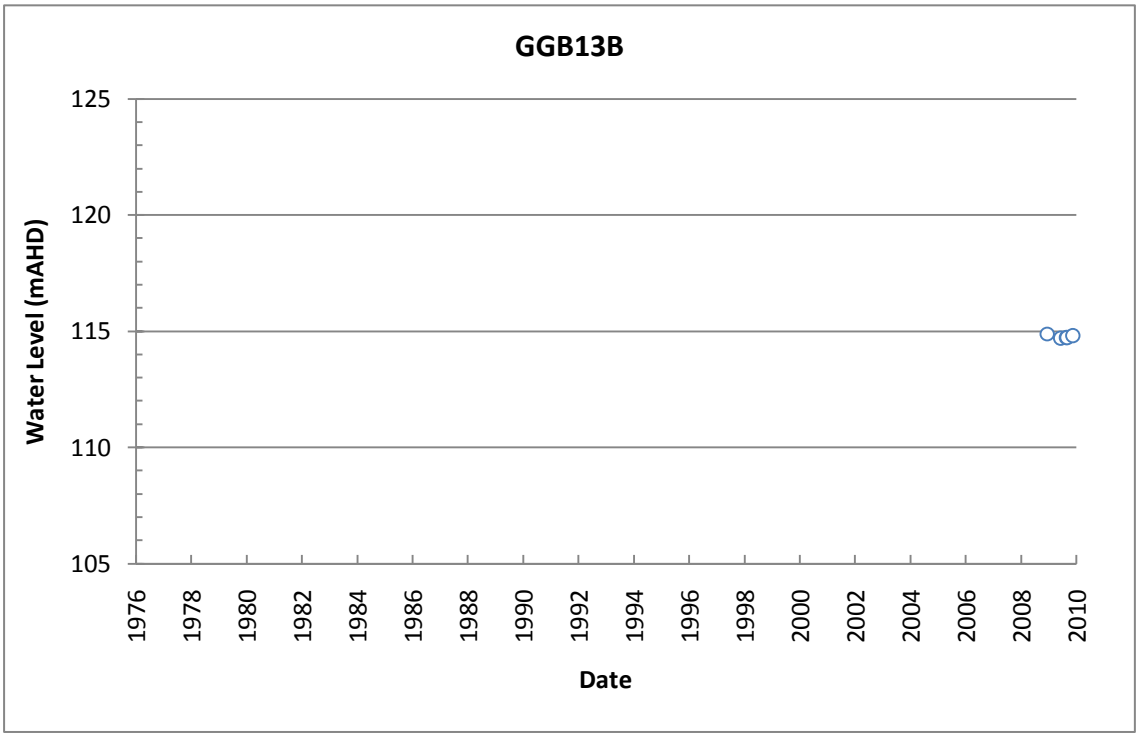


Figure 3-10: Gingin Townsite sub-area - monitoring bores within the Superficial aquifer


GGB13B
125
120
115
110
105
Water Level (mAHD)
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

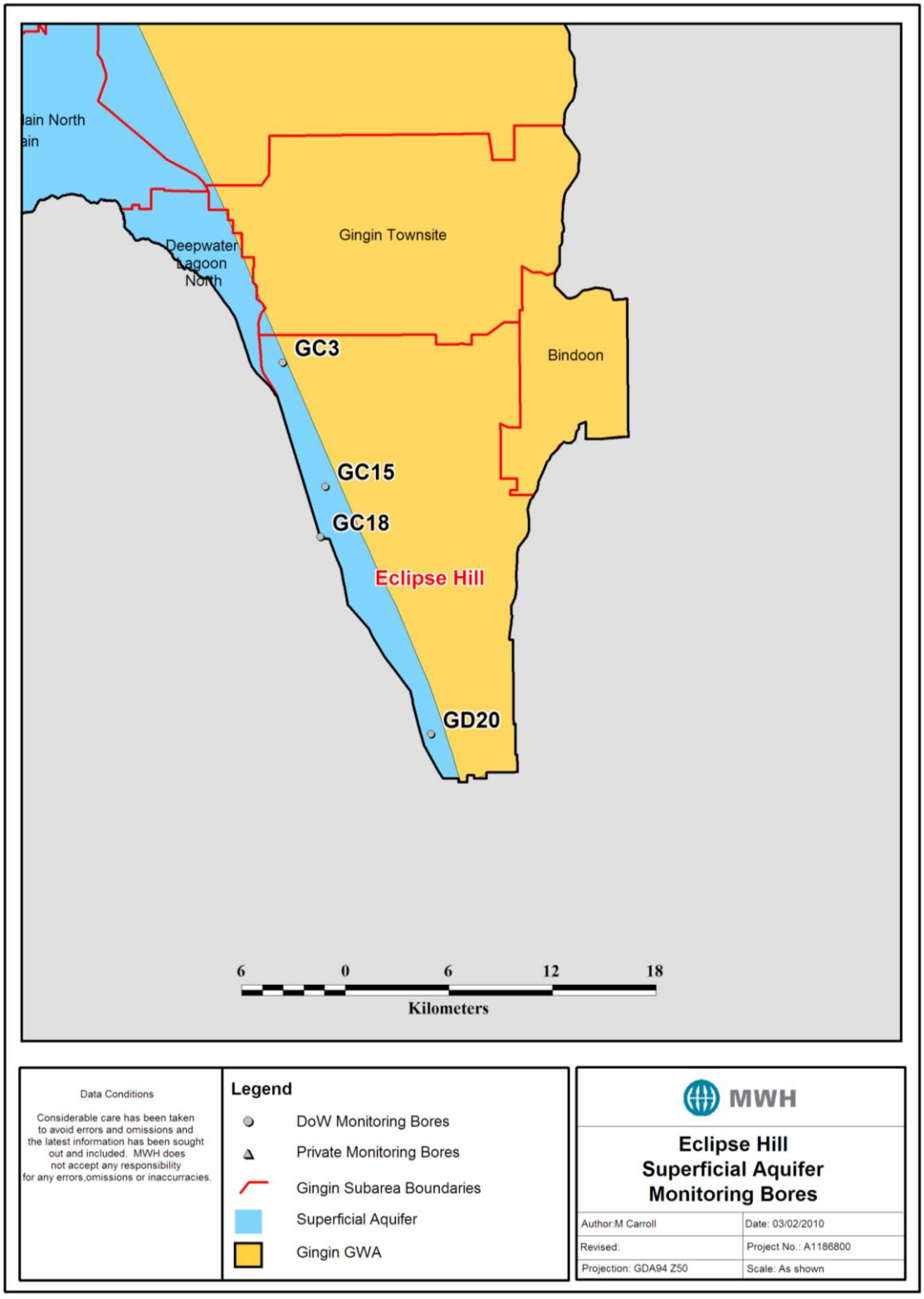
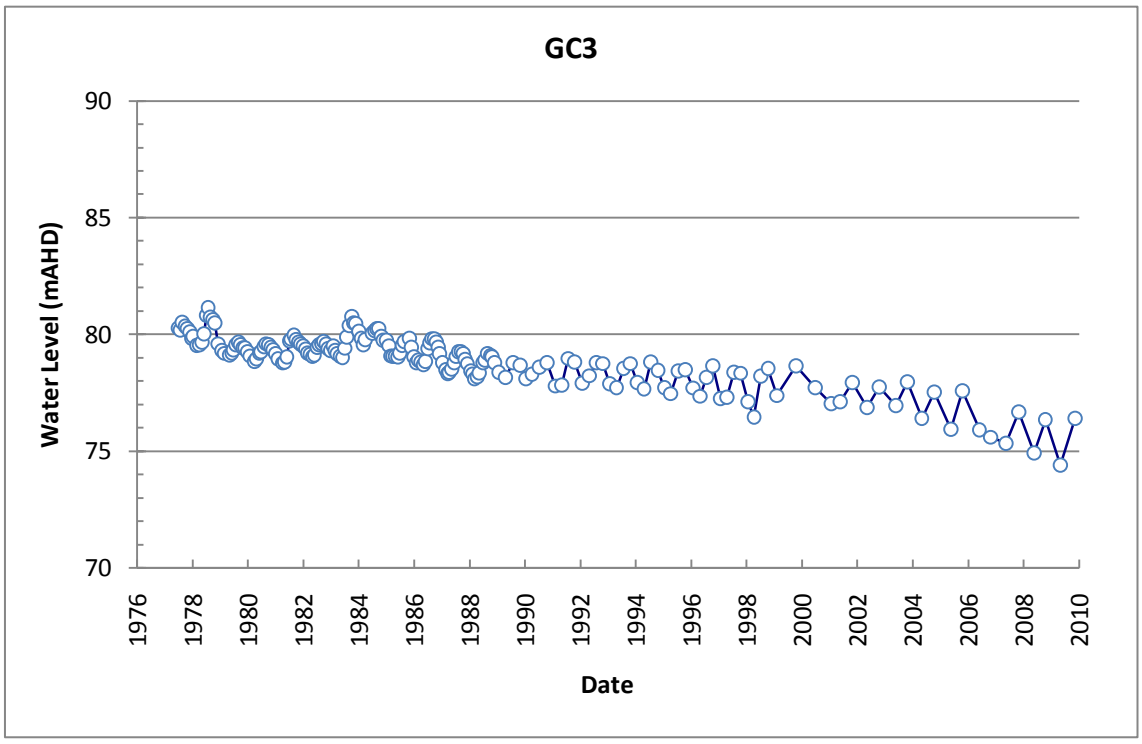
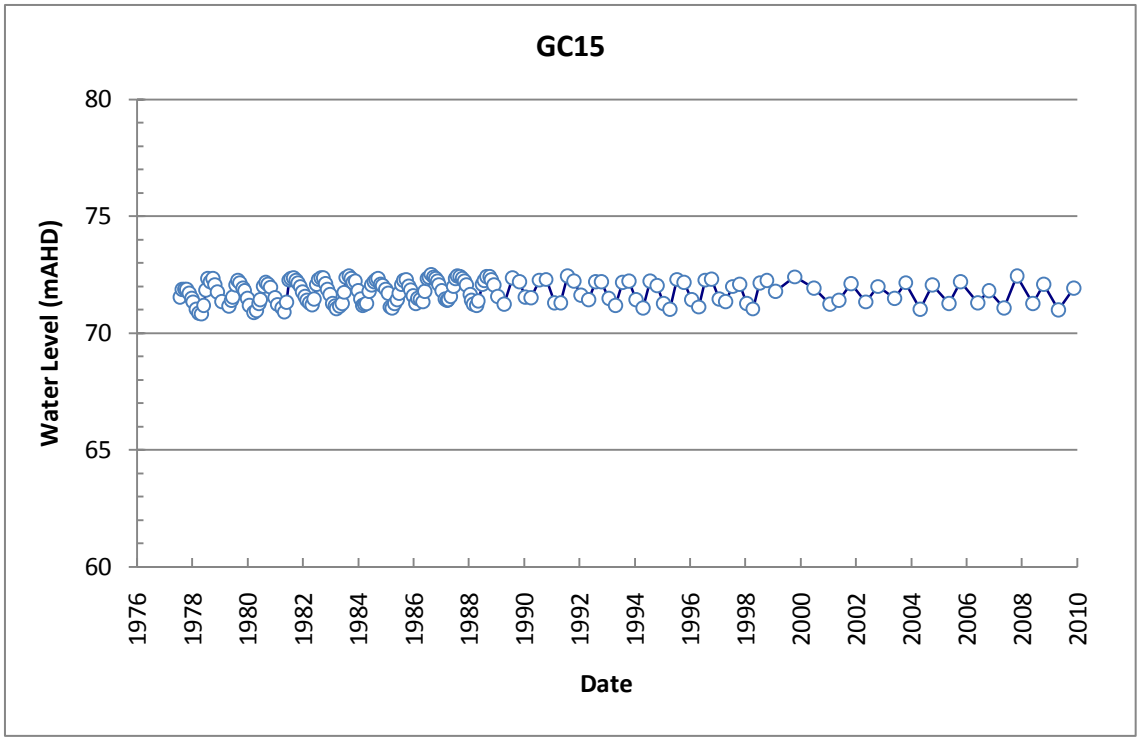
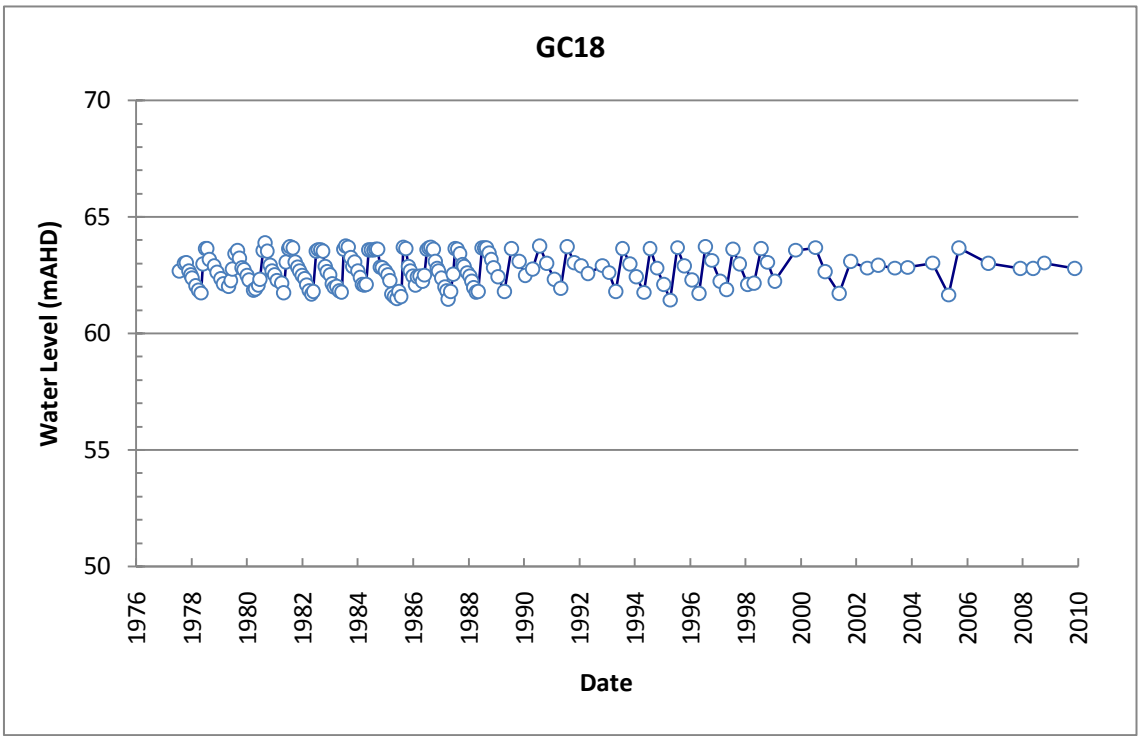
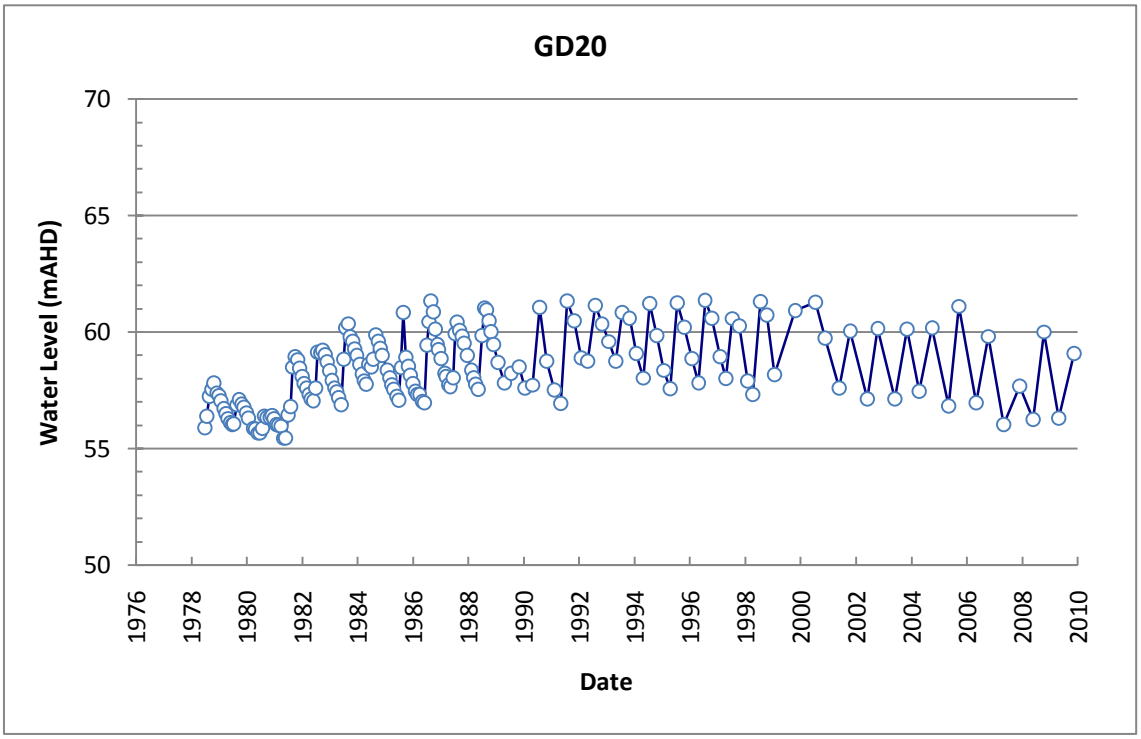


Figure 3-11: Eclipse Hill sub-area - monitoring bores within the Superficial aquifer


GC3
Water Level (mAHD)
90
85
80
75
70
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GC15
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GC18
Water Level (mAHD)
70
65
60
55
50
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GD20
Water Level (mAHD)
70
65
60
55
50
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

3.2 Confined/Semi-Confined Systems

The series of semi confined or locally confined aquifers within the Gingin GWA are managed via six allocation sub-areas; SA 1, SA 2, SA 3 North, SA 4, SA 5 and SA 6. The hydrographs below are arranged by sub-area, with further divisions for each aquifer.

3.2.1 Sub-area 1

This sub-area, in the north western corner of the Gingin GWA, contains the Lesueur, Leederville and Yarragadee aquifers. Data coverage is demonstrated in Figure 3-12, Figure 3-13 and Figure 3-14 below, with the hydrographs presented after each figure.

3.2.1.1 Lesueur aquifer

The sole monitoring bore in the Lesueur aquifer is part of the Cataby Shallows program, and has semi-consistent monitoring data available from 1994. The hydrograph for Bore CS17D displays a relatively steady water level, with a slight decline of 0.2 m observed since 2002.

3.2.1.2 Leederville aquifer

Monitoring bores within the Leederville aquifer originate from the Cataby Shallows and Gillingarra Line programs, with data semi-regularly available from 1994. The differing patterns observed, coupled with infrequent data collection, limit the identification of trends. The analysis conducted in Section 2 and displayed in Figure 2-6 demonstrates a slight decline since 2002. This is largely supported by the individual hydrographs below, although data from bores GL3A1 and GL2B1 suggest isolated long term increases.

3.2.1.3 Yarragadee aquifer

Monitoring within the Yarragadee aquifer consists of bores from the Moora Line, Cataby Shallows and Gillingarra Line programs. Consistent data is only available after 1994, although the frequency of monitoring is between 1 and 2 years in places. As shown in Figure 2-6, there is an overall decline of 0.2 m to 0.8 m in water levels throughout the region. The exceptions to this being in the north eastern corner of the sub-area and Bore GL3A3 on the southern boundary with SA 2.

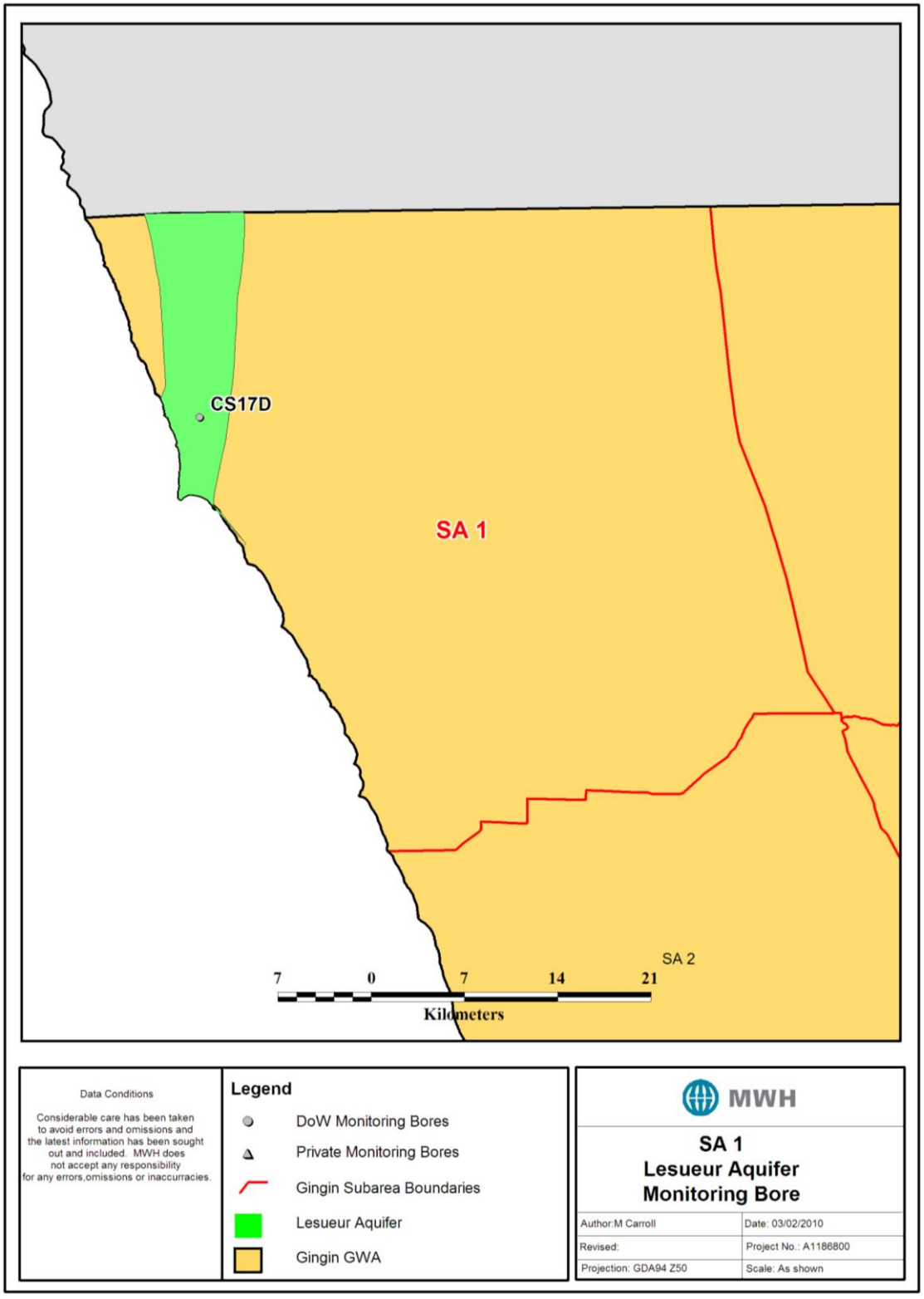
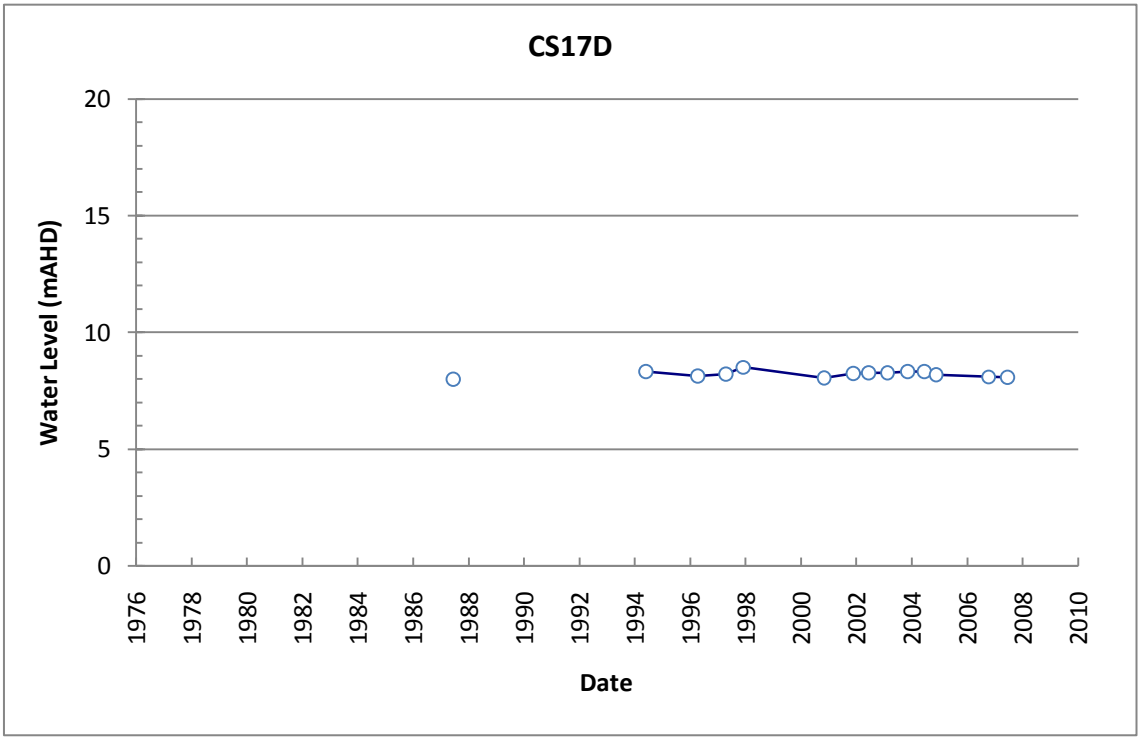


Figure 3-12: Sub-area 1 monitoring bores located within the Lesueur aquifer


CS17D
Water Level (mAHD)
20
15
10
5
0
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

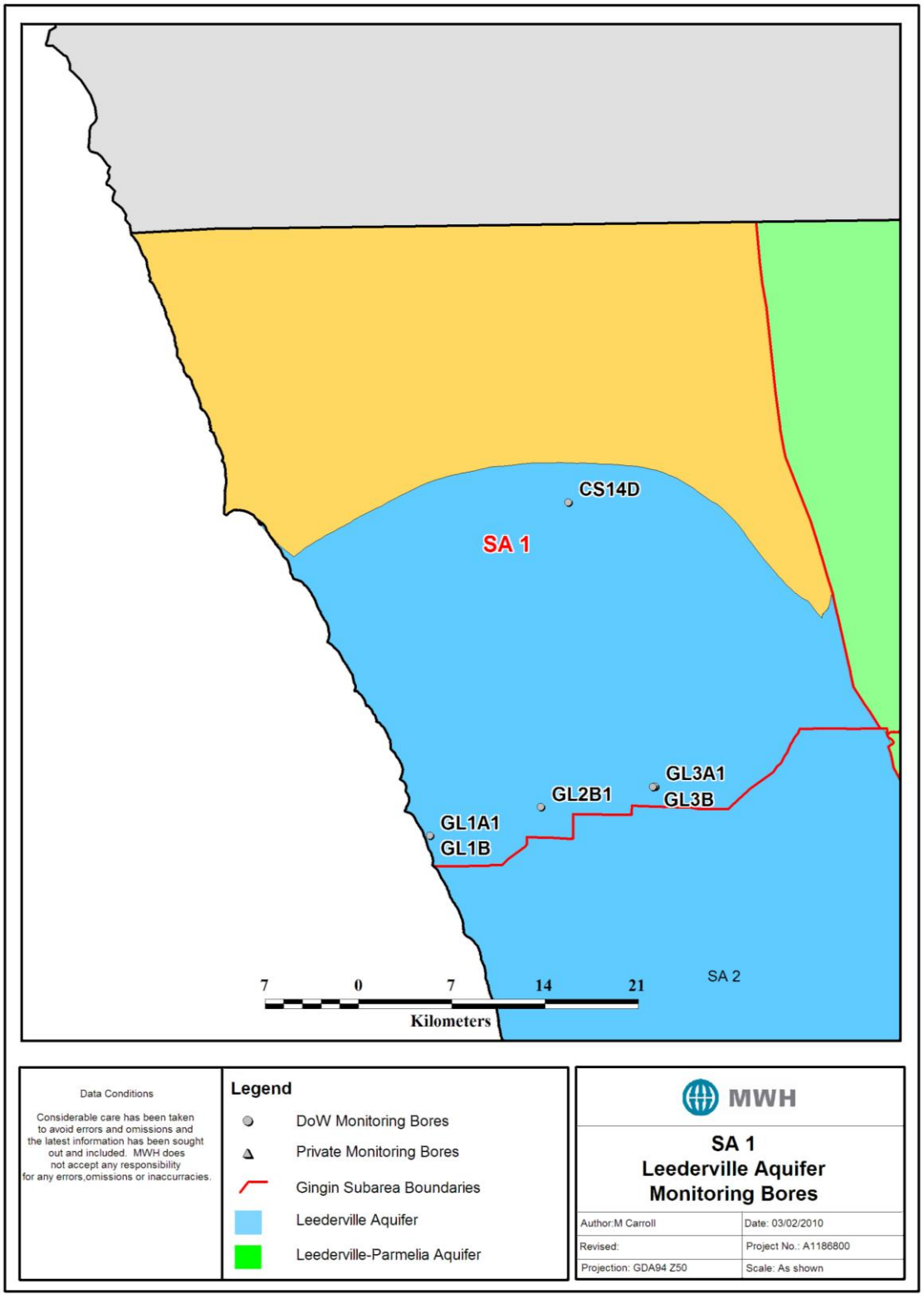
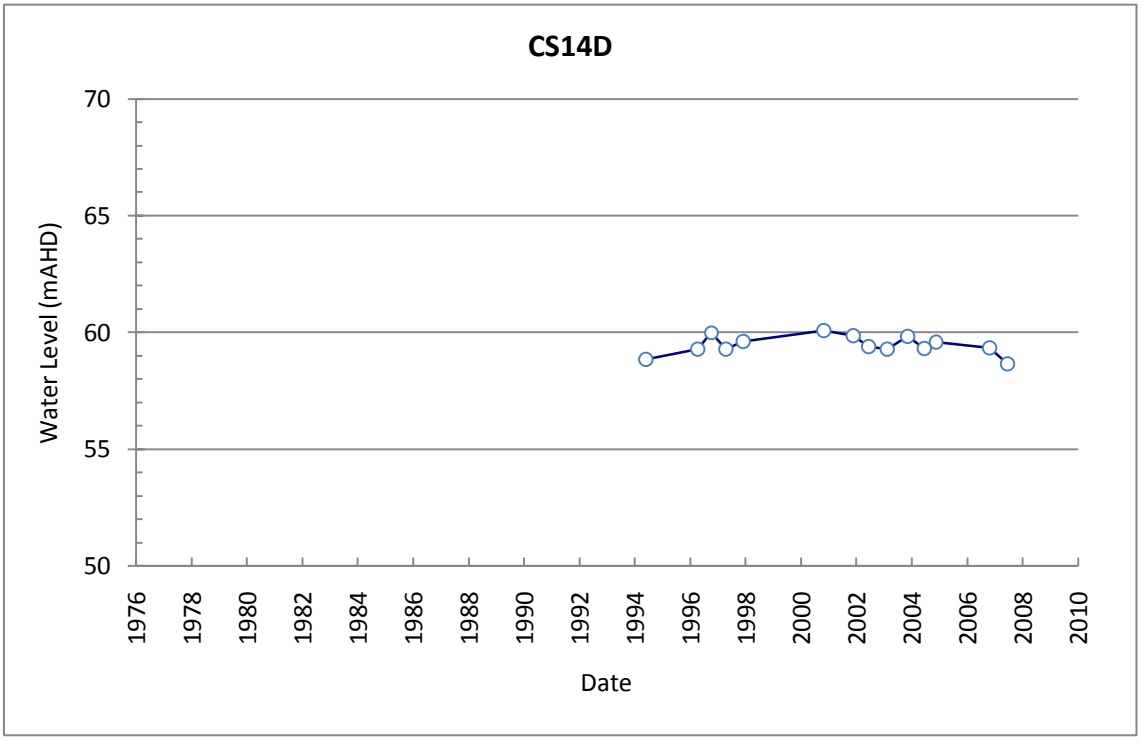
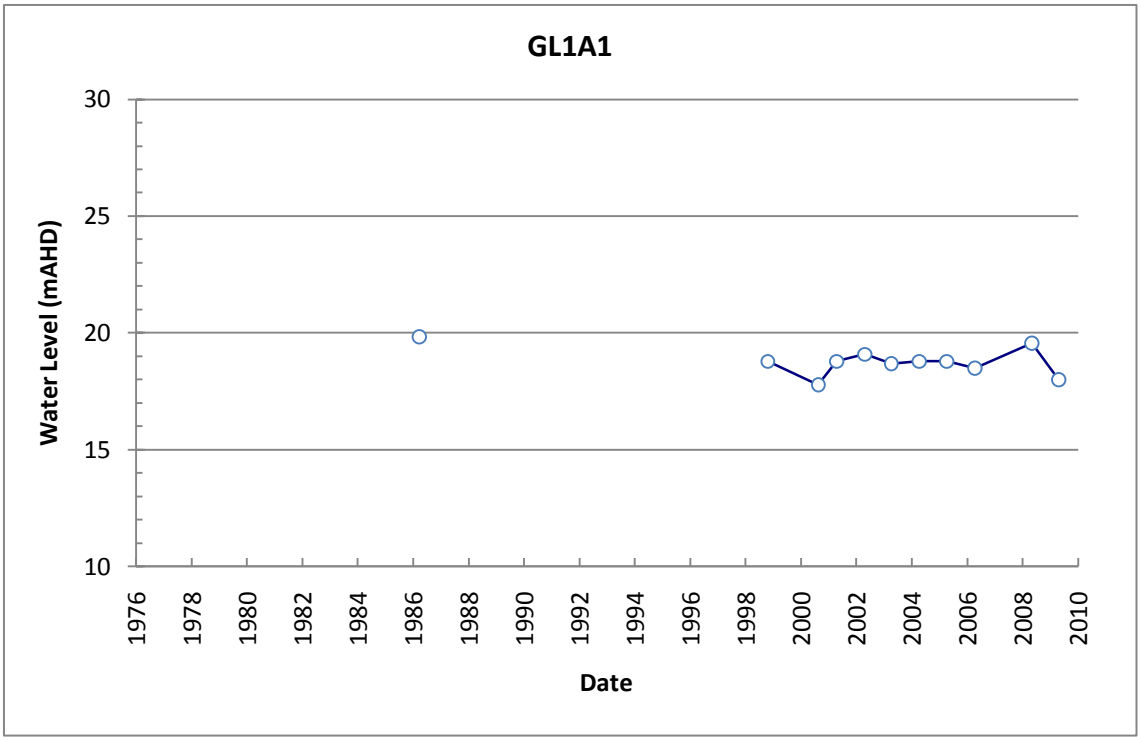
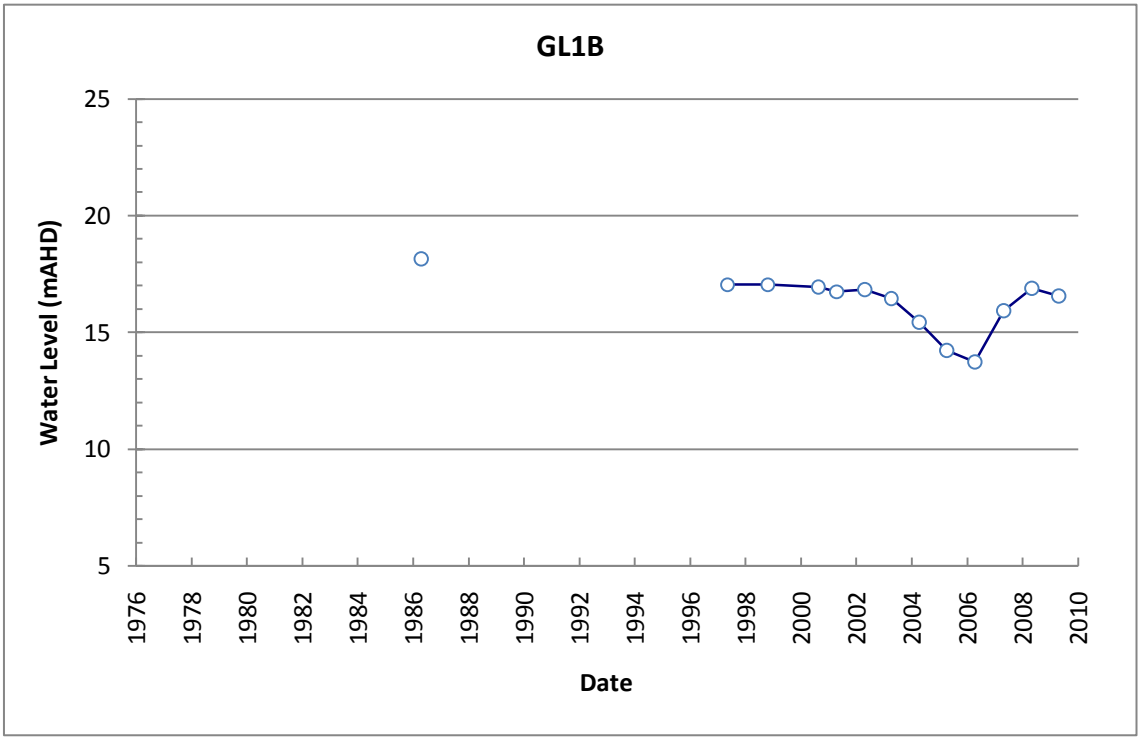
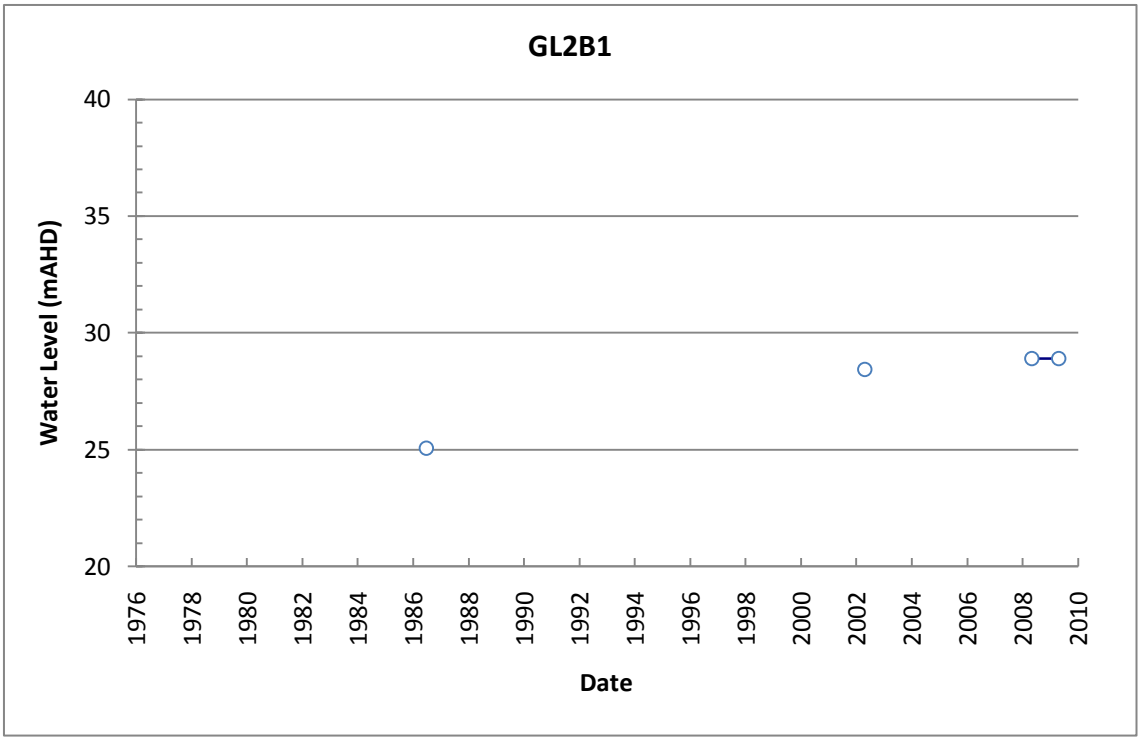


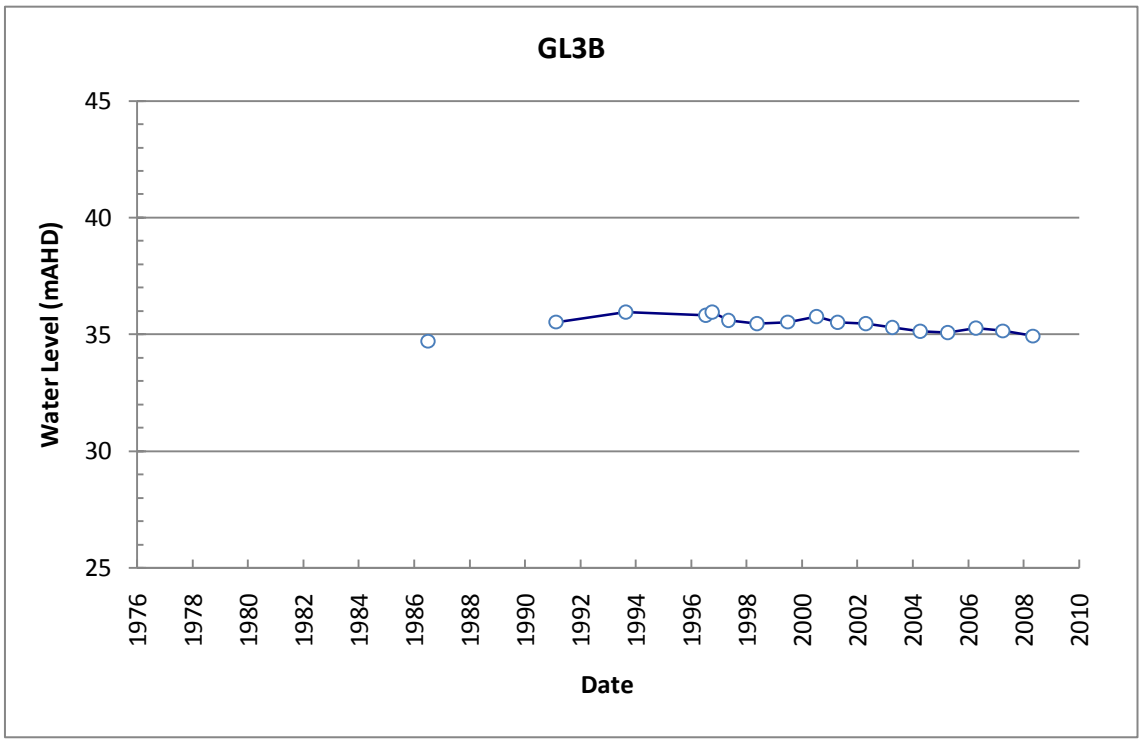
Figure 3-13: Sub-area 1 monitoring bores located within the Leederville aquifer

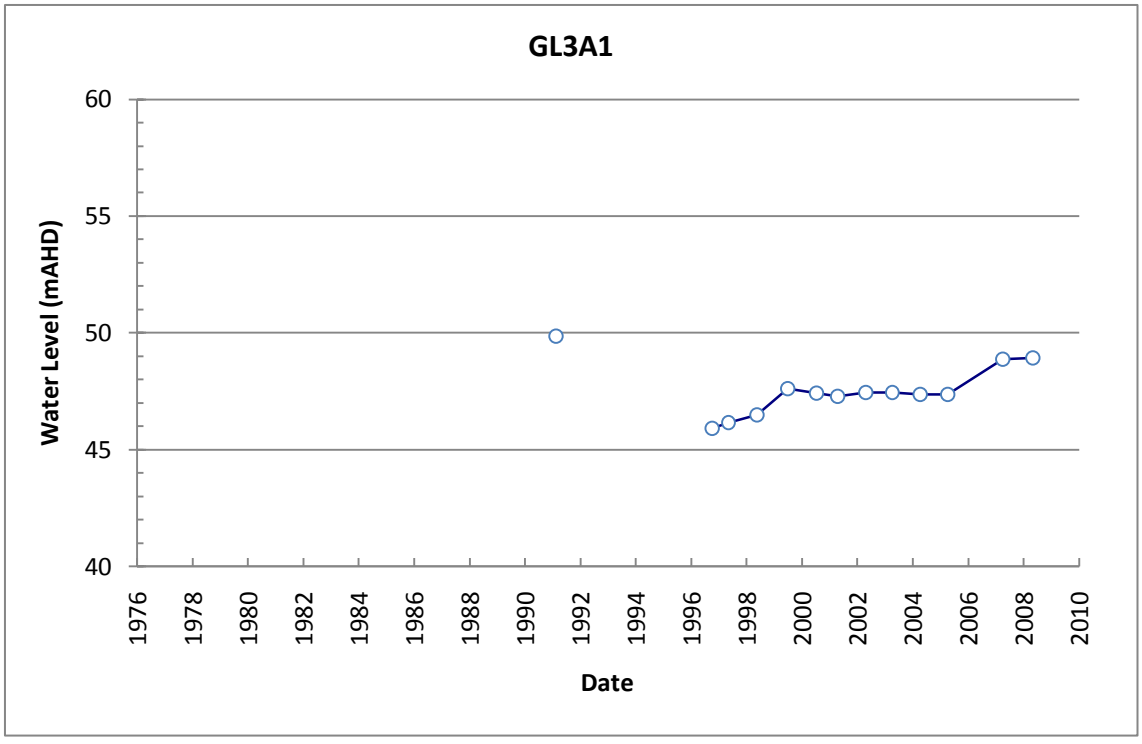

CS14D
70
65
60
55
50
Water Level (mAHD)
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL1A1
30
25
20
15
10
Water Level (mAHD)
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL1B
Water Level (mAHD)
25
20
15
10
5
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL2B1
Water Level (mAHD)
40
35
30
25
20
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL3B
Water Level (mAHD)
45
40
35
30
25
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL3A1
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

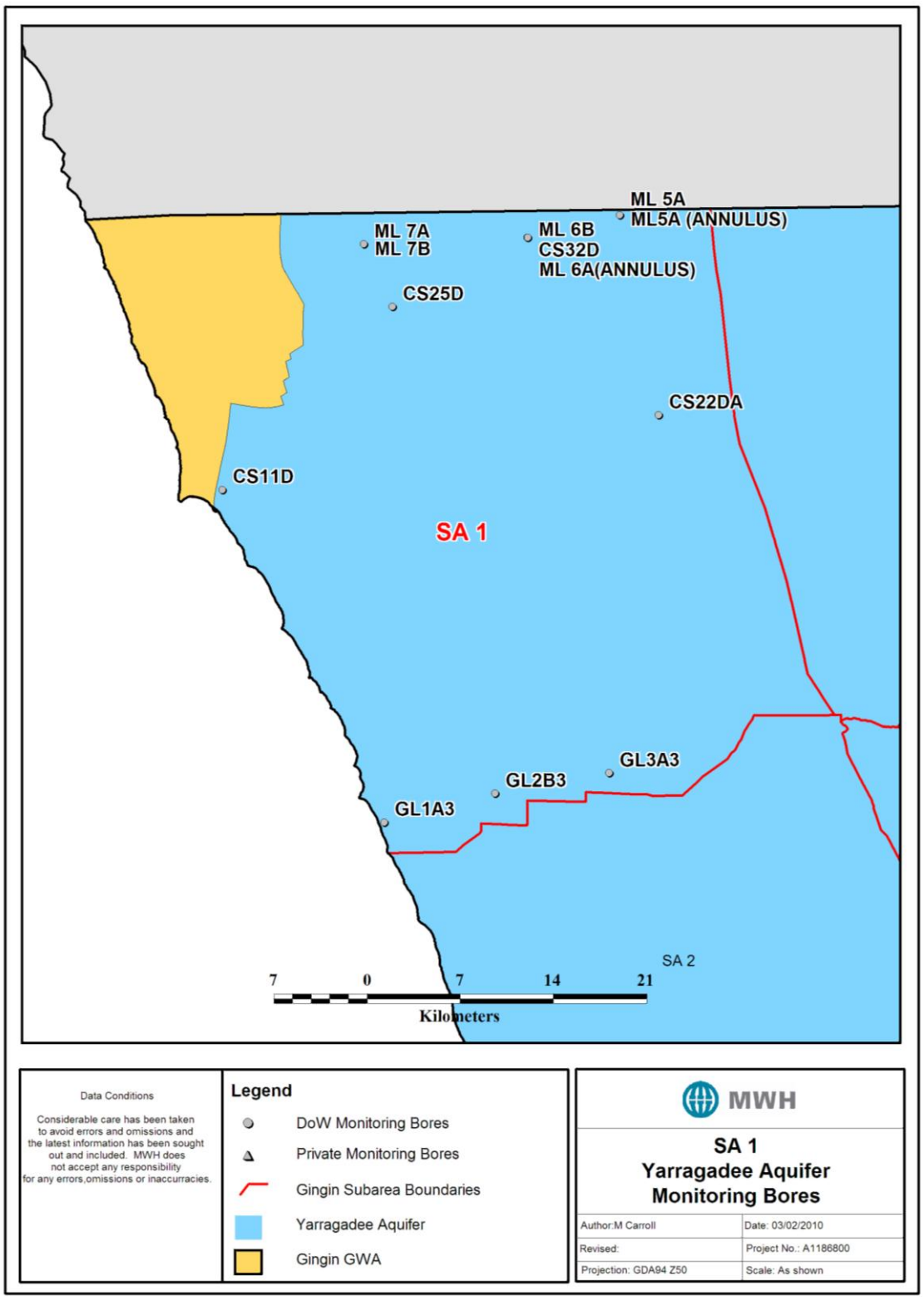
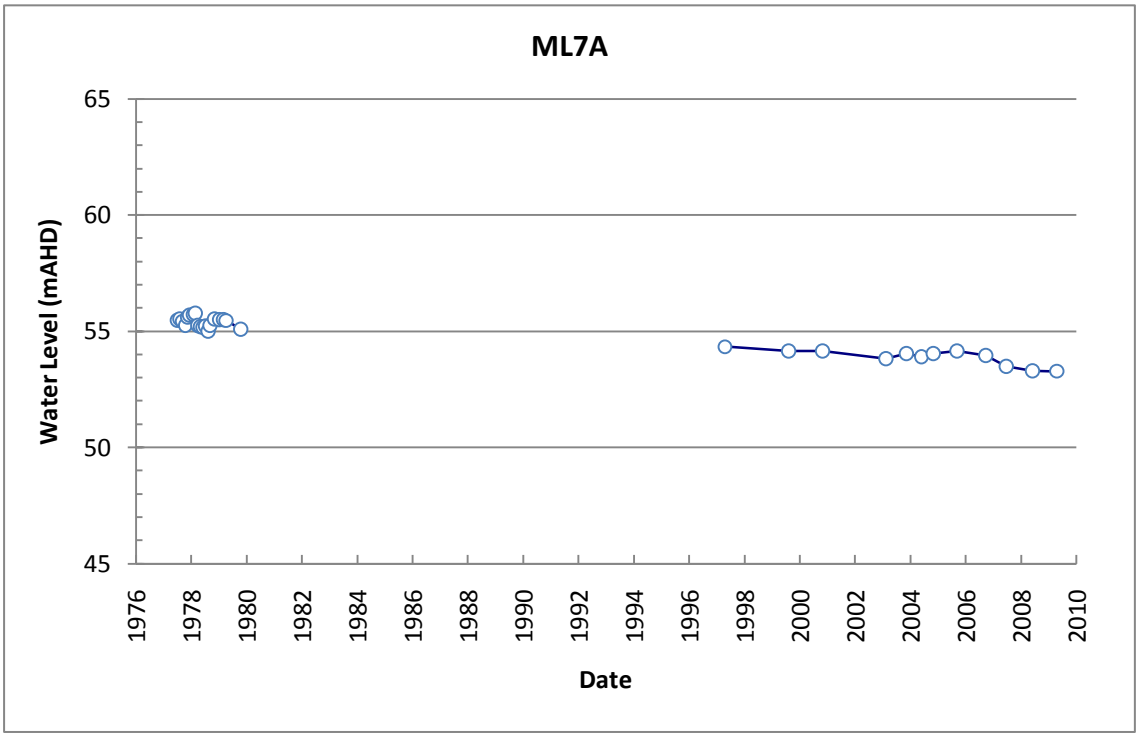
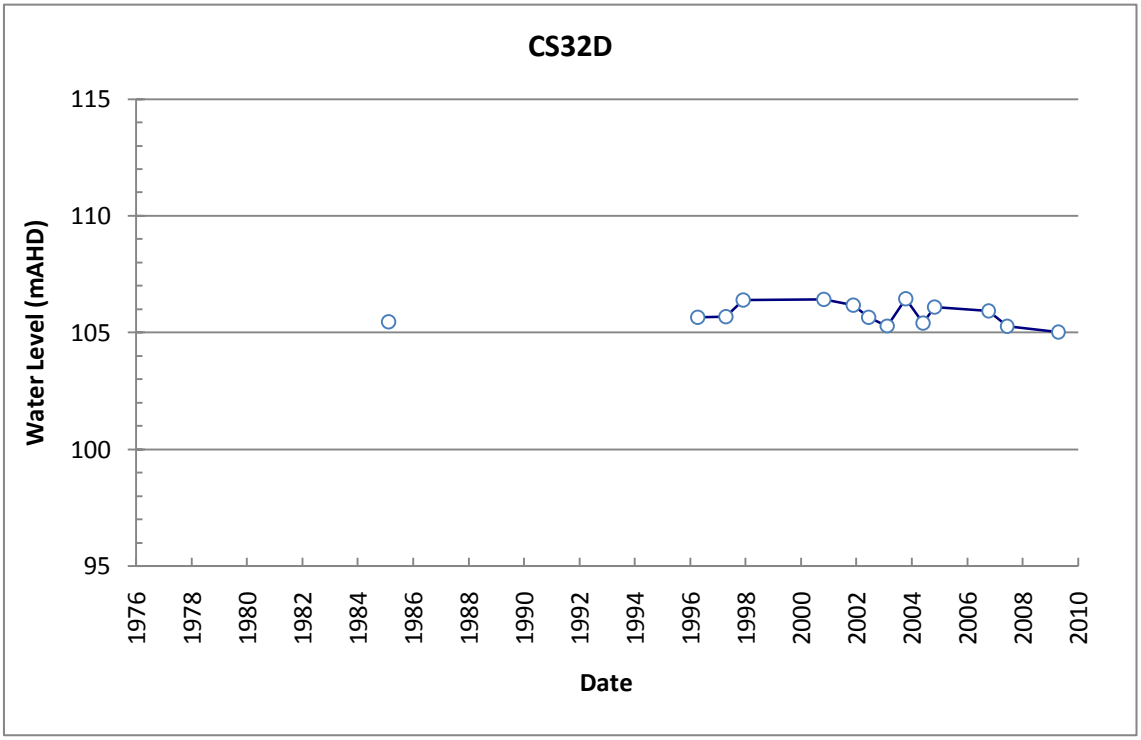
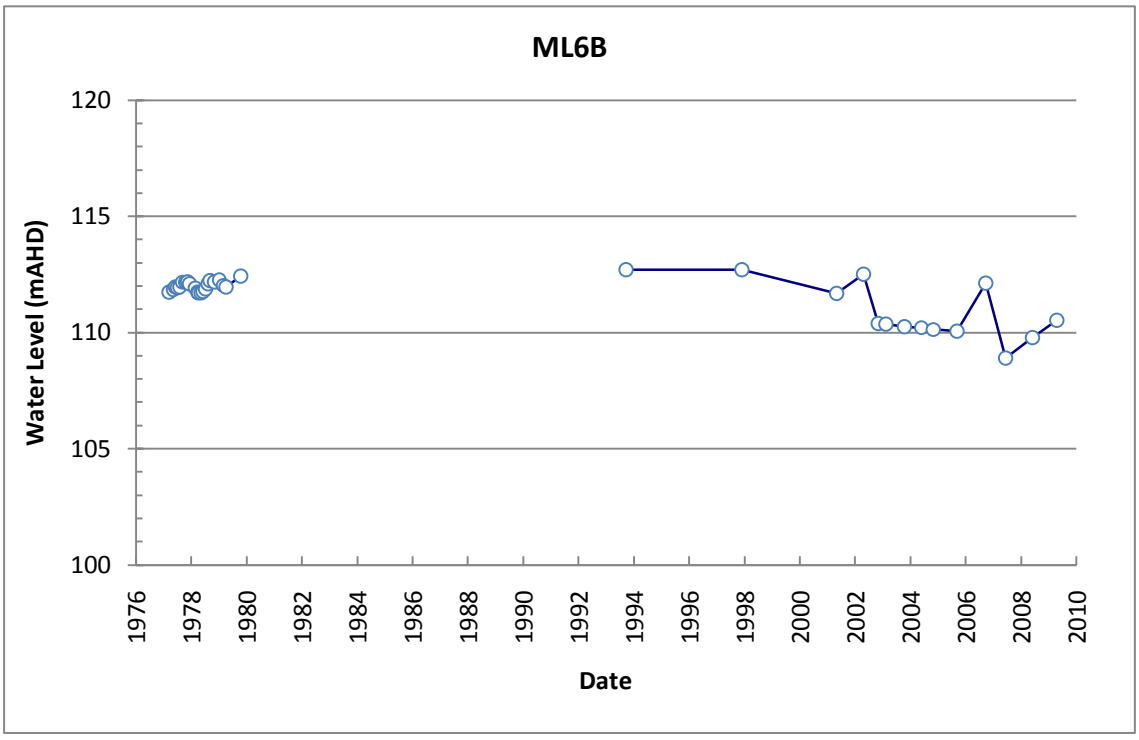
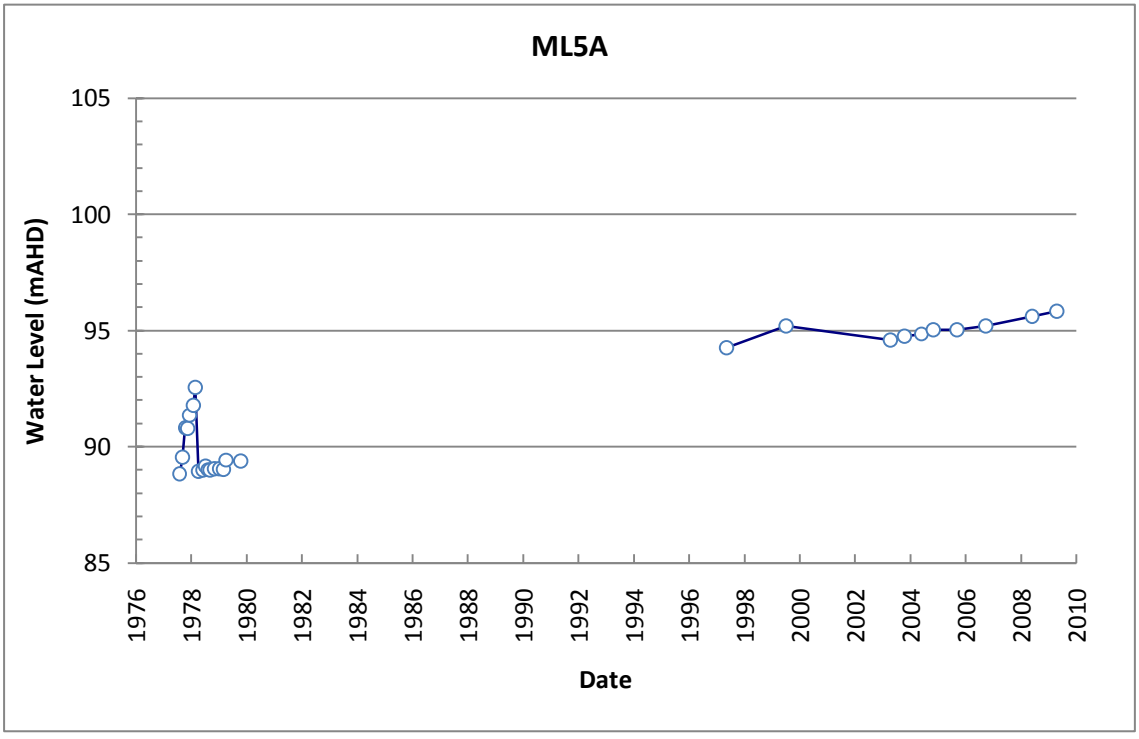


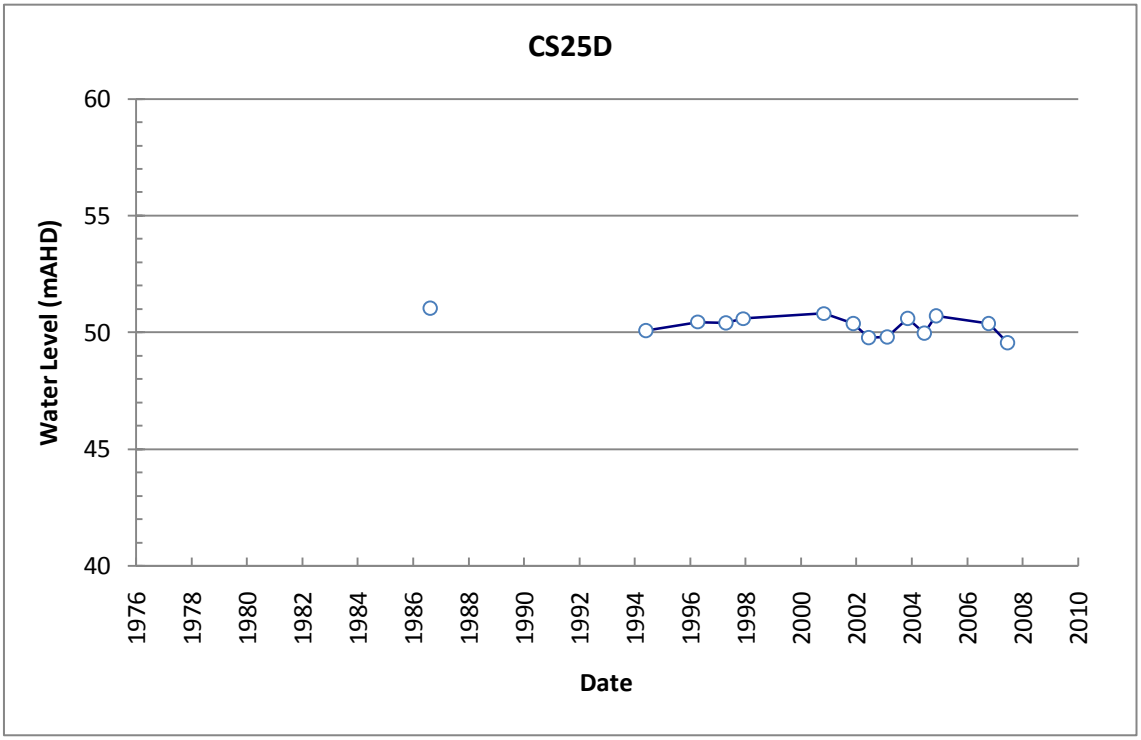
Figure 3-14: Sub-area 1 monitoring bores located within the Yarragadee aquifer

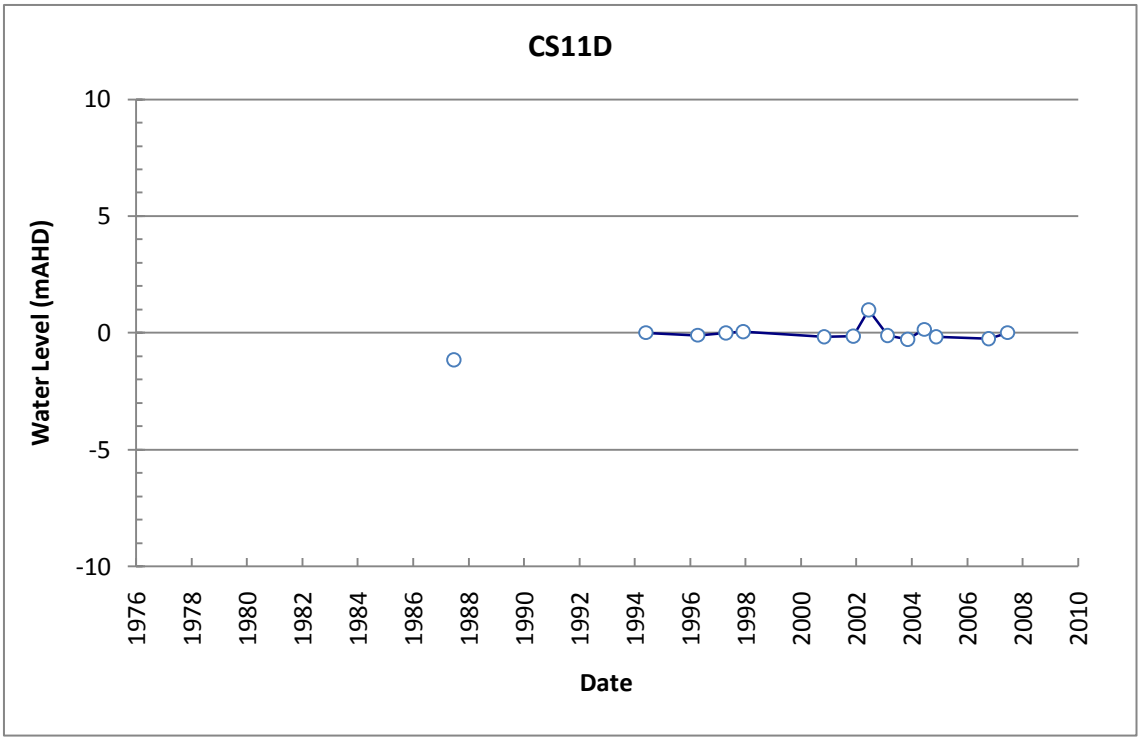

ML7A
Water Level (mAHD)
65
60
55
50
45
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

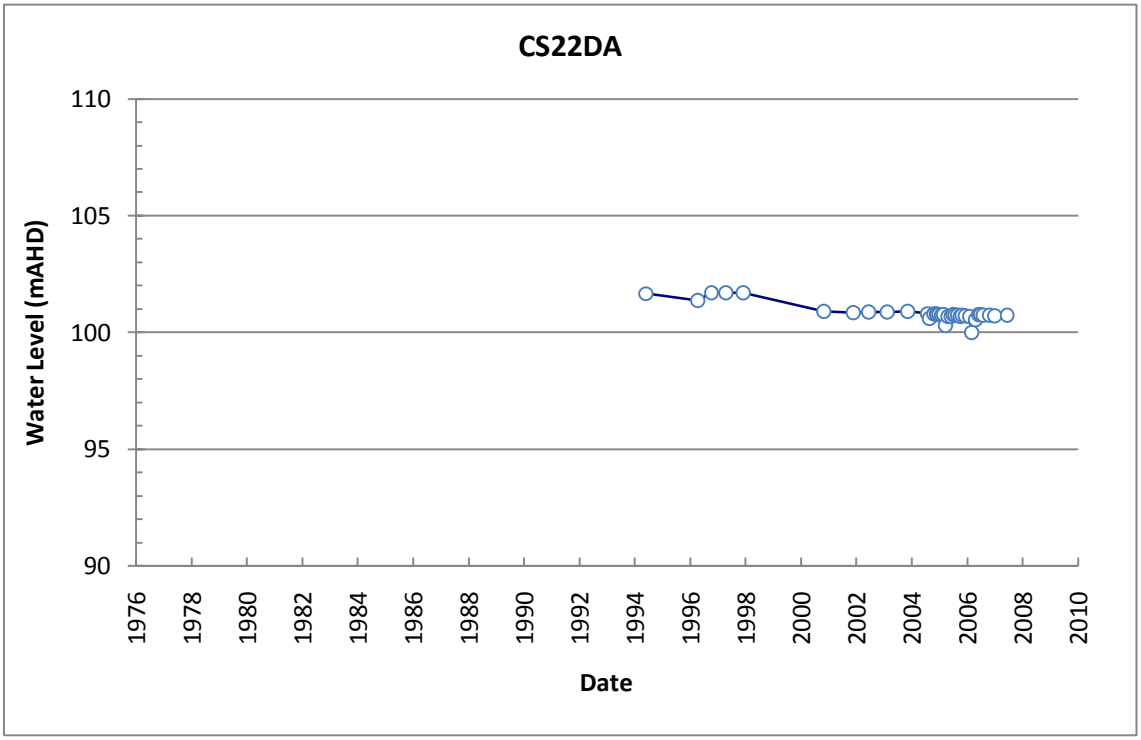

CS32D
Water Level (mAHD)
115
110
105
100
95
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

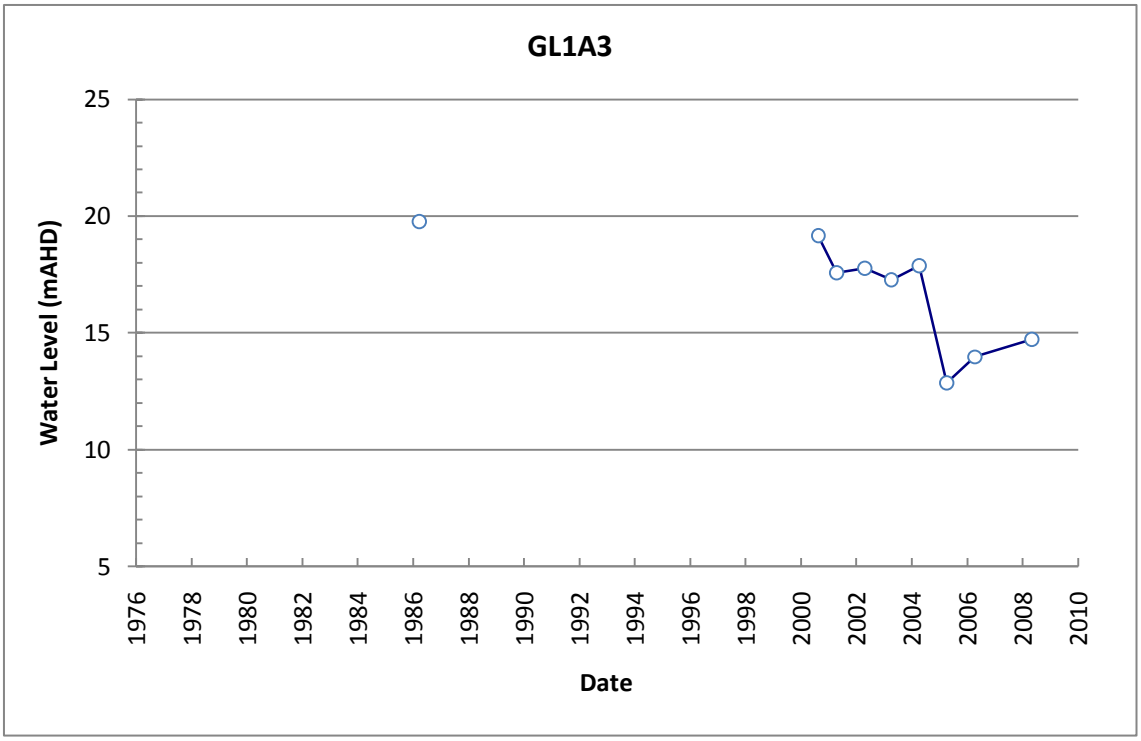

ML6B
Water Level (mAHD)
120
115
110
105
100
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

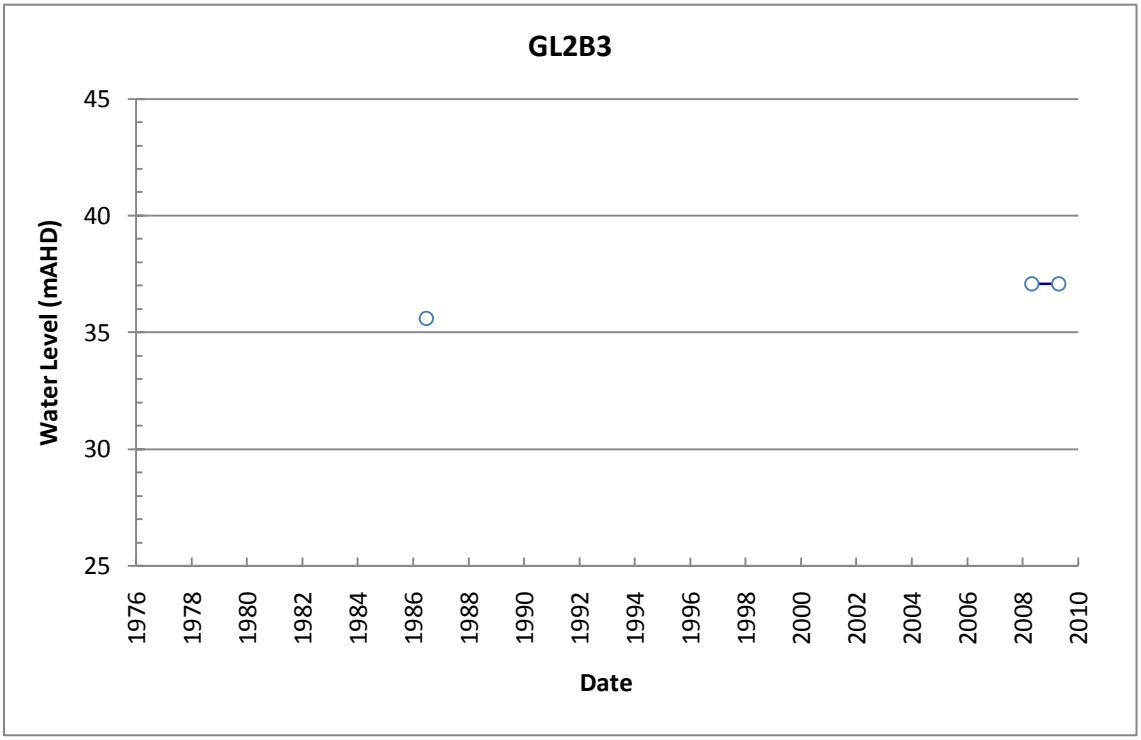

ML5A
Water Level (mAHD)
105
100
95
90
85
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

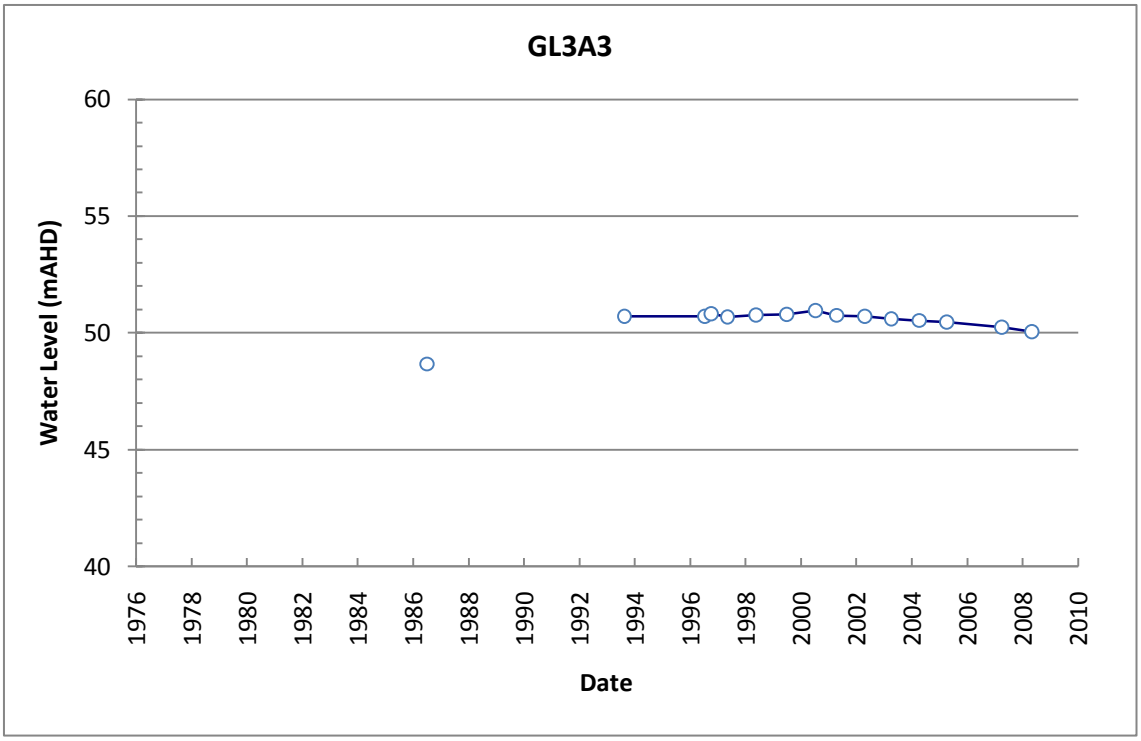

CS25D
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


CS11D
Water Level (mAHD)
10
5
0
-5
-10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


CS22DA
Water Level (mAHD)
110
105
100
95
90
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL1A3
Water Level (mAHD)
25
20
15
10
5
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL2B3
Water Level (mAHD)
45
40
35
30
25
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL3A3
Water Level (mAHD)
60
55
50
45
40
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

3.2.2 Sub-area 2

Sub-area 2 contains the Leederville and Yarragadee aquifers, although there is minimal coverage of both. Figure 3-15 and Figure 3-16 display the location of the available monitoring bores, with the hydrographs presented thereafter.

3.2.2.1 Leederville aquifer

Data coverage is limited to Bores GL4c and GL4W from the Gillingara Line, and two private abstraction bores towards the south of the sub-area.

The data, from 1994 onwards, displays a slight decline in water levels since 2002, following a period of stable readings. Data from the private bores contain some anomalous readings, with an overall increasing trend in one, and a decreasing trend in the other. This data may be affected by the pumping regime of nearby abstraction bores, and might not reflect regional changes

3.2.2.2 Yarragadee aquifer

The only monitoring bores in Sub-area 2 cased within the Yarragadee aquifer, Bore GL4A1 and Bore GL4A2, have regular yearly monitoring data from 1996. There has been a steady overall decrease in water levels which is reflected in Figure 2-8. The magnitude of the decrease is in the order of 0.6 m.

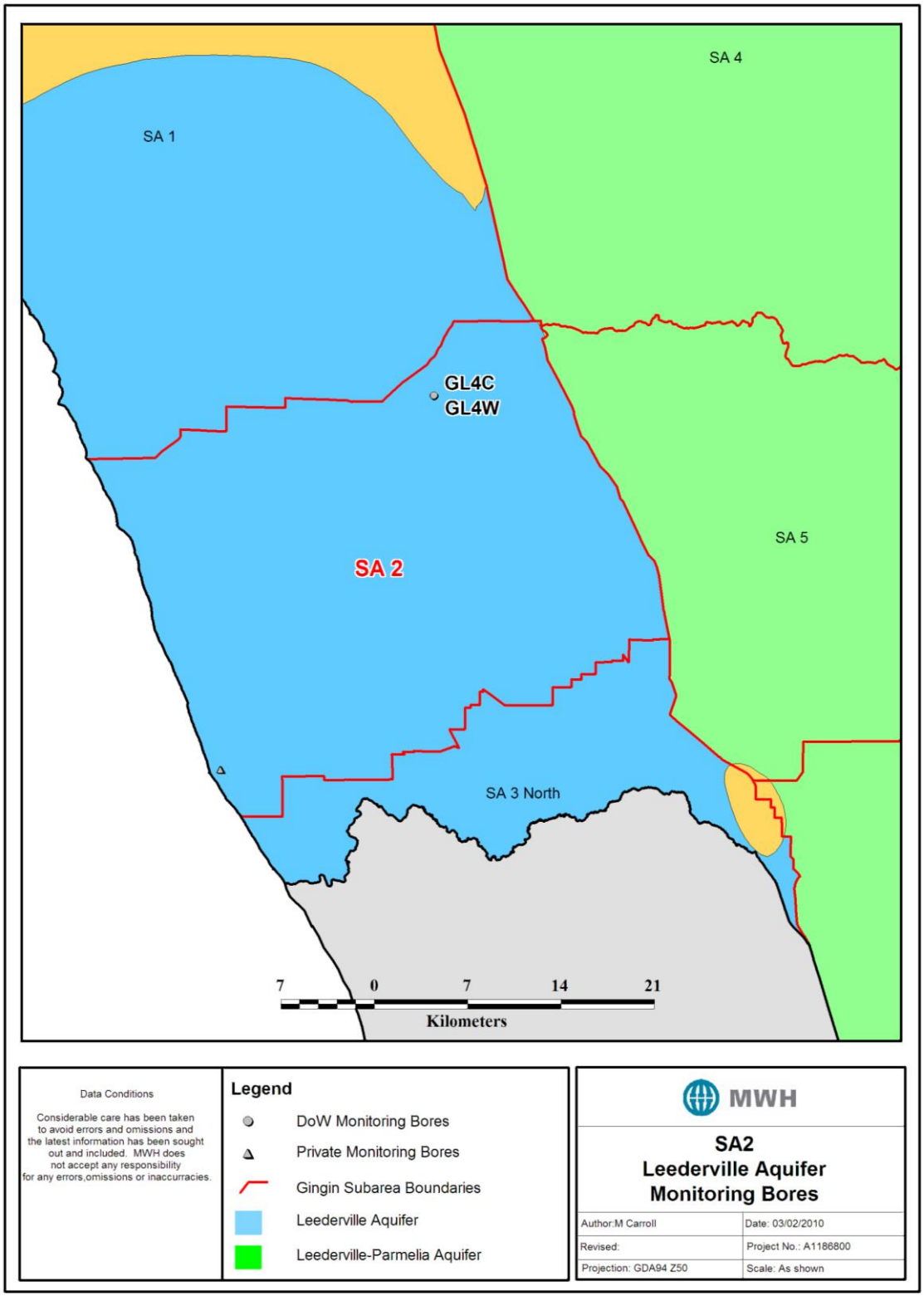
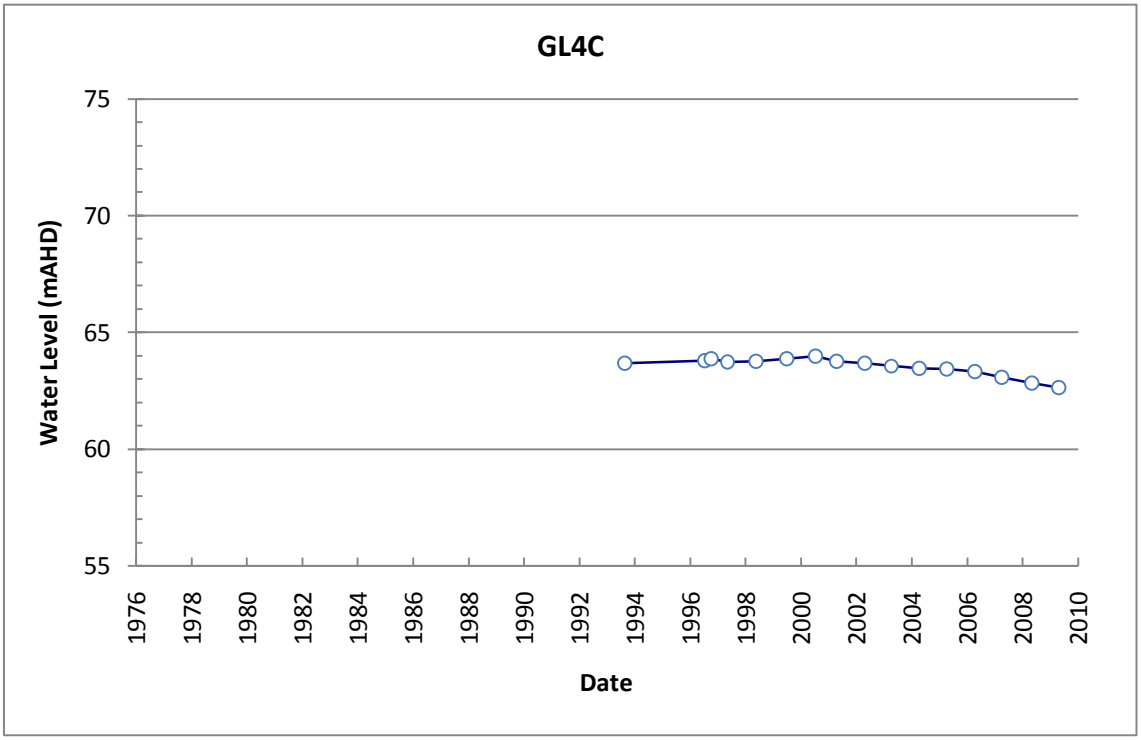
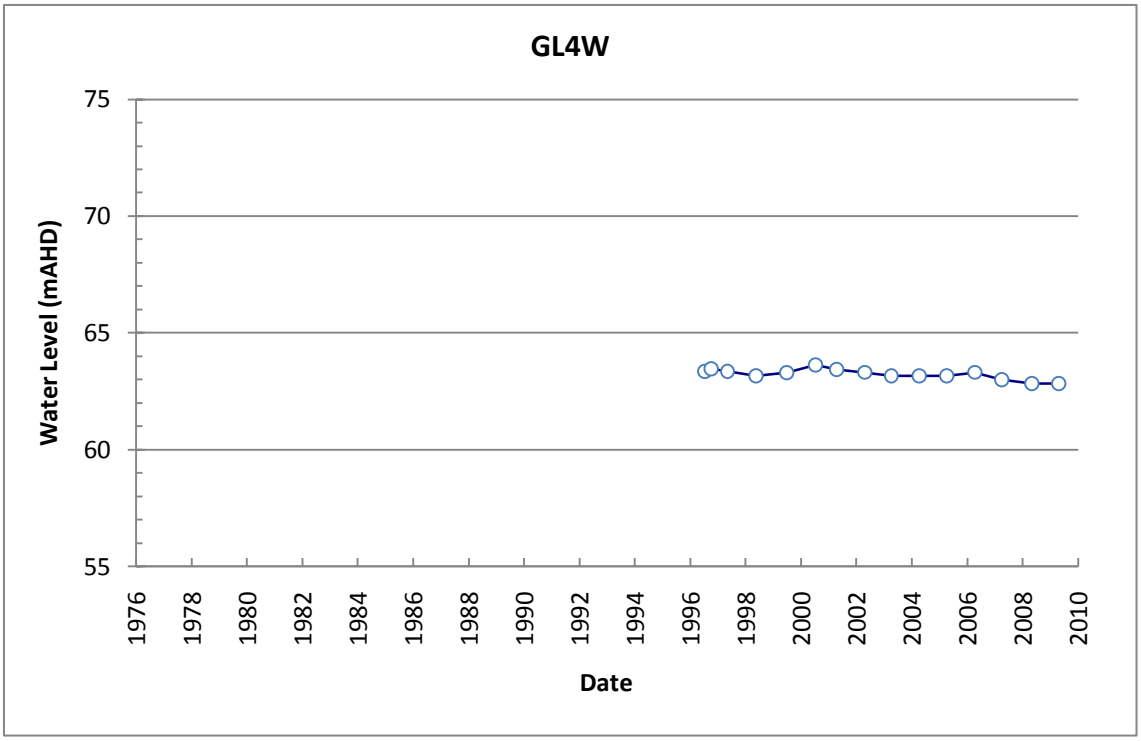
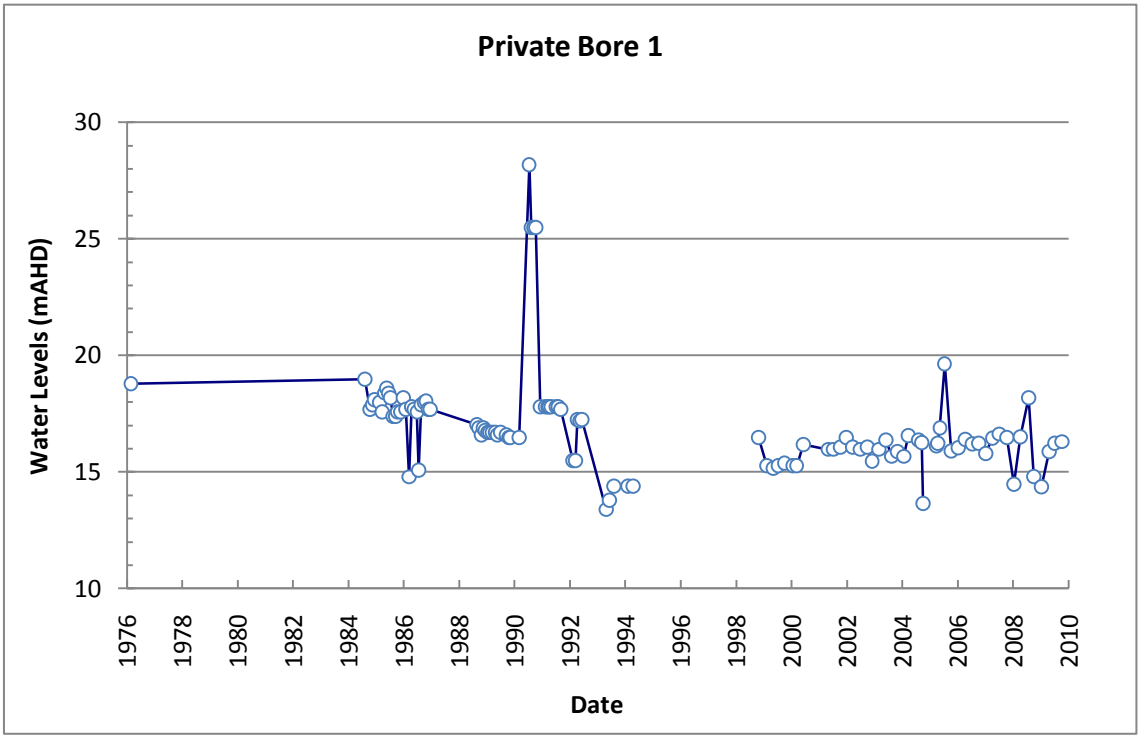
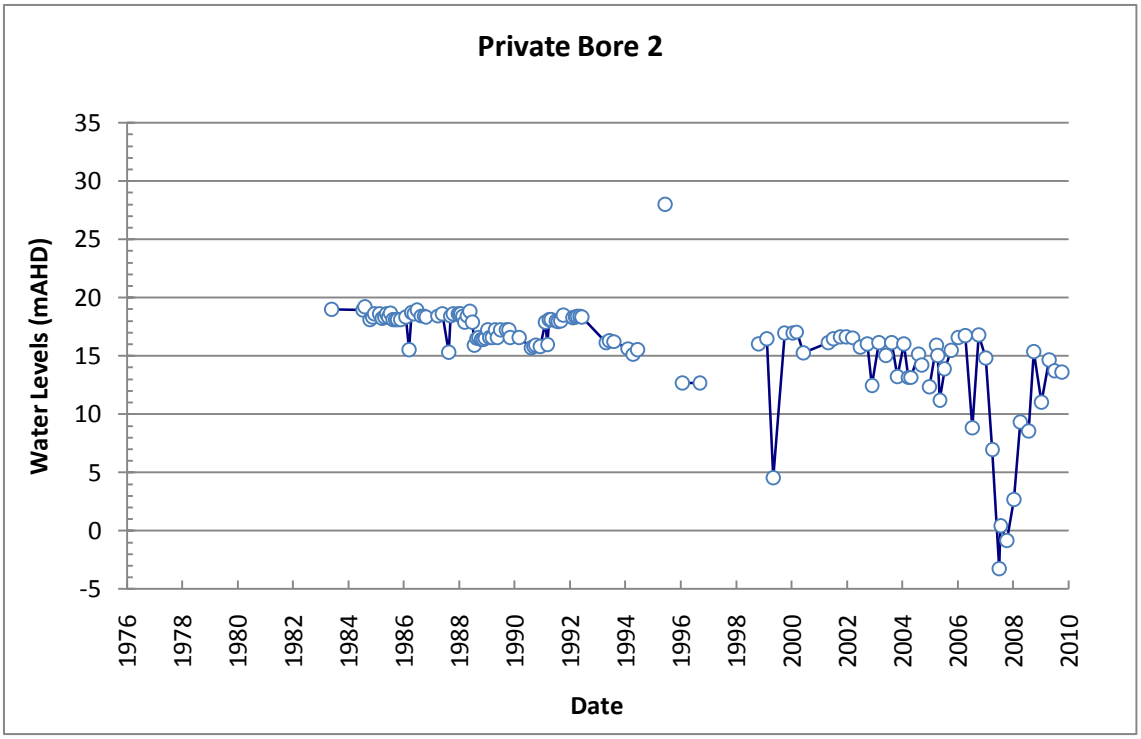


Figure 3-15: Sub-area 2 monitoring bores located within the Leederville aquifer


GL4C
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL4W
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


Private Bore 1
Water Levels (mAHD)
30
25
20
15
10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


Private Bore 2
Water Levels (mAHD)
35
30
25
20
15
10
5
0
-5
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

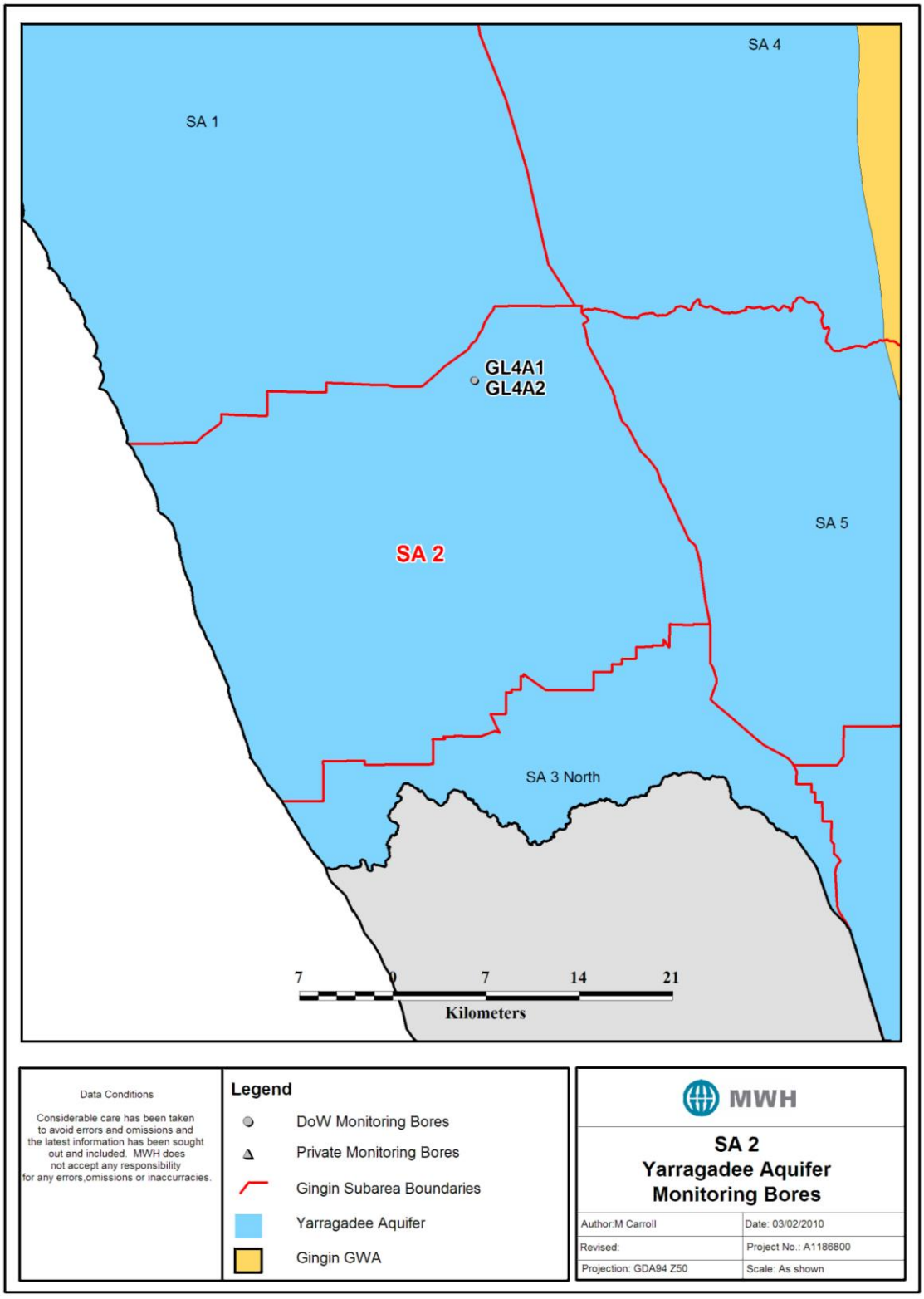
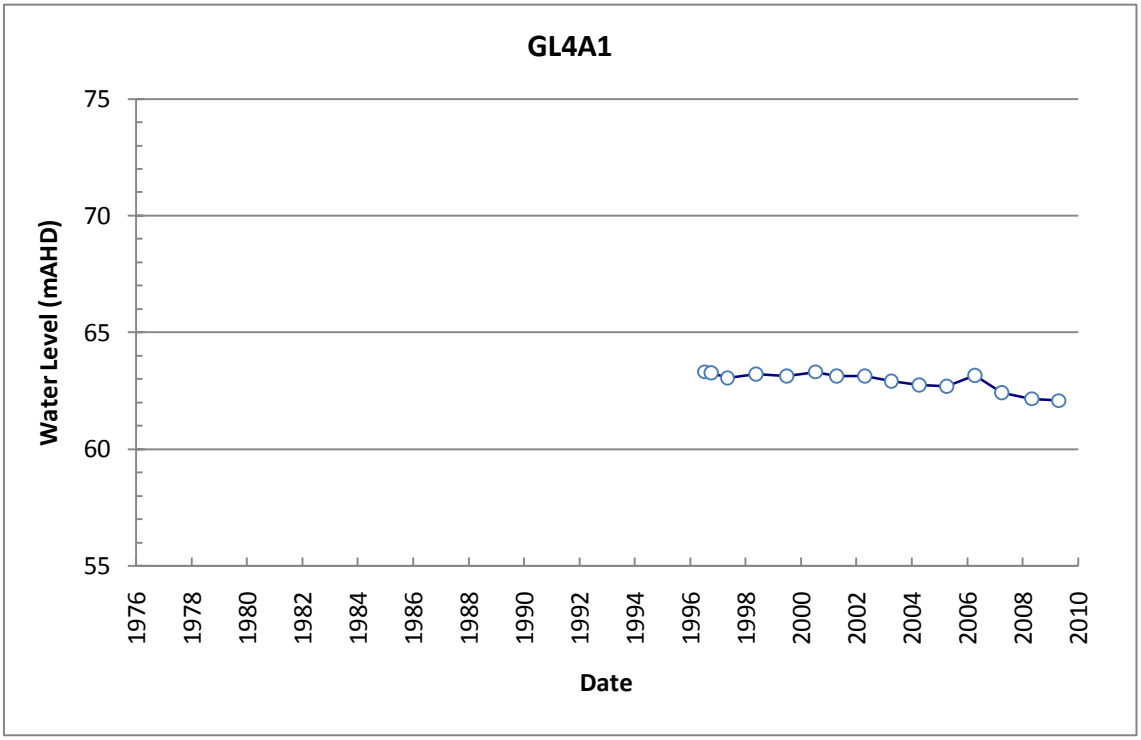
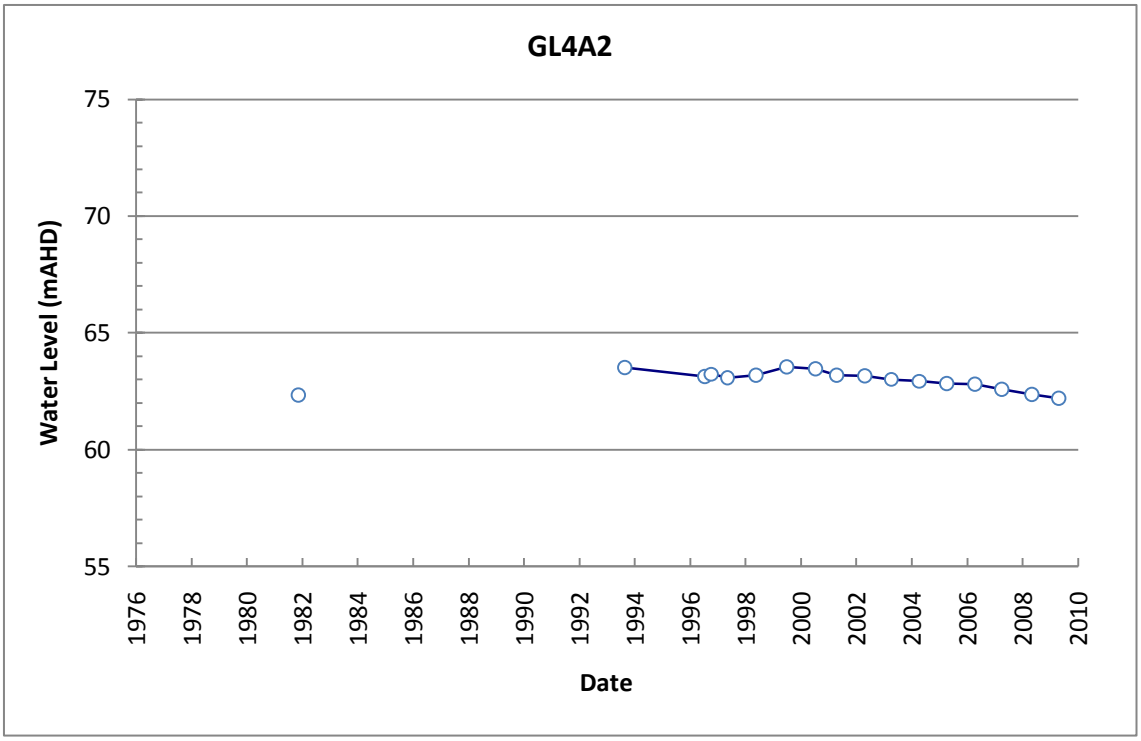


Figure 3-16: Sub-area 2 monitoring bores located within the Yarragadee aquifer


GL4A1
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL4A2
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

3.2.3 Sub-area 3 North

Both the Leederville and Yarragadee aquifers occur within Sub-area 3, although only the Leederville aquifer is monitored. Figure 3-17 demonstrates the location of the individual monitoring bore, with hydrograph following thereafter.

3.2.3.1 Leederville aquifer

The sole monitoring bore within the Leederville aquifer, Bore AM1, has regular monitoring data from 1987, with a 3 year gap between 2004 and 2007. Following a small rise in 1996, water levels have been consistently decreasing and were approximately 0.8 m below the 1996 peak at the end of 2009.

3.2.3.2 Yarragadee aquifer

No monitoring points exist within Sub-area 3 North for the Yarragadee aquifer.

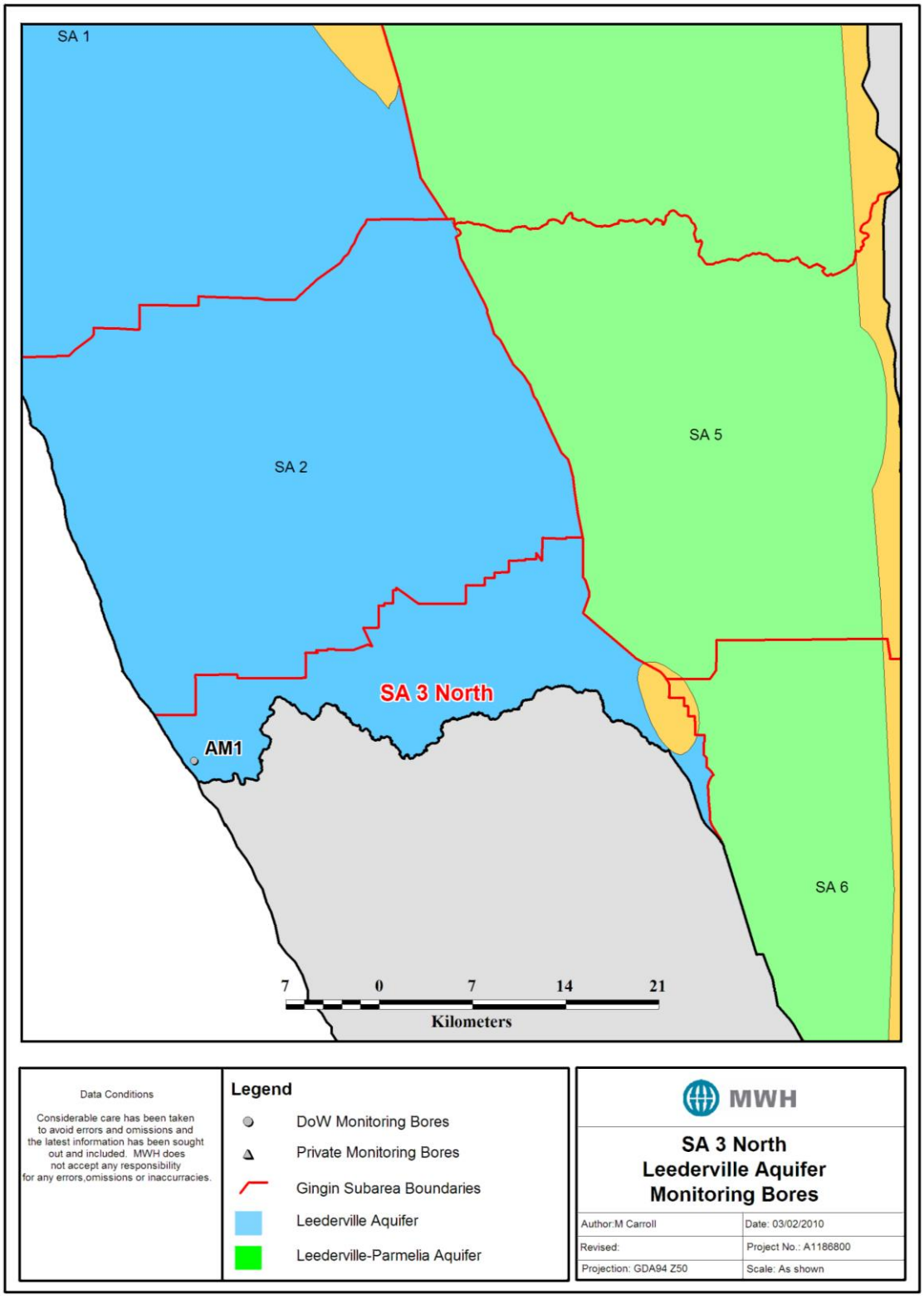
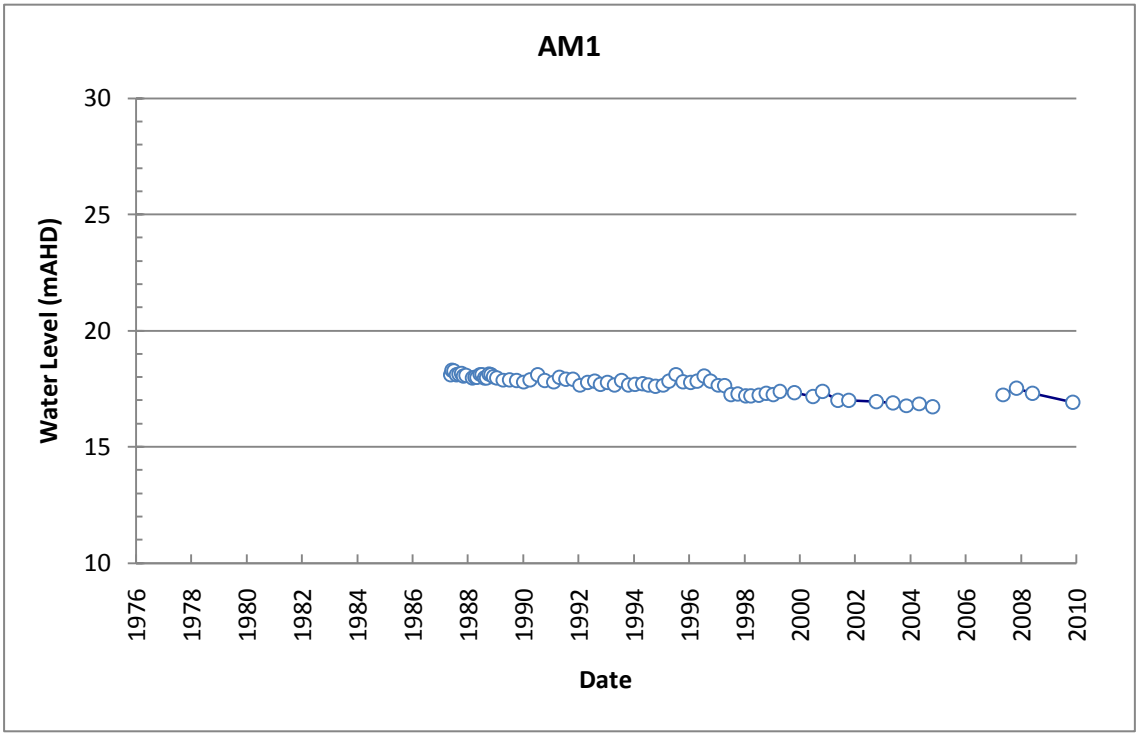


Figure 3-17: Sub-area 3 North monitoring bores located within the Leederville aquifer


AM1
Water Level (mAHD)
30
25
20
15
10
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

3.2.4 Sub-area 4

Sub-area 4 contains the Mirrabooka, Leederville-Parmelia and Yarragadee aquifers, although the Mirrabooka aquifer does not contain any monitoring bores. Figure 3-18 and Figure 3-19 illustrate the extent of available monitoring data within the sub-area; the hydrographs are presented thereafter.

3.2.4.1 Mirrabooka aquifer

No monitoring bores exist within Sub-area 4 for the Mirrabooka aquifer.

3.2.4.2 Leederville-Parmelia aquifer

The two observation bores within the Leederville-Parmelia aquifer are part of a private abstraction licence and have monitoring data available since 1998.

The data itself fluctuates regularly although there does appear to be a gradual rise in water levels through the period 1998 to 2009. However, this data may be affected by the pumping regime of the abstraction bores, and might not reflect regional changes.

3.2.4.3 Yarragadee aquifer

The only monitoring bore available within the Yarragadee aquifer is situated on the north western corner of the sub-area. Data is available since 1977, although there is a 23 year data gap from 1978 to 2001. During this time, the readings shifted about 180 m, although later time data appears more consistent with regional water levels. This pattern is currently under investigation and will be reported separately.

Since 2001, the water levels have been fairly steady, with a slight peak observed in 2002 followed by a minor decline. Currently, levels are at 260 mAHD.

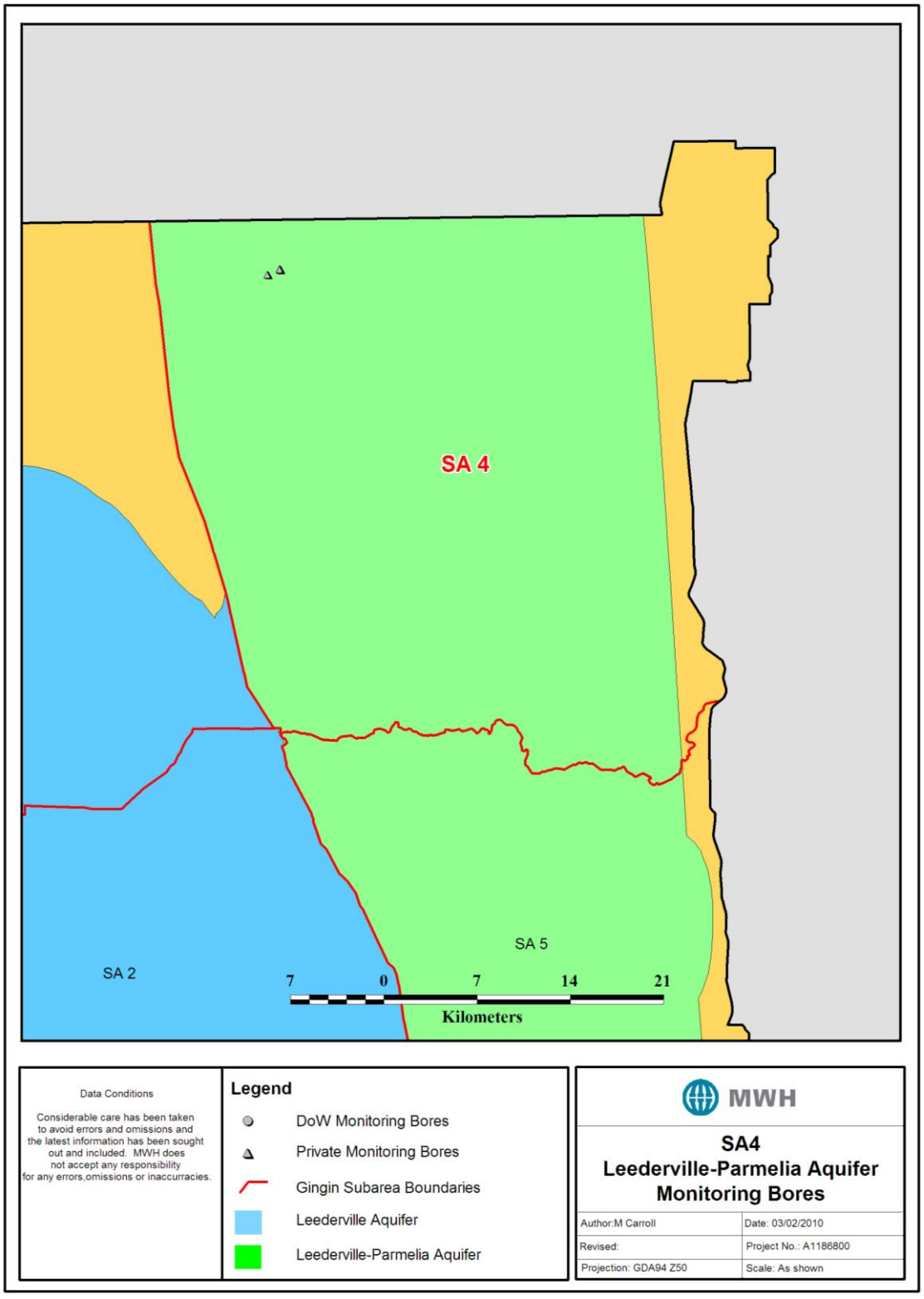
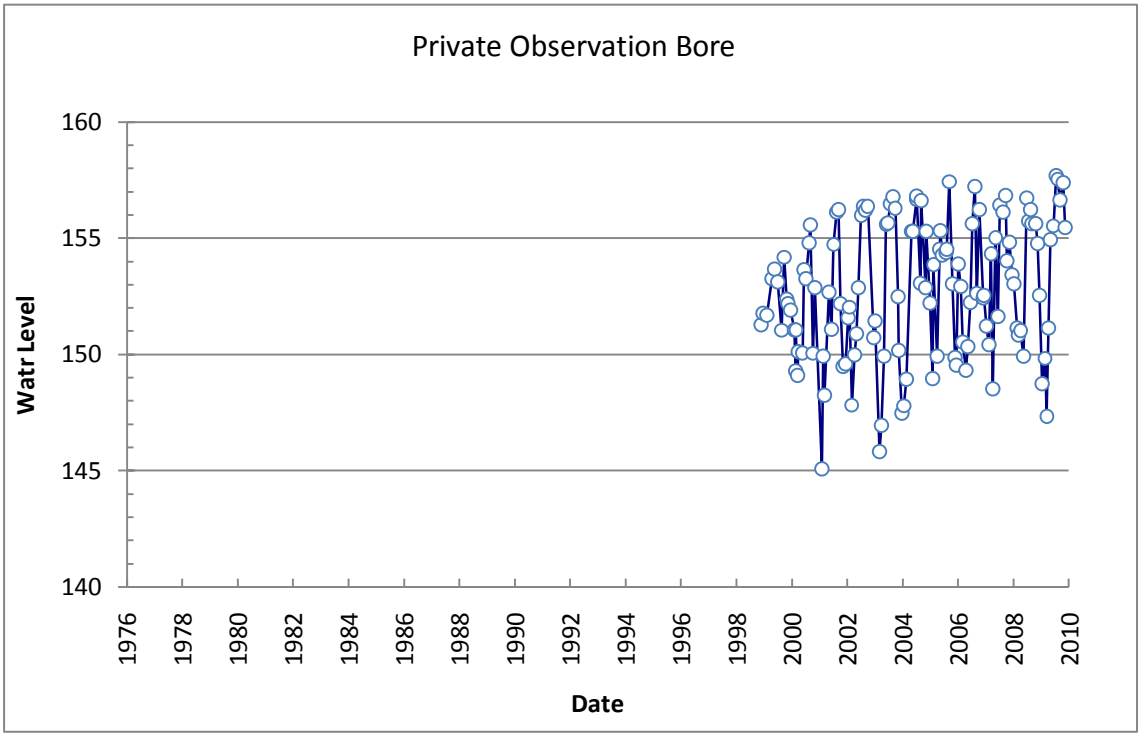
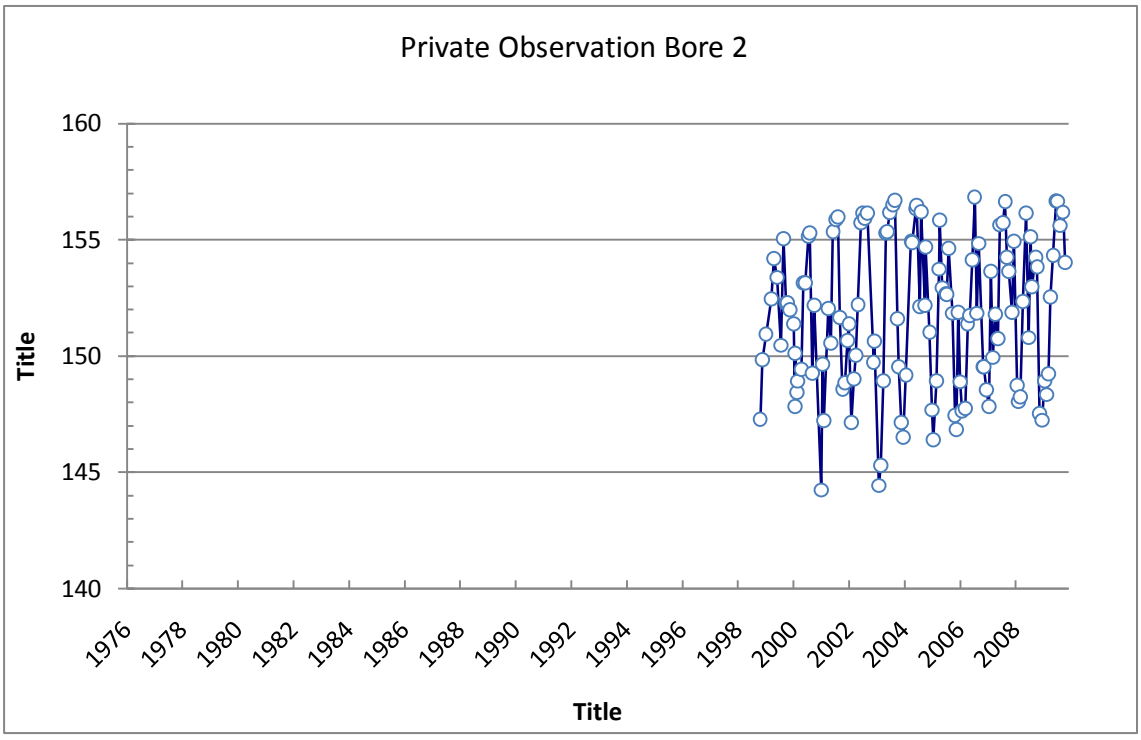


Figure 3-18: Sub-area 4 monitoring bores located within the Leederville-Parmelia aquifer


Private Observation Bore
Watr Level
160
155
150
145
140
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


Private Observation Bore 2
Title
160
155
150
145
140
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Title

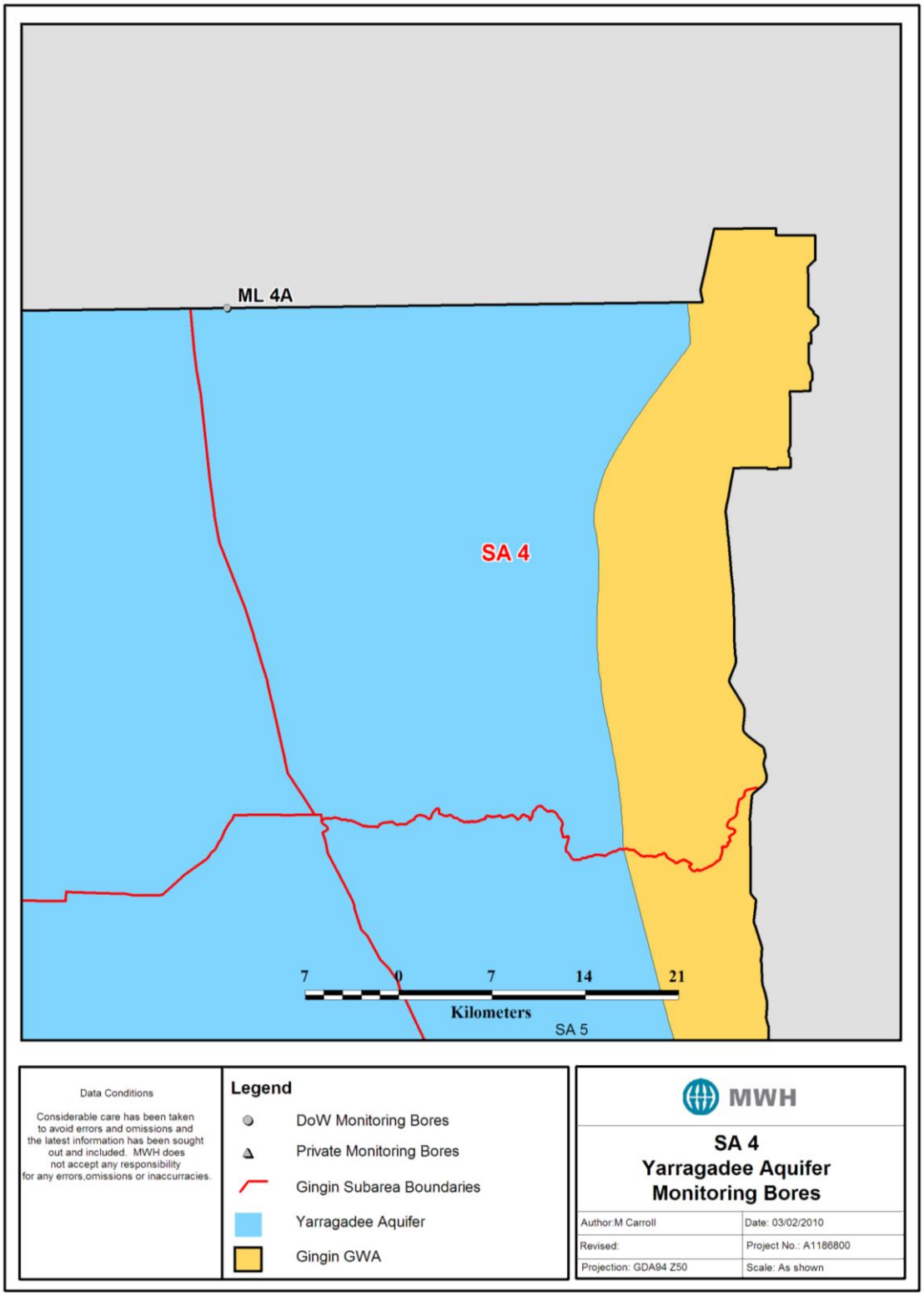
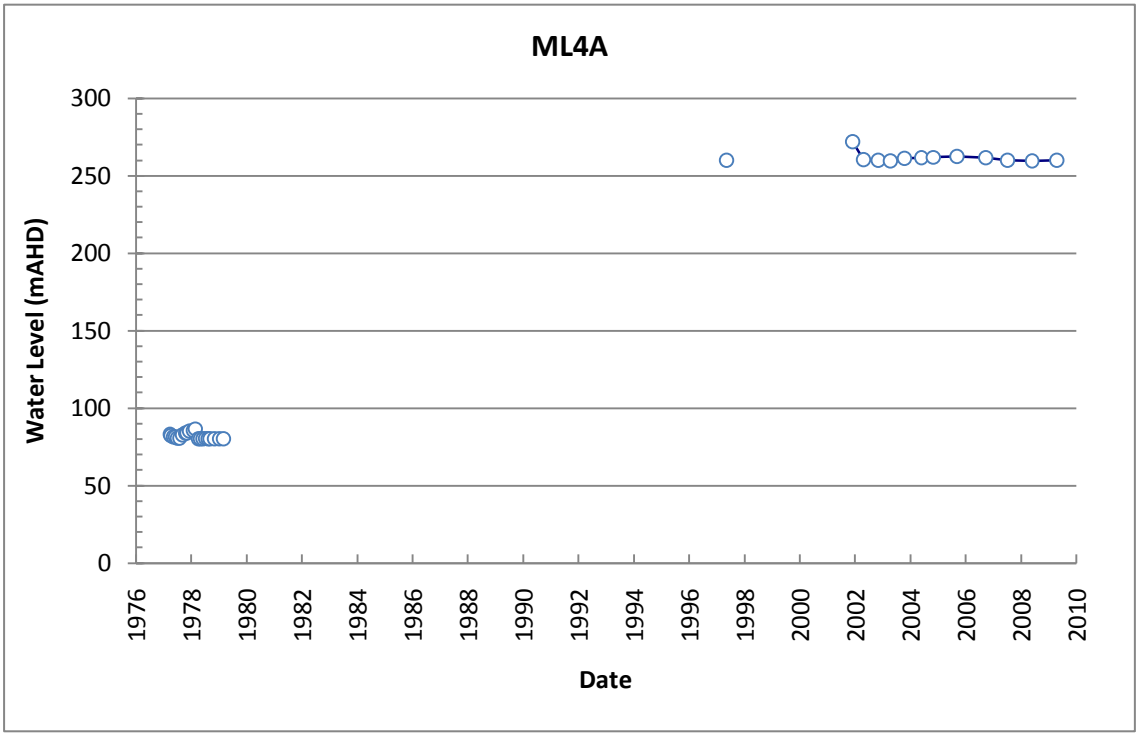


Figure 3-19: Sub-area 4 monitoring bores located within the Yarragadee aquifer


ML4A
Water Level (mAHD)
300
250
200
150
100
50
0
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

3.2.5 Sub-area 5

Sub-area 5 encompasses the Mirrabooka, Leederville-Parmelia and Yarragadee aquifers, with data extent illustrated in Figure 3-20, Figure 3-21, and Figure 3-22. Hydrographs for each aquifer are presented after these figures.

3.2.5.1 Mirrabooka aquifer

The sole Mirrabooka aquifer monitoring bore in Sub-area 5, Bore GL7W, has regular monitoring data available since 1993. The bore has demonstrated a long term decline from 144.0 mAHD in 1999 to 143.0 mAHD in 2009. The regional analysis in Section 2 used data from a water level low experienced in 1997, and the stable trend illustrated in Figure 2-7 does not therefore reflect this downward pattern.

3.2.5.2 Leederville-Parmelia aquifer

There are 10 sets of monitoring data available for the Leederville-Parmelia aquifer within Sub-area 5, drilled as part of the Gillingara Line and Red Gully programs.

Regionally, the data demonstrates a steady rise in groundwater levels along the northern border of the sub-area, the magnitude of which increases in an easterly direction. The westernmost bores do not display such a rise, with Bore GL5W remaining steady while Bore GL5B1 has experienced a recent drop in groundwater levels. Further south, the central Red Gully monitoring bores demonstrate a more subdued rise, while the southernmost bore reveals a steady decline in groundwater levels.

The cause of the data shift in Bore GL7A1 will be the subject of a further investigation.

3.2.5.3 Yarragadee aquifer

The monitoring bores within the Yarragadee aquifer are located along the northern boundary of the sub-area, with regular data collection commencing in 1996. There has been a recent groundwater decline in the western bores, following a slight rise prior to the year 2000.

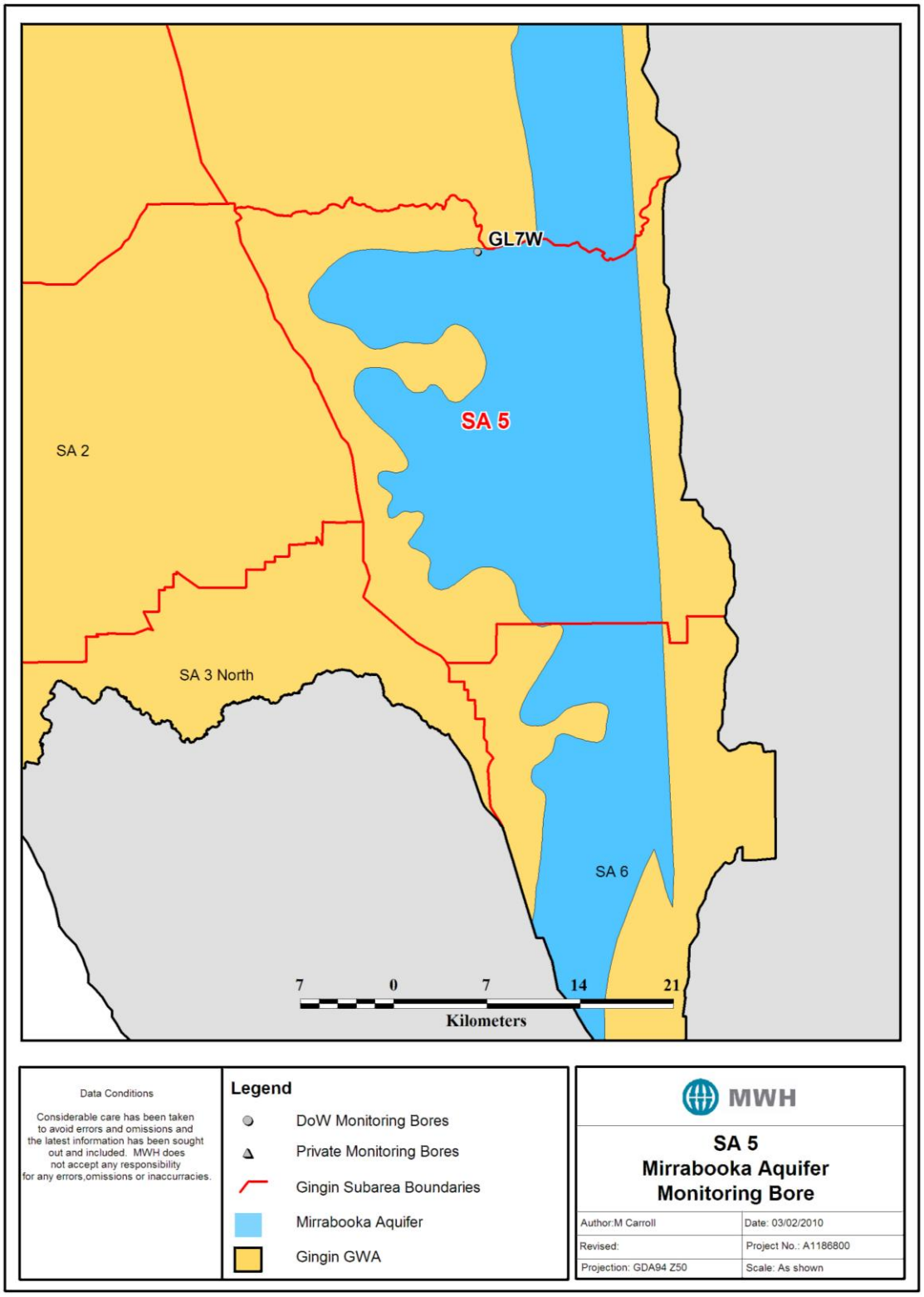
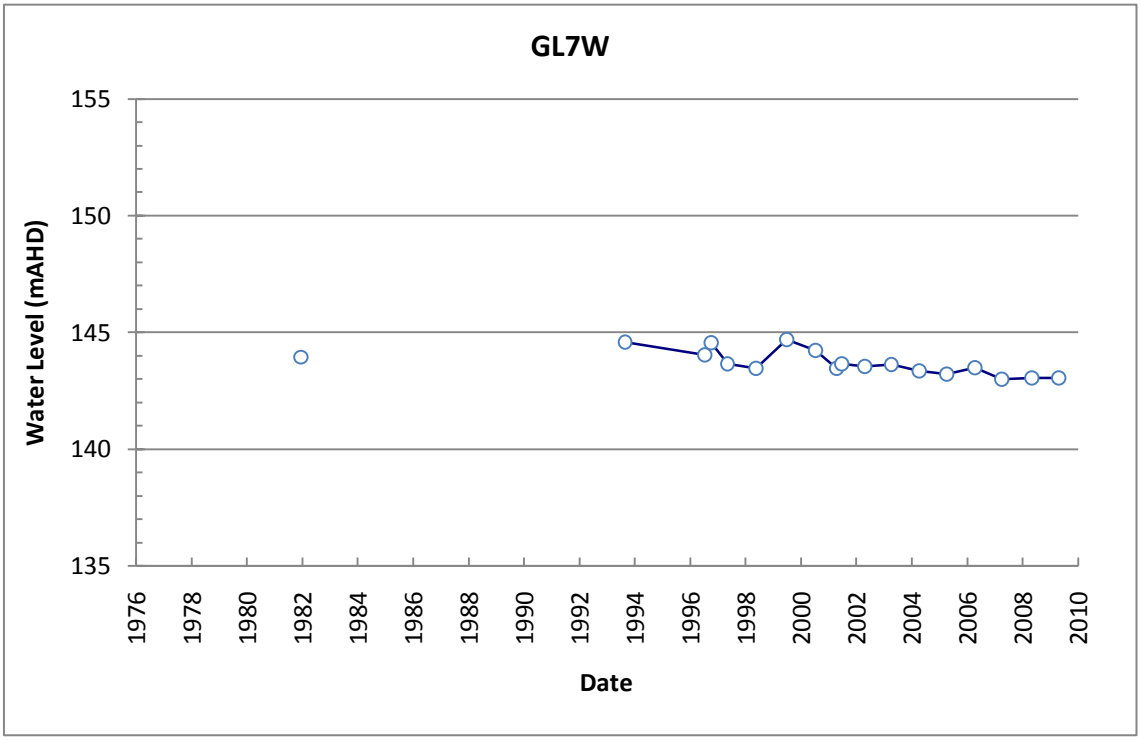


Figure 3-20: Sub-area 5 monitoring bores located within the Mirrabooka aquifer


GL7W
Water Level (mAHD)
155
150
145
140
135
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

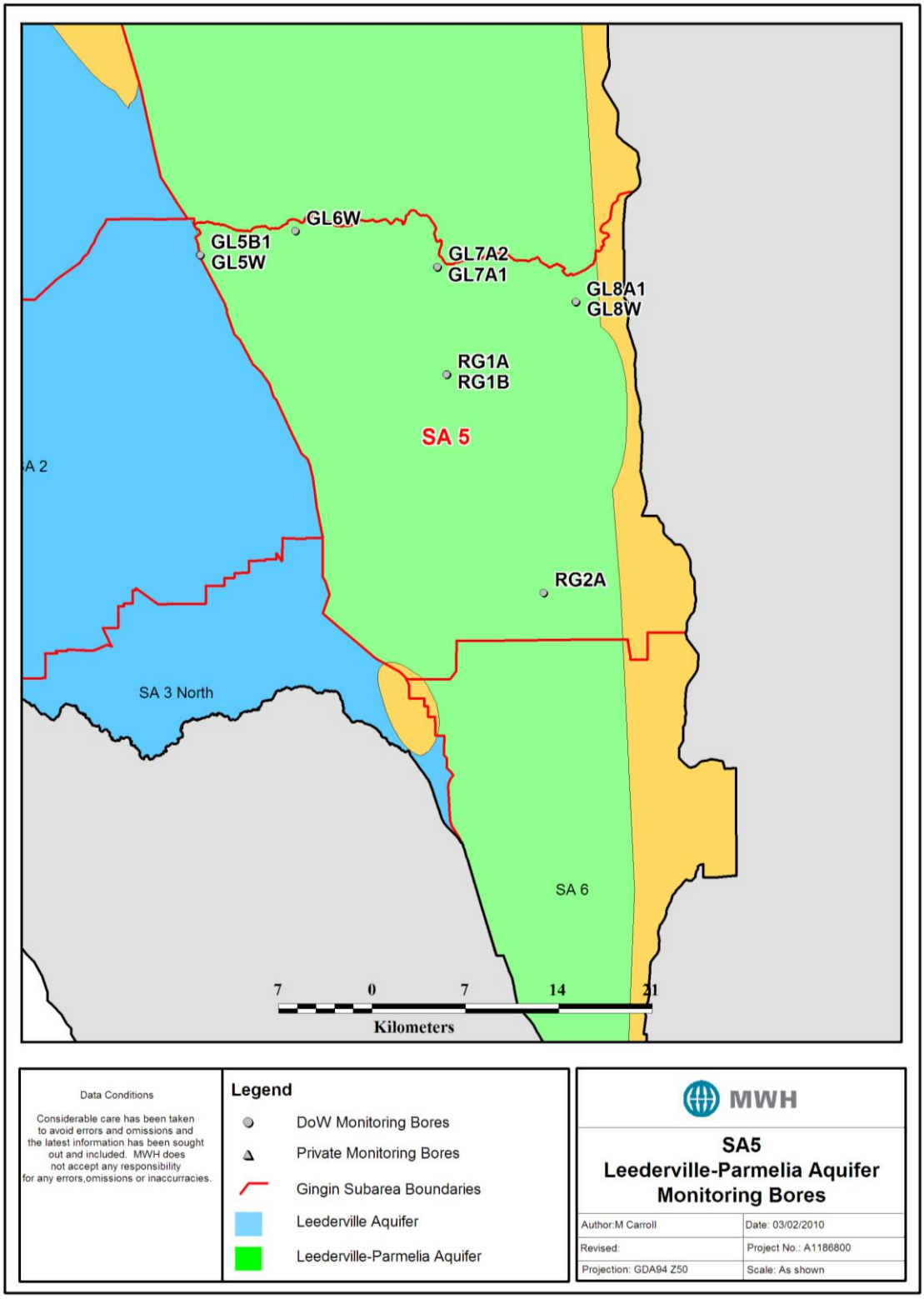
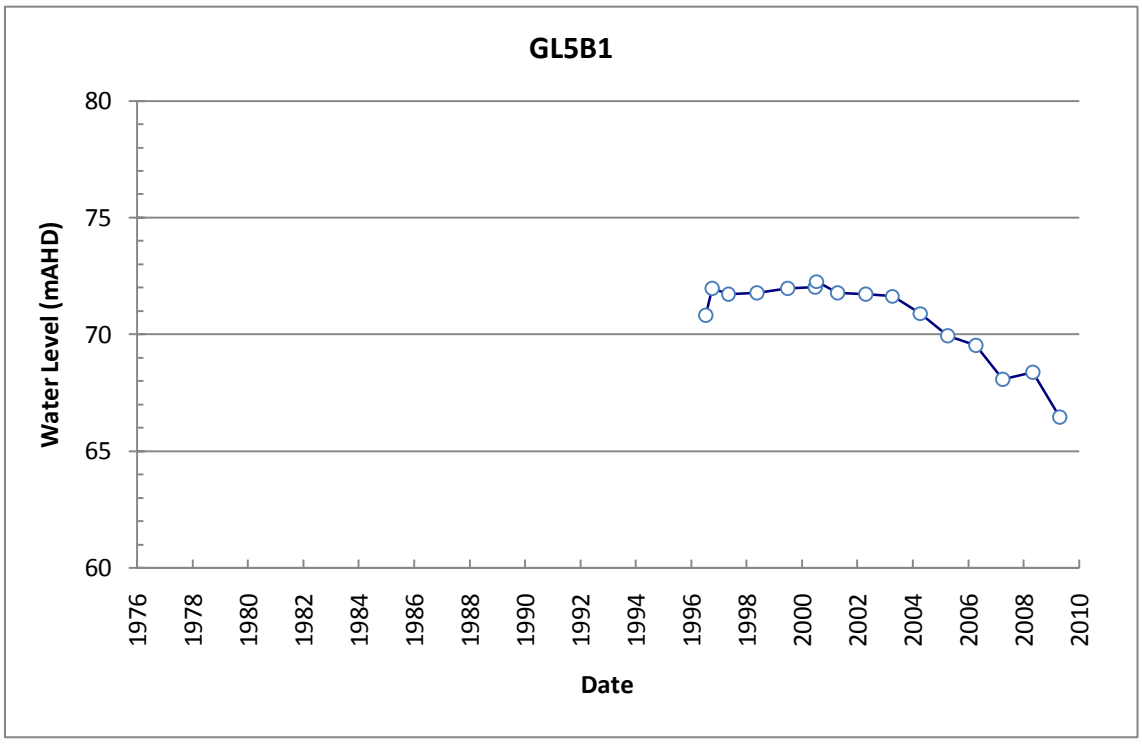
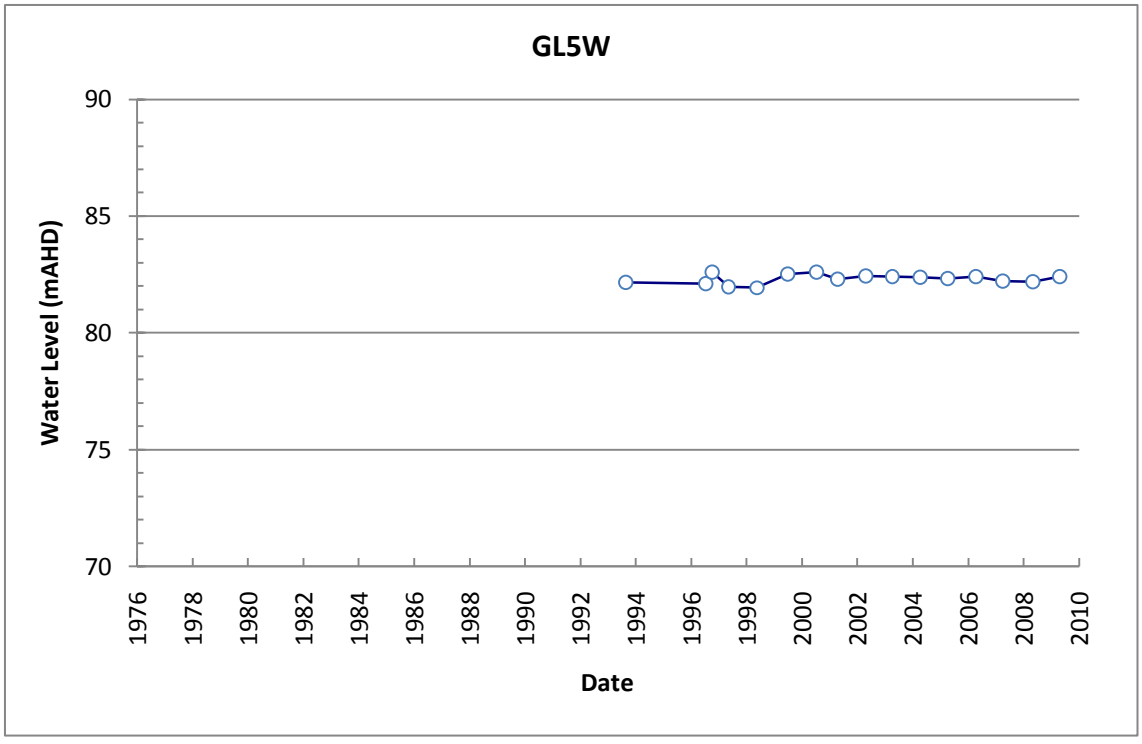
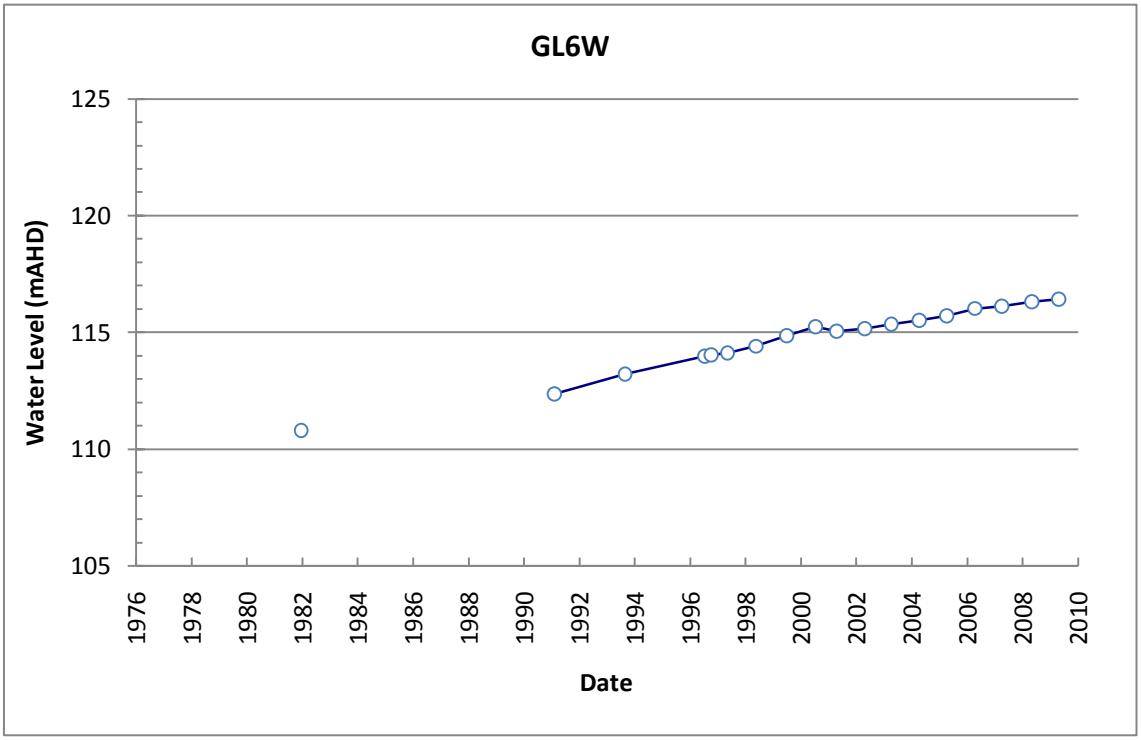
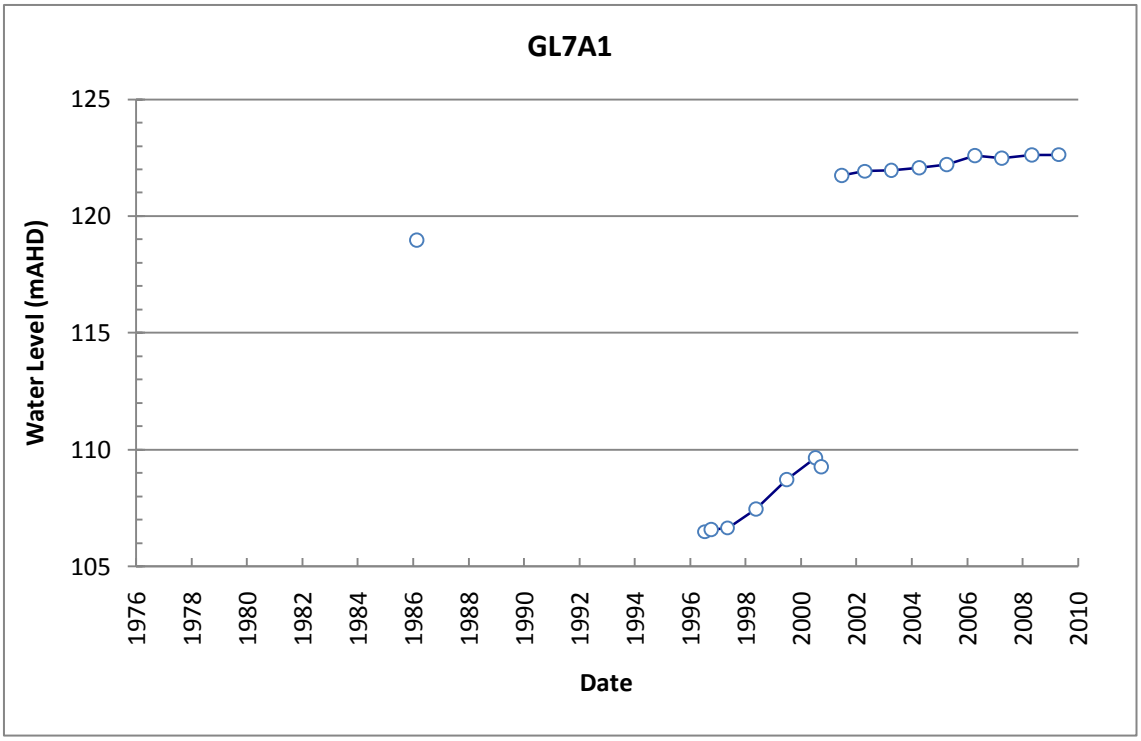


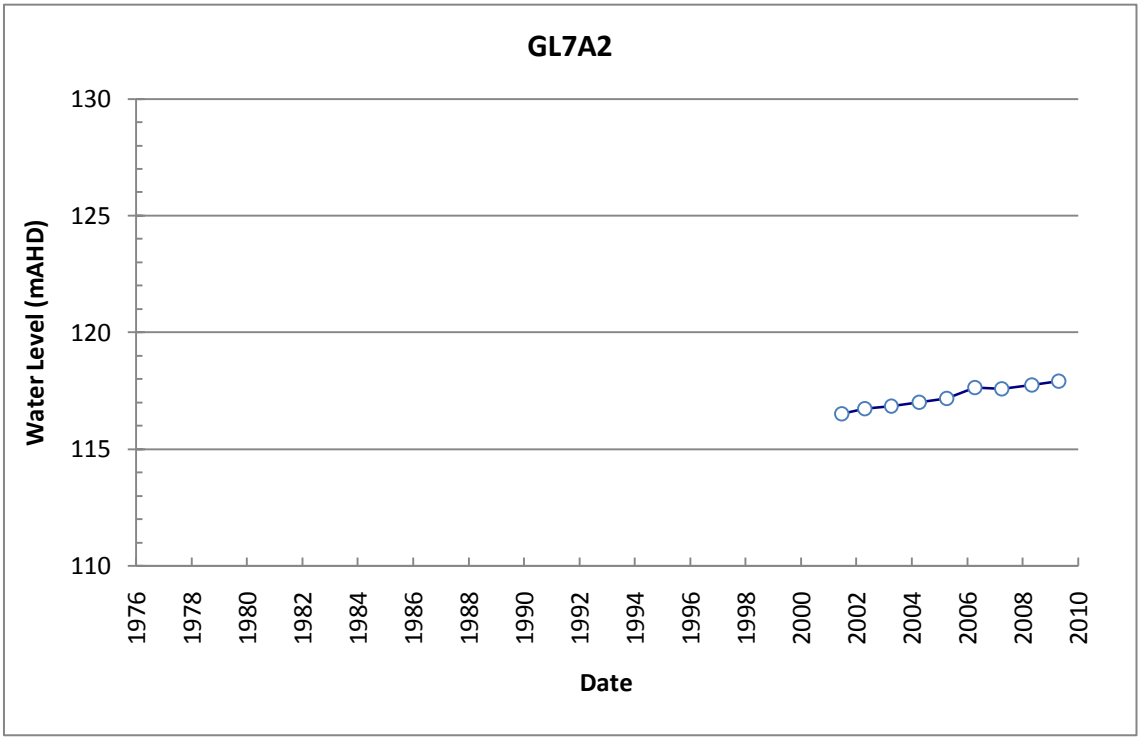
Figure 3-21: Sub-area 5 monitoring bores located within the Leederville-Parmelia aquifer

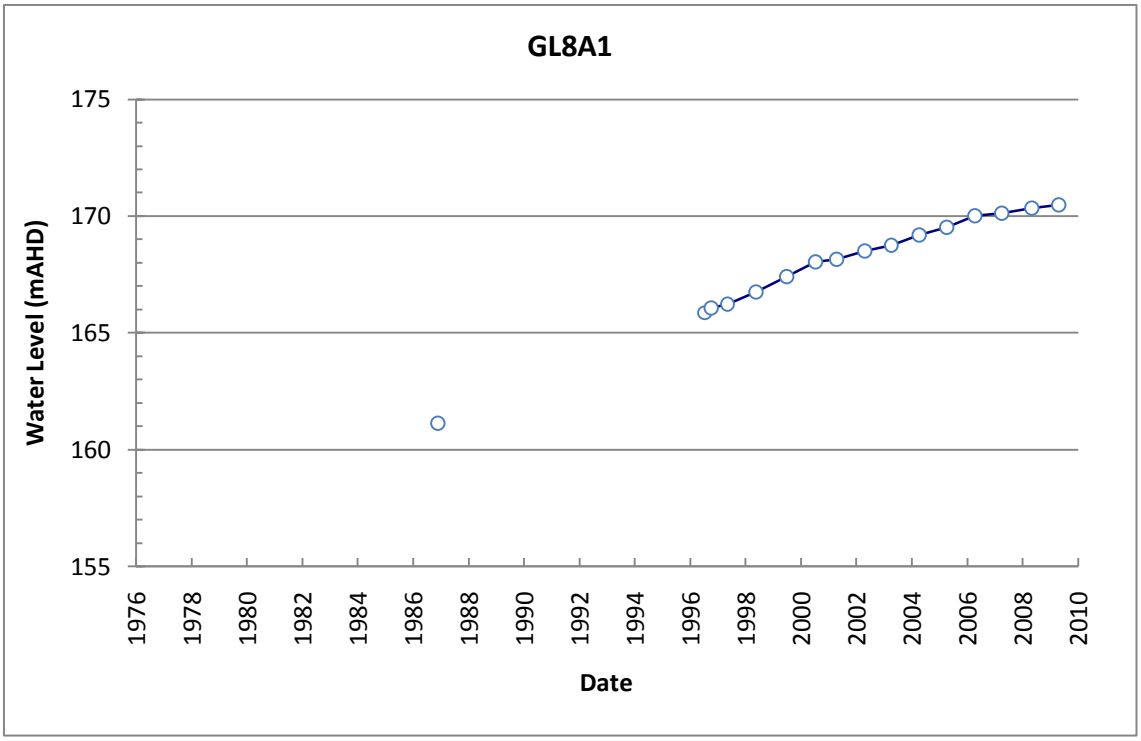

GL5B1
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

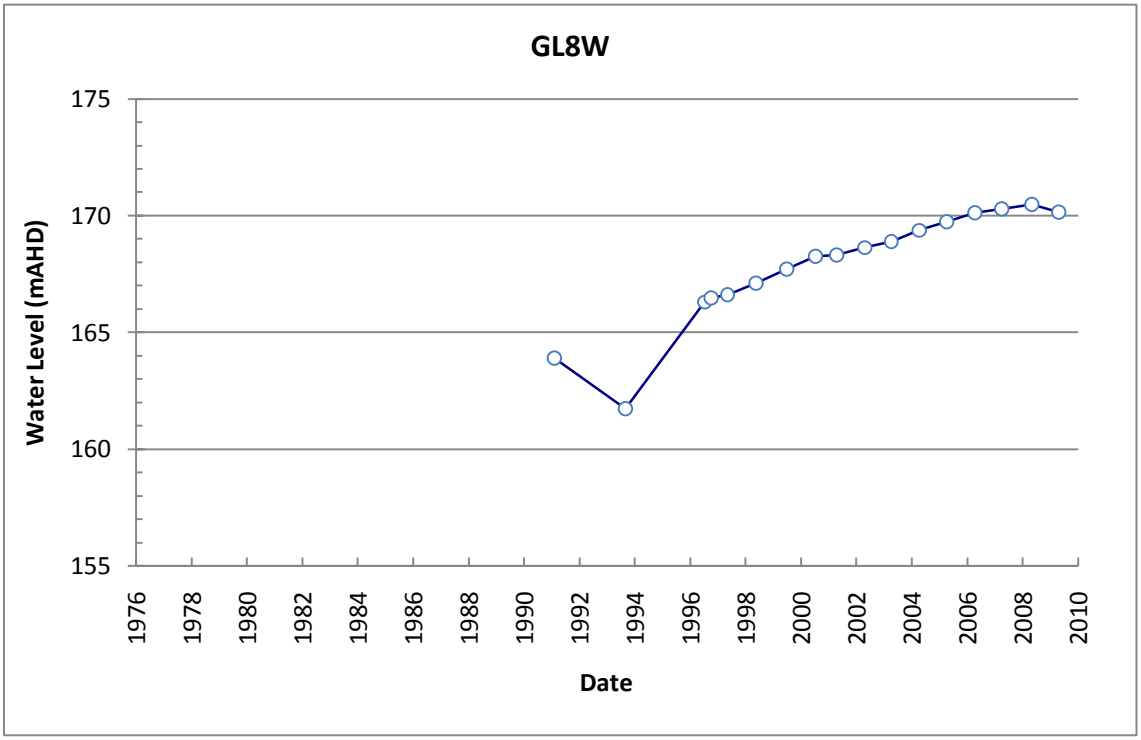

GL5W
Water Level (mAHD)
90
85
80
75
70
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

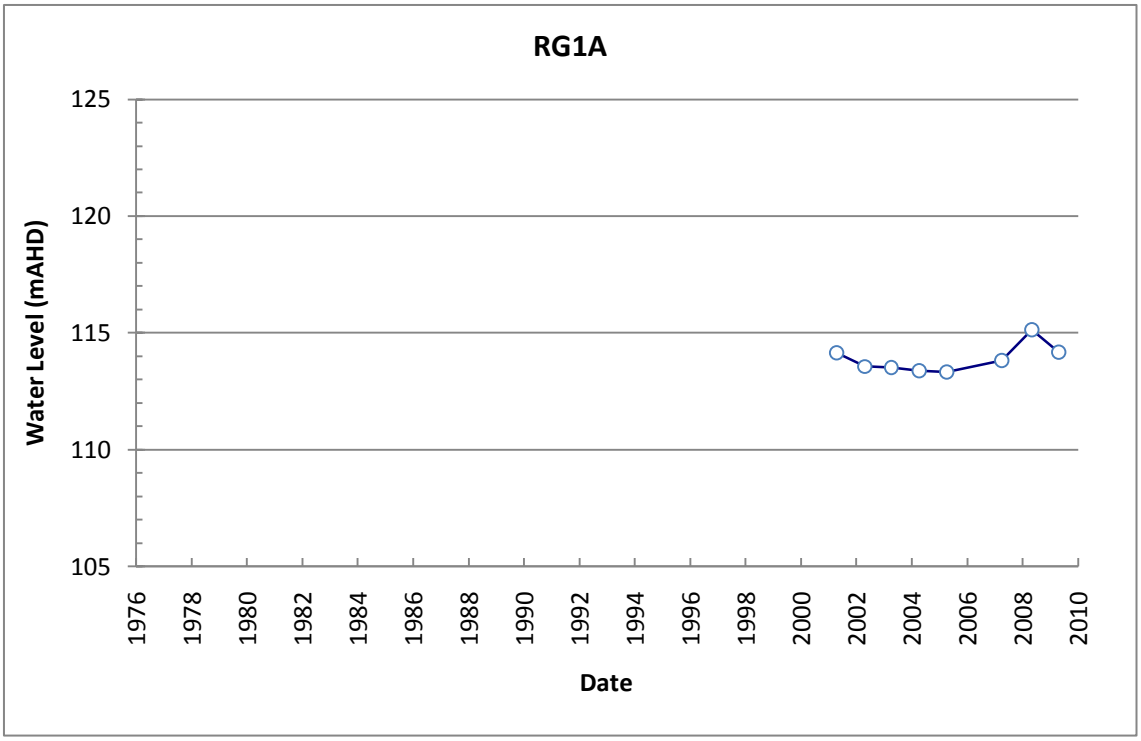

GL6W
Water Level (mAHD)
125
120
115
110
105
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

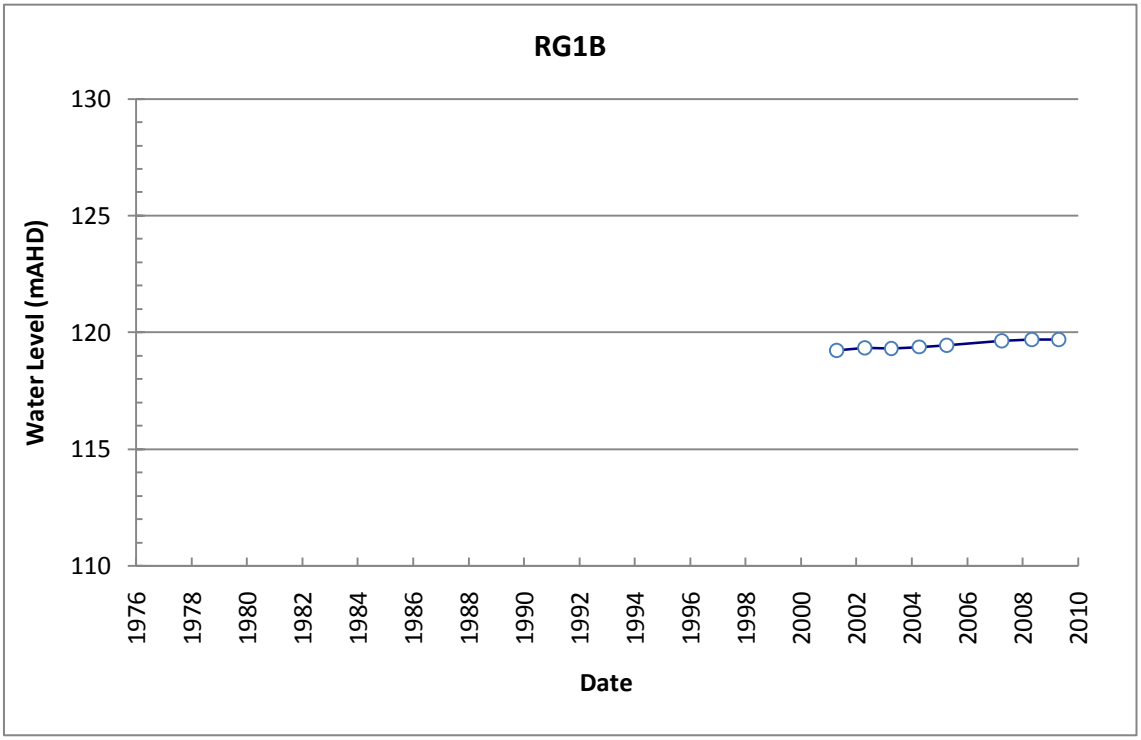

GL7A1
Water Level (mAHD)
125
120
115
110
105
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

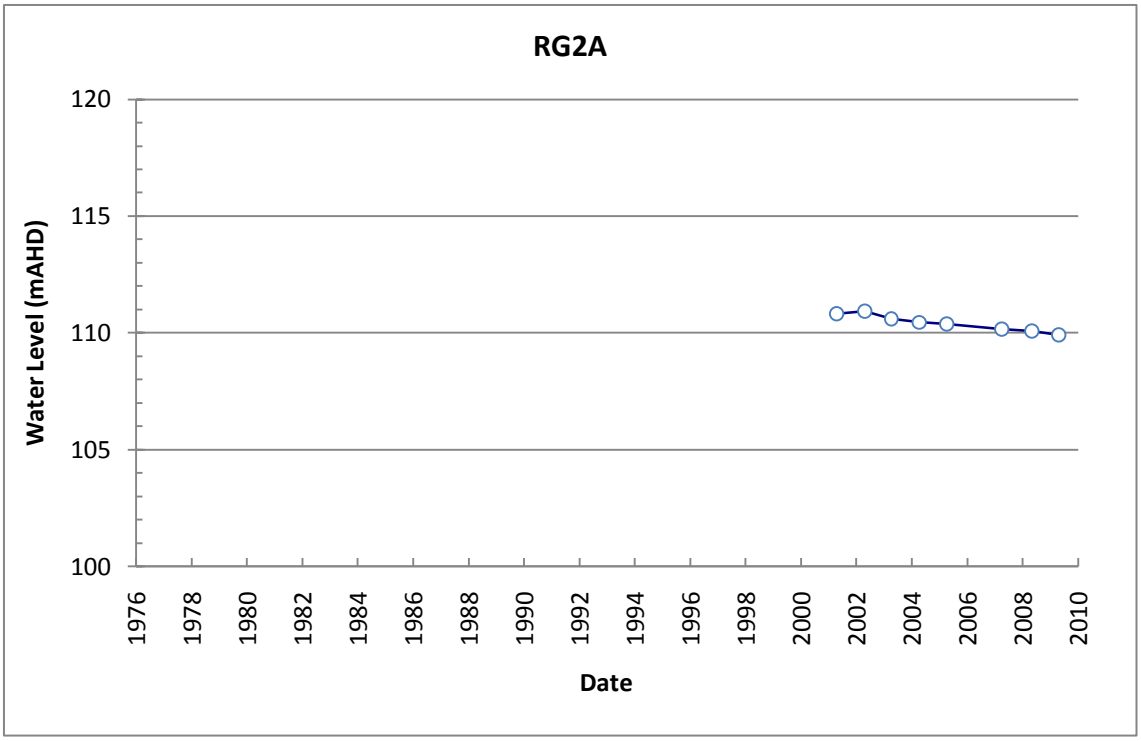

GL7A2
Water Level (mAHD)
130
125
120
115
110
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL8A1
Water Level (mAHD)
175
170
165
160
155
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL8W
175
170
165
160
155
Water Level (mAHD)
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


RG1A
125
120
115
110
105
Water Level (mAHD)
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


RG1B
Water Level (mAHD)
130
125
120
115
110
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


RG2A
Water Level (mAHD)
120
115
110
105
100
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

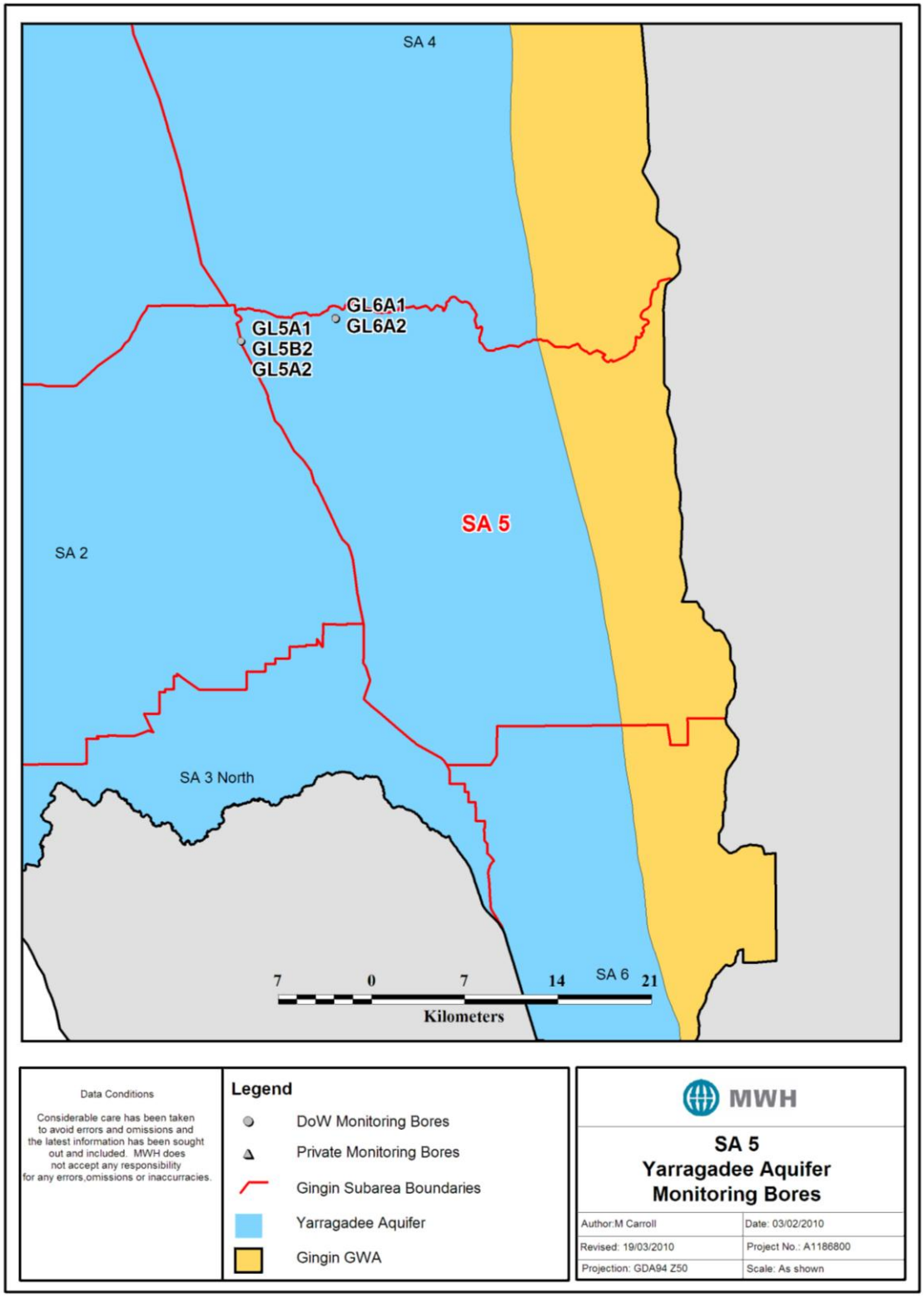
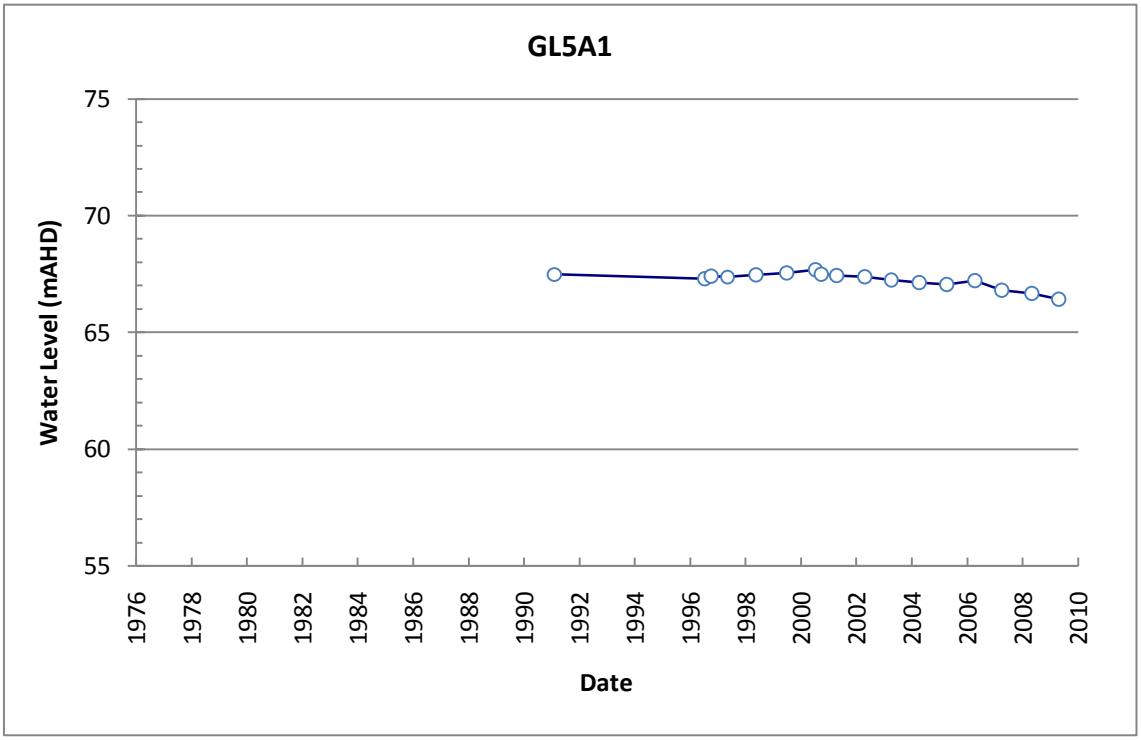
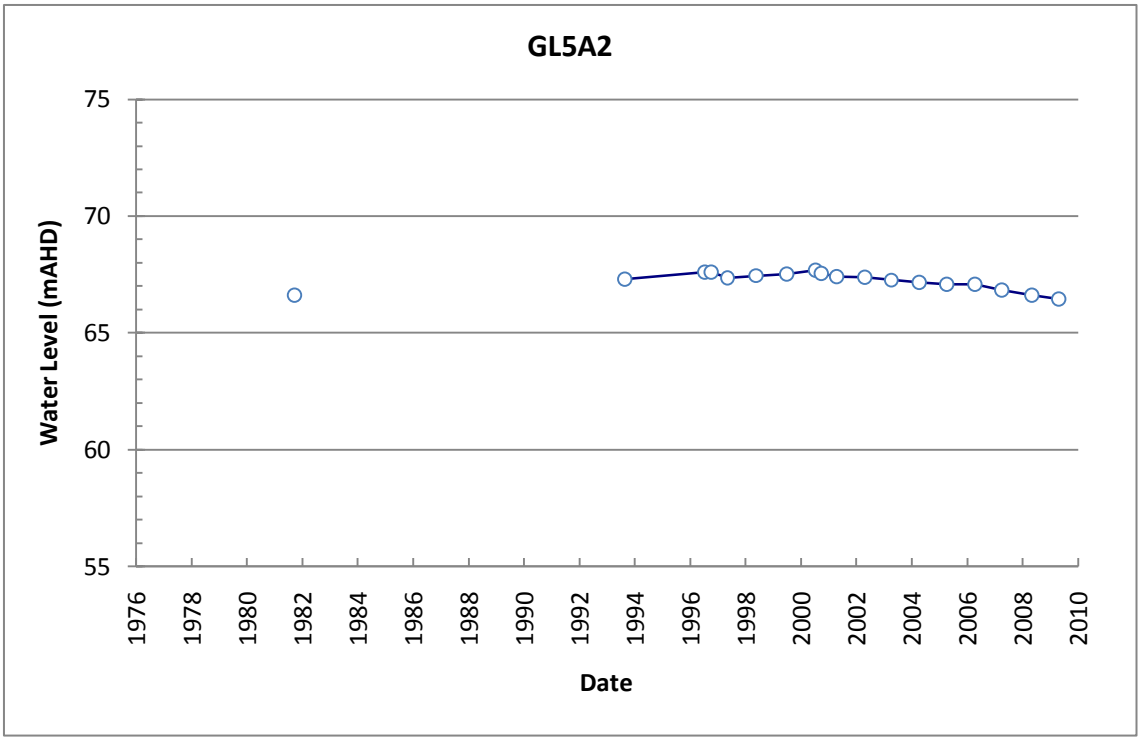
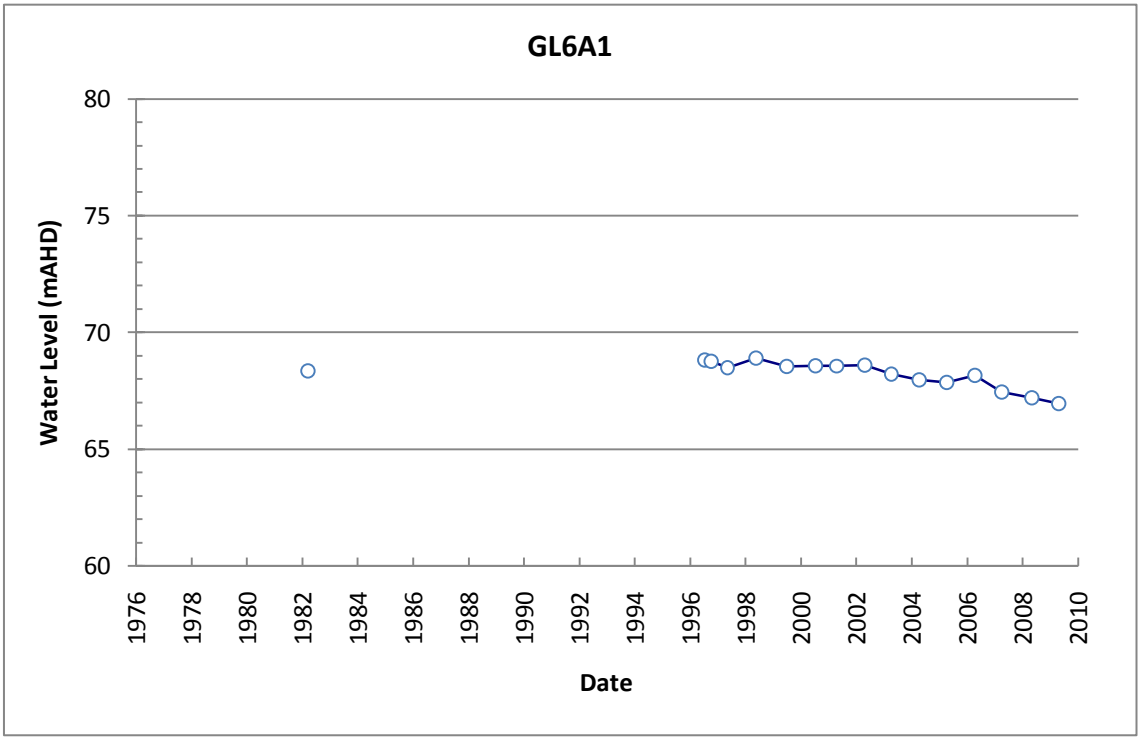
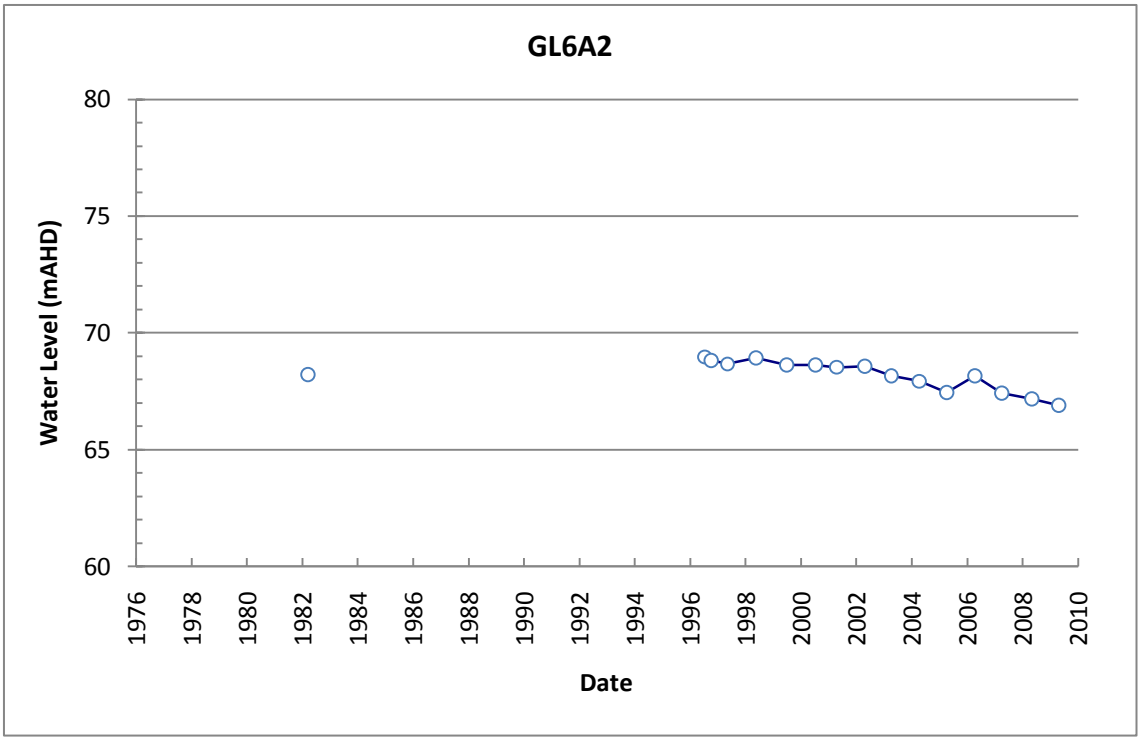


Figure 3-22: Sub-area 5 monitoring bores located within the Yarragadee aquifer


GL5A1
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL5A2
Water Level (mAHD)
75
70
65
60
55
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL6A1
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GL6A2
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

3.2.6 Sub-area 6

Sub-area 6 contains the Mirrabooka, Leederville-Parmelia and Yarragadee aquifers; although no monitoring bores exist within the Yarragadee aquifer. Figure 3-23 and Figure 3-24 illustrate the location of the Mirrabooka and Leederville-Parmelia bores, with hydrographs following thereafter.

3.2.6.1 Mirrabooka aquifer

All but two of the monitoring bores in the Mirrabooka aquifer are part of the Gingin Brook program and have only been operating since late 2008. It is therefore not possible to make inferences on the groundwater trends within these bores.

Bore RG3B, in the south of Sub-area 6, has monitoring data from 2001 onwards, taken at yearly intervals. There does not appear to be any consistent trend in the data, which fluctuates over a range of 1 m. Bore GC 7 has demonstrated a fairly steady groundwater level since 1977, with no apparent declining or increasing trends.

3.2.6.2 Leederville-Parmelia aquifer

The Leederville-Parmelia aquifer in Sub-area 6 is monitored by 8 bores constructed as part of the Artesian, Red Gully and Gingin Brook programs. Data from the latter set of bores is only available from 2008 and cannot yet be used for trend analysis. There are also two private observation bores available as part of an abstraction scheme.

Data from the Artesian bores suggests a steady decline of between 5 and 10 m in head since 1980. The magnitude of the decline appears to increase along the western boundary of the sub-area. The overall declining trend is supported by Bore RG3A, which since 2001 has experienced a 2.8 m drop in groundwater levels.

3.2.6.3 Yarragadee aquifer

No monitoring bores exist in Sub-area 6 for the Yarragadee aquifer.

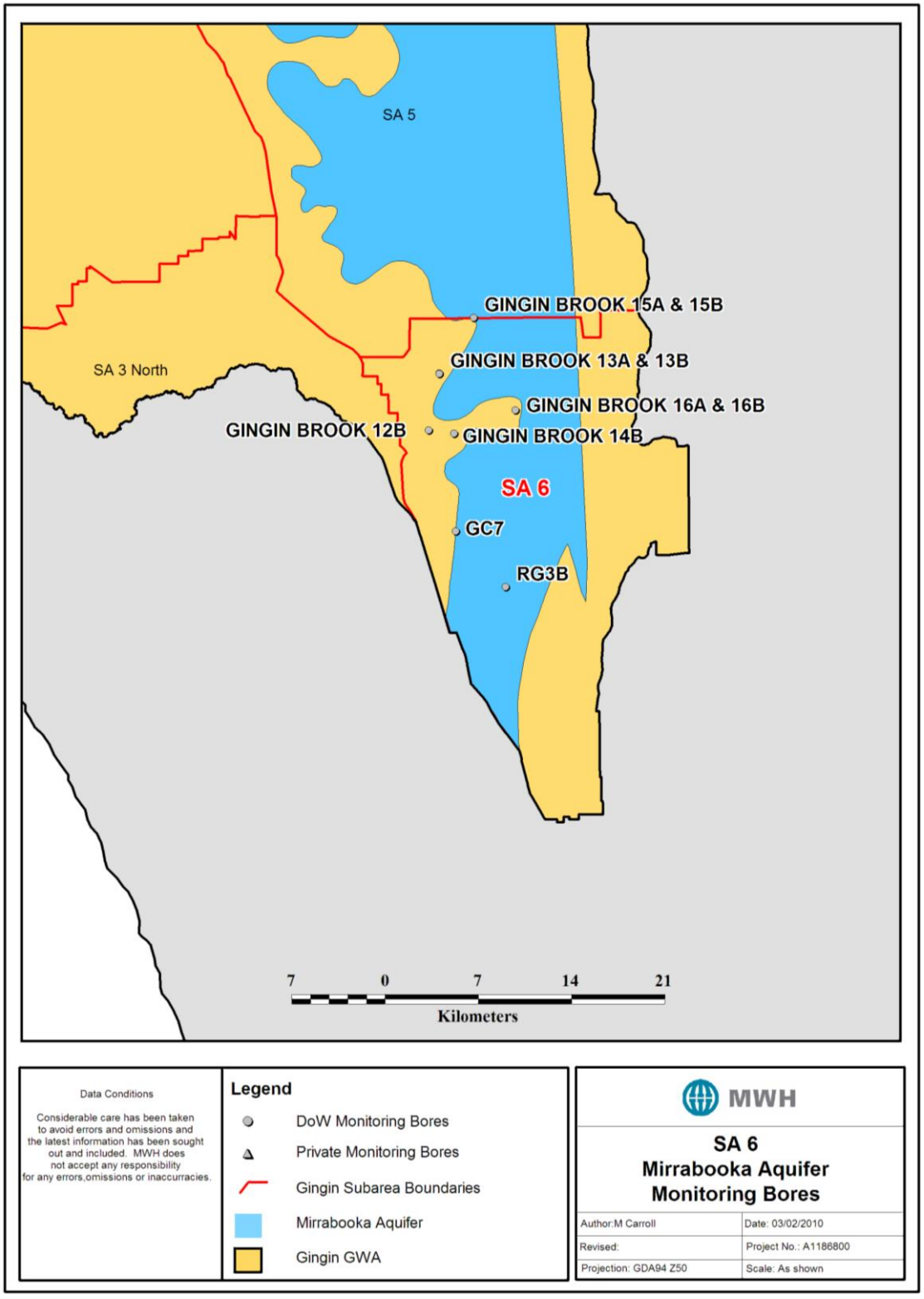
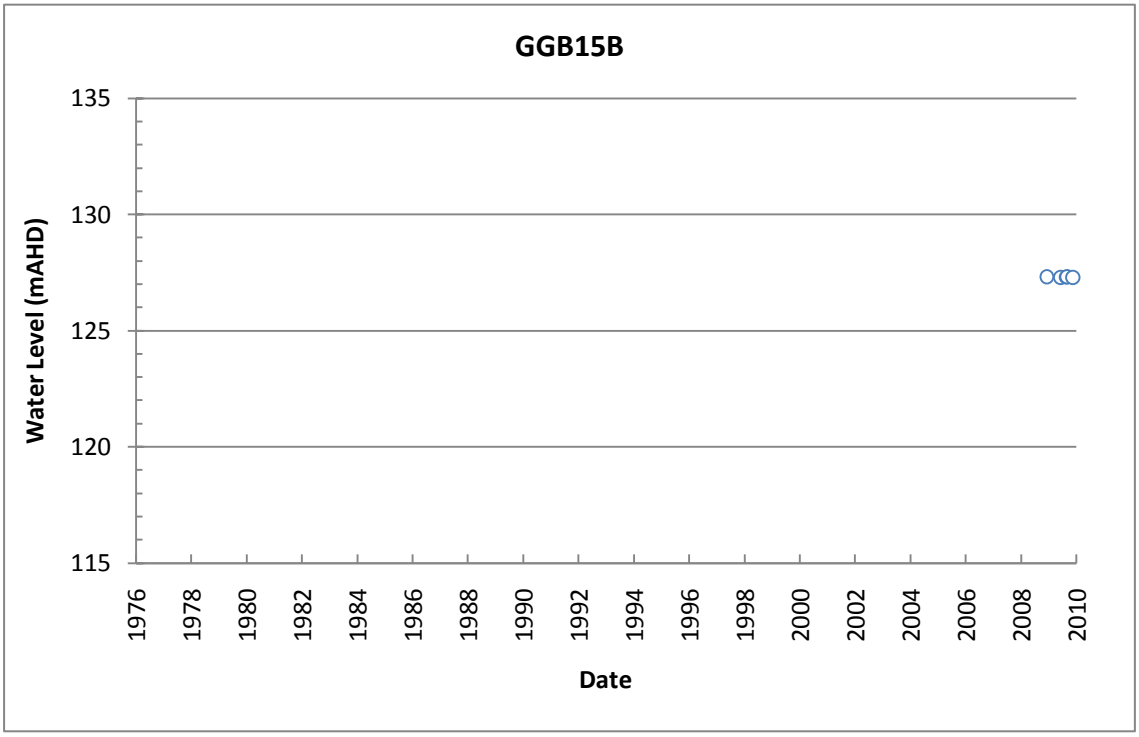
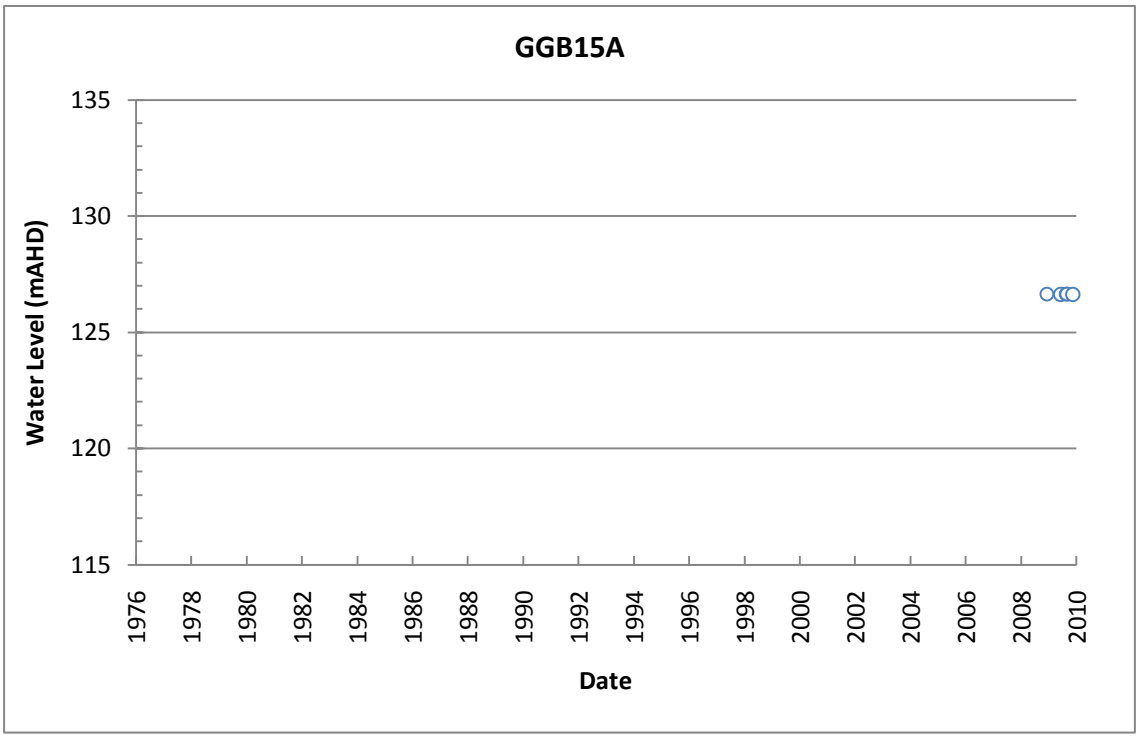
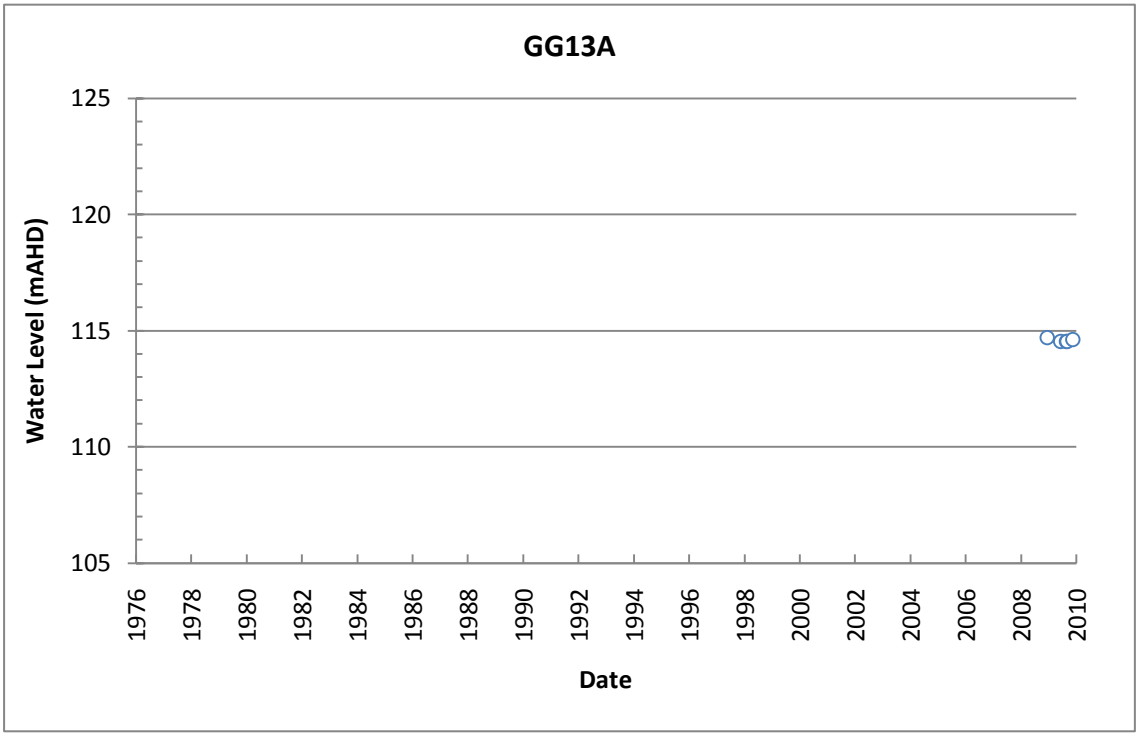
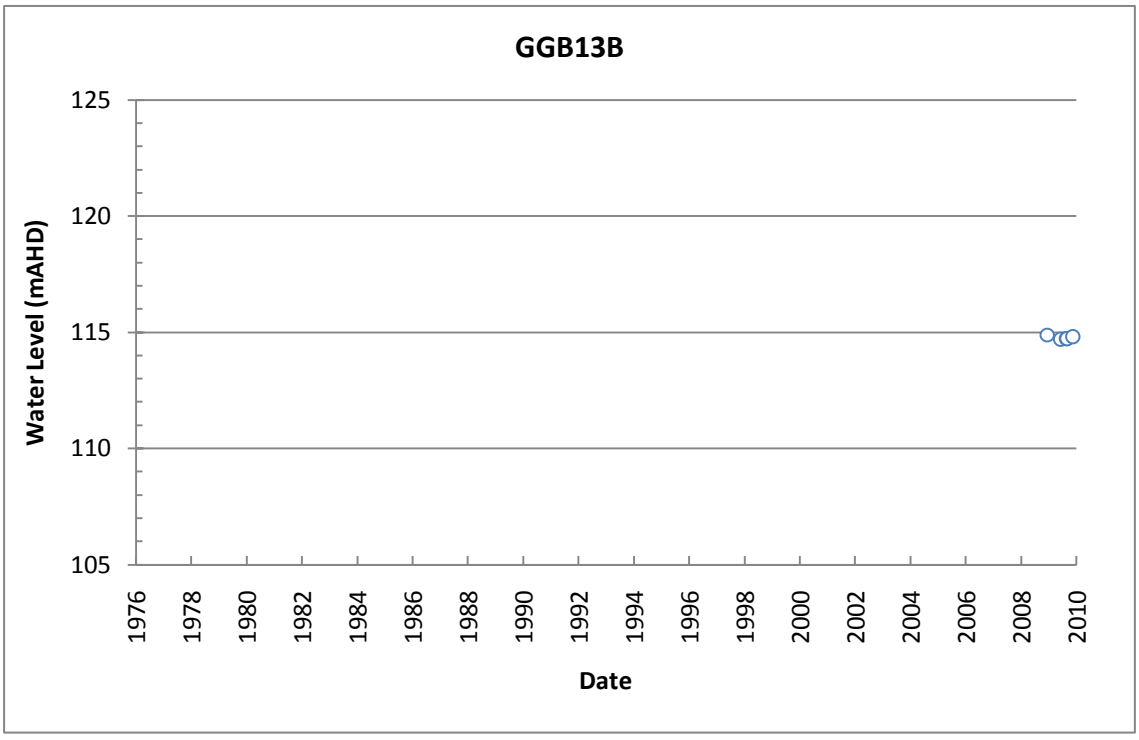


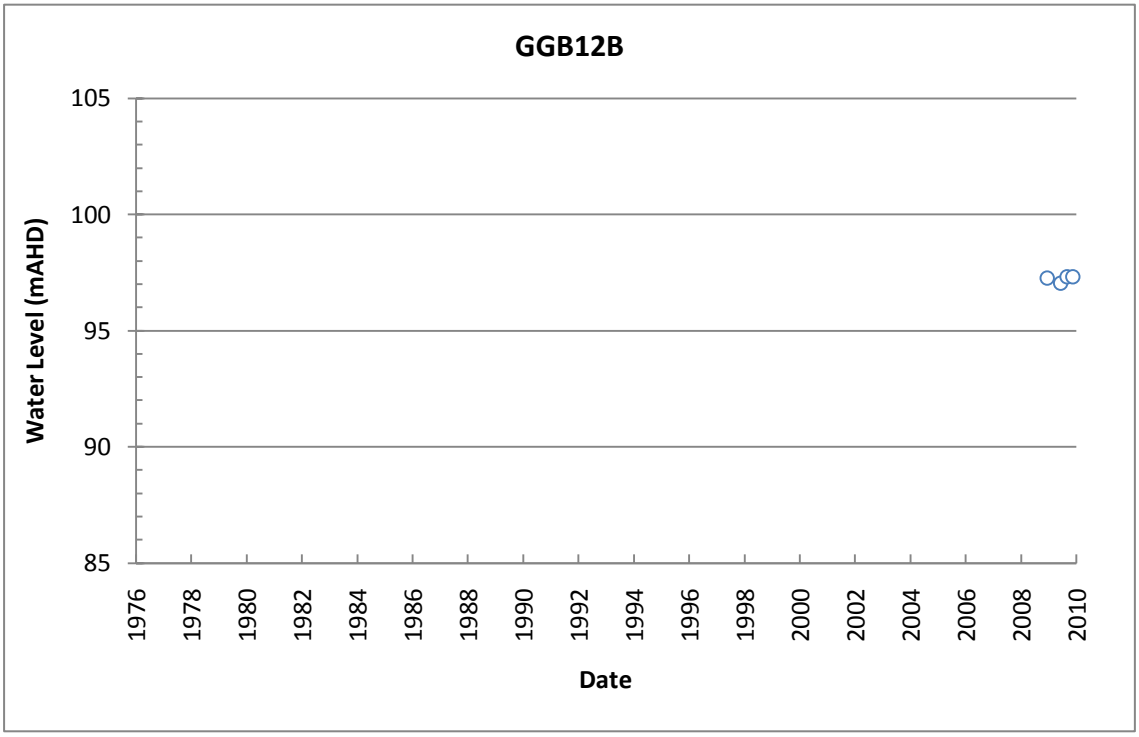
Figure 3-23: Sub-area 6 monitoring bores located within the Mirrabooka aquifer

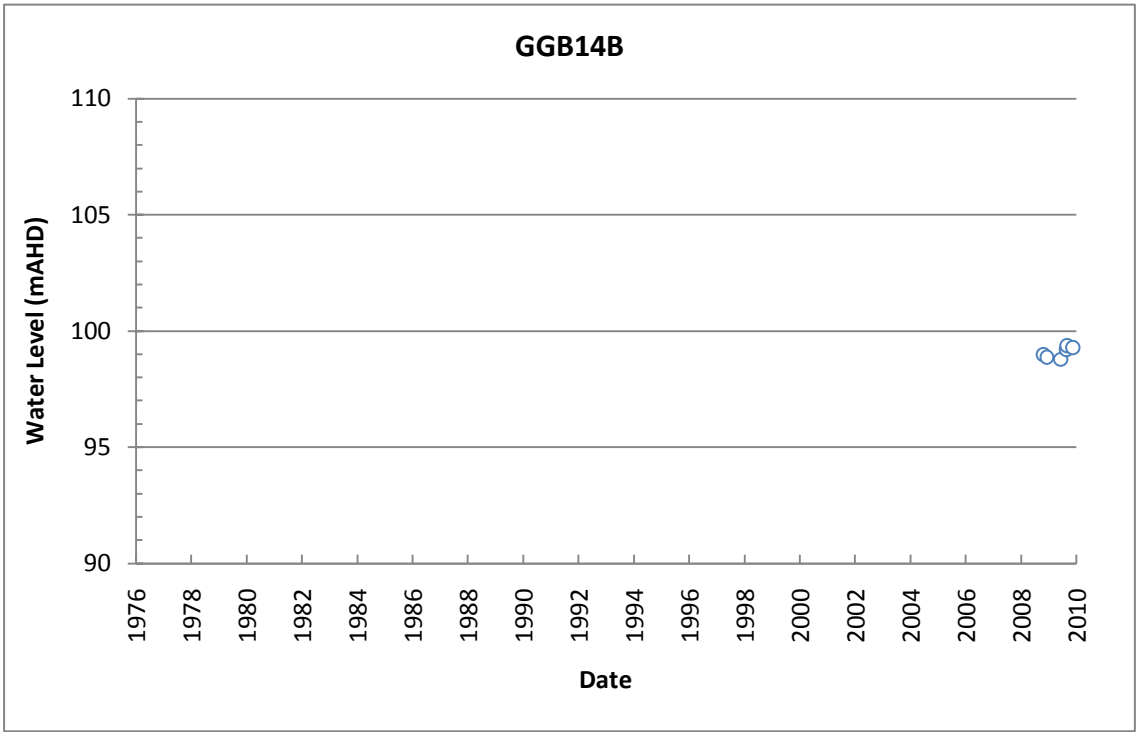

GGB15B
Water Level (mAHD)
135
130
125
120
115
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

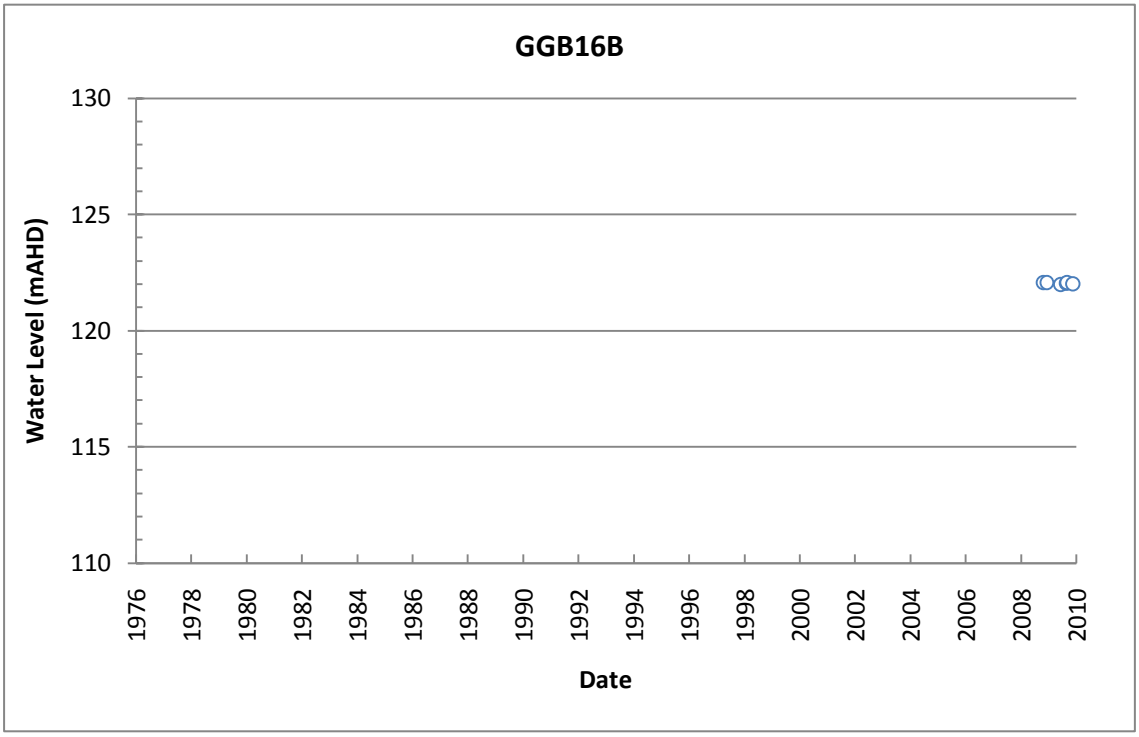

GGB15A
Water Level (mAHD)
135
130
125
120
115
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

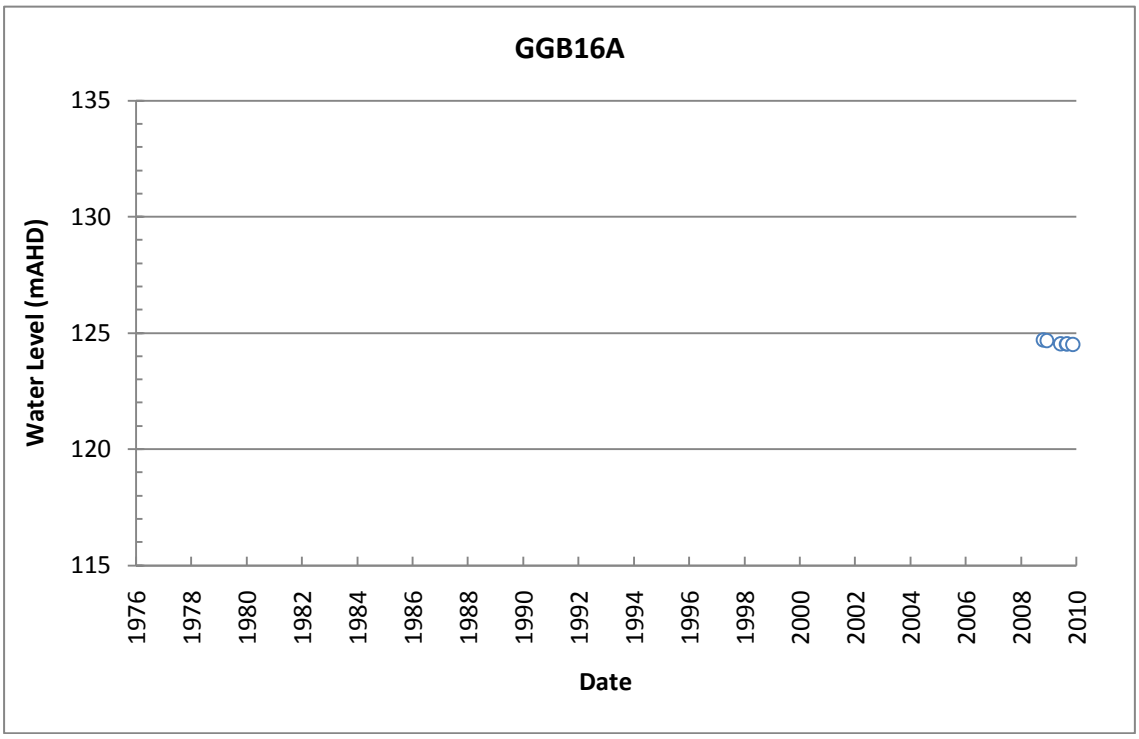

GG13A
Water Level (mAHD)
125
120
115
110
105
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

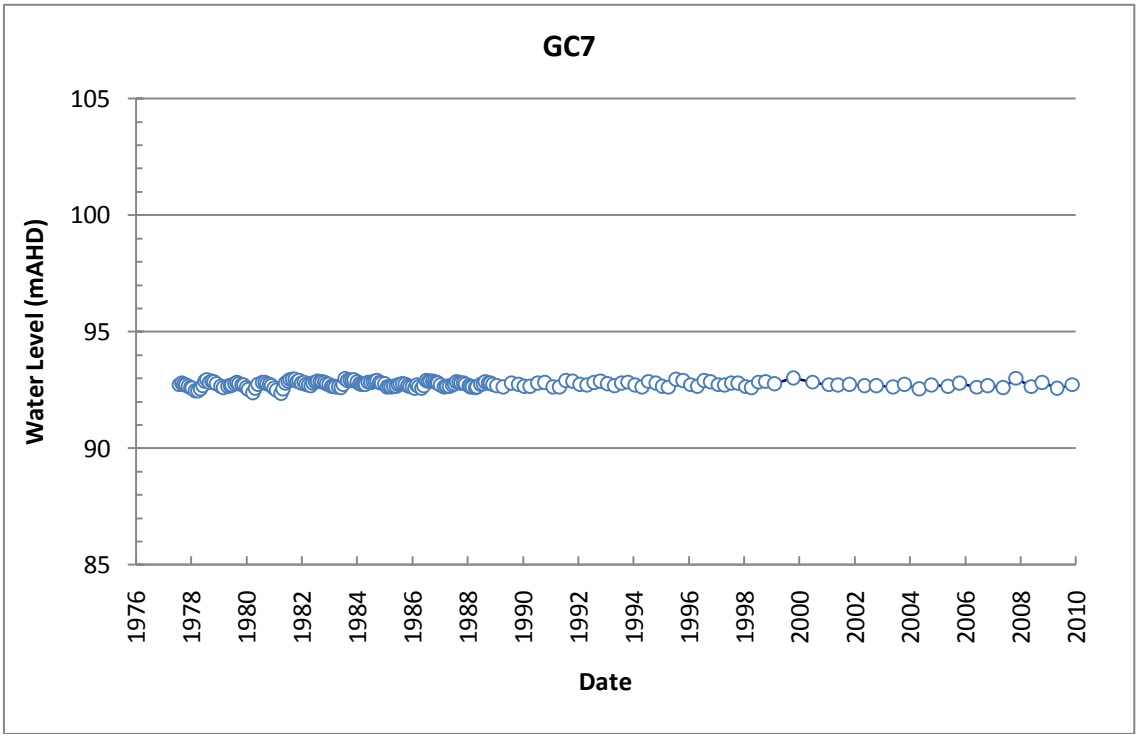

GGB13B
Water Level (mAHD)
125
120
115
110
105
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

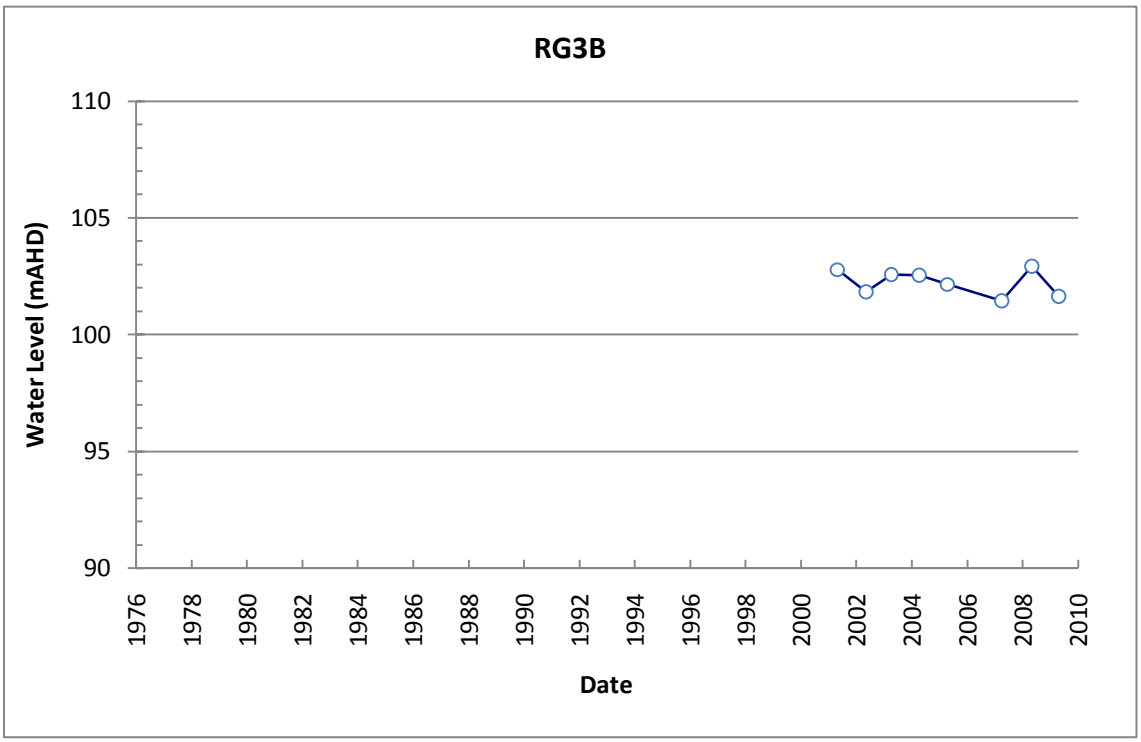

GGB12B
Water Level (mAHD)
105
100
95
90
85
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB14B
Water Level (mAHD)
110
105
100
95
90
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB16B
Water Level (mAHD)
130
125
120
115
110
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB16A
Water Level (mAHD)
135
130
125
120
115
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GC7
Water Level (mAHD)
105
100
95
90
85
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


RG3B
Water Level (mAHD)
110
105
100
95
90
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

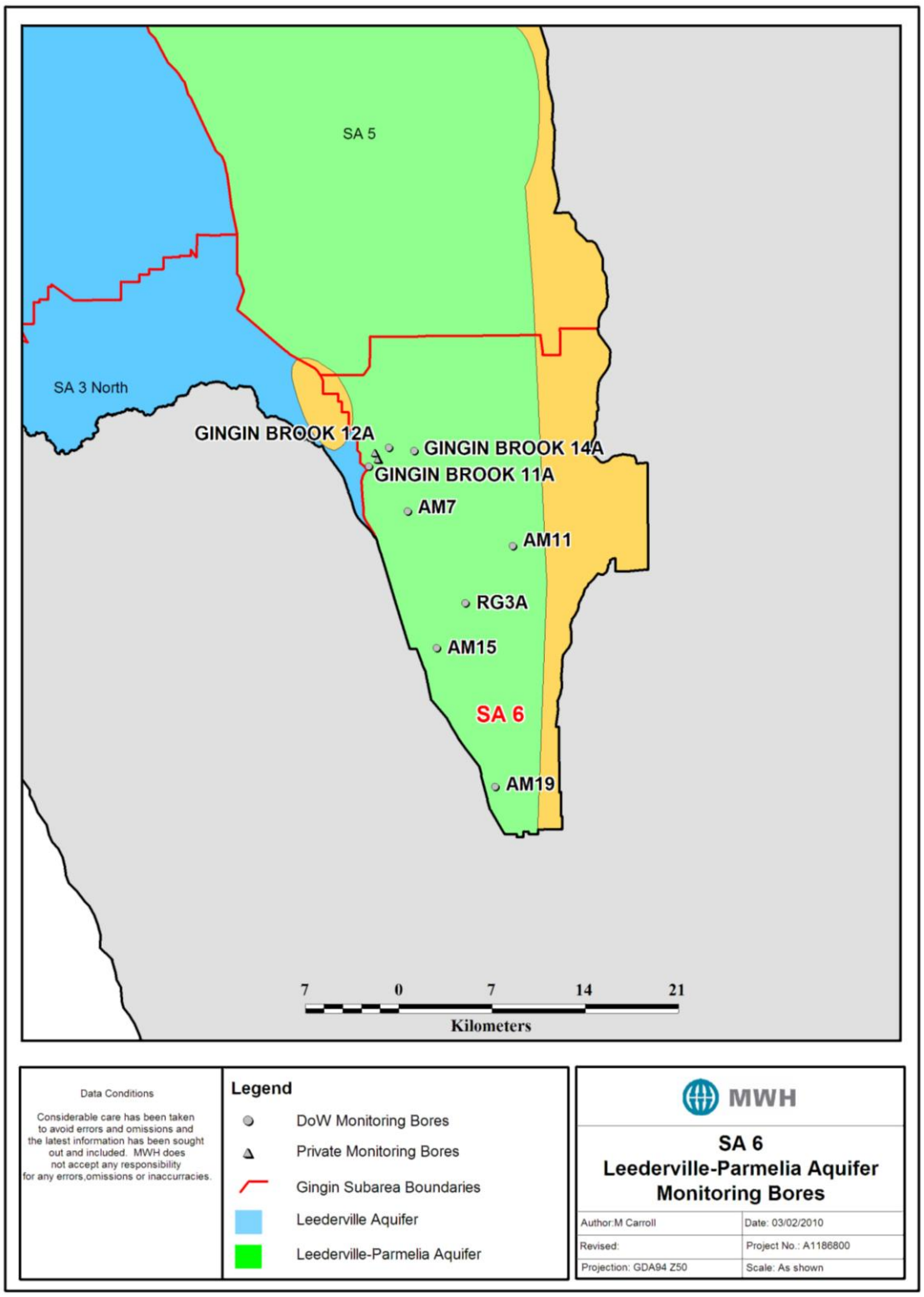
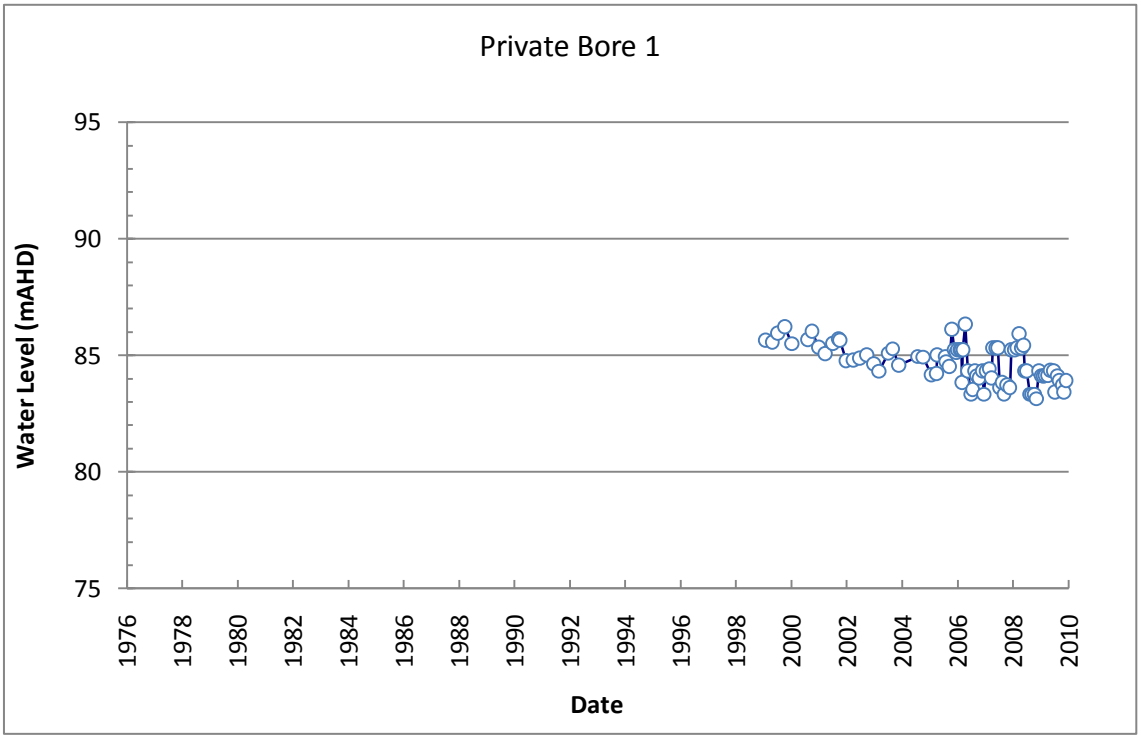
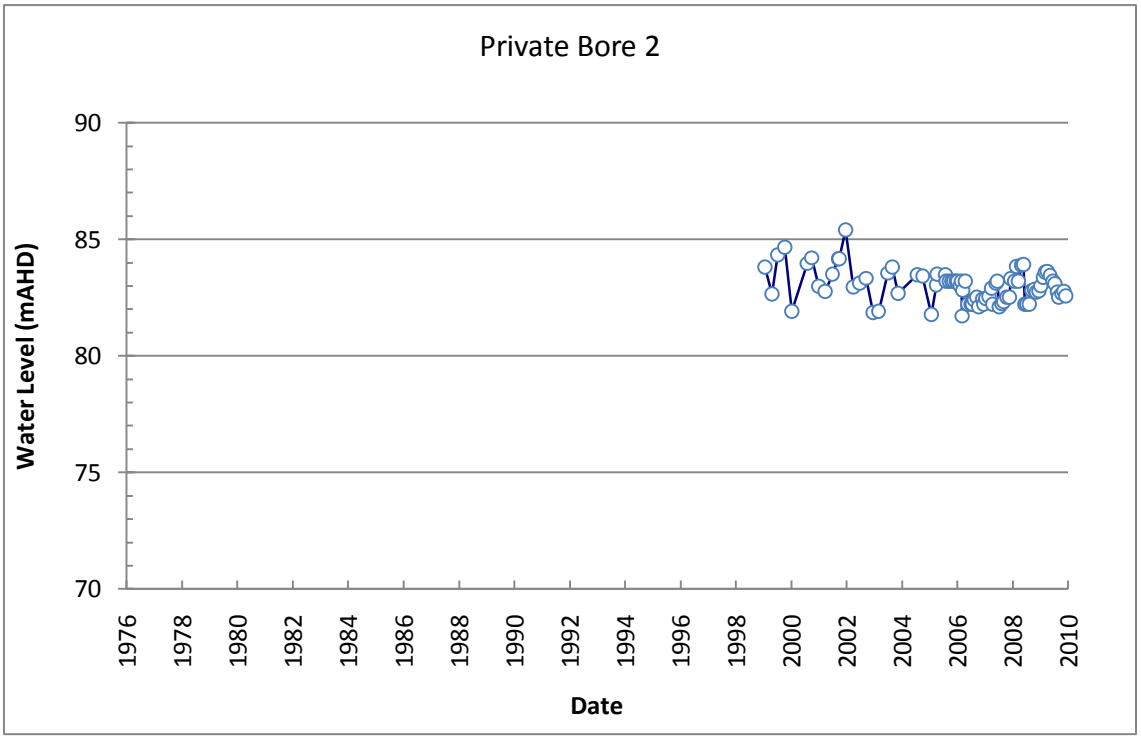
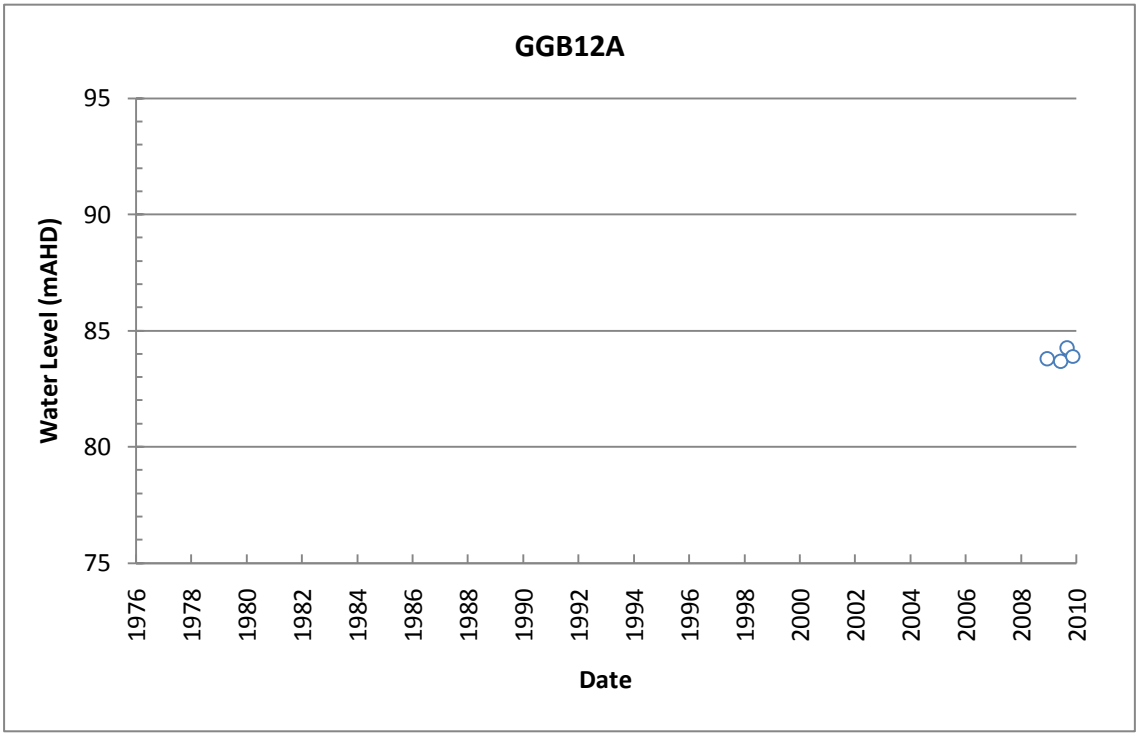
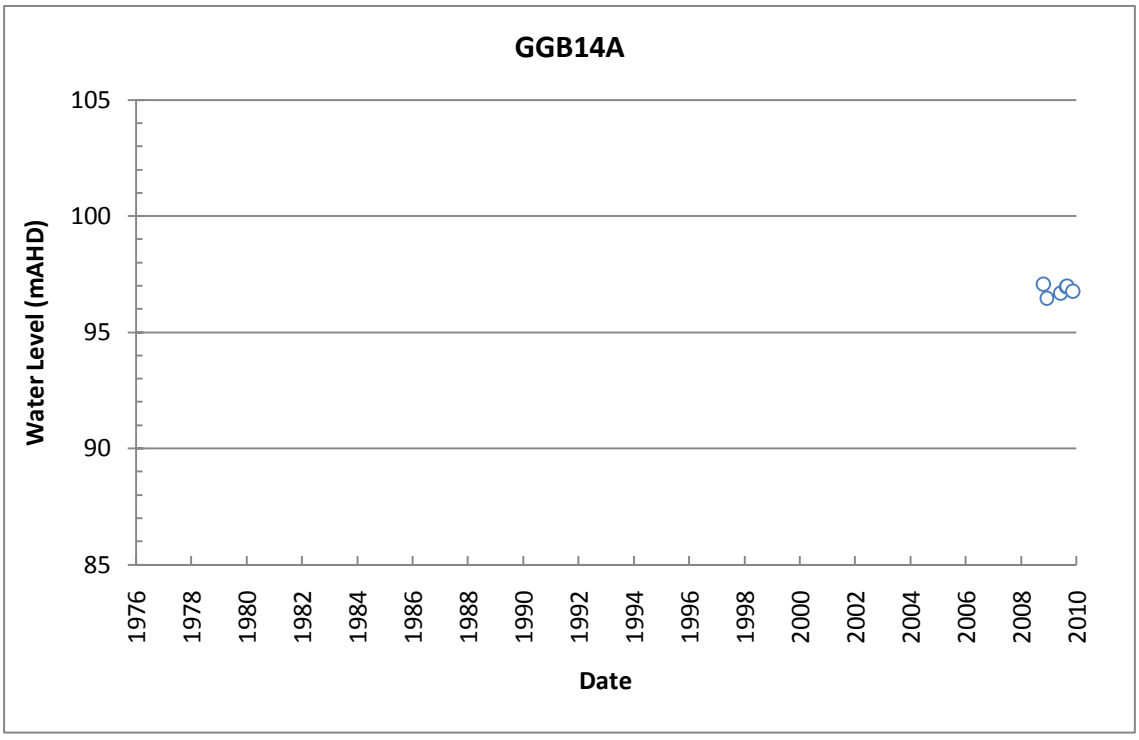


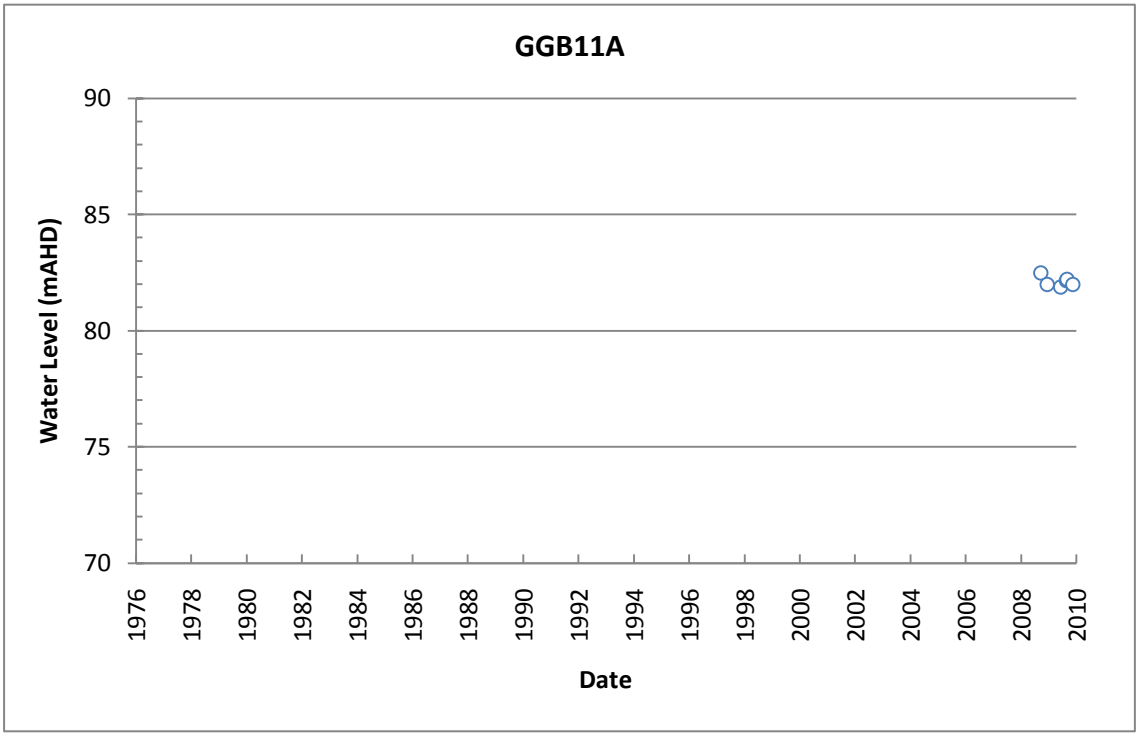
Figure 3-24: Sub-area 6 monitoring bores located within the Leederville-Parmelia aquifer

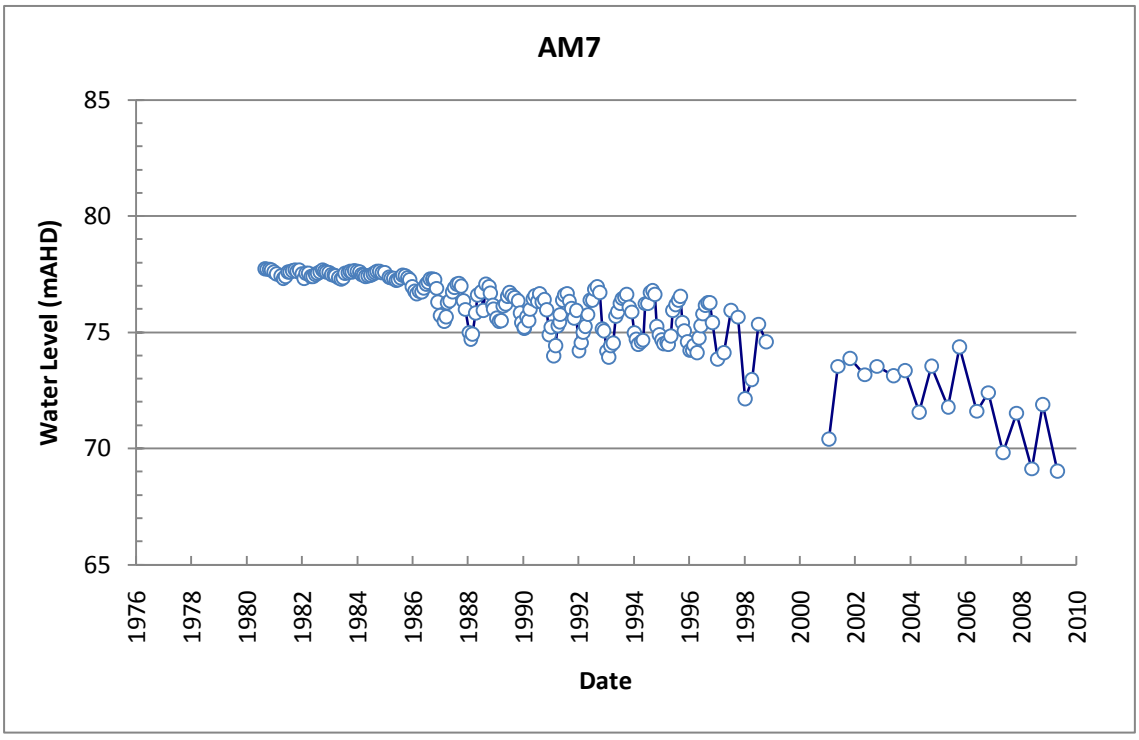

Private Bore 1
Water Level (mAHD)
95
90
85
80
75
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

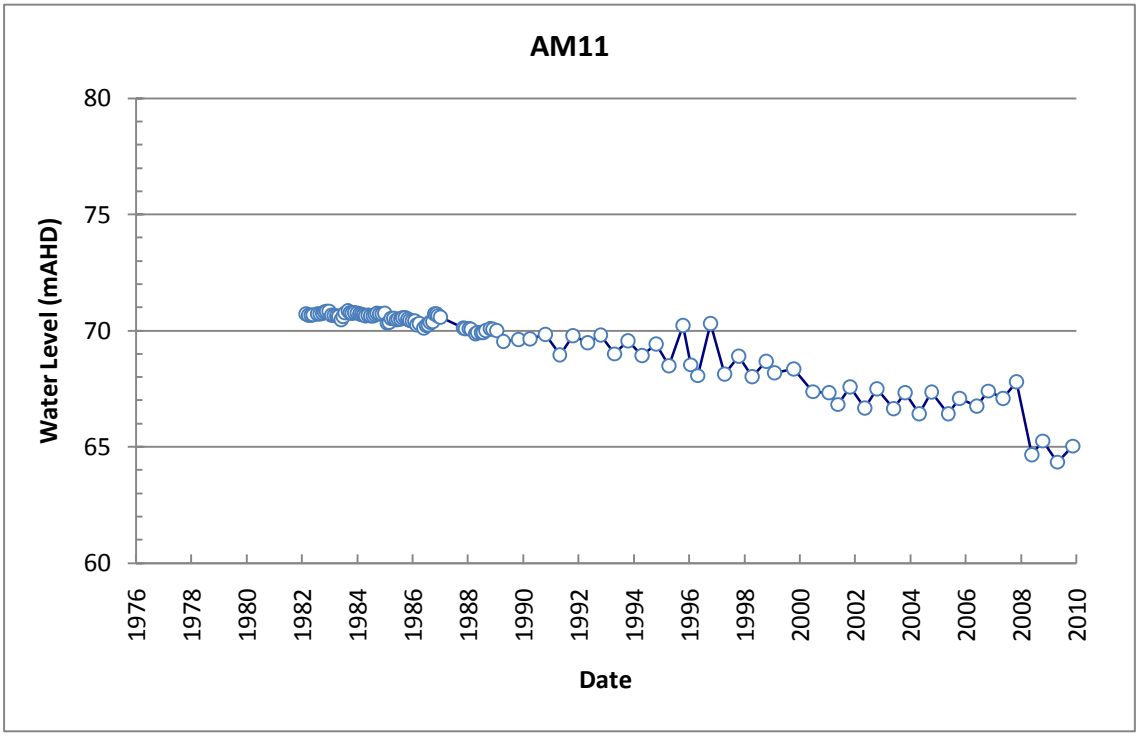

Private Bore 2
Water Level (mAHD)
90
85
80
75
70
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

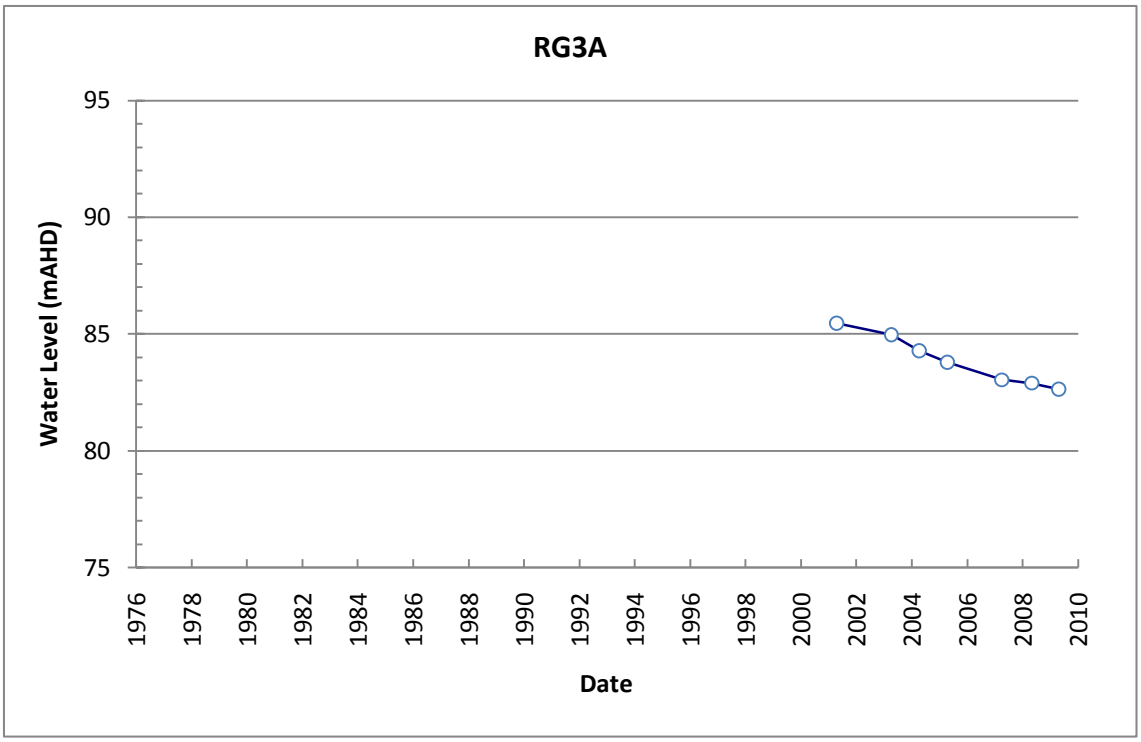

GGB12A
Water Level (mAHD)
95
90
85
80
75
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

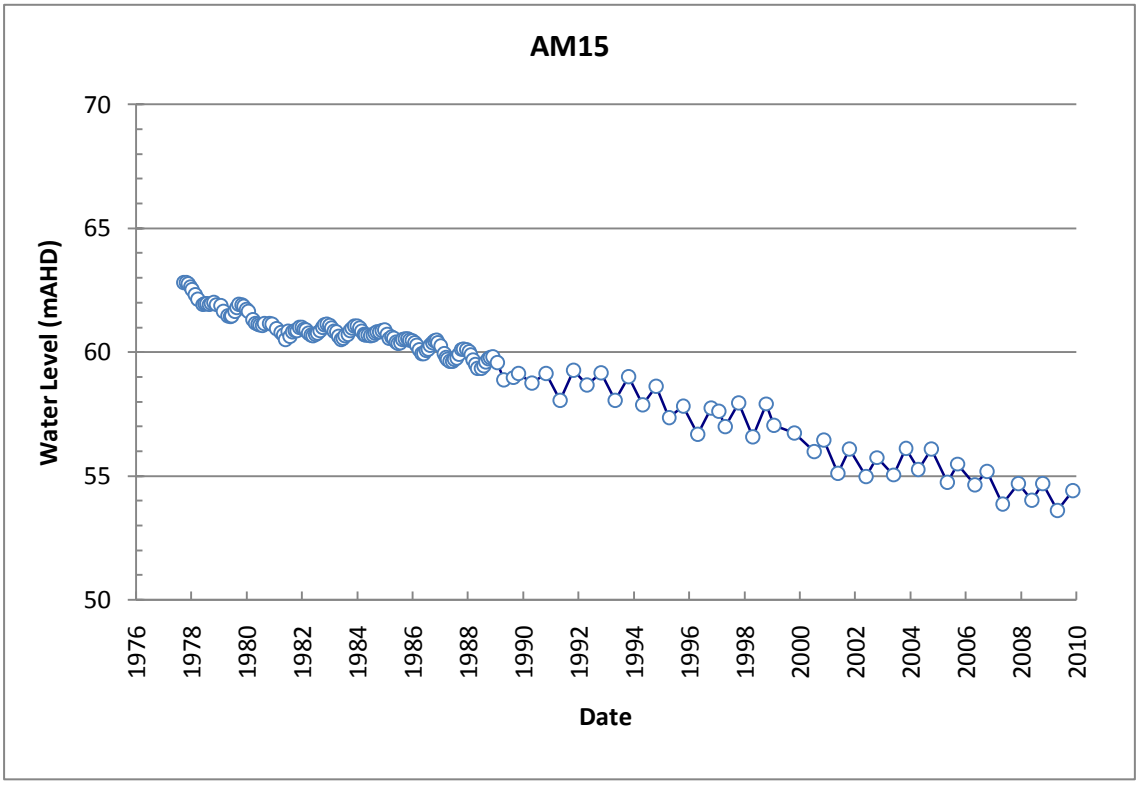

GGB14A
Water Level (mAHD)
105
100
95
90
85
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


GGB11A
Water Level (mAHD)
90
85
80
75
70
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


AM7
Water Level (mAHD)
85
80
75
70
65
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


AM11
Water Level (mAHD)
80
75
70
65
60
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


RG3A
Water Level (mAHD)
95
90
85
80
75
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


AM15
Water Level (mAHD)
70
65
60
55
50
1976
1978
1980
1982
1984
1986
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1990
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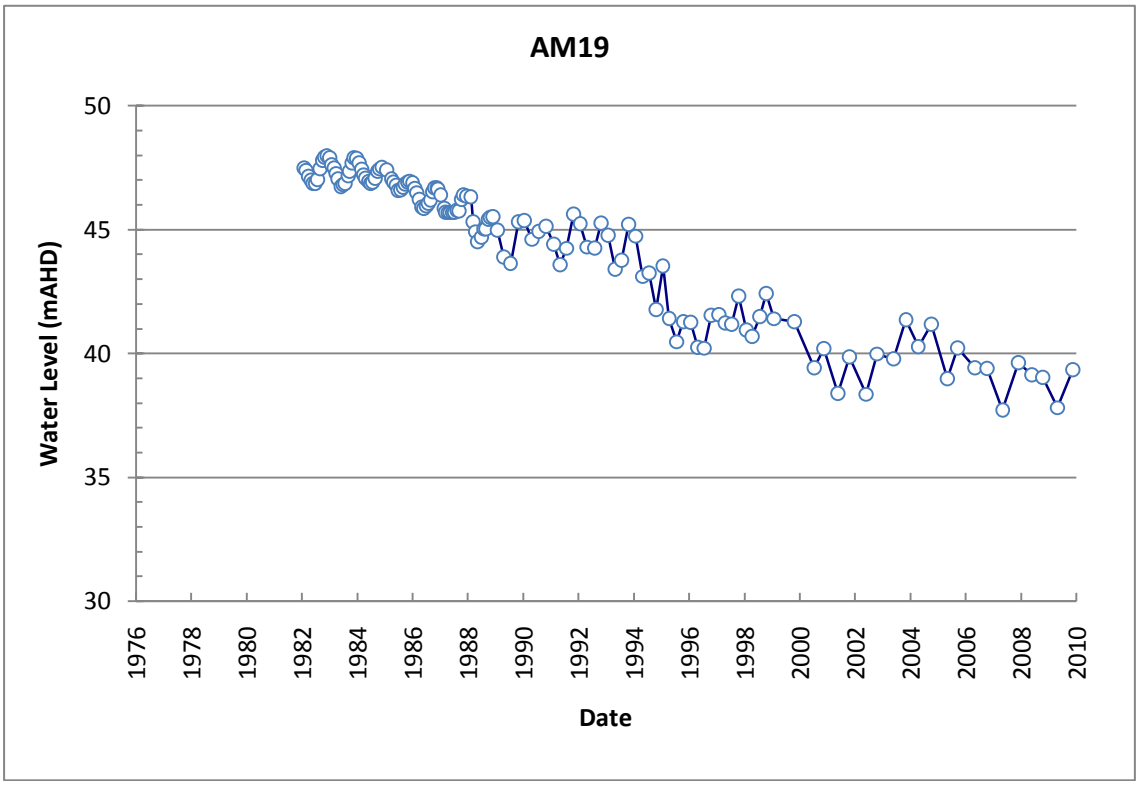
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date


AM19
Water Level (mAHD)
50
45
40
35
30
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Date

Appendix A: Borehole Screen Details

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
61715023	ARTESIAN MONITORING	AM1	Perth - Leederville	794	465 to 475
61615106	ARTESIAN MONITORING	AM11	Perth - Leederville	810	603 to 609
61615092	ARTESIAN MONITORING	AM15	Perth - Leederville	784	334.5 to 339.5
61615103	ARTESIAN MONITORING	AM19	Perth - Leederville	802	316 to 330
61715018	ARTESIAN MONITORING	AM7	Perth - Leederville	721	177 to 183
61730515	CATABY SHALLOW	CS10D	Perth - Superficial Swan	45	31.5 to 35.5
61730514	CATABY SHALLOW	CS10S	Perth - Superficial Swan	20	13 to 19
61730517	CATABY SHALLOW	CS11D	Perth - Yarragadee North	107.3	86 to 102
61730516	CATABY SHALLOW	CS11S	Perth - Superficial Swan	45.2	33 to 45
61730518	CATABY SHALLOW	CS12D	Perth - Superficial Swan	66.1	30 to 42
61730522	CATABY SHALLOW	CS14D	Perth - Leederville	63	51 to 57
61730520	CATABY SHALLOW	CS14M1	Perth - Superficial Swan	28	21 to 27
61730521	CATABY SHALLOW	CS14M2	Perth - Superficial Swan	43	36 to 42
61730519	CATABY SHALLOW	CS14S	Perth - Superficial Swan	9	2 to 8
61730525	CATABY SHALLOW	CS15D2	Perth - Superficial Swan	61	51 to 57
61730524	CATABY SHALLOW	CS15M	Perth - Superficial Swan	37	30 to 36
61730523	CATABY SHALLOW	CS15S	Perth - Superficial Swan	16	9 to 15
61730526	CATABY SHALLOW	CS16D	Perth - Superficial Swan	39	28 to 36
61730527	CATABY SHALLOW	CS16DA	Perth - Superficial Swan	50.7	34 to 40
61730528	CATABY SHALLOW	CS17D	Perth - Lesueur	54.2	36.2 to 54.2
61730529	CATABY SHALLOW	CS18D	Perth - Superficial Swan	59.9	28 to 36
61730530	CATABY SHALLOW	CS19S	Perth - Superficial Swan	26	16 to 25
61730533	CATABY SHALLOW	CS20D	Perth - Superficial Swan	80.8	37 to 46
61730532	CATABY SHALLOW	CS20S	Perth - Superficial Swan	19	9 to 18
61730534	CATABY SHALLOW	CS21D	Perth - Superficial Swan	31	25.5 to 30
61730535	CATABY SHALLOW	CS22DA	Perth - Yarragadee North	53.8	29 to 35
61730537	CATABY SHALLOW	CS24D	Perth - Superficial Swan	30.8	8 to 16
61730539	CATABY SHALLOW	CS25D	Perth - Yarragadee North	80.5	68 to 74.5
61730538	CATABY SHALLOW	CS25S	Perth - Superficial Swan	80.5	17 to 23
61730541	CATABY SHALLOW	CS26D	Perth - Superficial Swan	56.6	47 to 53
61730540	CATABY SHALLOW	CS26S	Perth - Superficial Swan	14	6 to 12
61730542	CATABY SHALLOW	CS27D	Perth - Superficial Swan	30.6	19 to

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
					24
61730543	CATABY SHALLOW	CS28D	Perth - Superficial Swan	14.4	4.5 to 8
61730545	CATABY SHALLOW	CS29D	Perth - Lesueur	50.5	41 to 47
61730544	CATABY SHALLOW	CS29S	Perth - Superficial Swan	12	5 to 11
61730501	CATABY SHALLOW	CS2D	Perth - Superficial Swan	111	71 to 77
61730547	CATABY SHALLOW	CS30D	Perth - Yarragadee North	50.5	42.5 to 48.5
61730546	CATABY SHALLOW	CS30S	Perth - Superficial Swan	10	4 to 9
61730549	CATABY SHALLOW	CS31D	Perth - Superficial Swan	38.6	28 to 34
61730548	CATABY SHALLOW	CS31S	Perth - Superficial Swan	15	8 to 14
61730550	CATABY SHALLOW	CS32D	Perth - Yarragadee North	27	7.5 to 12.5
61730551	CATABY SHALLOW	CS33D	Perth - Superficial Swan	17.6	4 to 11
61730553	CATABY SHALLOW	CS34D	Perth - Lesueur	50.5	43 to 48
61730552	CATABY SHALLOW	CS34S	Perth - Lesueur	24	17 to 23
61730555	CATABY SHALLOW	CS35D	Perth - Yarragadee North	47.5	36.8 to 42.8
61730554	CATABY SHALLOW	CS35S	Perth - Yarragadee North	15	10 to 14
61730556	CATABY SHALLOW	CS36S	Perth - Superficial Swan	9.5	2 to 8.5
61730558	CATABY SHALLOW	CS37D	Perth - Yarragadee North	50.5	41.6 to 47.6
61730557	CATABY SHALLOW	CS37S	Perth - Yarragadee North	11	4 to 10
61730503	CATABY SHALLOW	CS3D	Perth - Superficial Swan	68.3	48 to 54
61730504	CATABY SHALLOW	CS4D	Perth - Superficial Swan	77.5	33.5 to 39.5
61730505	CATABY SHALLOW	CS4S	Perth - Superficial Swan	19	11 to 17
61730506	CATABY SHALLOW	CS5D	Perth - Superficial Swan	60.5	21 to 26
61730507	CATABY SHALLOW	CS7D	Perth - Superficial Swan	87.3	73.5 to 79.5
61730510	CATABY SHALLOW	CS8D	Perth - Superficial Swan	50.8	41.5 to 46.5
61730509	CATABY SHALLOW	CS8I	Perth - Superficial Swan	32.4	26.5 to 32.4
61730508	CATABY SHALLOW	CS8S	Perth - Superficial Swan	12	6 to 12
61730513	CATABY SHALLOW	CS9D	Perth - Superficial Swan	71	56 to 62
61730512	CATABY SHALLOW	CS9I	Perth - Superficial Swan	50	42 to 48
61730511	CATABY SHALLOW	CS9S	Perth - Superficial Swan	15.5	8 to 14
61730531	CATABY SHALLOW	CS19D	Perth - Superficial Swan	48	35 to 45
61730500	CATABY SHALLOW	CS1D	Perth - Superficial Swan	59	44 to 46
61730536	CATABY SHALLOW	CS23D	Perth - Superficial Swan	17.5	3 to 11
61730502	CATABY SHALLOW	CS3S	Perth - Superficial Swan	19	12 to 18
61730034	GILLINGARRA LINE	GL1B	Perth - Leederville	121.0	102 to 108
61730036	GILLINGARRA LINE	GL2A	Perth - Superficial Swan	195.0	125.5 to 140.5

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
61730037	GILLINGARRA LINE	GL2B1	Perth - Leederville	1004.0	273 to 279
61730039	GILLINGARRA LINE	GL2B3	Perth - Yarragadee North	1004.0	939 to 945
61730040	GILLINGARRA LINE	GL3A1	Perth - Leederville	1007.0	477 to 483
61730042	GILLINGARRA LINE	GL3A3	Perth - Yarragadee North	1007.0	980 to 986
61730043	GILLINGARRA LINE	GL3B	Perth - Leederville	306.5	239 to 251
61730044	GILLINGARRA LINE	GL3W	Perth - Superficial Swan	140.0	42.5 to 48.5
61730045	GILLINGARRA LINE	GL4A1	Perth - Yarragadee North	1202.0	759 to 765
61730046	GILLINGARRA LINE	GL4A2	Perth - Yarragadee North	1200.0	1076 to 1082
61730048	GILLINGARRA LINE	GL4C	Perth - Leederville	450.0	408 to 414
61730049	GILLINGARRA LINE	GL4W	Perth - Leederville	95.0	84 to 90
61730050	GILLINGARRA LINE	GL5A1	Perth - Yarragadee North	1202.0	726 to 732
61730051	GILLINGARRA LINE	GL5A2	Perth - Yarragadee North	1200.0	1092 to 1098
61730052	GILLINGARRA LINE	GL5B1	Perth - Leederville	350.0	93 to 99
61730053	GILLINGARRA LINE	GL5B2	Perth - Yarragadee North	350.0	318 to 324
61730054	GILLINGARRA LINE	GL5W	Perth - Leederville	60.0	52 to 58.4
61730055	GILLINGARRA LINE	GL6A1	Perth - Yarragadee North	975.0	574 to 580
61730056	GILLINGARRA LINE	GL6A2	Perth - Yarragadee North	975.0	949 to 959
61730057	GILLINGARRA LINE	GL6W	Perth - Leederville - Par melia	114.0	100 to 106
61730058	GILLINGARRA LINE	GL7A1	Perth - Leederville	1201.0	226 to 232
61730059	GILLINGARRA LINE	GL7A2	Perth - Leederville - Par melia	1201.0	693 to 699
61730061	GILLINGARRA LINE	GL7W	Perth - Mirrabooka	61.0	54 to 60
61730062	GILLINGARRA LINE	GL8A1	Perth - Leederville	1172.5	224 to 233
61730064	GILLINGARRA LINE	GL8A3	Perth - Yarragadee North	1169.0	757 to 763
61730065	GILLINGARRA LINE	GL8W	Perth - Leederville	103.0	97 to 103
61730031	GILLINGARRA LINE	GL1A1	Perth - Leederville	1002	200.5 to 206.5
61730033	GILLINGARRA LINE	GL1A3	Perth - Yarragadee		953 to 959
61730035	GILLINGARRA LINE	GL1W	Perth - Superficial Swan	27	21 to 27
	GINGIN BROOK CATCMENT	GGB1A	Perth - Superficial Swan	27	21.67 to 24.67
	GINGIN BROOK CATCMENT	GGB1B	Perth - Superficial Swan	9	3.73 to 6.73
	GINGIN BROOK CATCMENT	GGB2A	Perth - Superficial Swan	39	32.38 to 32.38
	GINGIN BROOK CATCMENT	GGB2B	Perth - Superficial Swan	21	15.94 to 18.94

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
	GINGIN BROOK CATCMENT	GGB3A	Perth - Superficial Swan	30	22.93 to 25.93
	GINGIN BROOK CATCMENT	GGB3B	Perth - Superficial Swan	9	3.93 to 6.93
	GINGIN BROOK CATCMENT	GGB4A	Perth - Superficial Swan	30	18.48 to 21.48
	GINGIN BROOK CATCMENT	GGB4B	Perth - Superficial Swan	15	7.71 to 10.71
	GINGIN BROOK CATCMENT	GGB5A	Perth - Superficial Swan	42	30 to 33
	GINGIN BROOK CATCMENT	GGB5B	Perth - Superficial Swan	9	4 to 7
	GINGIN BROOK CATCMENT	GGB6A	Perth - Superficial Swan	33	26.51 to 29.51
	GINGIN BROOK CATCMENT	GGB6B	Perth - Superficial Swan	12	6.7 to 9.7
	GINGIN BROOK CATCMENT	GGB7A	Perth - Superficial Swan	42	28.95 to 31.95
	GINGIN BROOK CATCMENT	GGB7B	Perth - Superficial Swan	9	3.95 to 6.95
	GINGIN BROOK CATCMENT	GGB8A	Perth - Superficial Swan	45	33.29 to 36.29
	GINGIN BROOK CATCMENT	GGB8B	Perth - Superficial Swan	9	3.94 to 6.94
	GINGIN BROOK CATCMENT	GGB9A	Perth - Superficial Swan	45	38.61 to 41.61
	GINGIN BROOK CATCMENT	GGB9B	Perth - Superficial Swan	15	9.67 to 12.67
	GINGIN BROOK CATCMENT	GGB10A	Perth - Superficial Swan	40	21.66 to 24.66
	GINGIN BROOK CATCMENT	GGB10B	Perth - Superficial Swan	9	4 to 7
	GINGIN BROOK CATCMENT	GGB11A	Perth - Leederville	24	19.8 to 22.8
	GINGIN BROOK CATCMENT	GGB11B	Perth - Superficial Swan	50	43.87 to 46.87
	GINGIN BROOK CATCMENT	GGB12A	Perth - Leederville	57	48 to 51
	GINGIN BROOK CATCMENT	GGB12B	Perth - Mirrabooka	16	10.12 to 13.12
	GINGIN BROOK CATCMENT	GGB13A	Perth - Mirrabooka	48	32.23 to 35.23
	GINGIN BROOK CATCMENT	GGB13B	Perth - Mirrabooka	21	15.42 to 18.42
	GINGIN BROOK CATCMENT	GGB14A	Perth - Leederville	57	51.73 to 54.73
	GINGIN BROOK CATCMENT	GGB14B	Perth - Mirrabooka	18	11.67 to 14.67
	GINGIN BROOK CATCMENT	GGB15A	Perth - Mirrabooka	75	65.42 to 68.42
	GINGIN BROOK CATCMENT	GGB15B	Perth - Mirrabooka	21	14.61 to 17.61
	GINGIN BROOK CATCMENT	GGB16A	Perth - Mirrabooka	45	36.1 to 39.1
	GINGIN BROOK CATCMENT	GGB16B	Perth - Mirrabooka	28	22.19 to 25.19
61610909	GINGIN MONITORING	GG1 (I)	Perth - Superficial Swan	72.0	44.6 to 62.6
61610910	GINGIN MONITORING	GG1 (O)	Perth - Superficial Swan	78.0	12.2 to 73.2
61710090	GINGIN MONITORING	GG11 (I)	Perth - Leederville	78.3	57.3 to 75.3

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
61710091	GINGIN MONITORING	GG11 (O)	Perth - Leederville	73.2	12.2 to 73.2
61610646	GINGIN MONITORING	GG2 (I)	Perth - Superficial Swan	75.0	54.15 to 72.15
61610950	GINGIN MONITORING	GG3 (I)	Perth - Superficial Swan	69.0	39.15 to 57.15
61610951	GINGIN MONITORING	GG3 (O)	Perth - Superficial Swan	69.0	11 to 23
61610712	GINGIN MONITORING	GG4 (I)	Perth - Superficial Swan	66.0	44.4 to 62.4
61610871	GINGIN MONITORING	GG5 (I)	Perth - Superficial Swan	60.4	39 to 57
61710095	GINGIN MONITORING	GG6 (I)	Perth - Superficial Swan	53.0	32 to 50
61710096	GINGIN MONITORING	GG6 (O)	Perth - Leederville	82.3	12.19 to 82.3
61710107	GINGIN MONITORING	GG7 (I)	Perth - Superficial Swan	42.0	26.9 to 39
61710084	GINGIN MONITORING	GG8 (I)	Perth - Superficial Swan	54.9	48.65 to 54.9
61710085	GINGIN MONITORING	GG8 (O)	Perth - Superficial Swan	66.0	10.97 to 66
61710099	GINGIN MONITORING	GG9 (O)	Perth - Leederville	46.0	16 to 46
61710220	GINGIN SUPERFICIAL	GS1	Perth - Superficial Swan	15	4 to 15
61710229	GINGIN SUPERFICIAL	GS10	Perth - Superficial Swan	33	18 to 33
61710221	GINGIN SUPERFICIAL	GS2	Perth - Superficial Swan	11	1 to 11
61710222	GINGIN SUPERFICIAL	GS3	Perth - Superficial Swan	10	2 to 11
61710223	GINGIN SUPERFICIAL	GS4	Perth - Superficial Swan	15	2 to 11
61710224	GINGIN SUPERFICIAL	GS5	Perth - Superficial Swan	16	2 to 16
61710225	GINGIN SUPERFICIAL	GS6	Perth - Superficial Swan	11	2 to 11
61710226	GINGIN SUPERFICIAL	GS7	Perth - Superficial Swan	19	12 to 19
61710227	GINGIN SUPERFICIAL	GS8	Perth - Superficial Swan	23	2 to 22
61710228	GINGIN SUPERFICIAL	GS9	Perth - Superficial Swan	18	2 to 18
61710024	GNANGARA MOUND MONITOR	GB1	Perth - Superficial Swan	26	13 to 26
61710064	GNANGARA MOUND MONITOR	GB3	Perth - Superficial Swan	34.9	19 to 34
61611090	GNANGARA MOUND MONITOR	GC15	Perth - Superficial Swan	14	2 to 14
61610985	GNANGARA MOUND MONITOR	GC18	Perth - Superficial Swan	3	0 - 3
61710111	GNANGARA MOUND MONITOR	GC3	Perth - Superficial Swan	17.2	2 to 17
61611091	GNANGARA MOUND MONITOR	GC7	Perth - Superficial Swan	14.2	2 to 14
61611073	GNANGARA MOUND MONITOR	GD20	Perth - Superficial Swan	18.9	5.7 to 18.9
61718061	MOORA LINE	ML 2A	Perth - Leederville	463.9	273 to 281
61718062	MOORA LINE	ML 2B	Perth - Parmelia	762	713 to 721
61718063	MOORA LINE	ML 2C	Perth - Leederville	99.6	66 to 72
61718064	MOORA LINE	ML 3A	Perth - Parmelia	762	730 to 740
61718065	MOORA LINE	ML 3B	Perth - Leederville	280	228 to 235
61718066	MOORA LINE	ML 3C	Perth - Leederville	116.6	88 to 95

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
61718067	MOORA LINE	ML 4A	Perth - Yarragadee North	732	644 to 652
61718071	MOORA LINE	ML 6A(ANNULUS)	Perth - Yarragadee North	761	493 to 503
61718072	MOORA LINE	ML 6B	Perth - Yarragadee North	170	147 to 157
61718073	MOORA LINE	ML 7A	Perth - Yarragadee North	801	318.5 to 703
61718075	MOORA LINE	ML 7B	Perth - Yarragadee North	86	75 to 81
61718076	MOORA LINE	ML 8A	Perth - Lesueur	770	446 to 651
61718078	MOORA LINE	ML 8B	Perth - Yarragadee North	103	91 to 103
61718051	MOORA LINE	ML1A	Perth - Leederville	755.7	622.5 to 629.5
61718052	MOORA LINE	ML1D	Perth - Leederville	325.7	316.4 to 322.4
61718053	MOORA LINE	ML1E	Perth - Leederville	205	189.2 to 195.2
61718080	MOORA LINE	ML5A (ANNULUS)	Perth - Yarragadee North	588.4	458 to 466
61715026	RED GULLY	RG1A	Perth - Leederville	426.0	414 to 420
61715027	RED GULLY	RG1B	Perth - Leederville	95.7	83.7 to 89.7
61715028	RED GULLY	RG2A	Perth - Leederville	301.0	289 to 295
61715029	RED GULLY	RG3A	Perth - Leederville	188.0	176 to 182
61715030	RED GULLY	RG3B	Perth - Mirrabooka	52.0	40 to 46
61730014	SALVADO LINE	10A	Perth - Superficial Swan	72.0	18 to 24
61730015	SALVADO LINE	10B	Perth - Superficial Swan	25.0	17.78 to 24.06
61730028	SALVADO LINE	11A (1-76)	Perth - Superficial Swan	37.0	26.4 to 29.78
61730016	SALVADO LINE	12A	Perth - Superficial Swan	59.5	40.1 to 46.1
61730017	SALVADO LINE	13A	Perth - Superficial Swan	90.0	57.4 to 75.4
61730018	SALVADO LINE	13B	Perth - Superficial Swan	79.0	56.92 to 75.68
61730019	SALVADO LINE	14A	Perth - Superficial Swan	73.0	39 to 51
61730020	SALVADO LINE	15A	Perth - Superficial Swan	60.0	6 to 36
61730030	SALVADO LINE	16A (3-76)	Perth - Superficial Swan	47.5	38.9 to 44.27
61730021	SALVADO LINE	17A	Perth - Superficial Swan	86.6	49.5 to 67.5
61730022	SALVADO LINE	18A	Perth - Superficial Swan	60.0	35 to 47
61730023	SALVADO LINE	19B	Perth - Superficial Swan	60.0	36 to 54
61730024	SALVADO LINE	19D	Perth - Superficial Swan	56.0	35.82 to 54.29
61730001	SALVADO LINE	1A	Perth - Superficial Swan	37.5	18.12 to 24.08
61730002	SALVADO LINE	1B	Perth - Superficial Swan	28.2	18.02 to 24.13

AWRC Ref Number	AWRC_CTXT	AWRC Name	Aquifers	Drilled Depth (m)	Bore Inlet (m)
61730025	SALVADO LINE	20A	Perth - Superficial Swan	54.0	27 to 39
61730026	SALVADO LINE	20B	Perth - Superficial Swan	41.0	26.75 to 39.12
61730027	SALVADO LINE	21A	Perth - Superficial Swan	81.0	51 to 63
61730029	SALVADO LINE	22A (2-76)	Perth - Superficial Swan	57.3	45.87 to 50.31
61730003	SALVADO LINE	2D	Perth - Superficial Swan	127.0	94.04 to 100
61730004	SALVADO LINE	3A	Perth - Superficial Swan	75.0	38 to 50
61730005	SALVADO LINE	4A	Perth - Superficial Swan	75.5	37 to 55
61730077	SALVADO LINE	4B	Perth - Superficial Swan	59.0	38.51 to 57.02
61730006	SALVADO LINE	5A	Perth - Superficial Swan	69.0	32.15 to 44.15
61730007	SALVADO LINE	5C	Perth - Superficial Swan	45.0	31.77 to 44.02
61730008	SALVADO LINE	6D	Perth - Superficial Swan	57.0	12.04 to 18
61730009	SALVADO LINE	6E	Perth - Superficial Swan	19.2	11.19 to 17.4
61730010	SALVADO LINE	7A	Perth - Superficial Swan	114.0	64.68 to 76.08
61730011	SALVADO LINE	8A	Perth - Superficial Swan	66.6	34 to 52
61730012	SALVADO LINE	9C	Perth - Superficial Swan	57.0	30 to 42
61730013	SALVADO LINE	9D	Perth - Superficial Swan	43.0	29.89 to 42.19