An aerial photograph of a vast, arid, red landscape. In the distance, a large industrial facility with several buildings and a large water reservoir are visible. The terrain is characterized by deep red soil and sparse vegetation.

# **OLYMPIC DAM**

## **Great Artesian Basin**

### **Wellfields Report**

**1 July 2017 – 30 June 2018**

**Report No. ODENV058**



**OLYMPIC DAM**  
**GREAT ARTESIAN BASIN WELLFIELDS REPORT**  
**1 JULY 2017- 30 JUNE 2018**  
**The Hon. Dan Van Holst Pellekaan, MP**  
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# 1 EXECUTIVE SUMMARY

The Wellfields Report is prepared annually in accordance with the conditions of the Roxby Downs (Indenture Ratification) Act 1982, and the Olympic Dam and Stuart Shelf Indenture (the Indenture) ratified by that Act. This report presents data that relates to the operation of the BHP Olympic Dam Great Artesian Basin water supply Wellfields A and B for the FY18 period 1 July 2017 to 30 June 2018.

## 1.1 Abstraction

The average abstraction during FY18 was 27.7 ML/d comprising 4.0 ML/d from Wellfield A and 23.7 ML/d from Wellfield B, representing no change for Wellfield A and a decrease of 6% for Wellfield B compared with FY17. Monthly total abstraction rates were variable, ranging from 12.8 to 38.0 ML/d, with highest total abstraction in November 2017 and the lowest in May 2018.

Total abstraction from the wellfields area, including Olympic Dam sources and pastoral wells in FY18 is estimated at 42.7 ML/d.

## 1.2 Wellfield A

Overall drawdown decreased in the vicinity of Wellfield A and the North East Hydrogeological Zones. Drawdown remained stable in the South West Hydrogeological Zone.

In FY18, average drawdown between sites GAB8 and HH2 was 1.3 m, which is less than the 4 m compliance criterion. The hydraulic gradient between North East Sub Basin bores and HH2 remained at 0.0009 m/m which is equal to the leading indicator and continues the stable trend seen since 2000.

## 1.3 Wellfield B

For Wellfield B, the drawdown pattern in FY18 is similar to that of earlier reports, consistent with a confined aquifer response to a wellfield that has operated for some 20 years.

The area contained within the 10 m drawdown footprint for Wellfield B is 2,382 km<sup>2</sup>, well within the 4,450 km<sup>2</sup> compliance criterion. The average drawdown at monitoring bores S1 and S2 (dedicated monitoring wells closest to key GAB springs) is 0.2 m, which is less than the 4 m drawdown compliance criterion. In general, drawdown and percentage wellhead pressure loss at pastoral bores remained less than the predicted long-term impact (as presented in the Environmental Impact Statement; Kinhill Engineers, 1997 – updated Golder Associates 2016).

## 1.4 Spring Flow

Spring flows remained stable in FY18 in the Wellfield A and South West Hydrogeological zones, continued a gentle increase in the South East and showed a minor decrease in the Western Lake Eyre South and North East Hydrogeological Zones. Reductions in GAB spring discharges remained less than the predicted long-term impact (as presented in the Environmental Impact Statement; Kinhill Engineers, 1997 – updated Golder Associates 2016).

Spring and bore electrical conductivity data indicate no significant change from previously identified trends.

## 2 INTRODUCTION

### 2.1 Scope

This report is produced in accordance with the conditions of the Roxby Downs (Indenture Ratification) Act 1982, and the Olympic Dam and Stuart Shelf Indenture (**Indenture**) ratified by that Act.

The Indenture states that an annual hydrogeological report shall be prepared to define the following:

- Aquifer response to wellfields operation.
- Ability of the resource to maintain the supply.
- Strategy for future abstraction and management.
- Requirements for further exploration or development.

Data presented relate to the operation of the BHP Billiton Olympic Dam Corporation Pty Ltd (**ODC**) Great Artesian Basin (**GAB**) water supply wellfields A and B, for FY18. The objectives are to:

- Meet the requirements of Clause 13 of the Indenture;
- Report total abstraction and individual well abstraction on a monthly basis.
- Report water pressure and levels in monitoring and production wells and at the boundary of Designated Areas.
- Report water quality at monitoring and production wells on a quarterly basis.
- Compare actual impacts to predictions in the Environmental Impact Statement (EIS) by Kinhill Engineers, 1997 (updated Golder Associates 2016). Ensure that impacts are within predictions and expectations.
- Evaluate drawdown response of the aquifer to ODC abstraction, particularly within the Designated Areas of both wellfields.
- Delineate the drawdown induced by the wellfields, and particularly the impact on pastoral water supplies and environmental flows.
- Identify possible changes in water chemistry that may occur.
- Assess compliance with legal requirements for the operation of the GAB water supply.

### 2.2 Background

Water used at Olympic Dam and the Roxby Downs Township is pumped from two wellfields located within the GAB. Wellfield A is located 100 km north of the operation at the southwest margin of the GAB. Wellfield B is located an additional 80 km to the northeast of Wellfield A, further into the basin.

The local hydrogeology has been previously described by WMC during investigations for the establishment of Wellfield B (WMC, 1995). Wellfield A is located at the margin of the GAB, where there is a relatively complicated basin architecture and strong influence of aquifer boundary effects. There are separate hydrogeological domains with distinctively different responses to the Wellfield A abstraction. The distribution of the aquifer is strongly influenced by both the depositional setting of the aquifer sediments and post-depositional faulting, which has formed sub-basins that are hydraulically separated. Wellfield B is located further into the basin where the aquifer is much thicker, aquifer zonation is less marked and the effects of faulting greatly reduced. The drawdown around Wellfield B is more radially symmetrical than from Wellfield A.

A detailed description of the physical environment of the wellfields is contained in the Draft EIS (Kinhill-Stearns Roger, 1982) and the Survey and Assessment Report (Kinhill Engineers, 1995). Wellfield construction details are contained in 'Wellfield A Construction' (AGC, 1987) and 'Borefield B Development' (WMC, 1997) and related documents.

### **3 MONITORING PROGRAM**

A full and detailed description of monitoring sites, frequency, priorities and methodologies is maintained in the Monitoring Program – Great Artesian Basin (GAB) 2017 ([BHP, 2017a](#)).

## 4 ABSTRACTION

### 4.1 Development History

Trends in long-term abstraction (Table 4-1, Figure 4-1 and Figure 4-2) can be summarised as follows:

- Abstraction from Wellfield A commenced in July 1983 and remained uniform at 1.3 ML/d until December 1986.
- Through 1987 and 1988 there was a gradual increase to approximately 10 ML/d, associated with construction and increase of mill production to 45,000 t/yr copper.
- Abstraction continued at approximately 10 ML/d from 1989 until 1992.
- From 1992 to 1995 abstraction was approximately 12 ML/d following the first optimisation at Olympic Dam and an increase in production to 66,000 t/yr copper.
- From 1995 to September 1996 Wellfield A abstraction was typically 14–16 ML/d, following a second optimisation which saw production rise to 85,000 t/yr copper.
- Wellfield B came on line in October 1996, and since this time abstraction from Wellfield A has typically been at approximately 5 ML/d.
- Wellfield B abstraction rose continuously from 4 ML/d in October 1996 to 12 ML/d in November 1998, with total abstraction remaining at approximately 16 ML/d.
- From December 1998 to October 1999 total abstraction rose to 30 ML/d as copper production was ramped up to the full capacity of the mine and processing plant.
- During FY00 to FY09 a reasonably stable abstraction pattern developed. Average total abstraction over the 9 year period was 32.3 ML/d, comprising 27.0 ML/d from Wellfield B and 5.3 ML/d from Wellfield A. Rates varied seasonally between 27–37 ML/d, with typical rates of 3–6 ML/d from Wellfield A and 22–32 ML/d from Wellfield B. Higher abstraction rates generally occurred during summer months.
- During FY10 abstraction fell dramatically due to the failure of the main ore haulage shaft (Clark Shaft) in October 2009 and the subsequent reduction in processing in the hydrometallurgical plant. Abstraction for the 12 months averaged 21.9 ML/d comprising 2.3 ML/d from Wellfield A and 19.6 ML/d from Wellfield B.
- From FY11 to FY14 total abstraction increased to pre-October 2009 levels and averaged 33.2 ML/d total (5.8 ML/d from Wellfield A and 27.4 ML/d from Wellfield B).
- In FY15 average abstraction decreased to 28.8 ML/d due to the failure of the Svedala Mill and subsequent reduction in ore processing.
- In FY18 average abstraction decreased to 27.7 ML/d due to the planned SCM17 smelter campaign shutdown.

### 4.2 Olympic Dam Abstraction during the Current Review Period

The average abstraction during FY18 was 27.7 ML/d comprising 4.0 ML/d from Wellfield A and 23.7 ML/d from Wellfield B, representing no change for Wellfield A and a decrease of 6% for Wellfield B compared with FY17 (Table 4-1).

Monthly total abstraction rates were variable, ranging from 12.8 to 38.04 ML/d, with lowest total abstraction in November 2017 and the highest in May 2018 (Table 4-2).

### 4.3 Total Abstraction

Flow rate from 30 important pastoral bores in the wellfields area, where variation in flow rate could produce short-term impacts on regional monitoring, is measured or estimated at the end of the review period. Pastoral abstractions from those 33 bores and those from Wellfields A and B are shown in Figure 4-2.

Total abstraction from the wellfields area, including ODC wellfields and the 33 pastoral bores rose from approximately 40 ML/d in 1995 to 60–70 ML/d in 2000–01 and subsequently declined to 45-50 ML/d since 2010 (Figure 4-2). Total abstraction from the wellfields area in FY18 is estimated at 42.7 ML/d due to reduced ODC abstraction.

Pastoral flows have declined due to the significant bore closure program ODC has implemented since 2000. Water savings of approximately 42 ML/d have been achieved through the sponsored closure of free flowing pastoral wells in the ODC wellfield area.

**Table 4-1 Wellfields average annual daily abstraction rate in ML/d**

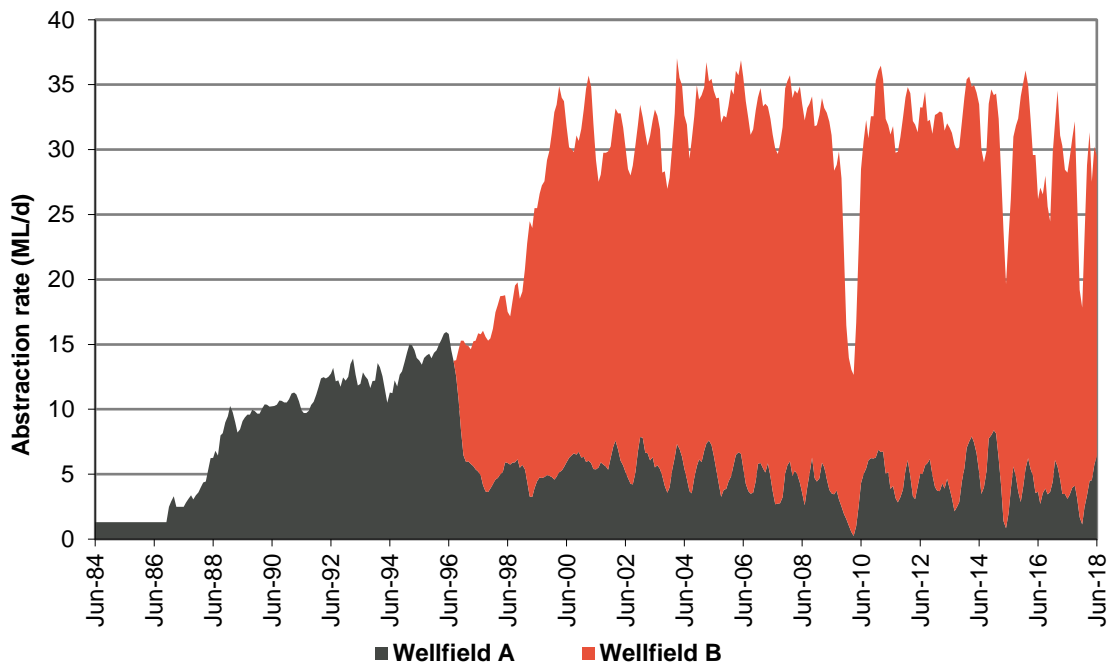
Year Ended	Wellfield A	Wellfield B	Total
30-Jun-1986	1.3	0.0	1.3
30-Jun-1987	2.2	0.0	2.2
30-Jun-1988	4.4	0.0	4.4
30-Jun-1989	8.9	0.0	8.9
30-Jun-1990	10.0	0.0	10.0
30-Jun-1991	10.6	0.0	10.6
30-Jun-1992	11.6	0.0	11.6
30-Jun-1993	12.6	0.0	12.6
30-Jun-1994	12.1	0.0	12.1
30-Jun-1995	13.5	0.0	13.5
30-Jun-1996	15.1	0.0	15.1
30-Jun-1997	8.2	7.4	15.6
30-Jun-1998	5.3	12.3	17.6
30-Jun-1999	4.9	17.3	22.1
30-Jun-2000	5.2	26.2	31.4
30-Jun-2001	6.1	25.5	31.5
30-Jun-2002	6.0	24.7	30.7
30-Jun-2003	6.1	25.3	31.4
30-Jun-2004	5.4	26.0	31.4
30-Jun-2005	5.9	28.1	34.0
30-Jun-2006	4.9	29.4	34.3
30-Jun-2007	4.5	27.9	32.5
30-Jun-2008	4.3	29.1	33.5
30-Jun-2009	4.6	27.8	32.4
30-Jun-2010	2.3	19.6	21.9
30-Jun-2011	5.8	27.4	33.2
30-Jun-2012	4.1	28.2	32.3
30-Jun-2013	4.5	27.9	32.4
30-Jun-2014	5.2	27.8	33.0
30-Jun-2015	4.9	23.9	28.8
30-Jun-2016	4.5	26.9	31.4
30-Jun-2017	4.0	25.2	29.2
30-Jun-2018	4.0	23.7	27.7

**Table 4-2 Monthly average abstraction rate (ML/d), FY18**

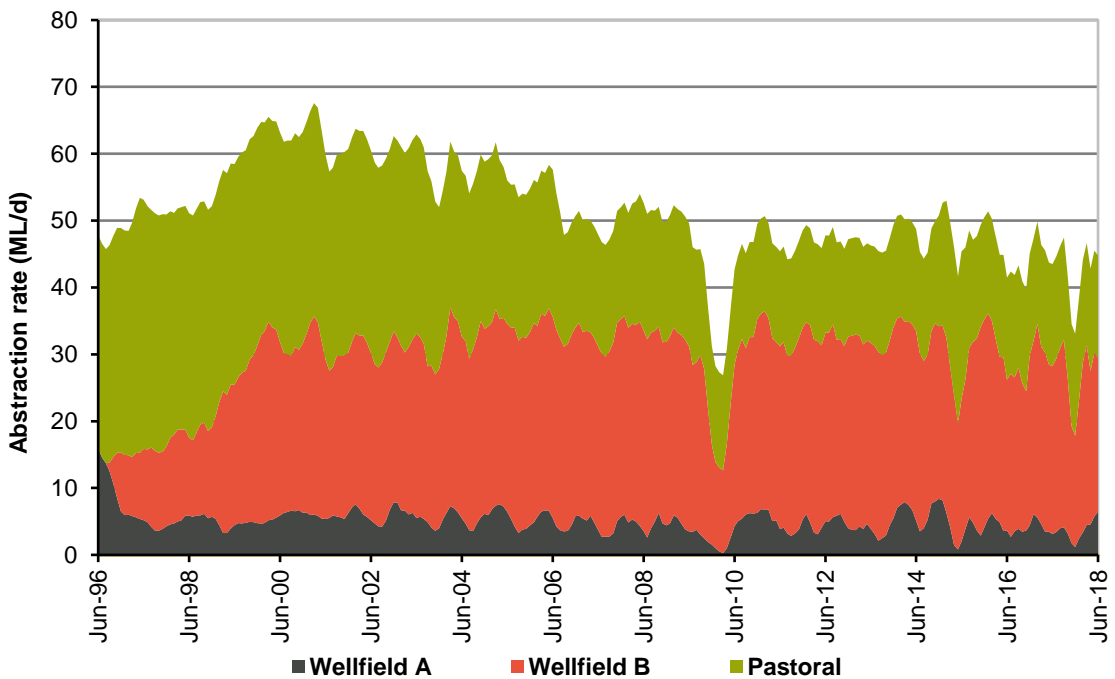
	<i>Wellfield A</i>							<i>Wellfield B</i>				<i>Wellfields</i>
	<i>GAB06</i>	<i>GAB12</i>	<i>GAB14</i>	<i>GAB15</i>	<i>GAB16</i>	<i>GAB18</i>	Total	<i>GAB51</i>	<i>GAB52</i>	<i>GAB53</i>	Total	Total
Jul-17	0.43	0.21	0.74	0.00	1.28	0.66	3.33	11.22	8.77	9.33	29.31	32.64
Aug-17	0.49	0.07	1.45	0.00	2.00	1.28	5.29	9.64	7.94	11.10	28.68	33.97
Sep-17	0.51	0.18	0.86	0.00	1.44	0.75	3.74	10.00	7.62	8.53	26.15	29.89
Oct-17	0.12	0.17	0.02	0.00	0.20	0.01	0.52	5.25	4.52	4.68	14.45	14.97
Nov-17	0.19	0.45	0.01	0.00	0.25	0.00	0.88	4.21	3.70	4.00	11.91	12.80
Dec-17	0.17	0.53	0.24	0.00	0.86	0.22	2.02	8.92	7.09	7.69	23.69	25.71
Jan-18	0.26	0.23	1.13	0.00	1.76	1.03	4.42	9.95	7.93	8.52	26.40	30.81
Feb-18	0.42	0.21	0.83	0.00	1.52	0.74	3.72	9.87	7.89	8.42	26.18	29.90
Mar-18	0.64	0.08	1.36	0.00	2.00	1.24	5.31	10.59	8.39	9.00	27.99	33.30
Apr-18	0.74	0.63	0.86	0.00	1.58	0.77	4.59	5.25	4.61	4.87	14.73	19.32
May-18	0.52	0.29	2.01	0.00	2.67	1.85	7.34	11.66	9.18	9.86	30.69	38.04
Jun-18	0.53	0.30	2.00	0.00	2.63	1.85	7.30	8.90	7.27	7.69	23.87	31.17
Average	0.42	0.28	0.96	0.00	1.52	0.87	4.04	8.80	7.08	7.82	23.70	27.74
Total ML	152.0	102.1	350.4	0.0	553.1	317.0	1474.7	3211.6	2585.0	2854.1	8650.7	10125.3

**Note:**

Sum of individual rows may not exactly match the totals due to rounding



**Figure 4-1 Historical abstraction from Wellfields A and B – 3 month moving average**



**Figure 4-2 Historical abstraction from the Wellfields area – 3 month moving average**

- See Appendix 7 for list of pastoral bores used to estimate pastoral GAB abstraction

## 5 WELLFIELD A AQUIFER PRESSURE RESPONSE

For the purposes of compliance, Wellfield A drawdown is measured in relation to reference heads established in May 1986 and, for monitoring bores MB1, MB5 and MB6, as a difference between contemporary and estimated 1996 Practical Reference Heads (PRHs) (BHP , 2010).

### 5.1 Compliance Criterion

- A 4 m drawdown limit at the point on the designated area for Wellfield A that is mid-way between GAB8 and HH2 based on the 12-month moving average.

### 5.2 Leading Indicators

- A hydraulic gradient between wells in the NESB and HH2 exceeding 0.0009 m/m, calculated as the six-monthly moving mean hydraulic gradient between HH2 and NESB wells GAB7, GAB8, GAB10, GAB11 and GAB19.

### 5.3 Wellfield A Monitoring Program Requirements

#### 5.3.1 Purpose

- Quantify by routine and appropriate methods water pressures and water levels in all monitoring and production wells, and at the boundary of the Designated Areas, as agreed with the State.
- Measure or infer the magnitude of the drawdown according to the relevant compliance criteria for Wellfield A.
- Provide data to support the leading indicator for GAB impacts, and alert management when levels approach the leading indicator value.

#### 5.3.2 Deliverables

- Records of artesian pressure and groundwater level data for assessment of drawdown.

### 5.4 Groundwater responses to Wellfield A

A summary of reference heads in m AHD is shown in Table 5-1. It is noted that some of these reference heads incorporate localised, prior drawdown due to the early operation of production bore GAB6. Average drawdown contours for FY18 are presented in Figure 5-1. The contour map for Wellfield A includes the geological structures that are interpreted to influence the hydrogeology of the Wellfield A region and has been drawn using the kriging process for contouring as outlined for Wellfield B in Monitoring Program – Great Artesian Basin (GAB) 2017 (BHP , 2017a).

#### 5.4.1 Wellfield A Hydrogeological Zone

Average drawdowns within the zone have decreased slightly during FY18 (Table 5-1) and are less than the 5-year average drawdown for the period FY13-17.

Drawdown for wells within the Wellfield A zone range from 15.9m at GAB14A to 4.9 m at Venables Bore.

Drawdown propagation within the sub-basin is controlled by hydraulic barriers (grey shaded areas in Figure 5-1) causing drawdown to spread asymmetrically and preferentially to the northwest and southeast. The drawdown pattern in Figure 5-1 is similar to those presented since FY12.

#### **5.4.2 North East Hydrogeological Zone (NESB)**

Average drawdowns within the zone have decreased slightly during FY18 (Table 5-1) and are less than the 5 year average drawdown.

Drawdowns for wells within the North East zone ranged from 0.8 m at HH2 to 2.3 m at GAB 11.

Groundwater head in the NESB would be expected to respond to changes in abstraction from Wellfield A to a lesser extent than the Wellfield hydrogeological zone due to the increased distance from Wellfield A and the dampening effect of hydraulic barriers associated with structural faults. Drawdown has always appeared to spread from the Wellfield sub-basin first southeast and northwest; and subsequently to the NESB. As a result, heads in the NESB are not expected to change as abruptly as they do near the Wellfield A production bores.

#### **5.4.3 South Western Hydrogeological Zone**

Average drawdowns within the zone have remained stable during FY18 at HH1 and HH3) and have slightly increased at HH4 (Table 5-1).

HH4 has been producing thick, silt laden flows for the past 3 years when opened. The suspended solids in the water column may be contributing to a decreased shut in pressure.

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

**Table 5-1 Wellfield A – summary of drawdown FY18**

<b>Area</b>	<b>Well</b>	<b>Reference Elevation (m AHD)</b>	<b>Mean Drawdown FY18 (m)</b>	<b>Mean Drawdown FY17 (m)</b>	<b>FY13-17 Mean Drawdown (m)</b>
Wellfield Sub-basin	GAB1	22.4	7.2	7.5	7.7
	GAB2	22.8	7.2	7.4	7.6
	GAB5A	27.7	5.9	6.3	6.5
	GAB6A	22.2	8.5	7.5	9.8
	GAB12A	27.2	13.4	12.6	14.2
	GAB13A	30.4	12.9	13.6	14.0
	GAB14A	30.1	15.9	15.2	15.4
	GAB16A	24.5	12.5	10.9	12.3
	GAB17	28.4	13.6	12.5	11.0
	GAB18A	28.8	15.3	14.3	14.4
	GAB21	25.4	11.4	10.6	11.7
	GAB22	24.7	10.7	10.0	11.6
	GAB23	27.7	13.2	12.2	13.5
	MB2	22.2	5.3	5.8	5.7
	New Years Gift	22.6	8.2	7.8	8.2
Venables	20.6	4.9	5.0	5.1	
Northeast Sub-basin	GAB7	16	2.2	2.3	2.9
	GAB8	11.7	1.7	1.7	1.8
	GAB10	19	2.2	2.5	2.6
	GAB11	20.7	2.3	2.4	2.5
	GAB19	15.1	2.0	2.1	2.2
	HH2	8.2	0.8	0.7	0.8
South West Sub-basin	HH1	11.1	-0.1	-0.1	-0.1
	HH3	9.3	-0.1	-0.1	-0.1
	HH4	14	0.6	0.2	0.5
Extension	GAB24	39.2	5.2	5.1	5.3

<b>Area</b>	<b>Well</b>	<b>Practical reference head (m AHD)</b>	<b>Mean Drawdown FY18 (m)</b>	<b>Mean Drawdown FY17 (m)</b>	<b>FY13-17 Mean Drawdown (m)</b>
Open GAB	MB1	55.5	0.1	0.0	0.0
	MB5	75.5	0.6	0.5	0.5
	MB6	75.0	0.6	0.5	0.5

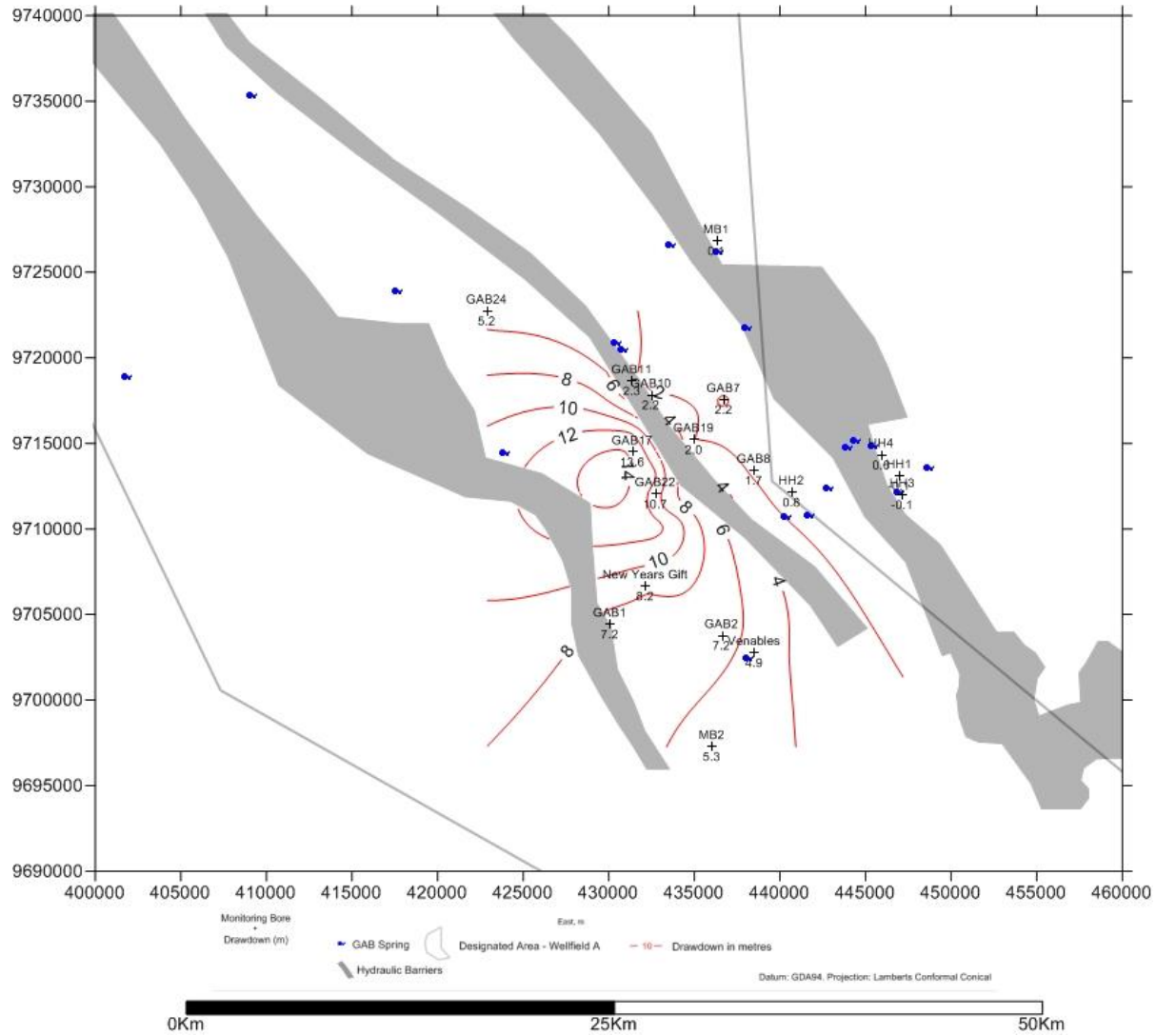


Figure 5-1 Wellfield A total drawdown contours for FY18, contour interval 2 m

## **5.5 Evaluation against Compliance Criteria**

### **5.5.1 Compliance Bores**

The Wellfield A designated area boundary runs between bores GAB8 and HH2. Boundary drawdown is determined as the 12-month moving average drawdown at a point midway between these two sites.

The FY18 average drawdown at GAB8 was 1.7 m and 0.8 m at HH2 (Table 5-1), therefore average boundary drawdown was 1.3 m, similar to that reported since 2010 and within the 4 m compliance criteria (Figure 5-2).

## **5.6 Evaluation against Leading Indicator**

GAB spring flows are primarily driven by groundwater pressure in the GAB aquifer, representing a head that is greater than the elevation of the spring vent. This head, in turn, is maintained by the distribution of potentiometric head across the aquifer in the vicinity of the spring.

The FY18 hydraulic gradient between wells in the NESB (GAB7, GAB8, GAB10, GAB11, and GAB19) and HH2 was 0.0009 m/m, equal to the leading indicator and similar to those reported since 2000 (Figure 5-3).

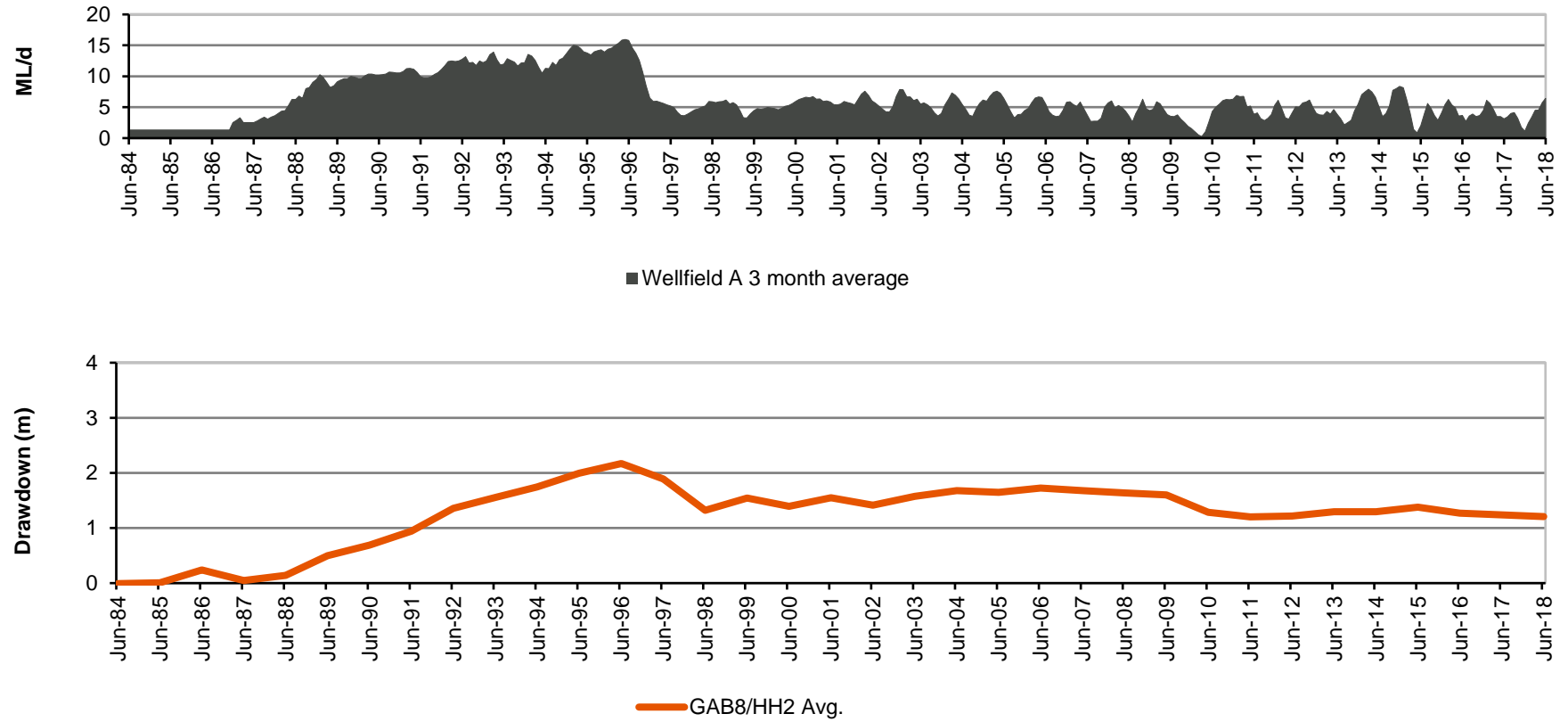


Figure 5-2 Wellfield A Compliance Bores – GAB8/HH2

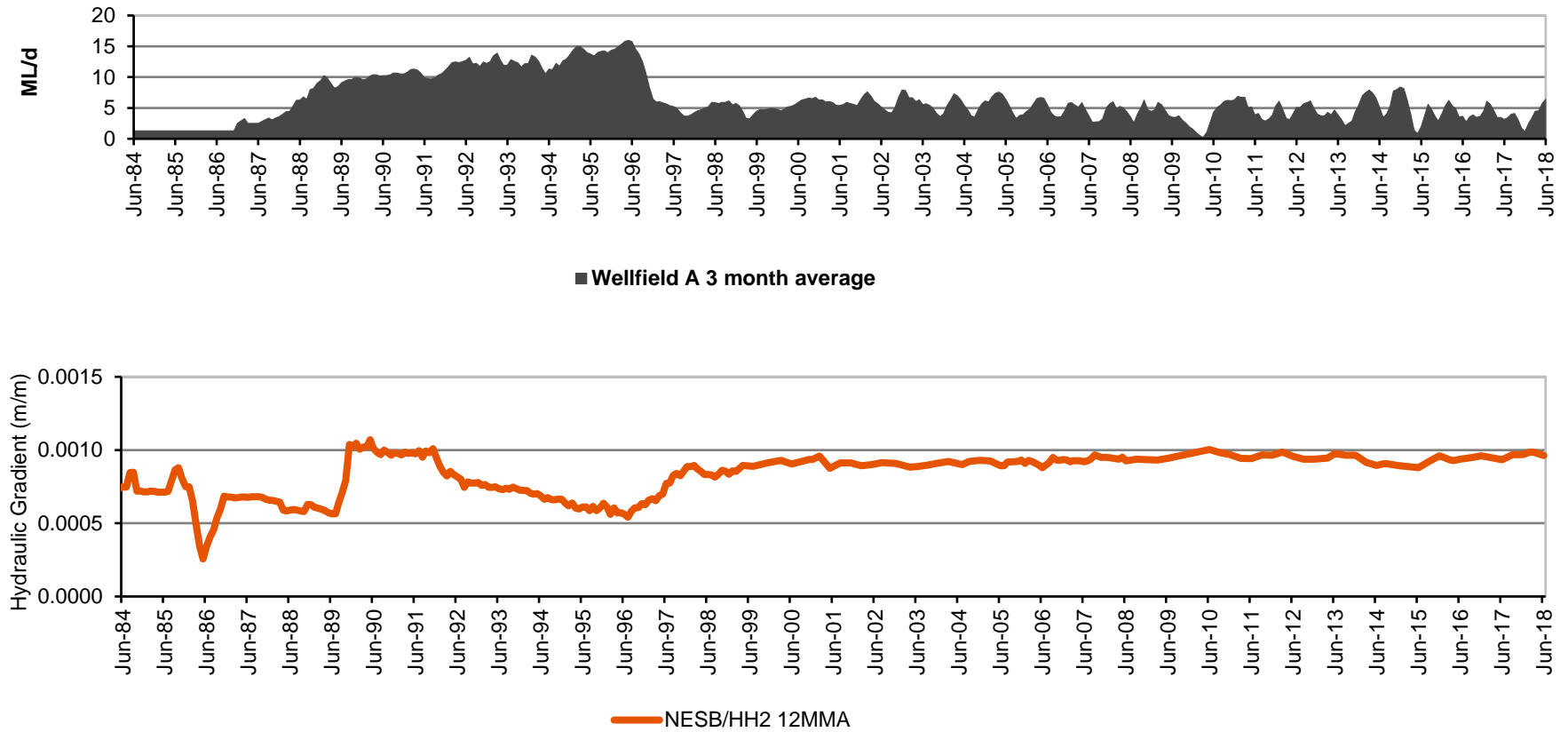


Figure 5-3 Wellfield A Leading Indicator – NESB Hydraulic Gradient

## 6 WELLFIELD B AQUIFER PRESSURE RESPONSE

Drawdown responses due to Wellfield B are measured and agreed by the State in accordance with the Indenture as:

- *Temperature-exclusive drawdown*: wellhead pressure difference from reference pressures (**PRPs**) established for the bores monitored; or
- *Temperature-inclusive drawdown*: as a difference between current measurement and estimated 1996 practical reference heads (**PRHs**).

### 6.1 Compliance Criteria

- A 4 m drawdown limit for Wellfield B at the point between monitoring bores S1 and S2 (measured as the average drawdown of the two bores) and based on the 12-month moving average.
- A drawdown footprint for Wellfield B, measured as the area contained within the 10 m drawdown contour, that is less than or equal to 4,450 km<sup>2</sup>.

### 6.2 Leading Indicators

- A drawdown trend at monitoring bore S1 that may exceed 4.5 m in the next 12 months.
- A drawdown footprint for Wellfield B, measured as the area contained within the 10 m drawdown contour that is greater than 4,000 km<sup>2</sup>.
- A continuing drawdown trend at GAB pastoral bores that may exceed the predictions of the Olympic Dam Environmental Impact Statement of 1997.

### 6.3 Monitoring Program Requirements

#### 6.3.1 Purpose

- Quantify by routine and appropriate methods water pressures and water levels in all monitoring and production wells, and at the boundary of the Designated Areas, as agreed with the State in accordance with the Indenture.
- Measure or infer the magnitude of the drawdown according to the relevant compliance criteria for Wellfield B.
- Provide data to support the leading indicator for GAB impacts, and alert management when levels approach the leading indicator value.

#### 6.3.2 Deliverables

- Records of artesian pressure and groundwater level data for assessment of drawdown.

### 6.4 Groundwater responses to Wellfield B

#### 6.4.1 Whole-of-Wellfield Drawdown Pattern

The drawdown cone shows marked asymmetry, reflecting structural and palaeogeographical control over drawdown impacts. The production wells are situated in a northwest oriented trough that contains a thicker, more transmissive aquifer sequence. The trough is flanked by lower transmissivity zones that limit the relative propagation of drawdown to the east and west (WMC, 1995).

The drawdown pattern shown in Figure 6-1 is similar to that of FY17 and earlier reports. Individual drawdown at bores used to create Figure 6-1 are listed in Table 6-1.

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

General interpretative comments, describing the drawdown pattern or drawdowns reported at individual sites, are:

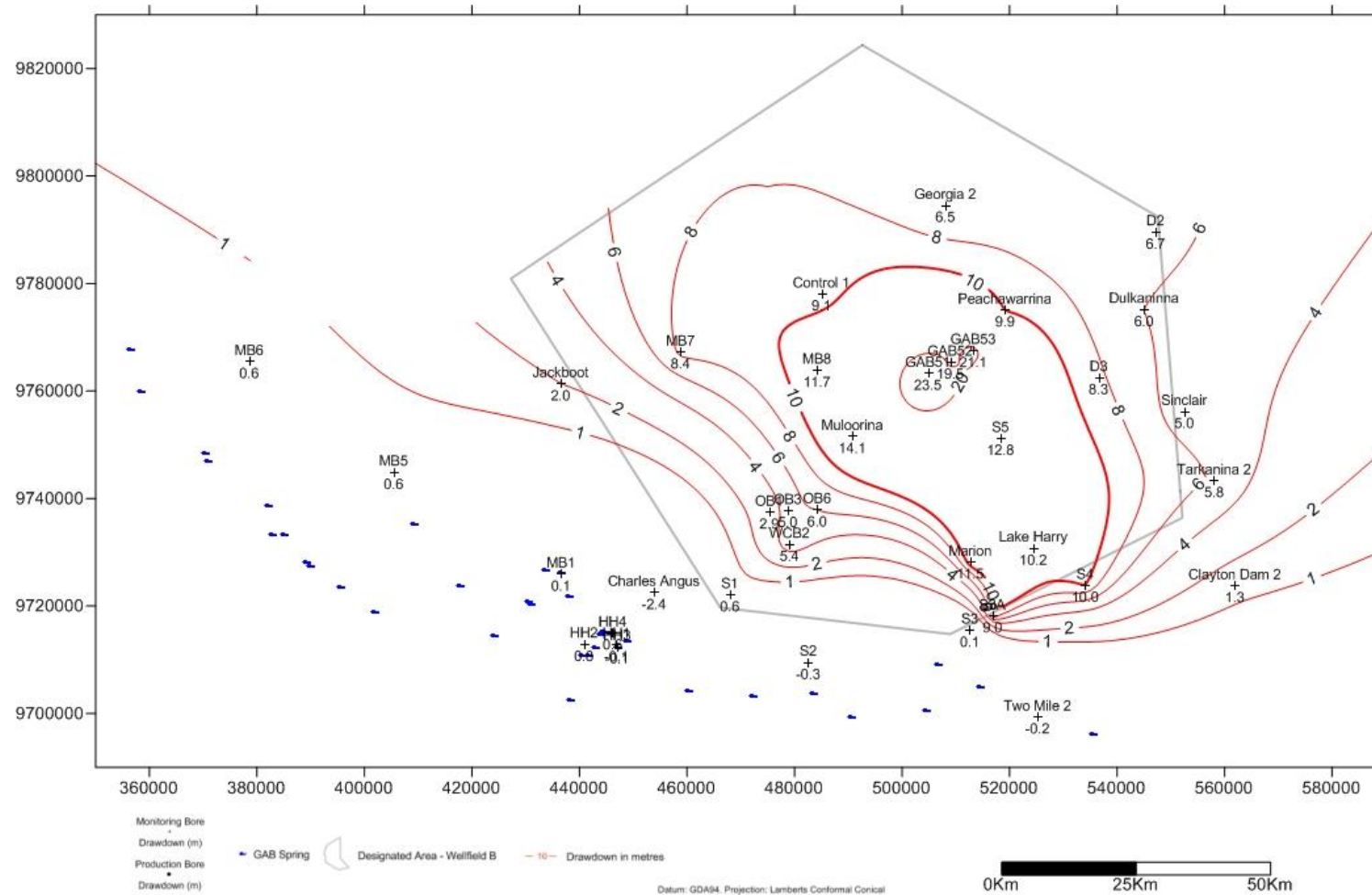
- Drawdowns are reported at the production bores GAB51, GAB52, and GAB53 as the average difference between respective PRHs and flow pressures. The 3 production wells were not shut in during FY18.
- The largest drawdown reported in an observation bore in FY18 is 14.1 m at Muloorina.
- Reported drawdown exceeds 10 m in six bores (Muloorina H/S, S4, S5, Lake Harry, Marion and MB8).
- WCB1 reports a drawdown of 2.4m, up from -0.1m in FY17. This is due to greatly increased well flow and broken reticulation infrastructure. WCB1 is not an ODC owned well.
- Drawdown along an arc of bores, situated in the west to south/south-east of Wellfield B, and closest to the GAB springs is less than 1 m and in most cases reported drawdown is 0 m.
- As indicated earlier, Figure 6-1 presents total drawdown, caused by both Wellfield B and third-party abstractions. The reported total drawdown at pastoral bores or at those used for any purposes other than dedicated monitoring, may be affected by both Wellfield B and third-party abstractions. This is best illustrated by Jackboot Bore, a pastoral bore, discharging at variable rates into a pipeline network until FY09. The pastoral flow was eliminated and the monitoring process was converted to 'cold' measurements. As a result, the reported "apparent" drawdown has significantly decreased from 3.9 m in 2009 to 2.0 m in FY18, revealing larger than previously expected drawdown due to pastoral abstraction.
- An artefact of the kriging process for contour preparation appears to be the over-projection of drawdown trends from near Wellfield B to areas without any observations, such as from the north-west to the north-east of Georgia bore in Figure 6-1. Kriging would have left the 2, 4 and 6 m contours open (i.e. these contours would not be closed within the northern extent of Figure 6-2). Contouring by hand would have closed the 4, 6 and 8 m contour lines within the extent of Figure 6-1. For these reasons, the 1, 2, 4 and 6 m contours in Figure 6-1 were blanked outside the Designated Area, from the north-west to the north-east of Wellfield B. This blanking, however, did not significantly influence the size of the 10 m drawdown footprint.

**Table 6-1 Summary of drawdowns used for Wellfield B contouring June 2018**

Bore	PRH (m AHD)	Mean Drawdown FY18 (m)	Mean Drawdown FY17 (m)	Change in Mean Drawdown (m)
Charles Angus	50.5	-2.4	-2.2	-0.2
Clayton Dam 2	87	1.3		
D2	90.5	6.7	6.6	0.1
D3	86	8.3	8.6	-0.3
Dulkaninna 2	88	6.0	6.0	0.0
GAB51 <sup>1</sup>	87.5	23.5	18.0	5.5
GAB52 <sup>1</sup>	87.5	19.5	19.6	-0.2
GAB53 <sup>1</sup>	88	21.1	18.6	2.5
Georgia 2	83.5	6.5	7.6	-1.1
HH1	11.1	-0.1	-0.1	0.0
HH2	8.2	0.8	0.7	0.1
HH3	9.3	-0.1	-0.1	0.0
HH4	14	0.6	0.2	0.4
Jackboot	84	2.0	1.9	0.1
Lake Harry	84.9	10.2	10.0	0.2
Marion	87.5	11.5	11.2	0.3
MB1	55.5	0.1	0.0	0.1
MB5	75.5	0.6	0.5	0.2
MB6	75	0.6	0.5	0.1
MB7	87	8.4	8.3	0.1
MB8	88	11.7	11.6	0.3
Muloorina	85.4	14.1	13.0	1.1
OB1	80	2.9	2.8	0.1
OB3	82	5.0	4.8	0.2
OB6	83	6.0	6.3	-0.3
Peachawarrina	85.2	9.9	11.0	-1.1
S1	70.5	0.6	0.6	0.0
S2	54	-0.3	-0.5	0.2
S3	72.5	0.1	0.0	0.1
S3A	85	9.0	9.0	0.0
S4	87	10.0	9.1	0.9
S5	86.5	12.8	12.8	0.0
Sinclair	87	5.0	5.0	0.0
Tarkanina 2	86.8	5.8	6.0	-0.1
Two Mile 2	72	-0.2	-0.3	0.1
WCB1 <sup>2</sup>	64.5	2.4	-0.1	2.5
WCB2	83	5.4	5.3	0.1

**Notes:**

1. Drawdown for wells GAB51-53 was measured with flow pressures during FY18
2. WCB1 was not used for contouring during FY18 as the greatly increased drawdown is caused by increased third party water usage.
3. Negative numbers indicate a reduction in drawdown (i.e. an increase in head) during FY18



**Note:**

- Total drawdown includes those caused by Wellfield B and third party abstractions

**Figure 6-1 Wellfield B total drawdown contours for FY18, generated by kriging**

### 6.4.2 Drawdown Pattern around Wellfield B

The drawdown map presented in Figure 6-1 followed the procedure as described in the Monitoring Program – Great Artesian Basin (GAB) 2017 (BHP, 2017a). One control point was used to the north-west of Wellfield B, between MB8 and Georgia Bore.

The drawdown for the control point in the north-west (Control 1 in Figure 6-1) was determined as follows:

1. Drawdowns at Wellfield B (21.4, average of GAB51-53), MB8 (11.7 m) and Georgia Bore (6.5 m) were plotted vs. their respective distance from Wellfield B. For Wellfield B, a nominal distance of 1 m was used).
2. A logarithmic trend was fitted to the distance-drawdown relationship, a standard groundwater hydraulic relationship for an extensive aquifer.
3. Using the logarithmic distance-drawdown trend from 2, the distance from Wellfield B where drawdown should equal 9.1 m (the average for MB8 and Georgia) was determined, and a control point for the purpose of contouring was placed at that distance and to the north-west of Wellfield B (red marker in Figure 6-2 and “Control 1” in Figure 6-1).

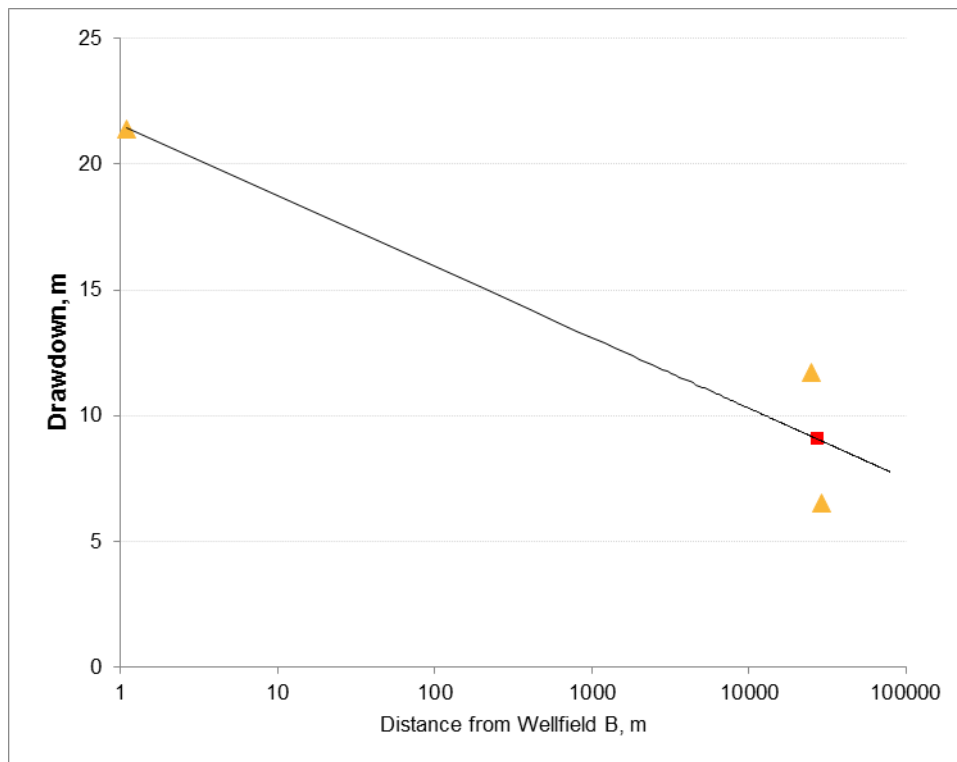


Figure 6-2 The assessment of drawdown at the control point

## 6.5 Evaluation against Compliance Criteria

### 6.5.1 The Area Contained Within the 10 m Drawdown Contour

The area contained within the 10 m drawdown contour line in Figure 6-1 is 2,382 km<sup>2</sup>, below the 4,450 km<sup>2</sup> compliance criterion. As Figure 6-3 indicates, measured values (black) for the 10 m drawdown contour are below modelled values (red markers) with the exception of FY2008 when drawdowns significantly influenced by temperature or pastoral use at two sites were reported.

The GAB aquifer near Wellfield B is highly confined with no recharge, other than through-flow from the north/northeast. Therefore drawdown at all sites is expected to

increase (even if the abstraction at Wellfield B remains constant) although the rate of increase is expected to slow down with time. The area within the 10 m drawdown contour line, as Figure 6-3 indicates, is predicted to increase near-linearly from 2010.

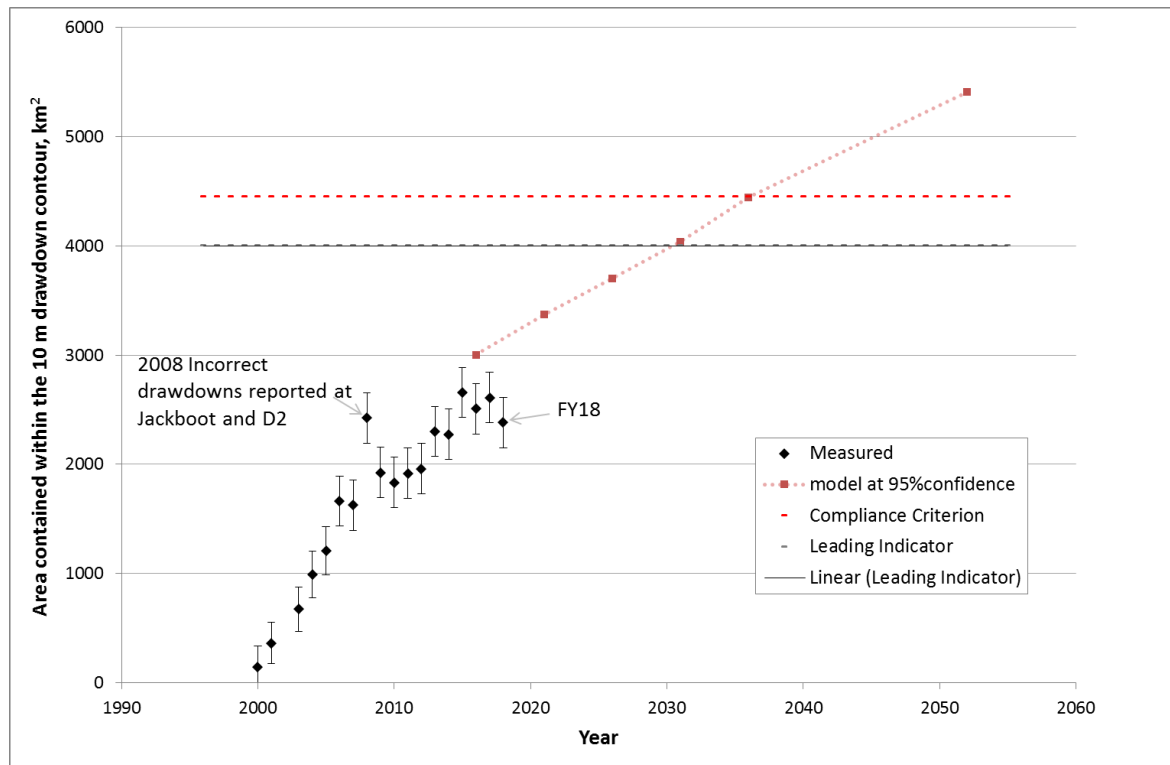


Figure 6-3 The Area Contained within the 10 m Drawdown Contour

### 6.5.2 Drawdown at bores S1 and S2

Sites S1 and S2 are the closest dedicated monitoring bores to GAB springs and were therefore selected as compliance sites.

Table 6-2 Summary of drawdown at S1 and S2, to June 2018

Bore	PRH (m AHD)	Mean Potentiometric Head FY18 (m AHD)	Mean Drawdown FY18 (m)
S1	70.5	69.9	0.6
S2	54.0	54.3	- 0.3
S1 – S2 12 month moving drawdown average			0.2

As Figure 6-4 indicates, the average drawdown for these sites has fluctuated between -0.5 and +0.6 m and has remained very close to 0 m since 2010. The latest reported drawdown at the point between monitoring bores S1 and S2 (measured as the average drawdown of the two bores based on the 12-month moving average) is 0.2 m, less than the 4 m drawdown compliance criteria.

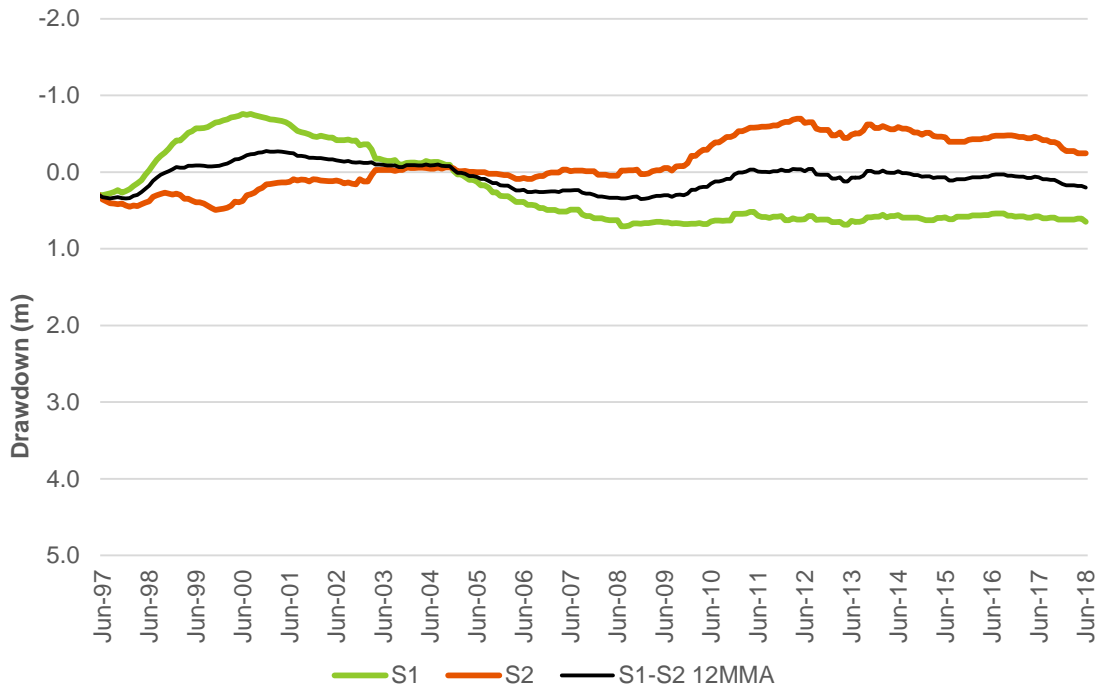


Figure 6-4 Drawdown at Wellfield B Compliance Bores S1 and S2

## 6.6 Evaluation against Leading Indicator

Pastoral wells are monitored to increase the density of observation points and to confirm that artesian pressures are preserved. The pastoral properties are large (~5000 km<sup>2</sup>), the water supply lines for their livestock are long, exceeding 20 km in places. The area is remote, and the drilling costs for bores that are several hundred metres deep are high. As a consequence, many of these pastoral wells are used more or less continuously and therefore may influence pressure and temperature measurements. The recovery of shut-in pressure at Jackboot Bore after its closure is a practical demonstration of over-estimating drawdown in head, caused by wellfields by several metres. The separation of drawdown caused by Wellfield B from that caused by pastoral wells, is uncertain. The drawdowns presented in this report, therefore, are total drawdowns caused by both Wellfield B and pastoral abstractions.

Total drawdown at EIS pastoral bore sites (Kinhill Engineers, 1997, updated Golder Associates 2016) can be assessed from Figure 6-1, which shows drawdown contours in the Wellfield B area due to all groundwater abstractions. A summary of measured drawdown is shown in Table 6-3.

**Table 6-3 Drawdown at 1997 EIS Pastoral bores**

Well	Temp Inclusive Drawdown		EIS predicted drawdown (m)
	PRH (m AHD)	Drawdown (m)	
Callanna	48.9	-0.3	0.8
Cannuwaukaninna	90.3	7.7	5.6
Chapalana	92	3.0	2.7
Charles Angus	50.5	-2.4	2.7
Clayton #1	71.5		10.9
Clayton #2	73.8		10.9
Cooranna	43.3	-17.1	4.3
Cooryaninna	96.3	8.0	4.1
Dulkaninna 2	89	6.0	7.4
Jackboot	84	2.0	5.0
Kopperamanna	92.1	10.7	3.7
Lake Harry	84.9	10.2	15.2
Marion	87.5	11.5	15.0
Maynards	55.4	-0.1	1.4
Morphetts	54.3		0.9
Morris Creek	63		4.1
Muloorina	85.4	14.1	16.2
Peachawarrina	85.2	9.9	13.4
Peters	52.4	4.0	12.0
Tarkanina #2	86.8	5.8	6.4
Yarra Hill	87.7	5.9	2.5

### Notes:

1. EIS (Kinhill Engineers, 1997, updates Golder Associates 2016) predicted drawdown is for the period 2016-2036.
2. PRH is calculated as the temperature corrected EIS pressure
3. Cooranna baseline pressure was given in the 1997 EIS as 61kPa. This is an incorrect value for the bore and represents a flow pressure rather than a shut-in pressure.
4. Measured pressures and calculated heads at Peters appear to be below those of adjacent GAB bores. Although drawdown is calculated the reference level for the well may be incorrect.

Drawdown is not reported for all 1997 EIS pastoral sites in Table 6-3. The reasons for this vary. For some bores there is no baseline head or pressure available or those assigned proved to be incorrect; for others contemporary measurements are not possible (the bore cannot be accessed or shut-in). For some bores, the shut-in times appear to be insufficient (not long enough to minimise the influence of antecedent flow). Leaks inside bores or on the wellhead or the delivery infrastructure also render some pressure measurements non-representative of the GAB aquifer (the pressure measured is lower than the correct pressure at the same place and time in the aquifer) and hence would report incorrect drawdowns.

The Practical Reference Head for EIS pastoral bores has been calculated as the temperature corrected 1997 EIS kPa value.

In general, drawdown at pastoral bores remains less than the predicted long-term impact as presented in the EIS (Kinhill Engineers, 1997, updated Golder 2016). Maximum drawdown (14.1m) was at Muloorina in FY18.

Shut in pressures could not be collected from several sites in FY18. Clayton 1 and 2 could not be shut in due to wellhead configuration. Morphetts and Morris Creek were not shut in due to poor headworks condition.

Several sites recorded drawdown in excess of the 1997 EIS predictions. Cannuwaukaninna, Chapalana, Kopperamanna and Yarra Hill have large pastoral antecedent flows and, similarly to Jackboot Bore in the past, the measured drawdowns may overestimate actual drawdown from Wellfield B.

Cooryaninna measured a drawdown of 8.0 m, of which a large portion is regarded as pastoral antecedent flow and not representative of wellfield effects as demonstrated by monitoring wells D2 and Sinclair which are to the west of Cooryaninna and closer to Wellfield B but report lower drawdowns of 6.7 and 5.0 m respectively.

## 7 GAB SPRING FLOWS

Groundwater abstraction from the GAB has the potential to reduce the flow of water from springs in the vicinity of a wellfield, in turn reducing the area of habitat that is available to organisms or increasing the rate of spring extinctions. A core group of 41 GAB springs in the vicinity of the wellfields are monitored annually (BHP 2017a). During this monitoring, flow rates and field chemistry (pH, EC and temperature) are recorded.

### 7.1 Leading Indicator

- Evidence that flow reductions at GAB springs in the vicinity of the wellfields may exceed the predictions made in the Olympic Dam Environmental Impact Statements of 1982 and 1997; that can be attributed to water extraction from Wellfields A and B.

### 7.2 Monitoring Program Requirements

#### 7.2.1 Purpose

- Determine the extent of flow change at GAB springs within each hydrogeological zone of impact that may be attributed to water abstraction from Wellfields A and B.
- To provide data to support the leading indicator for GAB impacts, and alert management when levels approach the leading indicator value.

#### 7.2.2 Deliverables

- Records of spring flow data for assessment of flow trends and possible drawdown impacts.

### 7.3 Evaluation against Leading Indicator

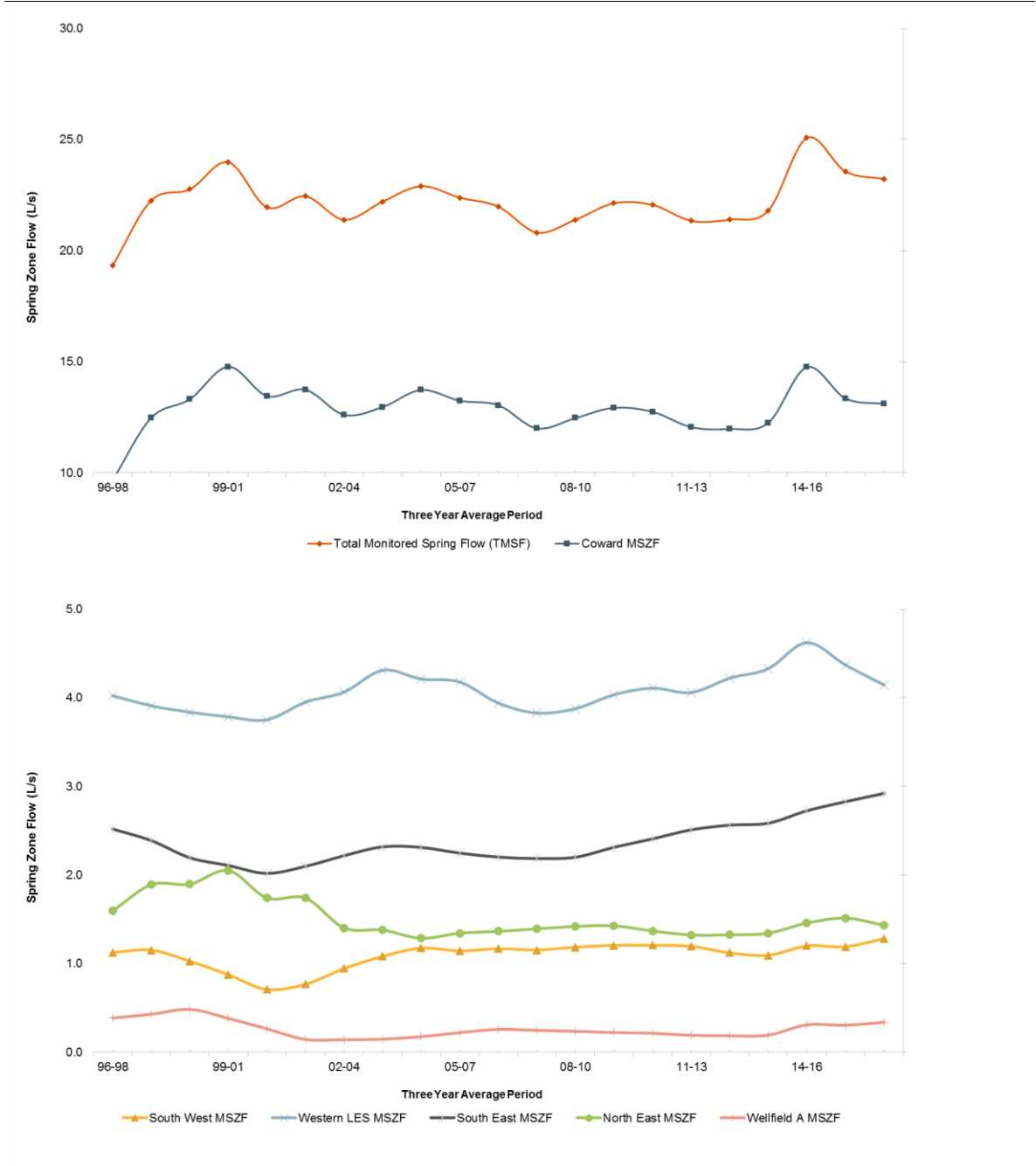
Spring flows are presented by hydrological zone based on Kinhill Stearns (1984) and Kinhill Engineers (1997a) (updated Golder Associates 2016) and further refined in the BHP GAB Contingency Plan (BHP 2015). Individual springs within each zone are listed in Appendix 8.

Total Monitored Spring Flow (TMSF) and Monitored Spring Zone Flows (MSZF) are shown in Figure 7-1. Flows are calculated as a 3 year rolling average (Table 7-1).

Since 2000, Olympic Dam has conducted an ongoing program of pastoral bore flow restrictions in conjunction with GABSI with a focus on recovering pressure in the Wellfields A & B area. Through the provision of closed reticulation systems, decommissioning wells and restricting flows ODC has realised approximately 42 ML/D in ongoing water savings for the GAB region. The targeted reduction in local GAB abstraction has resulted in increased aquifer pressure and spring flows in the Wellfields area (Figure 7-1).

**Table 7-1 Summary of Spring Flow data FY18**

Hydrogeological Zone	No. of records in period	2016-2018 average (L/s)	1996-1998 average (L/s)	Predicted Loss (%) 1982 EIS	Predicted Change (% 1996-2016) 1997 EIS <sup>1</sup>	EIS Predicted Decline (%)	2016-2018 Flow Change (%)
Coward	4	13.099	9.679	<1	0	<1	+35.3
South West	4	1.283	1.127	<1<3	-1	<1-<3	+13.8
Western Lake Eyre South	4	4.145	4.024	2 <sup>2</sup>	- 3-17	3-17	+3.0
South East	4	2.921	2.520	<1	- 3-16.5	3-16.5	+ 15.9
North East	4	1.434	1.596	8-20	- 1	8-20	- 10.2
Wellfield A	4	0.340	0.388	60-100*	-	60-100	- 12.4



**Figure 7-1: Total Monitored Spring Flow (TMSF) and Monitored Spring Zone Flows (MSZF)**

### **7.3.1 Coward Zone**

GAB spring flows in the Coward hydrogeological zone are not influenced by ODC abstractions but are monitored as a background for the wider GAB. Springs in the zone have been observed to produce highly variable flow rates. Measured flow decreased slightly in FY18 within historical ranges.

The flow rate was 35% higher than EIS background (Table 7-1).

### **7.3.2 South West Zone**

GAB Spring flow rates in the South Western Zone increased within historical ranges. The flow rate was 13% higher than EIS background (Table 7-1).

### **7.3.3 Western Lake Eyre South Zone**

GAB Spring flow rates in the Western LES zone decreased slightly within recent historical ranges. The flow rate was 3% higher than EIS background (Table 7-1).

### **7.3.4 South Eastern spring Zone**

GAB Spring flow rates in the South Eastern Zone continued the gradual rise in flow rate observed since 2008. The flow rate was 15 % higher than EIS background (Table 7-1).

### **7.3.5 North East Zone**

GAB spring flow rates in the North East Zone decreased slightly within the range of historical observations. The flow rate was 10.5% lower than EIS background (Table 7-1) but within the predicted decline of 8-20%.

### **7.3.6 Wellfield A Zone**

GAB Spring flow rates in the Wellfield A Zone increased slightly within the range of historical observations. The flow rate was 12.4% lower than EIS background (Table 7-1) but within the predicted decline of 60-100%.

## 8 GROUNDWATER CHEMISTRY

Assessment of spatial variation of groundwater chemistry throughout the wellfield and monitored area has been discussed previously by AGC (1982) and Habermehl (1983) and is not included in this report. In general, spatial variations in chemistry of the GAB aquifer occur on a very broad scale. A review of groundwater chemistry data collected in the vicinity of the OD Wellfields has been provided in a previous wellfield report (WMC, 2002).

Shallow aquifers containing saline water (20,000–50,000 mg/L TDS) occur in the vicinity of Wellfields A and B. A reduction in aquifer pressures caused by abstraction could conceivably reverse the potential for upward groundwater movement from the GAB aquifer to the shallow aquifers and, potentially affect water quality in the main GAB aquifer in the very long term.

Salinity, measured as Electrical Conductivity (**EC**) is the simplest, most robust diagnostic monitoring parameter and is the focus of the monitoring program.

### 8.1 Leading Indicator

- Evidence of water quality change (measured as pH or conductivity) at GAB springs that can be attributed to water extraction from Wellfields A and B.

### 8.2 Monitoring Program Requirements

#### 8.2.1 Purpose

- Quantify by routine and appropriate methods, water qualities in all monitoring and production wells on a quarterly basis, as stated in the Indenture.
- Identify any changes in EC at bores and springs in the region of either Wellfields A or B that, combined with other influencing factors, may be attributed to abstraction.
- Provide data to support the leading indicator for GAB impacts, and alert management when levels approach the leading indicators.

#### 8.2.2 Deliverables

- Records of GAB water EC, pH and temperature data for assessment of changes and trends in water quality.

### 8.3 Evaluation against Leading Indicator

A summary of EC and pH variations during FY18 and the previous reporting period is provided in Appendix 3. Large variations in average field water quality can occur at many springs from year to year. Despite such fluctuations, averages of field water quality generally remained within or close to the historical ranges.

As in previous years, statistically significant linear regression coefficients over the entire record (different from zero at the 95% confidence level) were identified and are shown in Figure 8-1. Sites identified by this method that had a regression coefficient (the slope of a regression line fitted to the dataset) outside the range of -0.15 to +0.15 were further analysed. Of the 125 groundwater and spring sites, four were identified as having regression coefficients outside that range, with three (Bopeechee HBO007, Welcome WWS001 and Welcome WWS013) indicating increasing salinity and one (Old Finnis HOF033) showing a decreasing trend (Figure 8-1).

Data shown in Appendix 3 also include the 5<sup>th</sup> and 95<sup>th</sup> percentile values for the historical range of values, and identify where the FY18 average is above the 95<sup>th</sup> percentile. This method identified six locations in FY18, Beatrice Bore HBS004,

Bopeechee HBO007, Clayton 1, Coward CBC002, Dulkaninna 2 and Welcome WWS002.

Individual trend graphs for these sites are provided in Appendix 5.

### 8.3.1 Wellfield A Salinity Trends

Four of the nine unique sites identified in Section 8.3 are within the Wellfield A region:

- One (Bopeechee HBO007) with increasing salinity trend,
- One site with decreasing salinity trend (Old Finniss HOF033),
- Three sites (Beatrice Bore HBS004, Bopeechee HBO007, Coward CBC002) where FY18 measurements exceeded the 95 percentile.

The results above are consistent with the general rise in salinity for Wellfield A, discussed in a previous wellfield report (BHP, 2005). It should be noted from the graphs however, that correlations (as measured by the correlation coefficient square) in Appendix 5, particularly for springs, are generally poor.

An increasing trend was detected at Bopeechee HBO007 (Figure 16-1). Salinity at other Bopeechee vents are in line with the historical range for the springs. The decreasing trend continued at Old Finniss HOF033 (Figure 16-2).

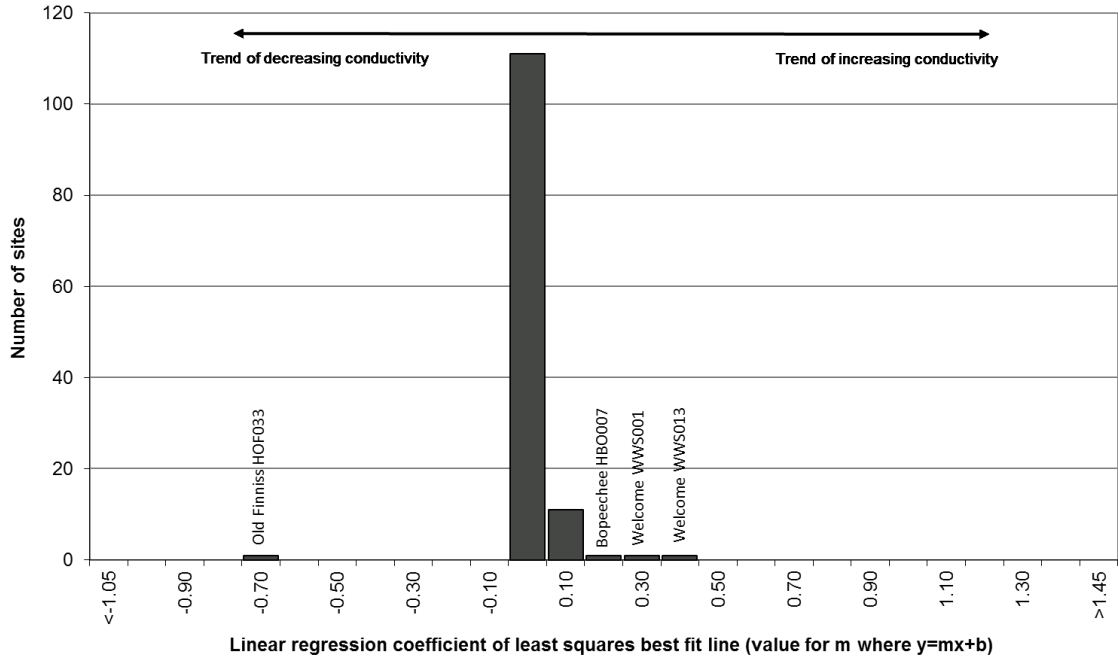
The anomalous measurement in FY18, above the 95th percentile, at Beatrice Bore HBS004 (**Error! Reference source not found.**) and Coward CBC002 (Figure 16-6) are not reflective of any significant trends at these springs.

### 8.3.2 Wellfield B Salinity Trends

Five of the nine slightly anomalous salinity trends identified in Section 8.3 are at sites within the Wellfield B region.

- Two with increasing salinity trend; Welcome Spring WWS001 (Figure 16-3) and Welcome Spring WWS013 (Figure 16-4)
- Three sites; Clayton 1 (Figure 16-7) Conductivity trend for Clayton 1), Dulkaninna 2 (Figure 16-8) and Welcome WWS002 (Figure 16-9) where FY18 measurements exceeded the 95 percentile.

The Welcome group of springs are highly disturbed due to stock grazing, at the edge of the GAB and historically have exhibited large variations in salinity. Clayton 1 and Dulkaninna 2 wells are used for pastoral operations and dependant on recent usage at the time of monitoring, fluctuations in salinity are common.



**Figure 8-1 Frequency distribution of conductivity trends for the wellfields area**

## 9 GAB WATER USE EFFICIENCY

The efficiency of water use at Olympic Dam and Roxby Downs is a significant driver in minimising the rate of water abstraction from the GAB. Efficient water use practice at the operation and at Roxby Downs is promoted through education and engineering controls. Targets and key performance indicators are developed to promote continuous improvement in water use efficiency. An efficiency rate of 1.24 kL of water per tonne of ore milled (kL/t), for a production rate of 200,000 tonnes per annum was anticipated in the 1997 EIS (Kinhill Engineers, 1997). The EIS approval required Olympic Dam to improve efficiency of water use and supply practices.

### 9.1 Monitoring Program Requirements

#### 9.1.1 Purpose

- Measure the industrial water use efficiency of the operation and total potable water use of associated townships and accommodation villages, including Andamooka.
- Quantify by routine and appropriate methods total water quantities withdrawn from any wellfield on both an individual well and wellfield basis, with abstraction added to the record on a monthly basis, as required by the Indenture.
- Provide a 10-year forward schedule for abstraction of groundwater from the GAB.

#### 9.1.2 Deliverable(s)

- Collated domestic and industrial water use efficiency data, to assess performance against improvement targets.
- Ten-year water use schedule to be submitted to the Indenture Minister by 1 January annually.

### 9.2 Results

In FY18 the GAB Industrial Water Efficiency of the operation was 1.19kL/t compared to the target of 1.16 kL/t and 0.96kL/t for FY17. An increase in kL of GAB water per tonnes milled is due to the SCM17 Smelter Shutdown and decreased production efficiency during this time. Domestic water use during FY18 averaged 2.3 ML/d compared to 2.2 ML/d in FY17, well below the target of 3.2 ML/d.

The current 10-year water use schedule, as provided to the Minister for Mineral Resources Development in December 2017, is presented in Appendix 6. An updated schedule will be provided by 1 January 2019.

## 10 RESOURCE SUSTAINABILITY AND MANAGEMENT

### 10.1 Further Exploration and Development

Further development of existing wellfield infrastructure may be required to supply additional capacity to the operation as part of the 10 year water forecast. To realise a full wellfield B abstraction rate of 36 ML/d a fourth production well and associated pipeline infrastructure is being studied. No exploration for additional wellfields is currently planned.

### 10.2 Future Perspective

The 10-year forecast (Appendix 6) predicts total wellfield abstraction to reach 41.7 ML/day by 2022 and remain constant to 2028. Abstraction rates for Wellfield A are expected to remain at an annual average of 5 ML/d and at 36.7 ML/d for Wellfield B.

### 10.3 Sustainability Comments

Since 2000, Olympic Dam has conducted an ongoing program of pastoral bore flow restrictions in conjunction with GABSI with a focus on recovering pressure in the Wellfields A&B area. Through the provision of closed reticulation systems, decommissioning wells and restricting flows ODC has realised approximately 235 GL in cumulative water savings for the GAB region since 1999 (Figure 10-1) at an ongoing rate of approximately 42 ML/d – above the projected abstraction rate of ~ 34 ML/d (Appendix 6). The targeted reduction in local GAB abstraction has resulted in increased aquifer pressure and spring flows in the Wellfields area.

In the Wellfield A area groundwater heads and spring flow rates have now been approximately stable for more than 15 years. Boundary drawdown, determined as the average drawdown at GAB8 and HH2, was 1.3 m, similar to those reported since 2000.

For Wellfield B, the drawdown cone continues to show marked asymmetry, reflecting structural and palaeogeographical control over drawdown propagation. The production wells are situated in a north-west oriented wide basin trough, which contains a thicker, more transmissive aquifer sequence. The drawdown pattern is similar to that of earlier reports and in line with modelled predictions.

The area contained within the 10 m drawdown contour line is 2,328 km<sup>2</sup>, below the 4,450 km<sup>2</sup> compliance criterion and consistent with modelling predictions. The latest reported average drawdown for bores S1 and S2 was 0.2 m, below the 4 m drawdown limit set for Wellfield B.

Given the rates of drawdown and current compliance margins, continued GAB abstractions are sustainable at the planned rate.

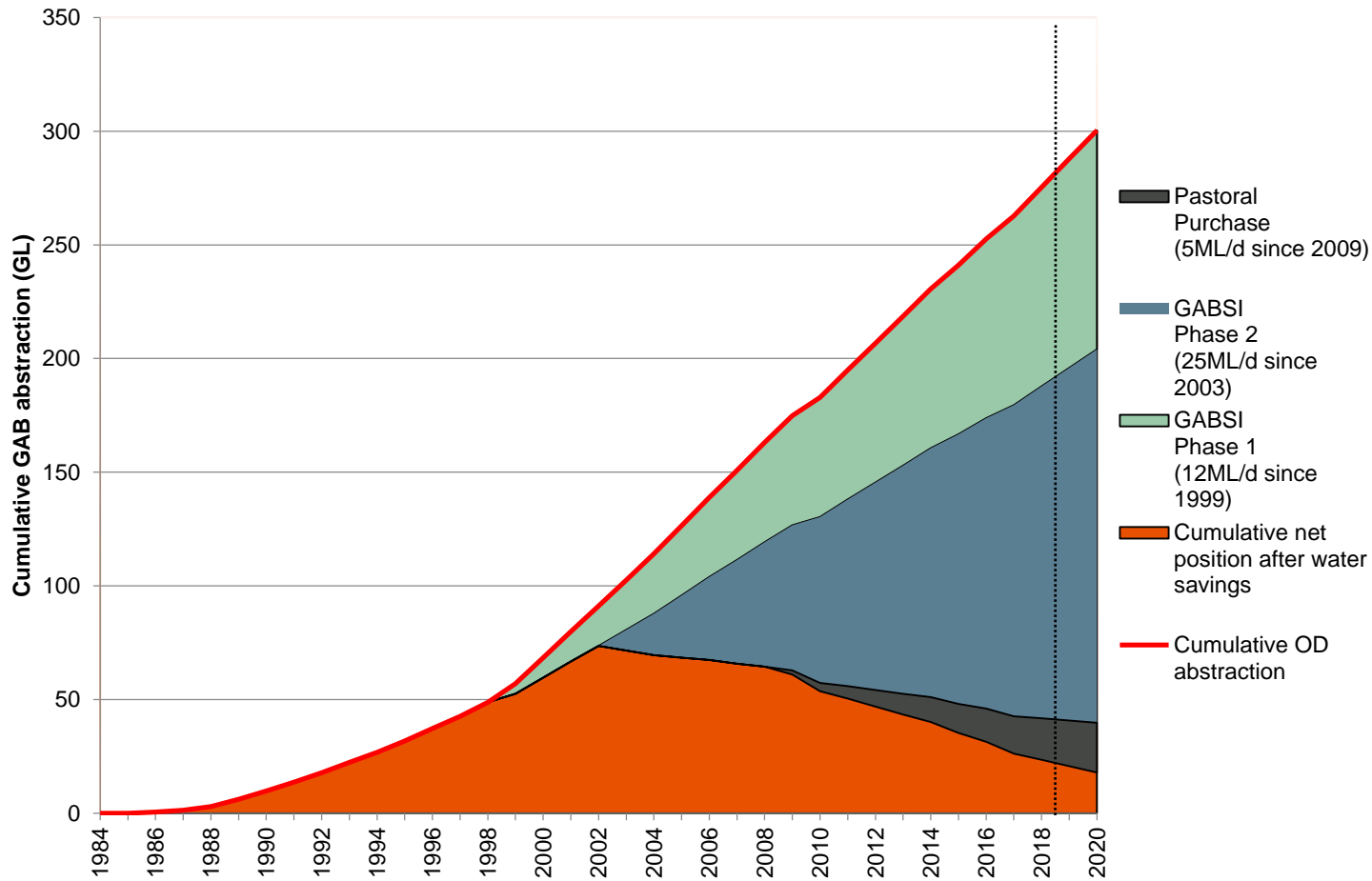


Figure 10-1 ODC cumulative GAB water savings

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## 12 Appendix 1: SUMMARY OF MONITORING RECORDS FOR FY18

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
Beatrice Bore HBS004					1	1	1	1	
Boocaltaninna	1	1	1	1	1	1	1	1	
Bopeechee Bore HBO013					4	4	4	4	
Bopeechee HBO004					1	1	1	1	
Bopeechee HBO007					1	1	1	1	
Bopeechee HBO011					1	1	1	1	
Callanna	1	1	1	1	1	1	1	1	
Cannuwaukaninna	1	1	1	1	1	1	1	1	
Chapalanna 2	1	1	1	1	1	1	1	1	
Charles Angus	1	1	1	1	1	1	1	1	
Clayton #1			1	1	1	1	1	1	
Clayton #2			1	1	1	1	1	1	
Clayton Dam 2	1	1	1	1	1	1	1	1	
Cooranna	1	1	1	1	1	1	1	1	
Cooryaninna	1	1	1	1	1	1	1	1	
Coward CBC001					1	1	1	1	
Coward CBC002					1	1	1	1	
Coward CBC013					1	1	1	1	
D2	4	4	4	4	4	4	4	4	
D3	4	4	4	4	4	4	4	4	
Davenport WDS001					1	1	1	1	
Davenport WDS042					1	1	1	1	
Davenport WDS052					1	1	1	1	
Dead Boy HDB004					1	1	1	1	
Dead Boy HDB005					1	1	1	1	
Dulkaninna 2	1	1	1	1	1	1	1	1	
Emerald LES001					1	1	1	1	
Fred LFE001					1	1	1	1	
Fred LFE006					1	1	1	1	

GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
GAB001	4	4	4	4			4	4	
GAB002	4	4	4	4			4	4	
GAB005A	4	4	4	4			4	4	
GAB006	4	4	4	4	Continuous		4	4	
GAB006A	4	4	4	4			4	4	
GAB007	4	4	4	4			4	4	
GAB008	4	4	4	4			4	4	
GAB010	4	4	4	4			4	4	
GAB011	4	4	4	4			4	4	
GAB012	4	4	4	4	Continuous		4	4	
GAB012A	4	4	4	4			4	4	
GAB013A	4	4	4	4			4	4	
GAB014	4	4	4	4	Continuous		4	4	
GAB014A		4	4	4			4	4	
GAB016	4	4	4	4	Continuous		4	4	
GAB016A	4	4	4	4			4	4	
GAB017	4	4	4	4	Continuous		4	4	
GAB018	4	4	4	4	Continuous		4	4	
GAB018A	4	4	4	4			4	4	
GAB019	4	4	4	4			4	4	
GAB021	4	4	4	4			4	4	
GAB022	4	4	4	4			4	4	
GAB023	4	4	4	4			4	4	
GAB030A	4	4	4	4			4	4	
GAB031A	4	4	4	4			4	4	
GAB033A	4	4	4	4			4	4	
GAB051	4	4	4	4	Continuous		4	4	
GAB052	4	4	4	4	Continuous		4	4	
GAB053	4	4	4	4	Continuous		4	4	
Georgia 2	1	1	1	1	1	1	1	1	
Gosse LGS002					1	1	1	1	

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
Gosse LGS004					1	1	1	1	
Hermit Hill HHS028					1	1	1	1	
Hermit Hill HHS035					1	1	1	1	
Hermit Hill HHS101					1	1	1	1	
Hermit Hill HHS125A					1	1	1	1	
Hermit Hill HHS137					1	1	1	1	
Hermit Hill HHS170					1	1	1	1	
HH1	4	4					4	4	
HH2	4	4					4	4	
HH3	4	4					4	4	
HH4	4	4					4	4	
Highway	1	1	1	1	1	0	1	1	
Jackboot	4	4	4	4	4	4	4	4	
Jewellery Creek	1	1	1	1	1	0	1	1	
Kopperamanna	4	4	4	4	4	4	4	4	
Lake Billy #2	4	4	4	4	4	4	4	4	
Lake Harry	4	4	4	4	4	4	4	4	
Marion	1	1	1	1	1	1	1	1	
Maynards	1	1	1	1	1	1	1	1	
MB001	4	4					4	4	
MB002	4	4					4	4	
MB005	4	4					4	4	
MB006	4	4					4	4	
MB007	4	4					4	4	
MB008	4	4					4	4	
McLachlan LMS004B					1	1	1	1	
Morphetts	1	0	1	1	1	0	1	1	Did not shut in due to headworks condition
Morris Creek	1	0	1	1	1	0	1	1	Did not shut in due to headworks condition
Muloorina	2	2	2	2	2	2	2	2	
New Years Gift	4	4	4	4	4	4	4	4	

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
OB001	4	4	4	4	4	4	1	4	
OB003	4	4	4	4	4	4	4	4	
OB006	4	4	4	4	4	4	4	4	
Old Finnis HOF004					1	1	1	1	
Old Finnis HOF033					1	1	1	1	
Old Finnis HOF081					1	1	1	1	
Old Finnis HOF094					1	1	1	1	
Old Finnis HOF096					1	1	1	1	
Old Woman HOW009					1	1	1	1	
Old Woman HOW015					1	1	1	1	
Old Woman HOW025					1	1	1	1	
Peachawarrina	1	1	1	1	1	1	1	1	
Peters	1	1	1	1	1	1	1	1	
S001	4	4	4	4	4	4	4	4	
S002	4	4	4	4	4	4	4	4	
S003A	4	4	4	4	4	4	4	4	
S004	4	4	4	4	4	4	4	4	
S005	4	4	4	4	4	4	4	4	
Sinclair	1	1	1	1	1	1	1	1	
Sulphuric HSS011					1	1	1	1	
Sulphuric HSS012					1	1	1	1	
Sulphuric HSS024					1	1	1	1	
Tarkanina #2	1	1	1	1	1	1	1	1	
Two Mile #2		4		0	1	0	1	0	
Venables		3		0	1	2	1	1	
WCB01	4	4	4	4	4	4	4	4	
WCB02	4	4	4	4	4	4	4	4	
Welcome WWS001					1	1	1	1	
Welcome WWS002					1	1	1	1	
Welcome WWS004					1	1	1	1	
Welcome WWS013					1	1	1	1	
Well Creek #2	4	4	4	4	4	4	4	4	

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
West Finnis HWF002					1	1	1	1	
West Finnis HWF003					1	1	1	1	
West Finnis HWF048					1	1	1	1	
Wurringinna Spring MWI001					1	1	1	1	
Yarra Hill	1	1	1	1	1	1	1	1	

**Notes:**

- Categories are defined in Monitoring Program – Great Artesian Basin (GAB) 2017 (BHP 2017a).

# 13 Appendix 2: CALIBRATION CERTIFICATES FOR DRUCK PRESSURE TRANSDUCER

**ThermoFisher**  
SCIENTIFIC

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Melbourne Office  
5 Caribbean Drive,  
Scoresby, Victoria, 3179

Ph: 1300 736 767  
Fax: (03) 9763 3832

Email: serviceau@thermofisher.com

## Calibration Certificate

### Details of Unit Under Test

Customer: Rowe Scientific  
Lot 7, 41-47 O'Sullivan Beach Road  
Lonsdale  
SA 5160

Manufacturer: Druck  
Model: DPI 705  
Description: Digital Pressure Indicator  
Serial Number: 70526779  
Asset Number: -  
Report Number: SV1711210052-2  
Purchase Order: -

### Test Conditions


Calibrated By:	Zach Gilby	Ambient Temperature:	22.0 °C ±2°C
Calibration Date:	22/11/2017	Humidity:	46 % ±5%RH
Cal Due Date:	-	Local Gravity:	9.799368 m/s <sup>2</sup>
Operating Axis:	Normal	Medium Used:	Nitrogen
Condition:	As Found and Left		
Procedure Used:	A Pressure Instrument (7252i kPa)HR range only		Ver:2.2

Thermo Fisher Scientific hereby certifies that...

As received, the above described instrument met or exceeded all published manufacturers specifications, of ranges tested, at the time of measurement.

After calibration, the above described instrument met or exceeded all published manufacturers specifications, of ranges tested, at the time of measurement, without having been adjusted.

Has been calibrated using standards whose accuracies are traceable to National and International Standards (NIST, NMI, NPL). The uncertainties stated in this report are for the correction values, and are at a confidence level of not less than 95% (Coverage Factor k=2).

Signed:   
 Darren Smart (Signatory: Electrical, Pressure, Temperature)  
 Peter D'Souza (Signatory: Electrical, Pressure)



**NATA Accredited Laboratory No . 2145, site 2138**

Accredited for compliance with ISO/IEC 17025 - Calibration.

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5 Caribbean Drive, Scoresby, Victoria, 3179 Fax: (03) 9763 3832

Email: serviceau@thermofisher.com

## Calibration Certificate

### Details of Unit Under Test

Customer: Rowe Scientific  
Lot 7, 41-47 O'Sullivan Beach Road  
Lonsdale  
SA 5160

Manufacturer: Druck  
Model: DPI 705  
Description: Digital Pressure Indicator  
Serial Number: 70556163  
Asset Number: -  
Report Number: SV1711210052-1  
Purchase Order: -

### Test Conditions

Calibrated By:	Zach Gilby	Ambient Temperature:	20.9 °C ±2°C
Calibration Date:	23/11/2017	Humidity:	45 % ±5%RH
Cal Due Date:	-	Local Gravity:	9.799368 m/s <sup>2</sup>
Operating Axis:	Normal	Medium Used:	Nitrogen
Condition:	As Found and Left		
Procedure Used:	A Pressure Instrument (7252i kPa)HR range only		Ver:2.2

Thermo Fisher Scientific hereby certifies that...

As received, the above described instrument met or exceeded all published manufacturers specifications, of ranges tested, at the time of measurement.

After calibration, the above described instrument met or exceeded all published manufacturers specifications, of ranges tested, at the time of measurement, without having been adjusted.

Has been calibrated using standards whose accuracies are traceable to National and International Standards (NIST, NMI, NPL). The uncertainties stated in this report are for the correction values, and are at a confidence level of not less than 95% (Coverage Factor k=2).

Signed: \_\_\_\_\_

- Darren Smart (Signatory: Electrical, Pressure, Temperature)  
 Peter D'Souza (Signatory: Electrical, Pressure)



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Name: Michelle Leong

Page 1 of 3

## 14 Appendix 3: SUMMARY OF FIELD CHEMISTRY DATA FY18

Site	FY18 average			Historical range		FY18 average above 95th percentile
	No. of records	EC25 ( $\mu\text{S}/\text{cm}$ )	pH	5th percentile	95th percentile	
Beatrice Bore HBS004	1	4496	8.44	3256	4457.3	TRUE
Boocaltaninna	1	1613	6.55	1275.35	1778.95	
Bopeechee Bore HBO013	4	4040	7.35	3410	4320	
Bopeechee HBO004	1	4140	7.8	3486	4691	
Bopeechee HBO007	1	6464	8.97	3489	6075	TRUE
Bopeechee HBO011	1	5296	9.21	3525	6090	
Callanna	1	3450	8.2	2522	3498	
Cannuwaukaninna	1	2150	6.82	1661.85	2222.75	
CHAPALANNA2	1	2020	7.6	1668	2606.5	
Charles Angus	1	2800	7.4	2547.5	3192.5	
Clayton #1	1	2650	7.5	1668.5	2340.3	TRUE
Clayton #2	1	2160	7.6	1640.5	2193	
CLAYTONDAM2	1	2600	7.8	2600	2600	
Cooranna	2	2580	7.65	2159.4	2670	
Cooryaninna	1	1890	7.3	1172.4	1944.9	
Coward CBC001	1	7786	7.9	6211.8	7810	
Coward CBC002	1	6848	7.04	2964	5608	TRUE
Coward CBC013	1	5689	6.3	4728	5800	
D2	4	1883	6.75	1697.5	2096.5	
D3	4	2247	7.34	1912.65	2436.3	
Davenport WDS001	1	3896	7.87	3000	4208	
Davenport WDS042	1	4109	8.57	2962.5	4850	
Davenport WDS052	1	3845	8.59	2498	5680	
Dead Boy HDB004	1	2325	9.87	2710	4528	
Dead Boy HDB005	1	4431	8.43	3179	5103	
Dulkaninna 2	1	2100	6.6	1526	2060	TRUE
Emerald LES001	1	4682	8.61	3076	4697	
Fred LFE001	1	3919	8.65	2800	4312.5	
Fred LFE006	1	3433	8.14	2580	4880	
GAB001	4	5300	7.45	4403.5	5680	
GAB002	2	4650	7.55	4047	4825.5	

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	FY18 average			Historical range		FY18 average above 95th percentile
	No. of records	EC25 ( $\mu\text{S}/\text{cm}$ )	pH	5th percentile	95th percentile	
GAB005A	4	2943	8.58	2670.5	3299	
GAB006	4	3853	7.25	3147.8	3936.5	
GAB006A	4	3760	7.3	3180	4000	
GAB007	4	3360	7.2	3000	3700	
GAB008	4	3430	7.3	2965	3915	
GAB010	4	3010	7.1	2590	3410	
GAB011	4	3215	7.25	2945.5	3716	
GAB012	3	3870	7.3	3243	3943	
GAB012A	4	3733	7.35	3314	3935.5	
GAB014	2	3740	7.4	3122.5	3770	
GAB016	4	3913	7.33	3241.5	3950	
GAB016A	4	3753	7.35	3440	4012.5	
GAB017	1		7.1	3802	4234	
GAB018	2	4220	7.4	3440	4414.5	
GAB019	4	3040	7.13	2797.5	3463.5	
GAB021	4	4200	7.3	3337.25	4327.5	
GAB022	4	3828	7.42	3224	3990	
GAB030A	4	3680	7.23	3110	3840	
GAB031A	4	3433	7.2	3034.5	3659.5	
GAB033A	4	4108	7.2	3620	4475	
GAB051	4	3010	7.08	2489	3180.5	
GAB052	4	3028	6.95	2396	3084	
GAB053	4	3000	7.05	2466	3060	
GEORGIA2	4	2475	6.7	2130	2625	
Gosse LGS002	1	2981	7.53	2699	3200.5	
Gosse LGS004	1	2965	7.92	2515	3105	
Hermit Hill HHS028	1	3810	8.19	2970	5510	
Hermit Hill HHS035	1	3593	8.78	2920	6724	
Hermit Hill HHS125A	1	3426	8.45	2182	3795	
Hermit Hill HHS137	1	3150	8.39	2728	5193	
Hermit Hill HHS170	1	3356	8.74	2609	3755	
HH001	4	3025	7.58	2709	3500	
HH002	4	3253	7.3	2788.8	3631	
Highway	1	3400	7.9	2970	3832	

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	FY18 average			Historical range		FY18 average above 95th percentile
	No. of records	EC25 ( $\mu\text{S}/\text{cm}$ )	pH	5th percentile	95th percentile	
Jackboot	4	4725	7.22	4010	4862.5	
Jewellery Creek	1	1841	7.2	1412.1	1858.1	
Kopperamanna	1	1819	6.88	1529.7	2085.1	
Lake Billy #2	4	5865	7.15	4915	6430	
Lake Harry	2	2525	7.35	2108.5	2633	
Marion	2	2495	7.3	2039	2593	
Maynards	1	3450	7.5	2742.5	3730.5	
MB001	4	2595	7.35	2368.7	3100	
MB005	4	4060	7.15	3543	4440	
MB006	4	7155	6.8	6095	7630	
MB007	4	2768	6.97	2326	2924	
MB008	4	2755	7.05	2255.5	2950	
McLachlan LMS004B	1	3552	8.5	2682.5	3607.5	
Morphetts	1	3830	7.8	3291	4112	
Morris Creek	1	2400	7.2	2518	3237	
Muloorina	2	2750	6.9	2382.5	2904.5	
New Years Gift	4	5083	7.78	3778.5	5172.5	
OB001	3	2693	7.7	2256	2850	
OB003	4	2860	7.57	2585	3056	
OB006	2	2895	7.6	2439.5	2965.5	
Old Finnis HOF004	1	4184	8.01	2355	4640	
Old Finnis HOF033	1	5780	9	3930	12750	
Old Finnis HOF081	1	4068	7.81	3000	4750	
Old Finnis HOF094	1	4585	9.93	3148	8110	
Old Finnis HOF096	1	3354	9.03	2930	3536	
Old Woman HOW009	1	10020	7.98	7209	10797.5	
Old Woman HOW015	1	5771	9.21	3980	8625	
Old Woman HOW025	1	4161	8.31	2700.5	5052	
Peachawarrina	1	2800	2.7	2381	3013.5	
Peters	1	2500	7.6	2065.5	2500	
S001	4	2800	7.38	2462.5	3057.5	
S002	4	3405	7.92	2943	3830	
S003A	4	2393	7.55	2075.2	2479	
S004	4	2730	7.42	2266	2898	

## GREAT ARTESIAN BASIN WELLFIELDS REPORT

Site	FY18 average			Historical range		FY18 average above 95th percentile
	No. of records	EC25 ( $\mu\text{S}/\text{cm}$ )	pH	5th percentile	95th percentile	
S005	4	2340	7.35	1950.2	2484	
Sinclair	1	2190	7.42	1722	2202	
Sulphuric HSS011	1	3850	8.85	3156	4006	
Sulphuric HSS012	1	3906	9.04	3074	5002	
Sulphuric HSS024	1	4038	9.25	2660	4500	
Tarkanina #2	4	2110	7.53	1877.5	2313	
Venables	1	5250	7.1	5310.5	6962.5	
WCB01	3	3120	7.87	2598	3127	
WCB02	4	2585	7.45	2146.5	2600.5	
Welcome WWS001	1	6354	8.23	4180.5	7480	
Welcome WWS002	1	8688	7.91	6212	8657	TRUE
Welcome WWS004	1	3901	8.27	3470	4211	
Welcome WWS013	1	7272	8.68	2615	7086	TRUE
Well Creek #2	4	2505	7.75	2146	2738.5	
West Finniss HWF002	1	4678	9.76	3076.6	5450	
West Finniss HWF003	1	4678	9.76	3076	5800	
West Finniss HWF048	1	4982	9.51	2795	5650	
Wirringinna Spring MWI001	4	7773	9.3	4428	9716	
Yarra Hill	1	2200	7.7	1717.3	2346.8	

## 15 Appendix 4: PRESSURE TREND DATA

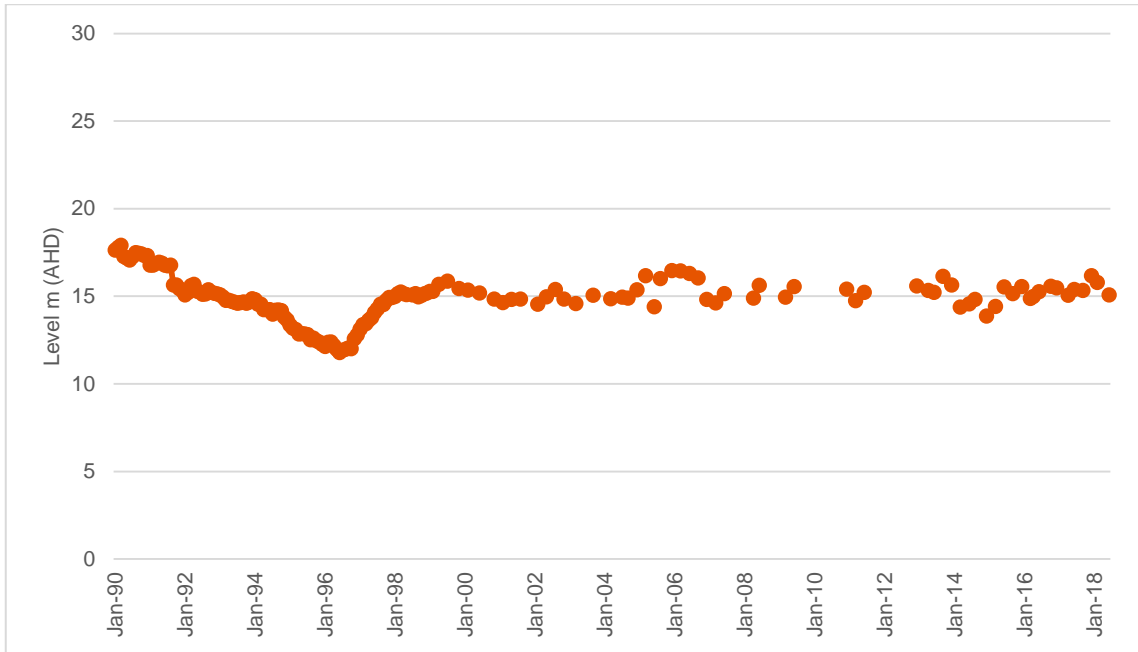


Figure 15-1 Groundwater Level for GAB2

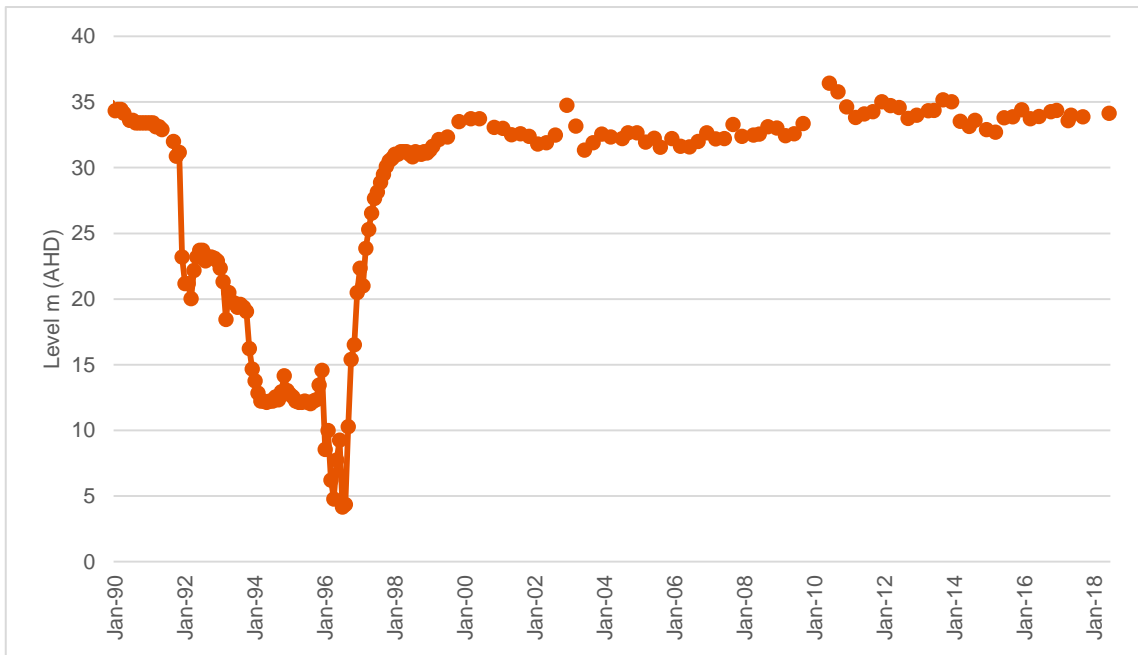
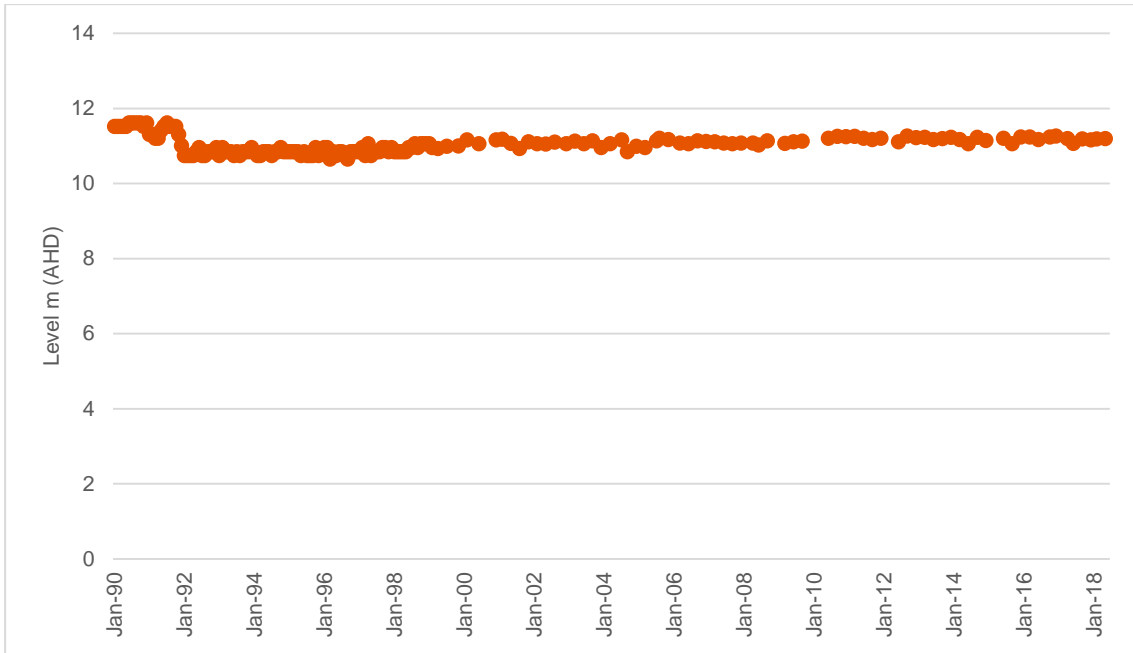
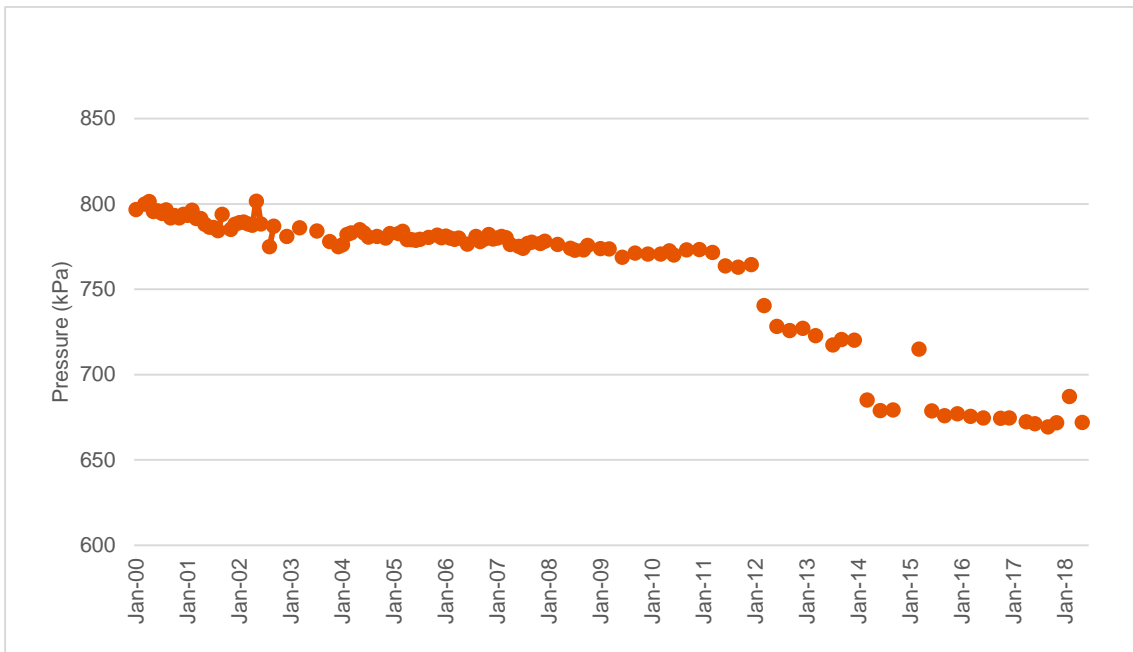


Figure 15-2 Groundwater Level for GAB24

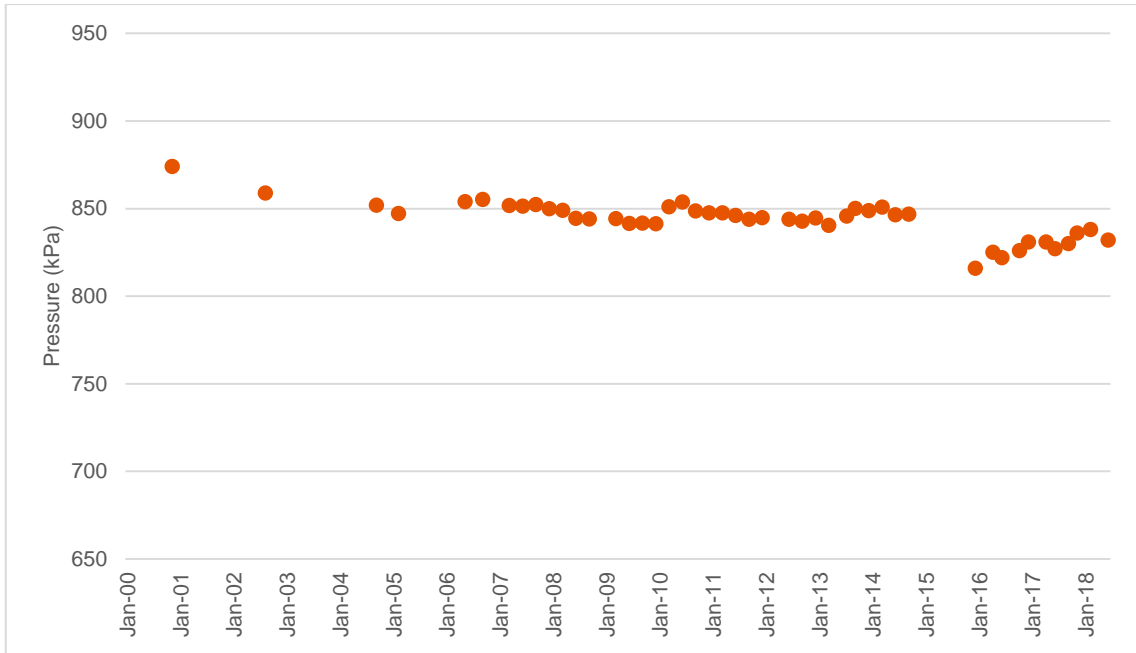


**Figure 15-3 Groundwater Level for HH1**



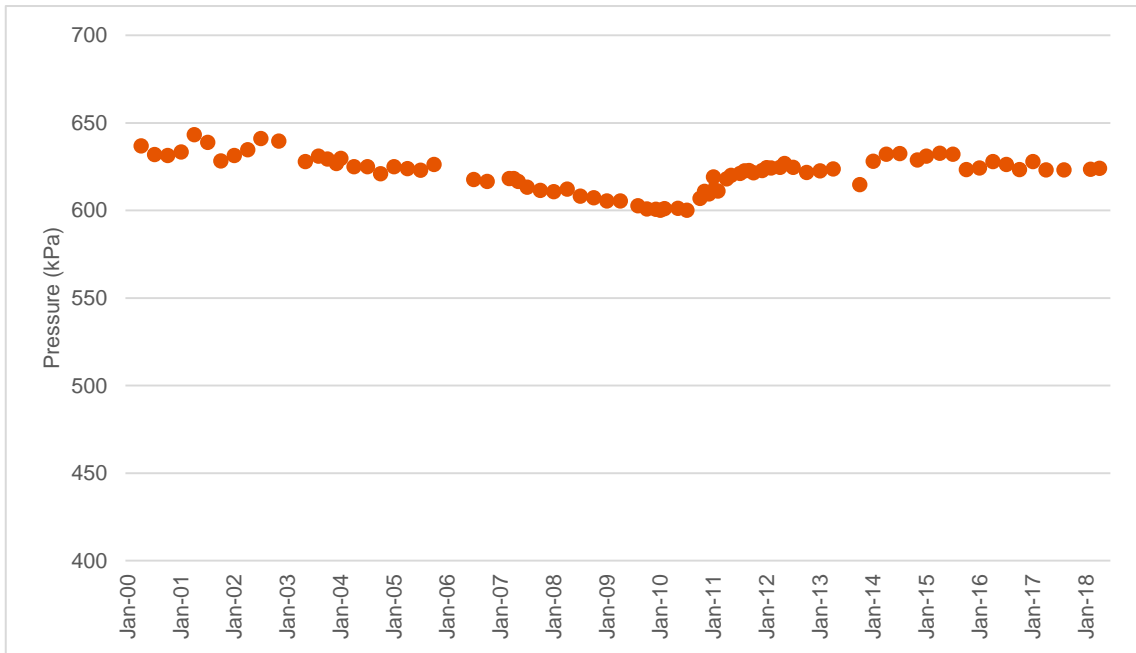
**Figure 15-4 Groundwater Pressure for D2**

\* Pressure measurements at D2 are taken as cold shut in pressure since 2014. Prior to this a pre-heat procedure was used measuring maximum pressure rather than cold pressure.

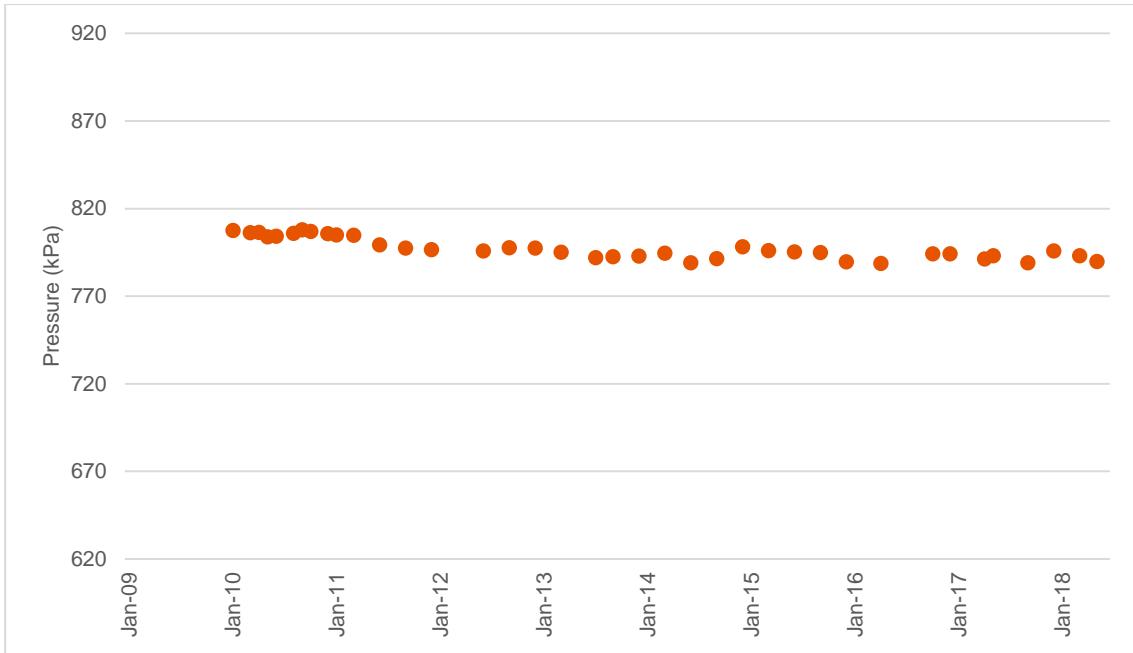


**Figure 15-5 Groundwater Pressure for Georgia/Georgia 2**

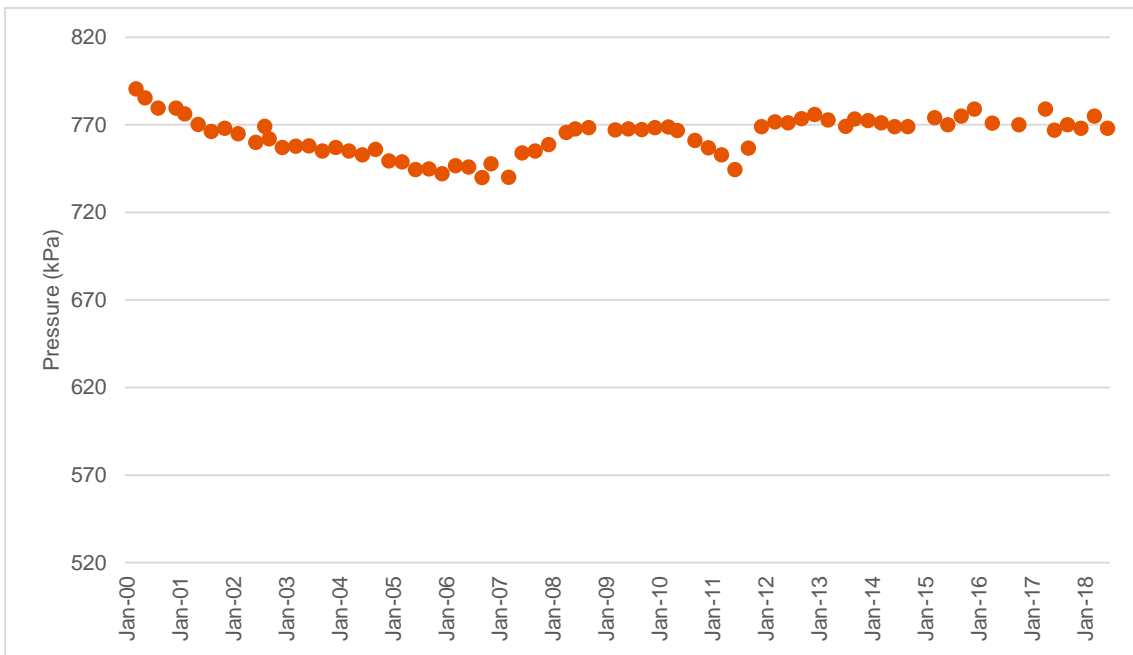
Measurements from October 2016 are from Georgia 2 – this well has a higher reference AHD hence a change in measured kPa.



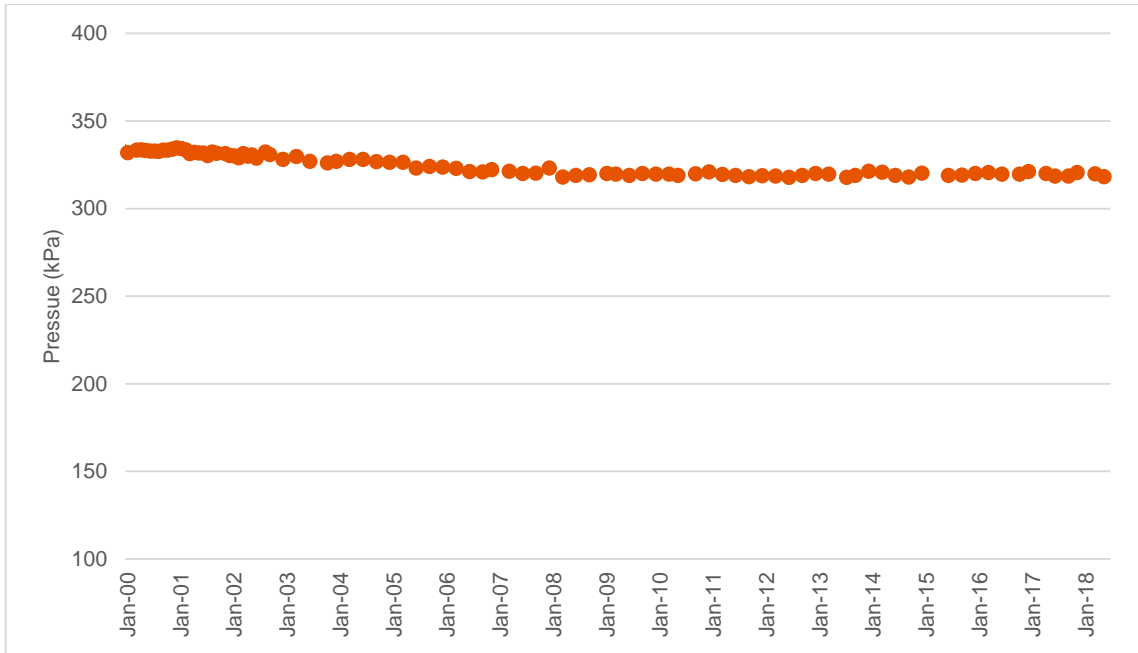
**Figure 15-6 Groundwater Pressure for Jackboot**



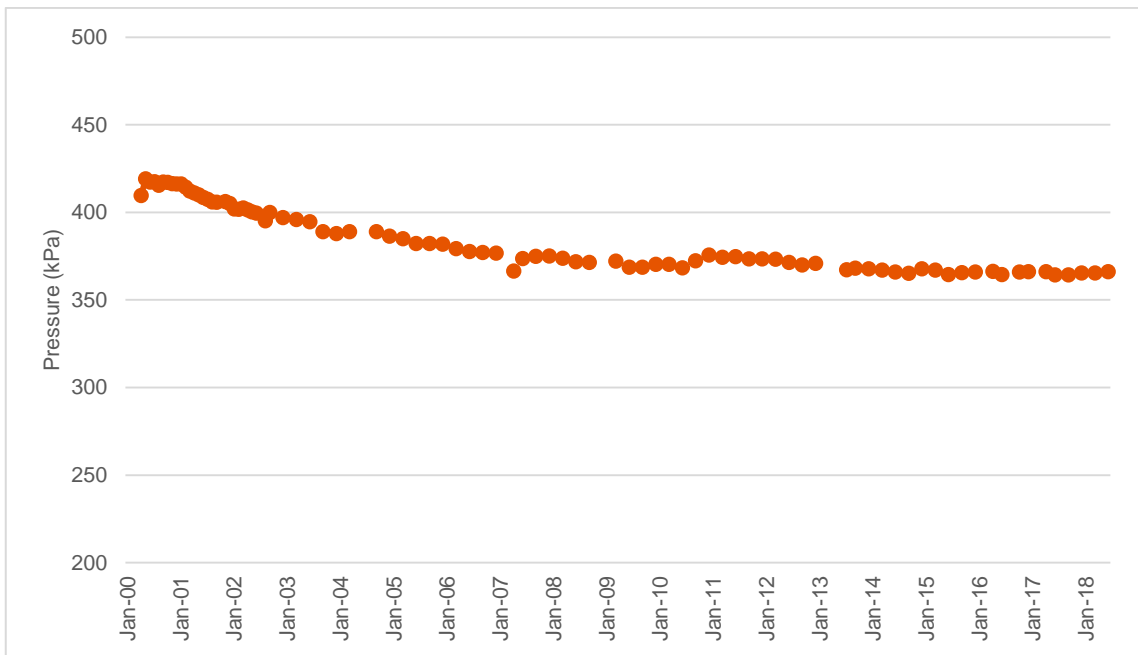
**Figure 15-7 Groundwater Pressure for MB8**



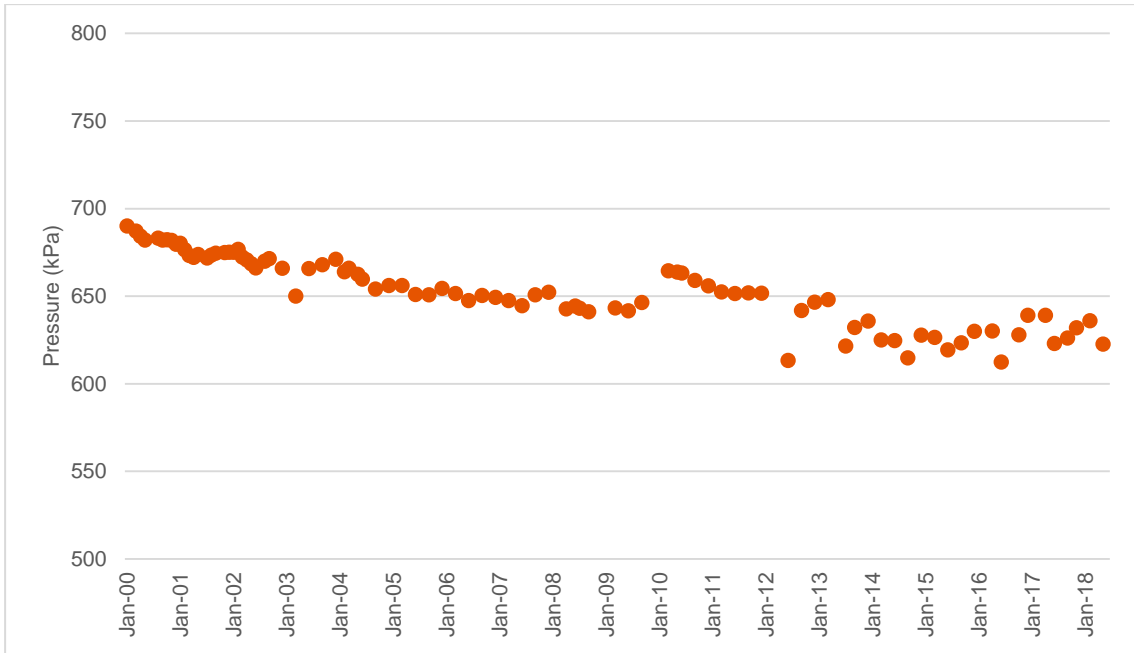
**Figure 15-8 Groundwater Pressure for OB3**



**Figure 15-9 Groundwater Pressure for S1**



**Figure 15-10 Groundwater Pressure for S3A**



**Figure 15-11 Groundwater Pressure for S5**

## 16 Appendix 5: CONDUCTIVITY TREND DATA

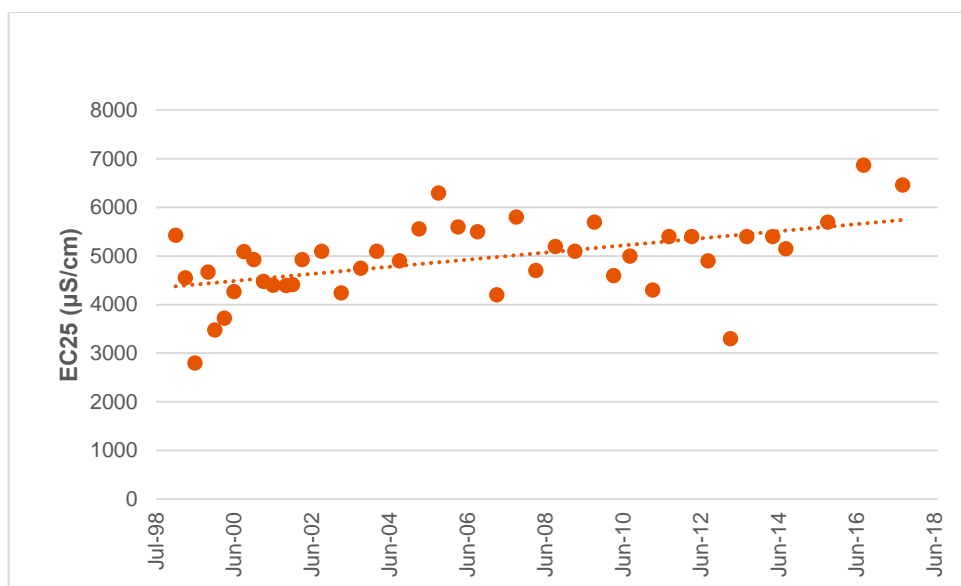
Conductivity trend graphs are provided here for:

- Bores and springs that have a regression coefficient that statistically differs from zero at the 95% confidence level and is greater than 0.10 or less than -0.10.
- Bores and springs that have an average conductivity for FY18 that is greater than the 95th percentile for that bore or spring.

Refer to Section 8 for discussion of these data.

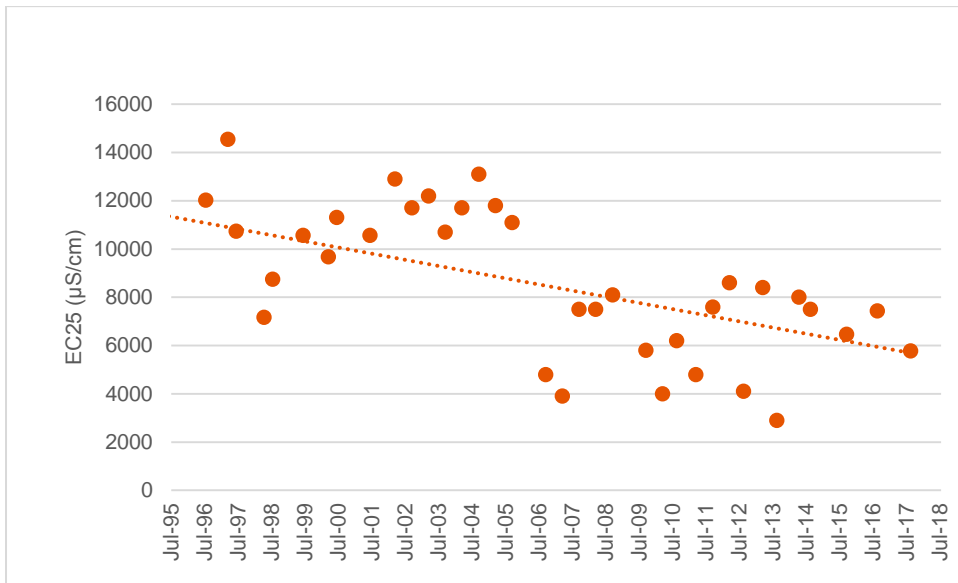
The following statistics are provided for each graph in this section:

- n            The number of data points used in the regression calculation.
- F            Overall F test value for null hypothesis  $H_0:m=0$  versus the alternative  $H_a:m\neq 0$ , where  $m$  is the slope of the line (regression coefficient) in the equation  $y=mx+b$ .
- p            The associated significance value for the F test at the 95% confidence level.
- $r^2$         R squared.



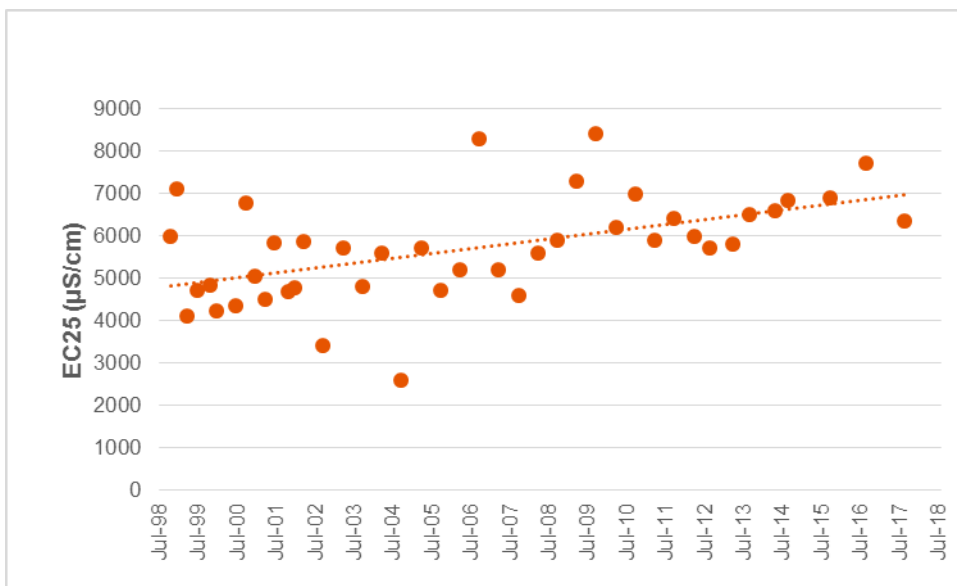
- $n = 42$ ,  $F = 13.6$ ,  $p = 0.0006$ ,  $r^2 = 0.25$ , significant ( $P < 0.05$ ) trend, FY18 measurement exceeds 95%-ile

**Figure 16-1 Conductivity trend for Bopeechee HBO007**



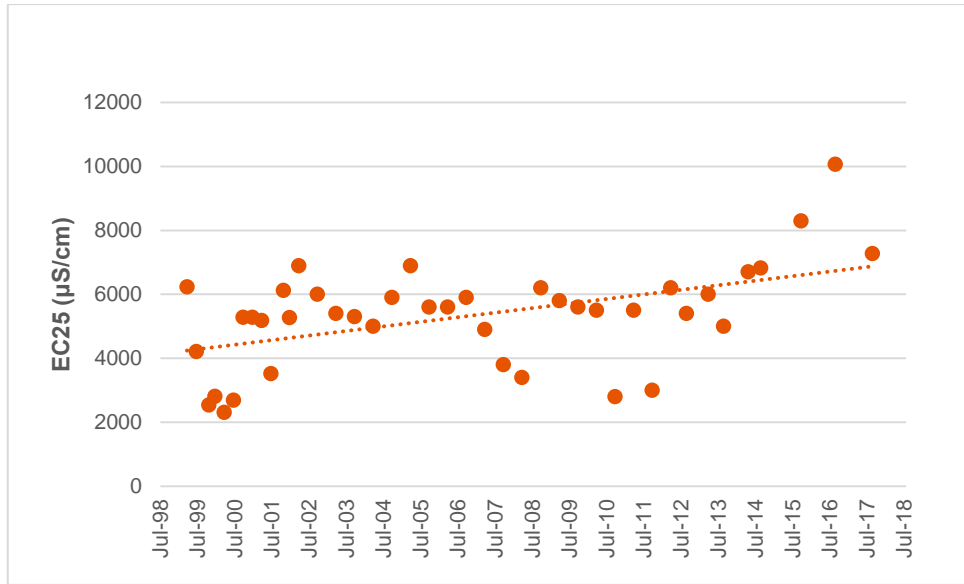
• n = 38, F = 22.2, p = 3.56E-05, r<sup>2</sup> = 0.38, significant (P<0.05) trend

**Figure 16-2 Conductivity trend for Old Finniss HOF033**



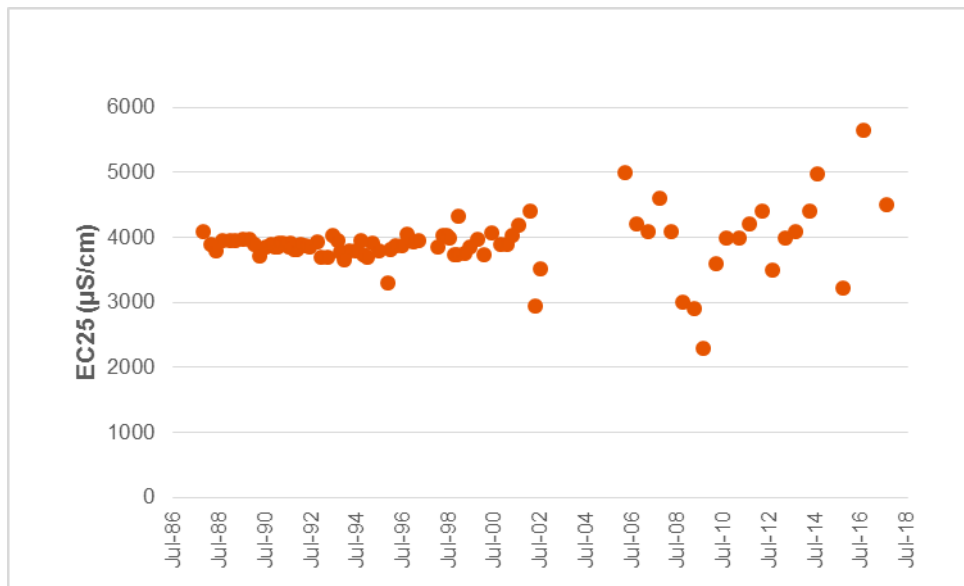
• n = 42, F = 14.7, p = 0.0004, r<sup>2</sup> = 0.269, significant (P<0.05) trend

**Figure 16-3 Conductivity trend for Welcome WWS001**



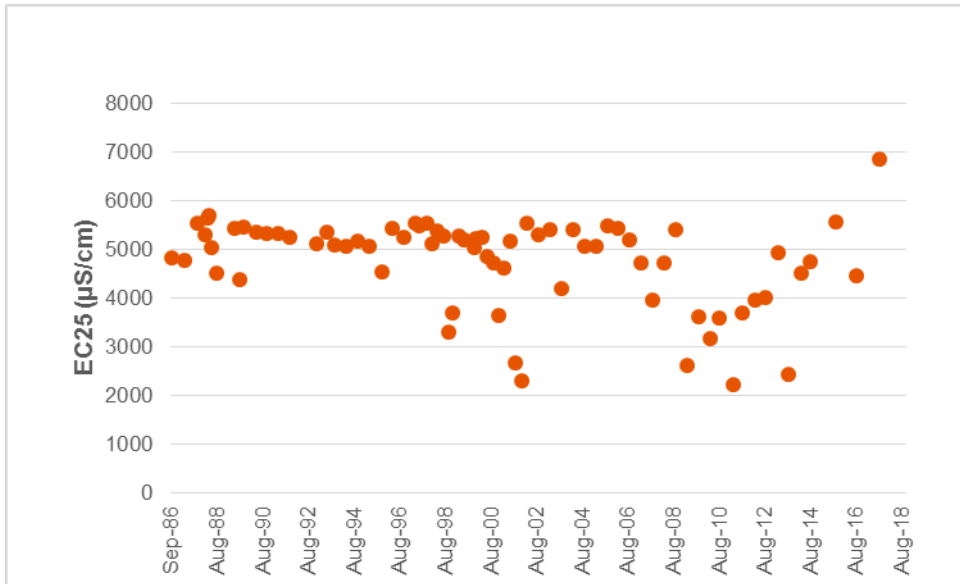
- $n = 41$ ,  $F = 12.28$ ,  $p = 0.001$ ,  $r^2 = 0.391$ , significant ( $P < 0.05$ ) trend, FY18 measurement exceeds 95%-ile

**Figure 16-4 Conductivity trend for Wellcome WWS013**



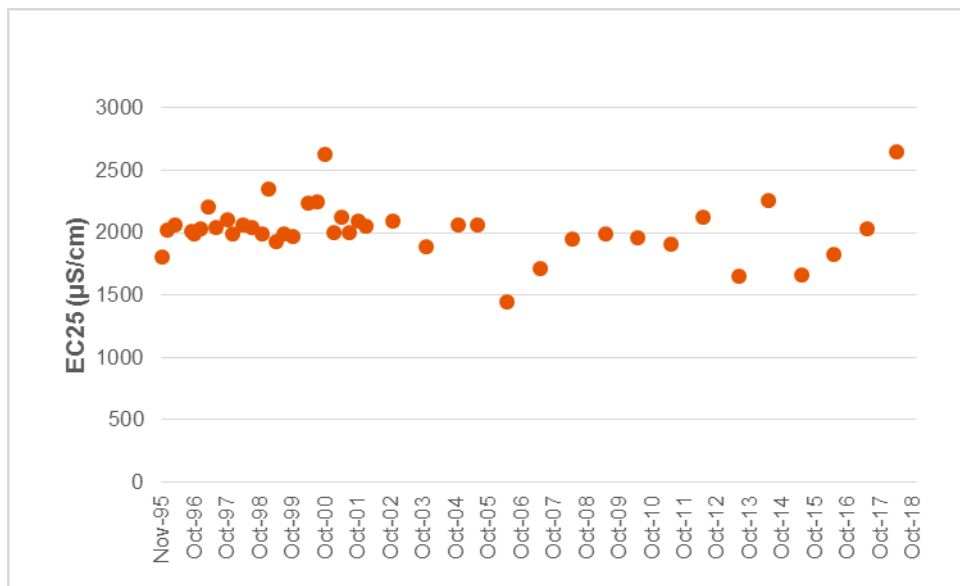
- FY18 measurement exceeds 95%-ile

**Figure 16-5 Conductivity trend for Beatrice Bore HBS004**



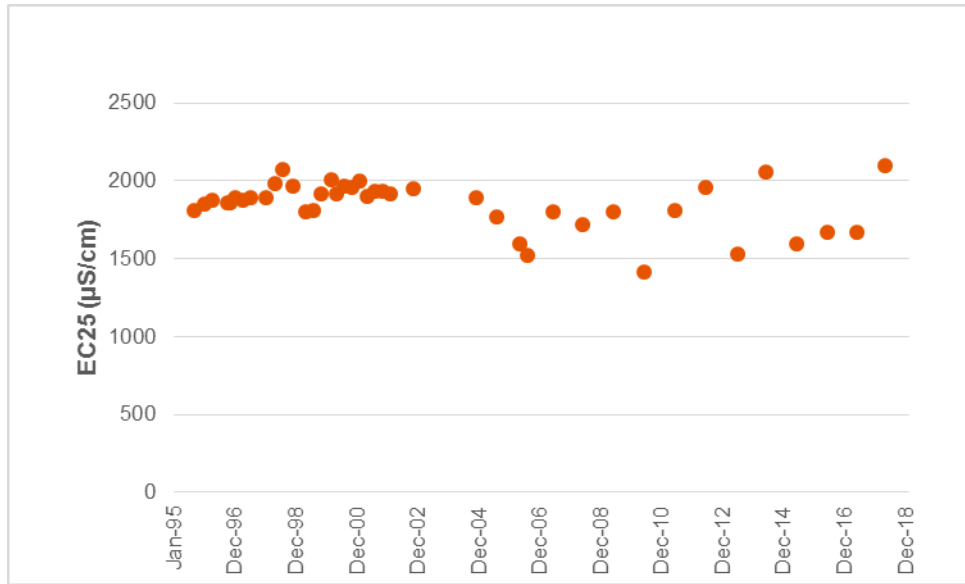
- FY18 measurement exceeds 95%-ile

**Figure 16-6 Conductivity trend for Coward CBC002**



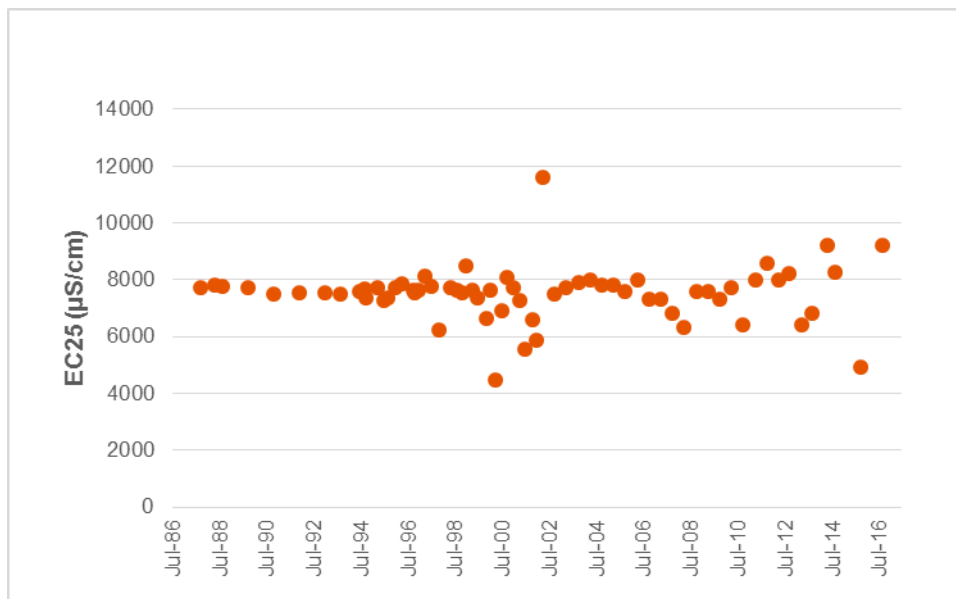
- FY18 measurement exceeds 95%-ile

**Figure 16-7 Conductivity trend for Clayton 1**



- FY18 measurement exceeds 95%-ile

**Figure 16-8 Conductivity trend for Dulkaninna 2**



- FY18 measurement exceeds 95%-ile

**Figure 16-9 Conductivity trend for Welcome WWS002**

## 17 Appendix 6: TEN YEAR FORWARD SCHEDULE FOR GAB ABSTRACTION

Year	Potable Water Township ML/day	Potable Water Plant & Mine ML/day	Non-potable Water Plant & Mine ML/day	Total Water Requirement ML/day	Source of Water GAB Borefield A ML/day	Source of Water GAB Borefield B ML/day
2018	2.8	8.5	22.4	33.7	5.0	28.7
2019	2.8	8.6	22.1	33.5	5.0	28.5
2020	2.8	8.6	22.6	34.0	5.0	29.0
2021	2.8	8.2	22.3	33.4	5.0	28.4
2022	3.0	11.6	27.1	41.7	5.0	36.7
2023	3.0	11.6	27.1	41.7	5.0	36.7
2024	3.0	11.6	27.1	41.7	5.0	36.7
2025	3.0	11.6	27.1	41.7	5.0	36.7
2026	3.0	11.6	27.1	41.7	5.0	36.7
2027	3.0	11.6	27.1	41.7	5.0	36.7
2028	3.0	11.6	27.1	41.7	5.0	36.7

**Notes:**

- As provided to the Minister for Mineral Resources Development in December 2017. An updated schedule will be provided by 1 January 2019.

## 18 Appendix 7: PASTORAL BORES IN THE WELLFIELD AREA

Bore	Flow Measured (M) / Estimated (E)
<i>Boocaltaninna</i>	E
<i>Cannuwaukaninna</i>	E
<i>Chapalanna 2</i>	M
<i>Charles Angus</i>	M
<i>Clayton 1</i>	E
<i>Clayton 2</i>	E
<i>Clayton Dam 2</i>	E
<i>Cooranna</i>	E
<i>Cooryaninna</i>	E
<i>Dulkaninna</i>	E
<i>Georgia</i>	E
<i>Highway (Brolga)</i>	M
<i>Jewellery Creek</i>	E
<i>Kopperamanna</i>	E
<i>Lake Harry</i>	E
<i>Marion</i>	E
<i>Maynards</i>	E
<i>Morphetts</i>	E
<i>Morris Creek</i>	M
<i>Mulka</i>	E
<i>Muloorina</i>	M
<i>Mungeranie</i>	E
<i>Peachawarinna</i>	E
<i>Peters</i>	E
<i>Poonarunna</i>	E
<i>Prices</i>	E
<i>Sinclair</i>	E
<i>Tarkanina #2</i>	M
<i>Yarra Hill</i>	M

## 19 Appendix 8: GAB SPRING ZONES

Hydrogeological zone	Springs within zone
Coward	Blanche Cup
South West	Hermit Hill, Old Finniss, Old Woman
Western Lake Eyre South	Emerald, Gosse, McLachlan
South East	Davenport, Welcome
North East	Bopeechee, Sulphuric, Dead Boy, West Finniss
Wellfield A	Beatrice, Venables, Fred