BHP

OLYMPIC DAM

Great Artesian Basin Wellfields Report

1 July 2019 – 30 June 2020

Report No.ODENV060

BHP acknowledges the Arabana and Dieri peoples as the traditional custodians of the land upon which our Olympic Dam asset draws its water. We pay our respects to Elders past, present and emerging and the contribution they and the broader Aboriginal Community have made to the region and the state of SA.

OLYMPIC DAM

GREAT ARTESIAN BASIN WELLFIELDS REPORT

1 JULY 2019- 30 JUNE 2020

The Hon. Dan Van Holst Pellekaan, MP
Minister for Energy and Mining
Level 17, 25 Grenfell Street,
ADELAIDE SA 5000

DISTRIBUTION

Department for Energy and Mining (DEM)	Director Mining Regulation Manager, Mining Compliance and Regulation
Department for Environment and Water (DEW)	Chief Executive Director, Water Science and Monitoring
Environment Protection Authority (SA)	Director Operations Manager Radiation Protection
Great Artesian Basin Stakeholder Advisory Committee	Chair
South Australian Arid Lands Landscape Board	Presiding Member

INTERNAL DISTRIBUTION

BHP Minerals Australia	Vice President External Affairs Vice President HSE Head of Environment A&I
BHP Olympic Dam/ Adelaide	Asset President Olympic Dam General Manager Mine Olympic Dam General Manager Surface Operations Olympic Dam General Manager Surface Technical Olympic Dam General Manager Engineering and NPI Operations Olympic Dam Head of Corporate Affairs SA Olympic Dam Principal Legal Olympic Dam Head of HSE Olympic Dam Manager Environment A&I

Table of Contents

List of Figures

List of Tables

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 FY20 period 1 July 2019 to 30 June 2020.

1.1 Abstraction

The average abstraction of Olympic Dam during FY20 was 33.3 ML/d comprising 5.3 ML/d from Wellfield A and 28 ML/d from Wellfield B, representing 17% increase for Wellfield A and a 17% increase for Wellfield B compared with FY19. Monthly total abstraction rates were variable, ranging from 27.5 to 38.9 ML/d, with lowest total abstraction in September 2019 and the highest in February 2020.

Total estimated abstraction from the wellfields area, including Olympic Dam sources and pastoral wells in FY20 is estimated at 48 ML/d.

1.2 Wellfield A

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

In FY20, average drawdown between sites GAB8 and HH2 was 1.45 m, which is less than the 4 m compliance criteria. 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 FY20 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 2,740km^2, well within the 4,450 km^2 compliance criterion. The average drawdown at monitoring bores S1 and S2 (dedicated monitoring wells closest to key GAB springs) is 2.3 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 decreased slightly in the Wellfield A, South West, North Eastern and South Eastern Hydrogeological zones and increased in the Western Lake Eyre South and Hydrogeological Zone. 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 electrical conductivity data indicate no significant change from previously identified trends.

1.5 Monitoring Data

Monitoring of GAB bores and springs was conducted as per the Monitoring Program – Great Artesian Basin (GAB) 2019 (BHP , 2019a). A summary of compliance to monitoring plan is presented in Appendix 1.

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 FY19. 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 that 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) 2019 (BHP , 2019a).

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.
- In FY19 average abstraction increased slightly to 28.4 ML/d but was affected by the acid plant outage between August to October 2018.
- In FY20 average abstraction increased by 17% to 33.3 ML/d with minimal unplanned plant downtime.

4.2 Olympic Dam Abstraction during the Current Review Period

The average abstraction during FY20 was 33.3 ML/d comprising 5.3 ML/d from Wellfield A and 28 ML/d from Wellfield B, representing 17% increase for Wellfield A and a 17% increase for Wellfield B compared with FY19 (Table 4-1), but in line with recent historical extraction rates.

Monthly total abstraction rates were variable, ranging from 27.5 to 38.9 ML/d, with lowest total abstraction in September 2019 and the highest in February 2020 (Table 4-2).

4.3 Total Abstraction

Flow rate from 29 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 29 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 29 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 FY20 is estimated at 48 ML/d.

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
30-Jun-2019	4.5	23.9	28.4
30-Jun-2020	5.3	28.0	33.3

Table 4-2 Monthly average abstraction rate (ML/d), FY19

	Wellfield A							*Wellfield B*				*Wellfields*
	GAB06	***GAB12***	***GAB14***	***GAB15***	***GAB16***	***GAB18***	**Total**	***GAB51***	***GAB52***	***GAB53***	**Total**	**Total**
Jul-19	0.45	0.07	0.82	0.00	1.40	0.77	3.51	11.57	9.02	9.81	30.40	33.91
Aug-19	0.54	0.09	0.84	0.00	0.33	0.78	2.57	10.56	8.23	9.00	27.79	30.36
Sep-19	0.40	0.12	0.41	0.00	1.81	0.38	3.13	9.16	7.31	7.90	24.36	27.49
Oct-19	0.54	0.06	1.39	0.00	2.06	1.28	5.32	9.47	7.56	8.13	25.16	30.48
Nov-19	0.57	0.13	0.89	0.00	1.57	0.82	3.98	9.68	7.69	8.31	25.68	29.66
Dec-19	0.49	0.11	1.67	0.00	2.43	1.63	6.33	11.13	8.79	9.44	29.36	35.69
Jan-20	0.46	0.24	1.74	0.00	2.36	1.64	6.44	8.23	6.59	7.39	22.21	28.65
Feb-20	0.60	0.39	2.23	0.00	2.77	1.30	7.27	12.00	9.43	10.16	31.59	38.86
Mar-20	0.58	0.56	1.70	0.00	2.57	0.34	5.76	12.31	9.59	10.36	32.26	38.01
Apr-20	0.38	0.11	1.91	0.00	2.70	1.75	6.85	9.60	9.25	8.23	27.08	33.92
May-20	0.49	0.34	2.12	0.00	2.36	1.65	6.96	12.17	9.54	8.13	29.84	36.80
Jun-20	0.32	0.01	1.33	0.00	1.99	1.51	5.15	11.68	9.17	9.90	30.75	35.90
Average	0.48	0.19	1.42	0.00	2.03	1.15	5.27	10.63	8.51	8.89	28.03	33.30
Total ML	177.2	68.0	519.2	0.0	741.4	422.1	1927.9	3889.6	3115.1	3254.8	10259.5	12187.4

Note:

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

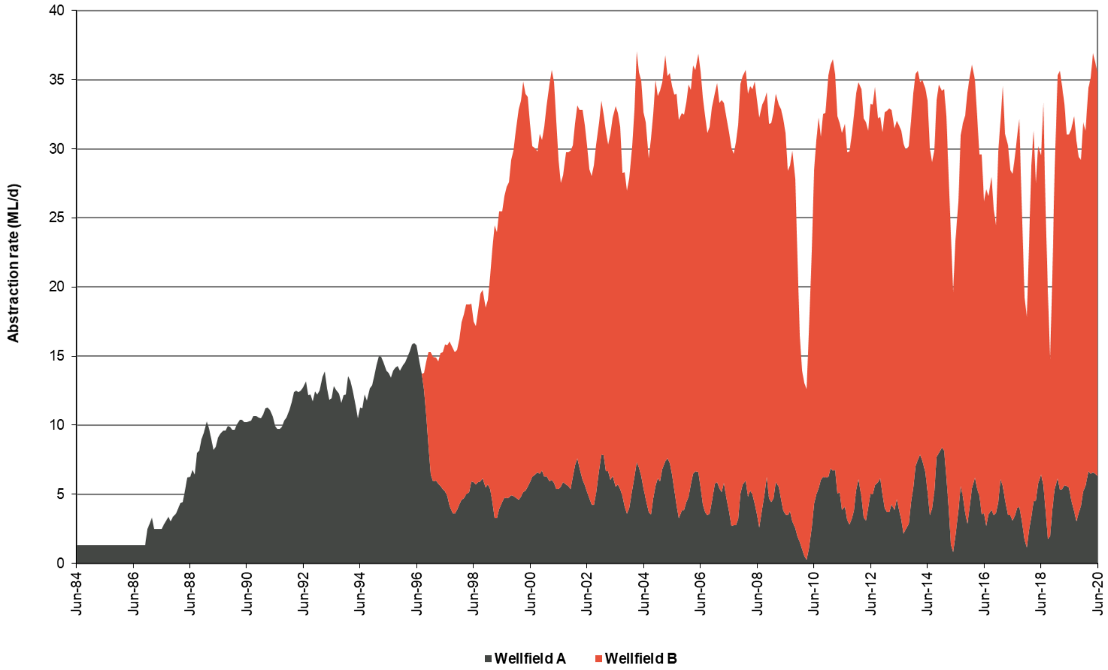


Figure 4-1 Historical abstraction from Wellfields A and B – 3 month moving average

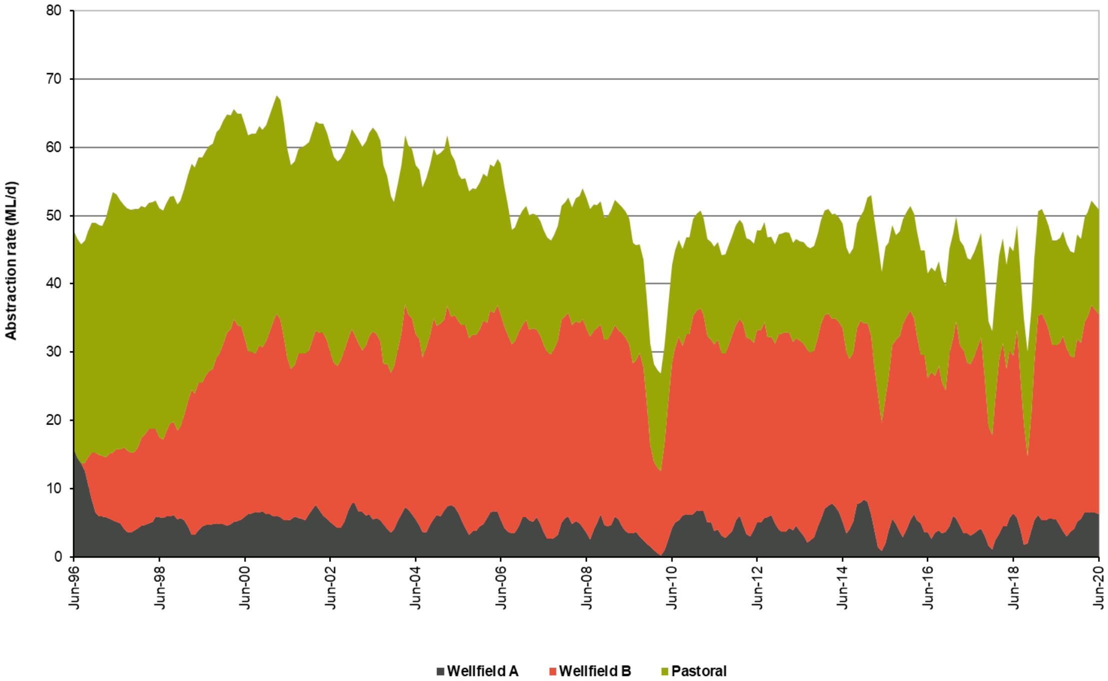


Figure 4-2 Historical abstraction from the Wellfields area – 3 month moving average

- 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 Criteria

- 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 FY20 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) 2018 (BHP , 2018a).

5.4.1 Wellfield A Hydrogeological Zone

Average drawdowns within the zone have locally increased during FY20 (Table 5-1) and are greater than the 5-year average drawdown for the period FY15-19. Wellfield A abstraction rates were consistently above 5 ML/d for most of FY20 (Table 4-2) resulting in increased drawdowns measured near the production wells. Drawdowns at wells further from the production centre show only slight increases.

Drawdown at wells within the Wellfield A zone range from 20.5m at GAB14A to 5.6 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 for FY20 shown in Figure 5-1.

5.4.2 North East Hydrogeological Zone (NESB)

Average drawdowns within the zone have increased during FY20 (Table 5-1) with the exception of HH2 and are slightly above the 5 year average drawdown.

Drawdowns for wells within the North East zone ranged from 0.9 m at HH2 to 3.2 m at GAB 10.

Groundwater head in the NESB would be expected to respond to changes in abstraction from Wellfield A to a lesser extent than the Wellfield hydrological zone due to the increased distance from Wellfield A and the damping 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 FY20 and are comparable with the 5 year average (Table 5-1).

Table 5-1 Wellfield A – summary of drawdown FY20

Area	Well	Reference Elevation (m AHD)	Mean Drawdown FY20 (m)	Mean Drawdown FY19 (m)	FY15-19 Mean Drawdown (m)
Wellfield Sub-basin	GAB1	22.4	8.9	8.0	7.7
	GAB2	22.8	8.4	7.5	7.6
	GAB5A	27.7	7.5	6.8	6.5
	GAB6A	22.2	11.5	9.8	9.2
	GAB12A	27.2	17.3	15.3	14.2
	GAB13A	30.4	17.2	15.8	14.2
	GAB14A	30.1	20.5	17.9	15.8
	GAB16A	24.5	16.0	13.2	12.3
	GAB17	28.4		9.7	9.6
	GAB18A	28.8	19.0	17.4	14.9
	GAB21	25.4	14.6	12.6	11.8
	GAB22	24.7	14.3	12.7	11.4
	GAB23	27.7		9.4	12.3
	MB2	22.2	6.2	5.8	5.8
	New Years Gift	22.6	9.7	8.6	8.2
	Venables	20.6	5.6	5.1	5.1
Northeast Sub-basin	GAB7	16	3.1	2.4	2.9
	GAB8	11.7	2.0	1.8	1.8
	GAB10	19	3.2	2.6	2.6
	GAB11	20.7	3.1	2.6	2.5
	GAB19	15.1	2.5	2.3	2.2
	HH2	8.2	0.9	0.9	0.8
South West Sub-basin	HH1	11.1	0.1	0.1	-0.1
	HH3	9.3	0.1	0.0	-0.1
	HH4	14	0.1	0.1	0.4
Extension	GAB24	39.2	6.5	5.5	5.4

Area	Well	Practical reference head (m AHD)	Mean Drawdown FY20 (m)	Mean Drawdown FY19 (m)	FY15-19 Mean Drawdown (m)
Open GAB	MB1	55.5	0.2	0.2	0.0
	MB5	75.5	0.8	0.6	0.5
	MB6	75.0	0.7	0.5	0.5

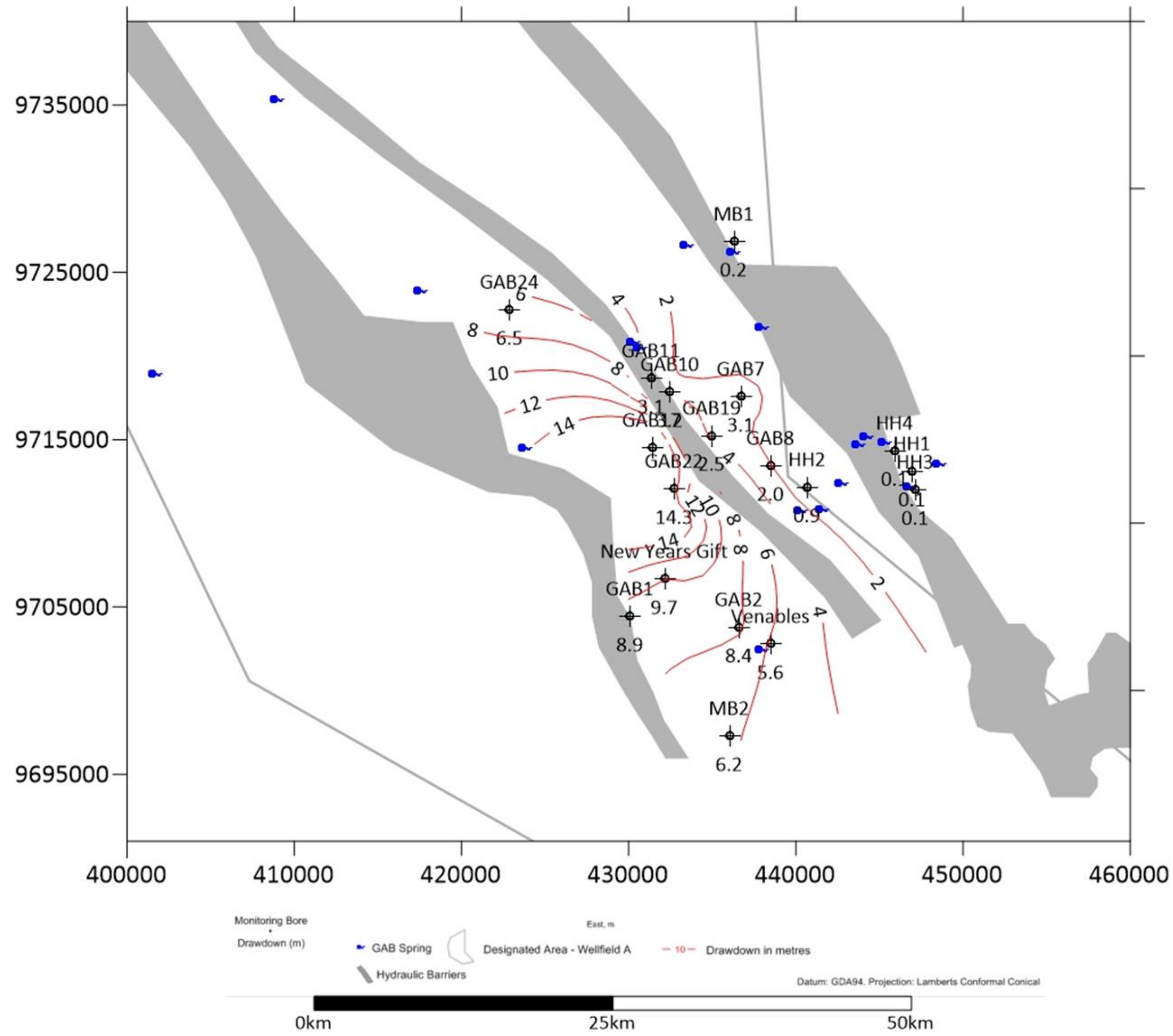


Figure 5-1 Wellfield A total drawdown contours for FY20

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 FY20 average drawdown at GAB8 was 2.0 m and 0.9 m at HH2 (Table 5-1), therefore average boundary drawdown was 1.45 m, similar to that reported since 2010 and less than 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 FY20 hydraulic gradient between wells in the NESB (GAB7, GAB8, GAB10, GAB11, and GAB19) and HH2 remained above or equal to 0.0009 m/m (6 month moving average) during FY20, equal to the leading indicator and similar to those reported since 2000 (Figure 5-3).

During the later part of FY20 the monthly calculation of the leading indicator fell slightly below the target range of 0.0009 m/m during December, February, March and June with recoveries above the leading indicator target in between. No management action is required at this time.

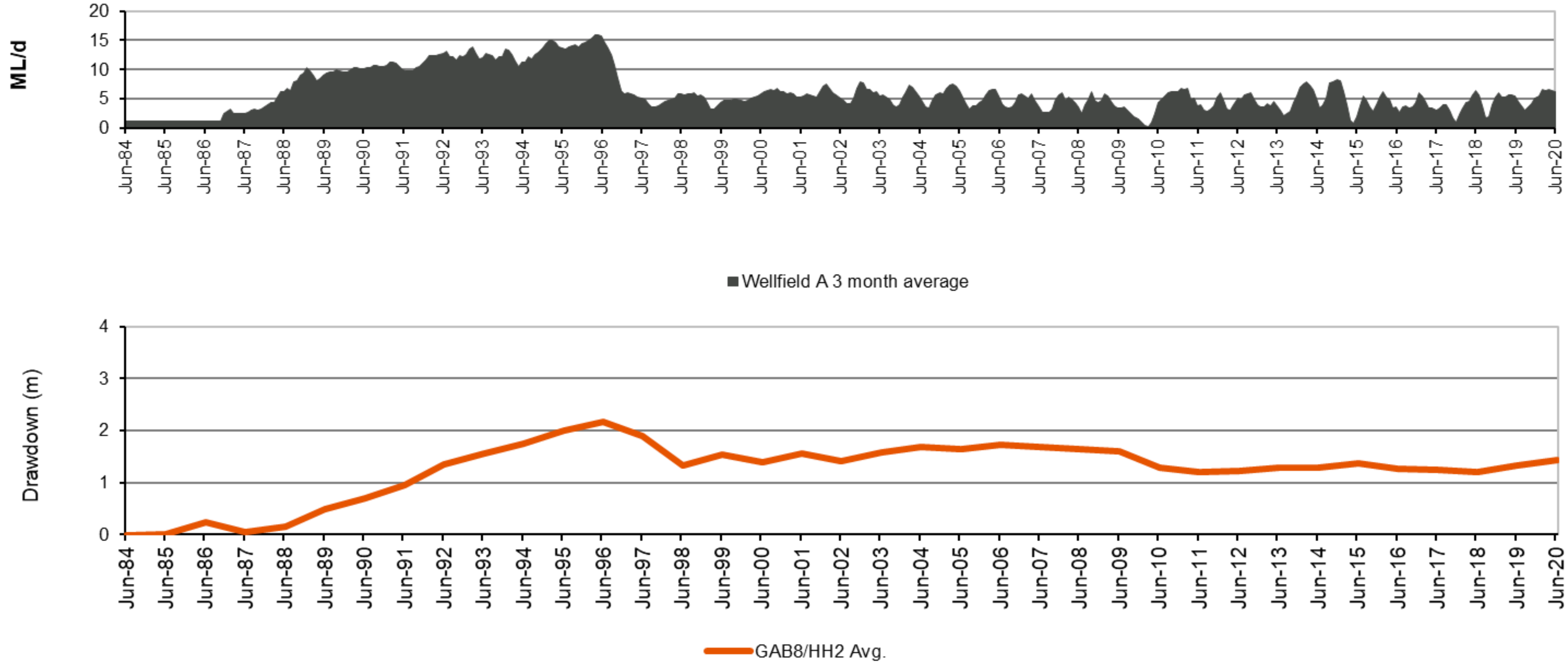


Figure 5-2 Wellfield A Compliance Bores – GAB8/HH2

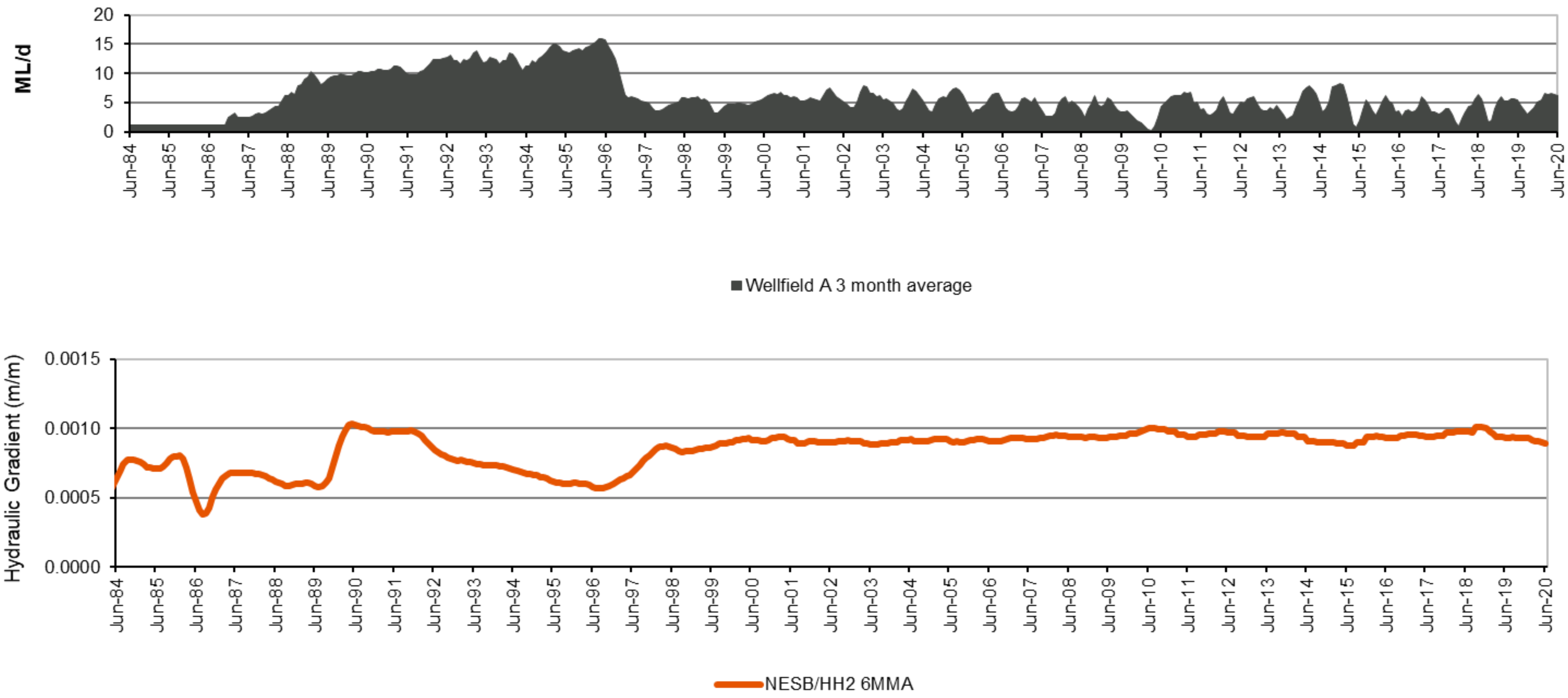


Figure 5-3 Wellfield A Leading Indicator – NESB Hydraulic Gradient

6 WELLFIELD B AQUIFER PRESSURE RESPONSE

Drawdown responses due to Wellfield B are measured and reported to 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^2.

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^2.
- 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 pattern 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 FY19 and earlier reports. Individual drawdown at bores used to create Figure 6-1 are listed in Table 6-1. General interpretative comments, describing the drawdown pattern or drawdowns reported at individual sites, are:

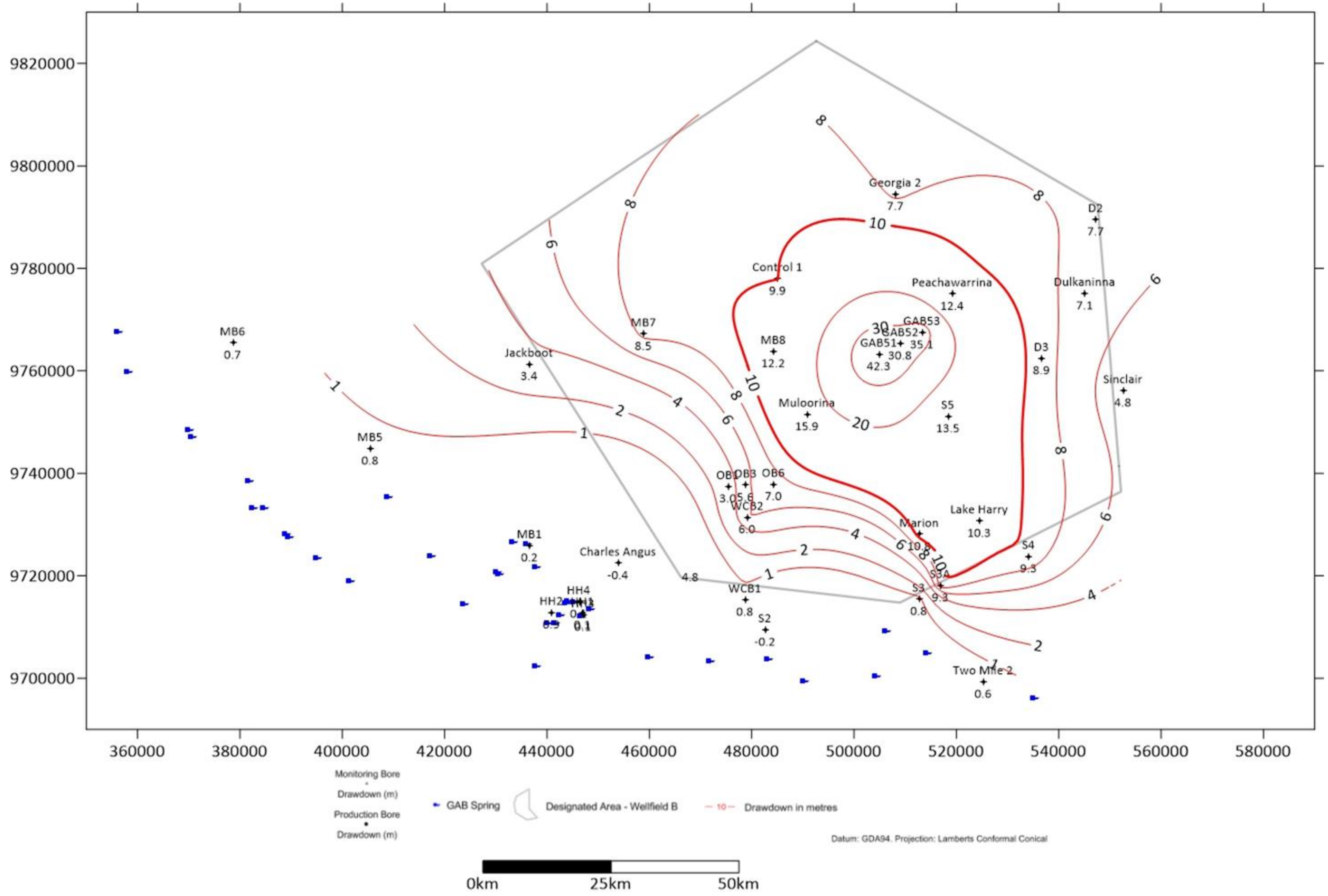
- Drawdowns are reported at the production bores GAB51, GAB52, and GAB53 as the average difference between respective PRHs and flow pressures. The 3 production wells were not shut in during FY20.
- The largest drawdown reported in an observation bore in FY20 is 15.9 m at Muloorina.
- Reported drawdown exceeds 10 m in six bores (Muloorina H/S, Peachawarrina, S5, Lake Harry, Marion and MB8).
- Monitoring well S1 has recorded a rapid increase in drawdown to 3.9m in June 2019 and an FY20 average of 4.8m (Figure 6-4). Other wells closer to wellfield B do not record a similar response (OB1, OB3, OB6, and WCB2) (Table 6-1). The cause of the anomalous drawdown is under investigation but is suspected to be a partial failure of the well casing underground. A downhole assessment of the S1 well to identify any structural failure was planned in FY20 but was delayed due to Covid-19 restrictions. The work will be completed by mid FY21. S1 is not used for drawdown contouring in FY20.
- 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 many 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 FY19, revealing larger than previously expected drawdown due to pastoral abstraction. Drawdown was measured at 3.4m in FY20 due to BHP allowing pastoral access to Jackboot well as part of a drought relief agreement.
- 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 6-1were 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 FY21

Bore	PRH (m AHD)	Mean Drawdown FY20 (m)	Mean Drawdown FY19 (m)	Change in Mean Drawdown (m)
Charles Angus	50.5	-0.4	-2.4	2.0
D2	90.5	7.7	6.9	0.7
D3	86	8.9	8.4	0.5
Dulkaninna	88	7.1	5.8	1.4
GAB51[1]	87.5	42.3	27.1	15.3
GAB52[1]	87.5	30.8	20.5	10.4
GAB53[1]	88	35.1	16.6	18.5
Georgia 2	83.5	7.7	5.9	1.8
HH1	11.1	0.1	0.1	0.0
HH2	8.2	0.9	0.9	0.0
HH3	9.3	0.1	0.0	0.1
HH4	14	0.1	0.1	0.0
Jackboot	84	3.4	2.0	1.3
Lake Harry	84.9	10.3	10.0	0.3
Marion	87.5	10.8	11.7	-0.8
MB1	55.5	0.2	0.2	0.1
MB5	75.5	0.8	0.6	0.3
MB6	75	0.7	0.5	0.2
MB7	87	8.5	8.1	0.3
MB8	88	12.2	11.6	0.6
Muloorina	85.4	15.9	13.5	2.4
OB1	80	3.0	2.9	0.1
OB3	82	5.6	4.9	0.7
OB6	83	7.0	6.3	0.7
Peachawarrina	85.2	12.4	11.2	1.2
S1[2]	70.5	4.8	1.4	3.4
S2	54	-0.2	-0.2	0.0
S3	72.5	0.8	0.3	0.5
S3A	85	9.3	9.4	-0.1
S4	87	9.3	9.5	-0.1
S5	86.5	13.5	13.0	0.4
Sinclair	87	4.8	4.9	-0.1
Two Mile 2	72	0.6	0.5	0.1
WCB1	64.5	0.8	1.0	-0.2
WCB2	83	6.0	5.5	0.5

Notes:

1. Drawdown for wells GAB51-53 was measured with flow pressures during FY20
2. S1 was not used for contouring during FY20 as the greatly increased drawdown is suspected to indicate a potential failure of the well casing below ground.
3. Negative numbers indicate a reduction in drawdown (i.e. an increase in head) during FY20



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

Figure 6-1 Wellfield B total drawdown contours for FY20, 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) 2019 (BHP, 2019a). 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 (36.1 m, average of GAB51-53), MB8 (12.2 m) and Georgia Bore (7.7 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 9.95 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).

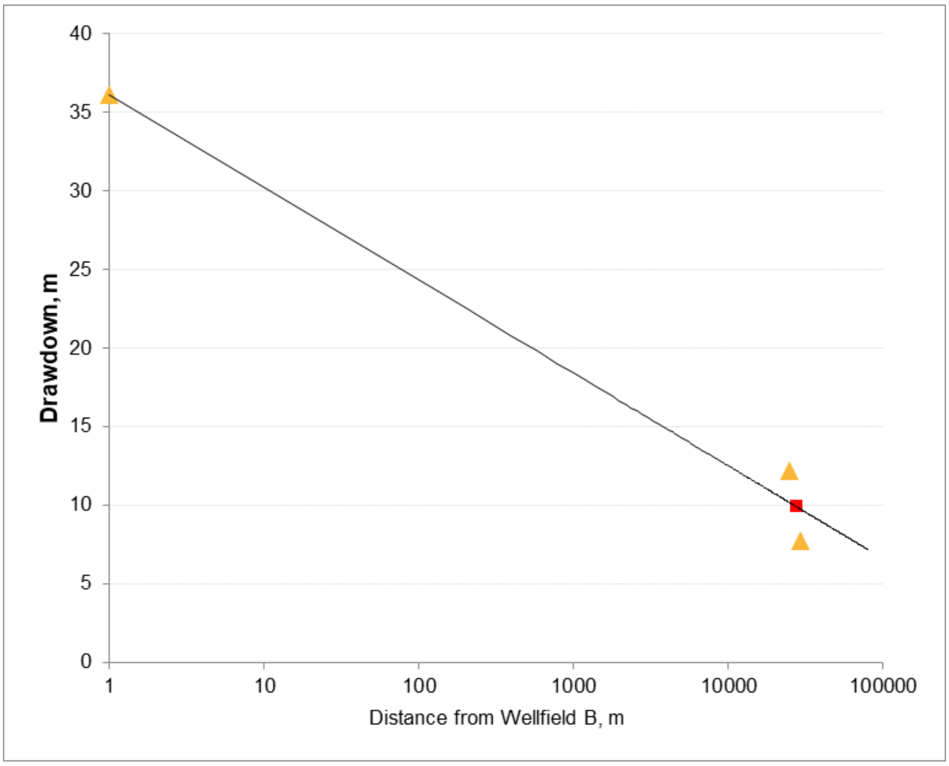


Figure 6-2 Assessment of drawdown at the control point

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 2,740 km^2, below the 4,450 km^2 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 limited 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 less than the modelled area due to ODC not abstracting the full modelled volume of 36 Ml/d (FY20 abstraction was 28.0 ML/d).

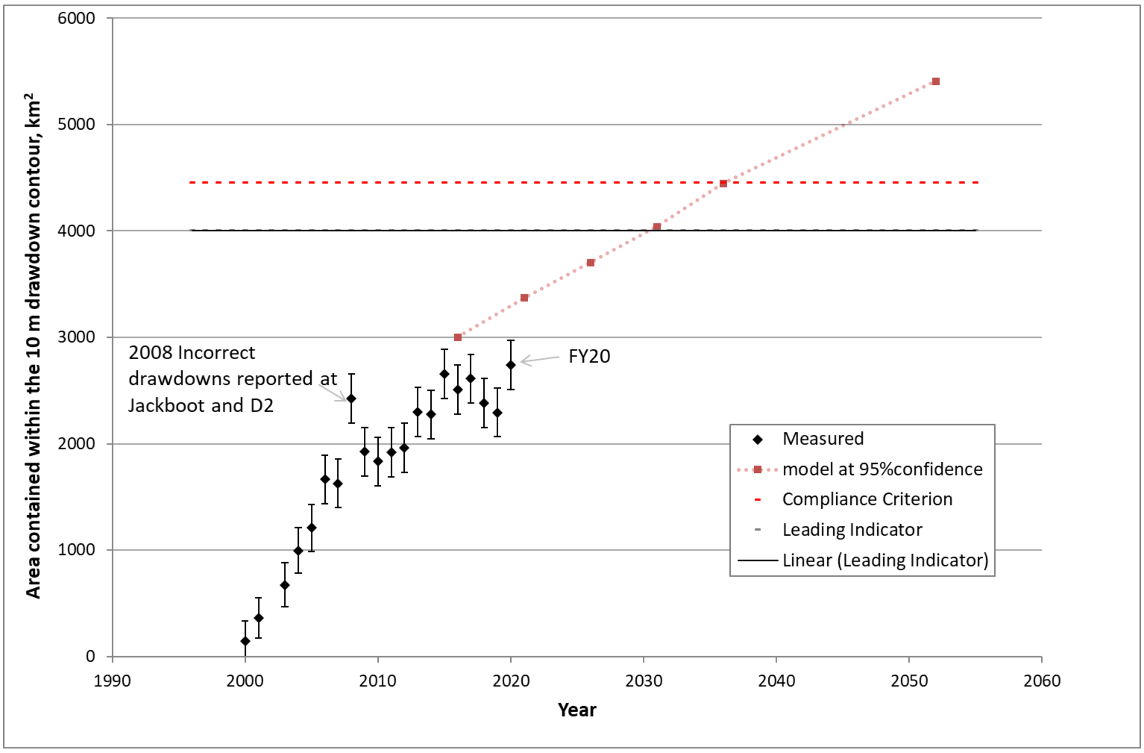


Figure 6-3 Area Contained within the 10 m Drawdown Contour

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 2020

Bore	PRH (m AHD)	Mean Potentiometric Head FY20 (m AHD)	Mean Drawdown FY20 (m)
S1	70.5	65.7	4.8
S2	54.0	54.2	- 0.2
S1 – S2 12 month moving drawdown average			2.3

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 2.3 m, less than the 4 m drawdown compliance criteria.

The rapid increase in drawdown to 4.8m at S1 is localised to the monitoring well. Other wells closer to wellfield B do not record a similar response (OB1, OB3, OB6, and WCB2) (Table 6-1). The cause of the anomalous drawdown is under investigation but is suspected to be a partial failure of the well casing underground. A downhole assessment of the S1 well to identify any structural failure was planned in FY20 but was delayed due to Covid-19 restrictions. The work will be completed by mid FY21.

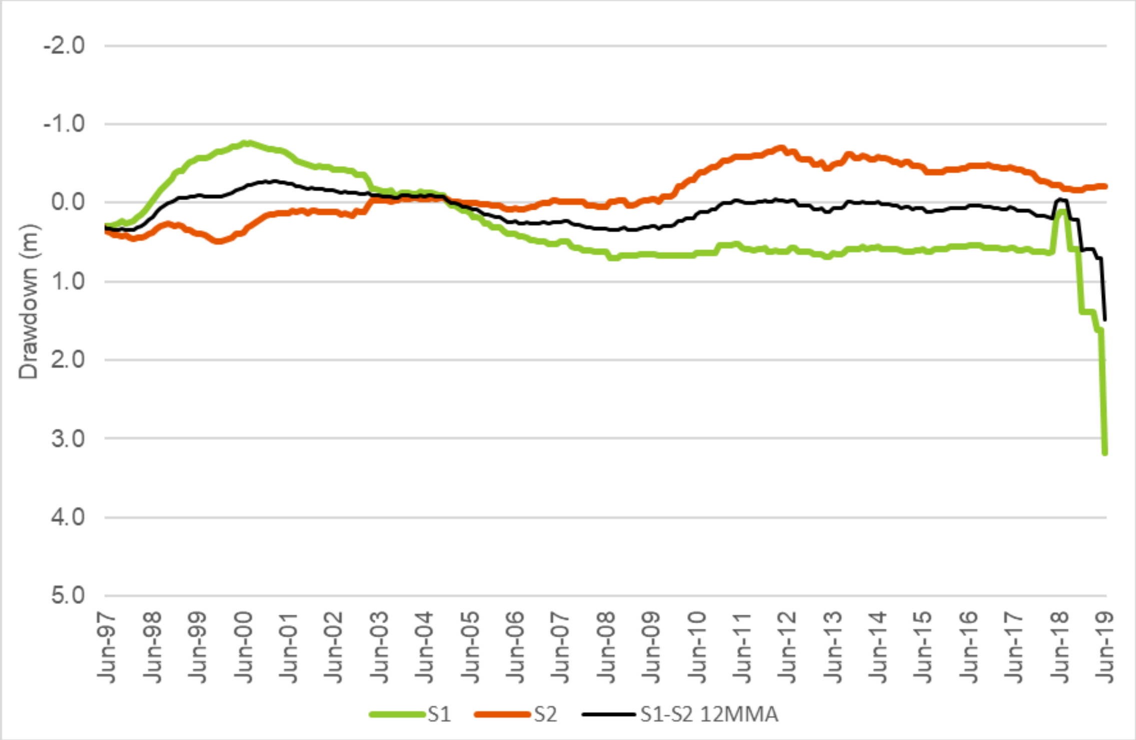


Figure 6-4 Drawdown at Wellfield B Compliance Bores S1 and S2

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^2), 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
	PRH (m AHD)	Drawdown (m)	(m)
Callanna	48.9	0.6	0.8
Cannuwaukaninna 2	90.3	7.4	5.6
Chapalana 2	92		2.7
Charles Angus	50.5	-0.4	2.7
Clayton #1*	71.5		10.9
Clayton #2*	73.8		10.9
Cooranna	43.3	-16.7	4.3
Cooryaninna	96.3	8.4	4.1
Dulkaninna 2	89	7.1	7.4
Jackboot	84	3.4	5.0
Kopperamanna	92.1	10.3	3.7
Lake Harry	84.9	10.3	15.2
Marion	87.5	10.8	15.0
Maynards#	55.4		1.4
Morphetts#	54.3		0.9
Morris Creek#2	63	-5.2	4.1
Muloorina	85.4	15.9	16.2
Peachawarrina	85.2	12.4	13.4
Peters	52.4	4.8	12.0
Tarkanina #2*	86.8		6.4
Yarra Hill*	87.7		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.
5. * Wells were not shut in at the request of land owner
6. # Well was not shut in due to poor headworks condition

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 (15.9m) was at Muloorina in FY20.

Shut in pressures could not be collected from several sites in FY20. Clayton 1 and 2, and Yarra Hill were not shut in at the request of the land holder. Tarkaninna # 2 has failed below ground and has an uncontrolled flow to surface. Morphetts and Maynards bores were not shut in due to poor headworks condition. Chapalana 2 bore had a broken monitoring valve which will be replace in FY21.

Two monitoring wells recorded drawdown in excess of the 1997 EIS predictions. Cannuwaukaninna and Kopperamanna continue to record drawdown which are anomalies when compared to other wells in the area, for example drawdown from dedicated monitoring well D2 which is closer to Wellfield B reports a drawdown of 6.9m. The anomaly drawdown cause is unknown however BHP will undertake a downhole geophysical survey of the wells in FY21/22 to determine whether physical well condition is a causal factor.

Cooryaninna measured a drawdown of 8.4 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 7.7 and 4.8 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

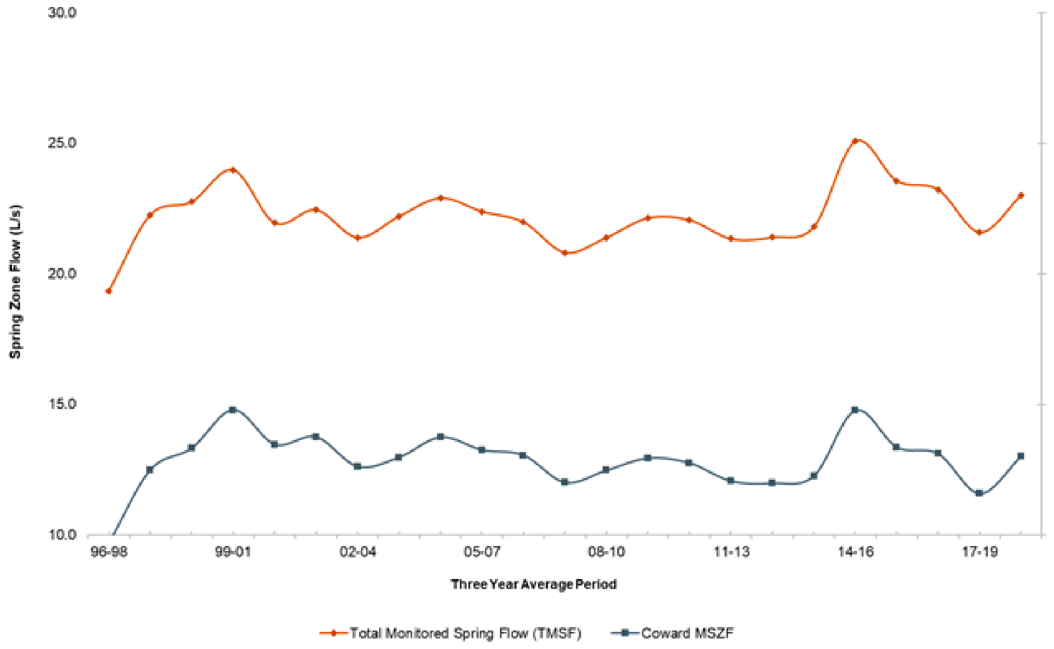
Spring flows are presented by hydrological zone based on Kinhill Stearns (1984) and Kinhill Engineers (1997a) (updated Golder Associates 2016) and further refined in the BHP GAB Contingency Plan (BHP 2015). Individual springs within each zone are listed in Appendix 8.

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 FY20

Hydrogeological Zone	No. of records in period	2018-2020 average (L/s)	1996-1998 average (L/s)	Predicted Loss (%) 1982 EIS	Predicted Change (% 1996-2016) 1997 EIS[1]	EIS Predicted Decline (%)	2018-2020 Flow Change (%)
Coward	3	12.99	9.68	<1	0	<1	+34.2
South West	3	1.31	1.13	<1<3	-1	<1-<3	+16.3
Western Lake Eyre South	3	4.12	4.02	2[2]	- 3-17	3-17	+ 2.3
South East	3	2.76	2.52	<1	- 3-16.5	3-16.5	+ 8.1
North East	3	1.58	1.59	8-20	- 1	8-20	-0.8
Wellfield A	3	0.28	0.39	60-100*	-	60-100	- 29.1



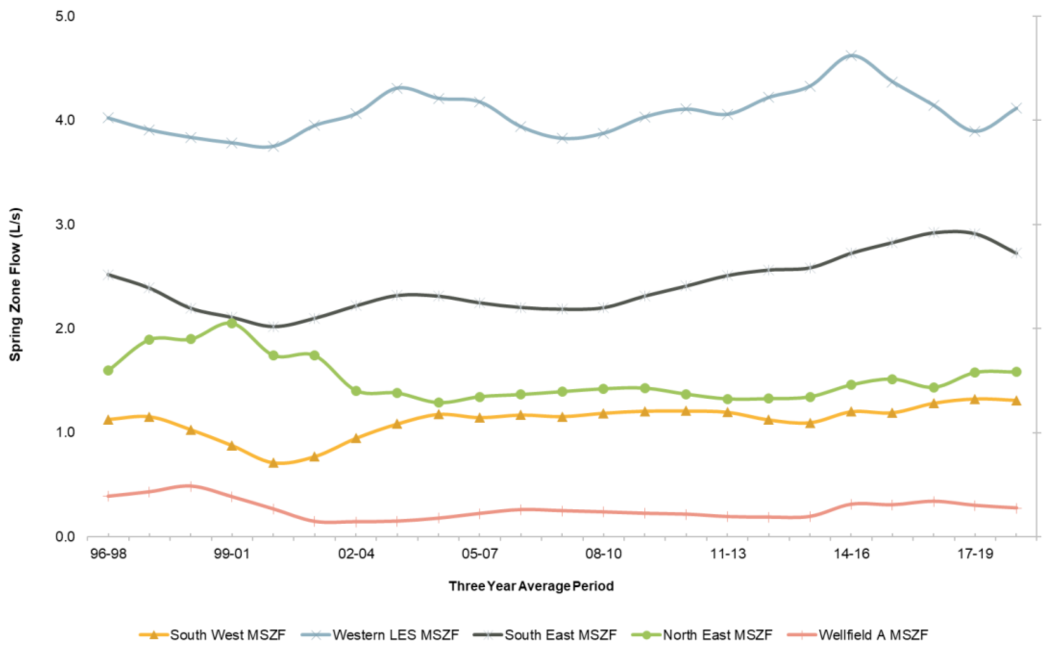


Figure 7-1: Total Monitored Spring Flow (TMSF) and Monitored Spring Zone Flows (MSZF)

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 increased slightly in FY20 within historical ranges.

The flow rate was 34% higher than EIS background (Table 7-1).

7.3.2 South West Zone

GAB Spring flow rates in the South Western Zone decreased slightly within historical ranges. The flow rate was 16.3% higher than EIS background (Table 7-1).

7.3.3 Western Lake Eyre South Zone

GAB Spring flow rates in the Western LES zone increased slightly within the range of historical observations. The flow rate was 2.3% higher than EIS background (Table 7-1).

7.3.4 South Eastern spring Zone

GAB Spring flow rates in the South Eastern Zone decreased slightly but maintain the increase in flow observed since 2008. The flow rate was 8.1 % 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 0.8% 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 decreased slightly within the range of historical observations. The flow rate was 29.06% 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 FY20 and the previous reporting period is provided in Appendix 3. Large variations in average EC 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 Finniss HOF033) showing a decreasing trend (Figure 8-1).

Data shown in Appendix 3 also include the 5th and 95th percentile values for the historical range of values, and identify where the FY20 average is above the 95th percentile. This method identified three (3) locations in FY20, Bopeechee HBO007, Fred LFE001 and Welcome WWS 013.

The two Welcome Springs are highly disturbed due to stock grazing and defecation and high EC values have been historically recorded. Fred LFE001 has recorded occasional high one off salinity readings historically and exhibits no long term increasing trend.

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

8.3.1 Wellfield A Salinity Trends

Three of the five sites identified in Section 8.3 are within the Wellfield A region:

- One (Bopeechee HBO007) and an increasing salinity trend where FY20 measurement exceeded the 95 percentile
- One site with decreasing salinity trend (Old Finniss HOF033),
- One site (Fred LFE001) where FY20 measurement 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 FY20 above the 95th percentile at Fred LFE001 (Figure 16-3) is not reflective of an increasing trend at this spring, the spring has recorded occasional high salinity readings in the past.

8.3.2 Wellfield B Salinity Trends

Two of the five sites identified in Section 8.3 are at sites within the Wellfield B region.

- Two with increasing salinity trend; Welcome Spring WWS001 (Figure 16-4) and Welcome Spring WWS013 (Figure 16-5)
- One site Welcome Spring WWS013 (Figure 16-5) where FY20 measurement 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.

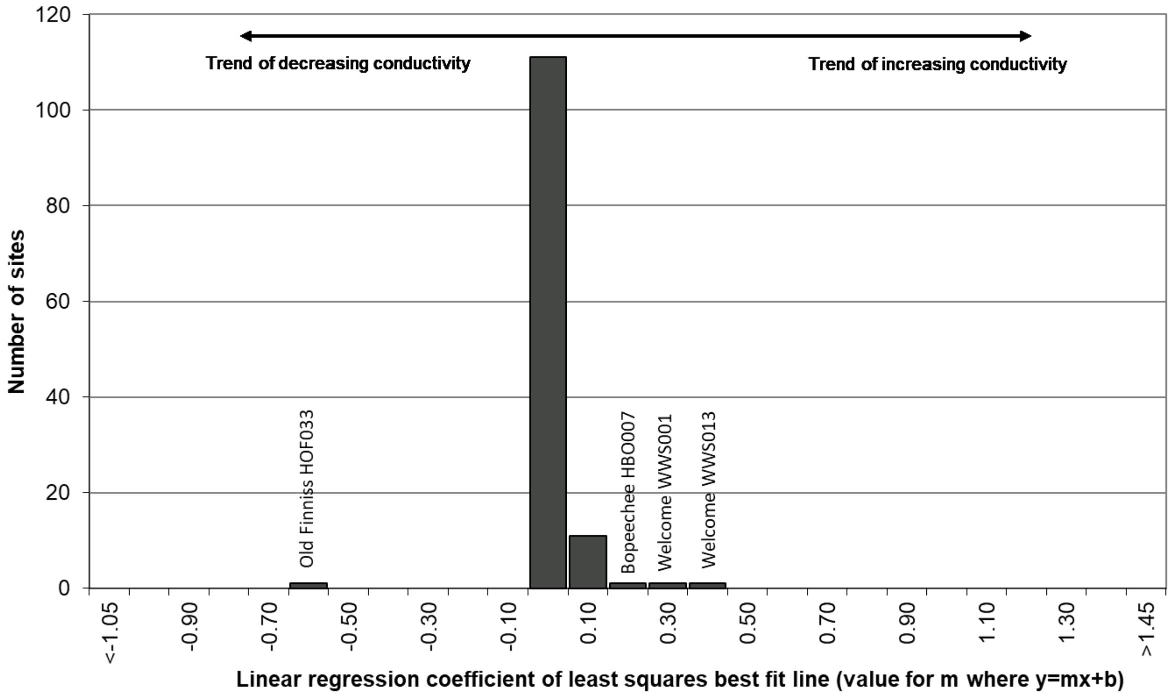


Figure 8-1 Frequency distribution of conductivity trends for the wellfields area

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 FY20 the GAB Industrial Water Efficiency of the operation was 1.16kL/t compared to the target of 1.16 kL/t and actual of 1.1kL/t for FY19. The increase in FY20 compared to FY19 was due to a number of factors, including:

- An increase in Smelter throughput and therefore water use, that was not accompanied by a proportional increase in material milled. This was due to higher plant copper grades, due to the recommencement of the treatment of high copper smelter slag, and higher mine grades which increased concentrate production.
- The use of process and potable water for airport runway and accommodation construction projects. Water quality requirements to meet engineering standards necessitated the use of high quality water for these projects.

Domestic water use during FY20 averaged 2.5 ML/d compared to 2.4 ML/d in FY19.

The current 10-year water use schedule, as provided to the Minister for Mineral Resources Development in January 2020, is presented in Appendix 6. An updated schedule will be provided by 1 January 2021.

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. The 10 year forecast includes current business as usual (Bau) operations only and includes the water demand of up to 42 ML/d being studied as part of the Olympic Dam Resource Development Strategy (OD-RDS).

To realise the abstraction rate of 42 ML/d to support the OD-RDS additional production wells and associated pipeline infrastructure will be required. This additional water take is expected to come from Wellfield B and no exploration for additional wellfields is currently planned.

10.2 Future Perspective

The 10-year Bau forecast (Appendix 6) predicts total wellfield abstraction to reach 41.7 ML/day by 2023 and remain constant to 2030. 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.

The OD-RDS GAB water demand of up to 42 ML/d is being studied and is subject to State, Federal and BHP Board approval.

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 265 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 current 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 1.45 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 2,740 km^2, below the 4,450 km^2 compliance criteria and consistent with modelling predictions. The latest reported average drawdown for bores S1 and S2 was 2.3 m, below the 4 m drawdown limit set for Wellfield B. As discussed in 6.5.2, the increase in drawdown at S1 is related to a well casing failure and is under investigation.

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

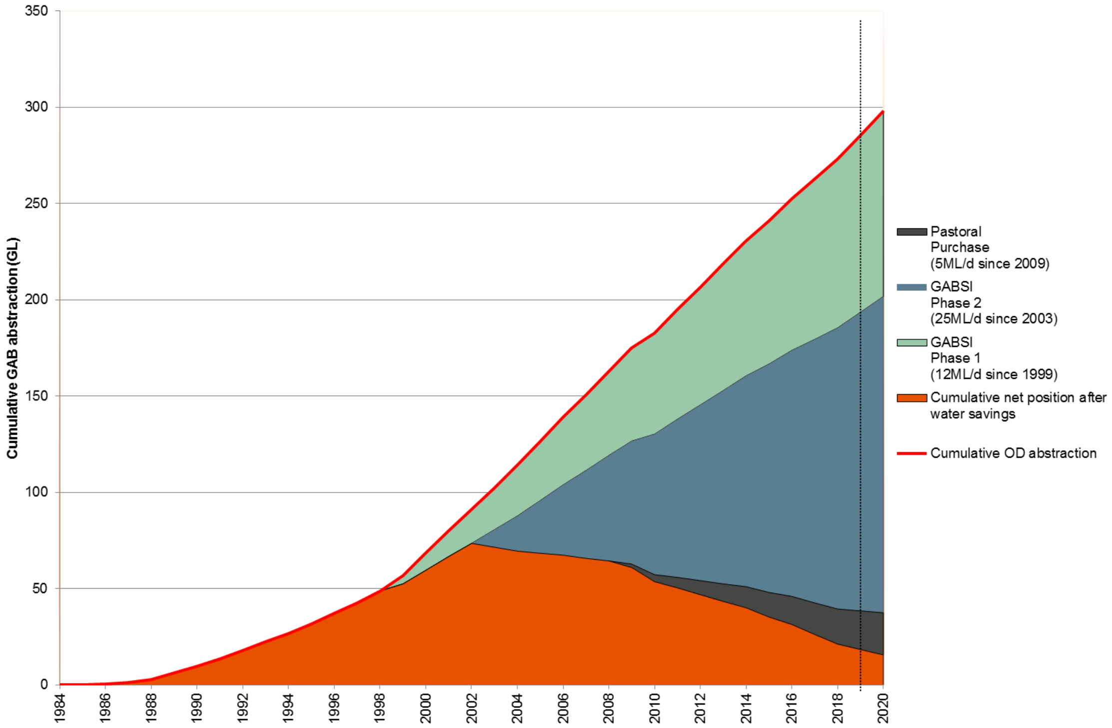


Figure 10-1 ODC cumulative GAB water savings

11 REFERENCES

ABARE, AGSO and BRS 1996, 'Lake Eyre Basin: An Economic and Resource Profile of the South Australian Portion', ABARE Research Report 96.1, Canberra.

AGC 1982, 'Olympic Dam Project, Groundwater Supply Investigations', unpublished report.

AGC 1987, 'Olympic Dam Water Supply, Wellfield A Construction', unpublished report.

BHP 2015, **'**Contingency measures and response plan for addressing unexpected drawdown or spring flow decline near the Olympic Dam Wellfields' Olympic Dam report ODENV034

BHP 2019a, 'Monitoring Program – Great Artesian Basin (GAB) 2019', Olympic Dam Document No. 2789.

Golder Associates 2016, GAB Technical Memorandum 14766004-019-M-Rev2.

Habermehl, MA 1980, 'The Great Artesian Basin, Australia', *BMR Journal of Australian Geology and Geophysics, 5*.

Kinhill Engineers 1995, 'Olympic Dam Operations Survey and Assessment Report Supplementary Environmental Studies Borefield B Development', Kinhill Engineers Pty Ltd, Parkside, SA.

Kinhill Engineers 1997, 'Olympic Dam Expansion Project, Environmental Impact Statement', Kinhill Engineers Pty Ltd, Adelaide.

Kinhill Stearns 1984, 'Olympic Dam Project Supplementary Environmental Studies Mound Springs', Kinhill Stearns, Adelaide.

Kinhill-Stearns Roger 1982, 'Olympic Dam Project, Draft Environmental Impact Statement', Kinhill-Stearns Roger, Adelaide.

Roxby Downs (Indenture Ratification) Act 1982

Welsh 2000, 'GABFLOW: A Steady State Groundwater Flow Model of the Great Artesian Basin', Bureau of Rural Sciences, Canberra.

WMC 1995, 'Hydrogeological Investigation and Numerical Modelling, Lake Eyre Region, Great Artesian Basin', unpublished WMC Report HYD T044.

WMC 1997, 'Olympic Dam Operation, Borefield B Development, Bore Completion Report', unpublished WMC Report HYD T065.

12 Appendix 1: SUMMARY OF MONITORING RECORDS FOR FY20

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	11	4	4	1	11	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	0	1	0	1	1	1	1	Monitoring valve needs replacement to allow pressure monitoring
Charles Angus	1	1	1	1	1	1	1	1	
Clayton #1	1	0	1	1	1	1	1	1	Well was not shut in at land owners request
Clayton #2	1	0	1	1	1	1	1	1	Well was not shut in at land owners request
Clayton Dam 2	1	0	1	1	1	1	1	1	Well was not shut in at land owners request
Cooranna	2	2	1	1	1	1	2	2	
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	
D3	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	

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
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	
GAB1	4	4					4	4	
GAB2	4	4					4	0	Well is currently sub artesian and WQ cannot be collected
GAB5A	4	4					4	4	
GAB6	4	0			Continuous		4	4	SIP only measured is production well not in use.
GAB6A	4	3					4	3	
GAB7	4	11					4	4	
GAB8	4	11					4	4	
GAB10	4	11					4	4	
GAB11	4	9					4	4	
GAB12	4	0			Continuous		4	4	When well is not running WQ cannot be collected. SIP only measured is production well not in use.
GAB12A	4	4					4	4	
GAB13A	4	4					4	0	When well is sub artesian WQ cannot be collected
GAB14	4	0			Continuous		4	4	When well is not running WQ cannot be collected. SIP only measured is production well not in use.
GAB14A	4	4					4	0	When well is sub artesian WQ cannot be collected
GAB16	4	0			Continuous		4	4	When well is not running WQ cannot be collected. SIP only measured is production well not in use.
GAB16A	4	4					4	4	
GAB17	4	1			Continuous		4	1	When well is not running WQ cannot be collected

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
GAB18	4	0			Continuous		4	1	When well is not running WQ cannot be collected. SIP only measured is production well not in use.
GAB18A	4	3					4	0	When well is sub artesian WQ cannot be collected
GAB19	4	11					4	4	
GAB21	4	4					4	4	
GAB22	4	4					4	4	
GAB23	4	4					4	1	When well is sub artesian WQ cannot be collected
GAB24	4	4					4	4	
GAB30A	4	4					4	4	
GAB31A	4	4					4	4	
GAB33A	4	4					4	4	
GAB51	4		4	4	Continuous		4	4	Production wells were not shut in
GAB52	4		4	4	Continuous		4	4	Production wells were not shut in
GAB53	4		4	4	Continuous		4	4	Production wells were not shut in
Georgia 2	4	4	4	4	1	1	4	4	
Gosse LGS002					1	1	1	1	
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	11					4	4	
HH3	4	4					4	0	Sub artesian well, WQ cannot be collected
HH4	4	4					4	4	
Highway	1	1	1	1	1	1	1	1	

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
Jackboot	4	4	4	4	1	1	4	4	
Jewellery Creek	1	0	1	0	1	0	1	1	Well has failed
Kopperamanna	1	1	1	1	1	1	1	1	
Lake Billy #2	4	4	4	4	1	1	4	4	
Lake Harry	2	2	2	2	1	1	2	2	
Marion	1	2	1	2	1	1	1	2	
Maynards	1	0	1	1	1	1	1	1	No shut in due to headwork's condition
MB1	4	4					4	4	
MB2	4	4					4	0	Sub artesian well, WQ cannot be collected
MB5	4	4					4	4	
MB6	4	4					4	4	
MB7	4	4					4	4	
MB8	4	4					4	4	
McLachlan LMS004B					1	1	1	1	
Morphetts	1	0	1	0	1	1	1		Did not shut in due to headworks condition
Morris Creek	1	1	1	1	1	1	1	1	
Muloorina	2	2	2	2	1	1	2	2	
New Years Gift	4	4	4	4	1	1	4	4	
OB1	4	4					4	4	
OB3	4	4	4	4	1	1	4	4	
OB6	4	4					4	4	
Old Finniss HOF004					1	1	1	1	
Old Finniss HOF033					1	1	1	1	
Old Finniss HOF081					1	1	1	1	
Old Finniss HOF094					1	1	1	1	
Old Finniss 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	

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
Peachawarrina	1	1	1	1	1	1	1	1	
Peters	1	1	1	1	1	1	1	1	
S1	4	4					4	4	
S2	4	4					4	4	
S3	4	4					4	0	WQ cannot be collected – well does not sustain flow
SA	4	4					4	4	
S4	4	4					4	4	
S5	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	4	0	4	0	1	0	4	5	Well has failed below ground and cannot be shut in
Tent Hill	4	4					4	0	WQ cannot be collected – well does not sustain flow
Two Mile #2	4	2					1	0	The installed pump at two mile #2 could not be shut off on several occasions – land owner needs to be present
Venables	4	11			1	1	1	1	
WCB01	4	4	4	4	1	1	4	4	
WCB02	4	4	4	4	1	1	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	1	1	4	4	
West Finniss HWF002					1	1	1	1	
West Finniss HWF003					1	1	1	1	
West Finniss HWF048					1	1	1	1	

Site	SIP/SWL		Flow Pressure		Flow Rate		Quality		Comments
	Required	Actual	Required	Actual	Required	Actual	Required	Actual	
Wirringinna Spring MWI001	4	4					1	1	
Yarra Hill	1	0	1	0	1	1	1	1	Well was not shut in at land owners request

Notes:

- Categories are defined in Monitoring Program – Great Artesian Basin (GAB) 2019 (BHP 2019a).

13 Appendix 2: CALIBRATION CERTIFICATES FOR DRUCK PRESSURE TRANSDUCER

Druck

CALIBRATION CERTIFICATE

Page 1 of 1

UNIT UNDER TEST (UUT)

Manufacturer : Druck
Type : DPI705
Serial Number : 70591268
Works Order ID : 1131972
Calibration Date : 14 June 2019
Calibrated By : A.Fernandes

Ambient Conditions

Ambient Temperature : 23.4°C

Comments

Calibrator Information

Instrument	Serial Number	Calibrated Against [1]	Medium	Uncertainty
DPI515	51502655	UKAS Lab.0221	Air	±0.025% Rdg

Performance Data

Parameter Range 0.0 to 20.0 bar g

Applied	Reading [2]	Deviation [3]	Permissable [4] Deviation
0.00008 bar	0.0000 bar	-0.0001 bar	±0.0200 bar
3.99982 bar	3.9980 bar	-0.0018 bar	±0.0200 bar
8.00003 bar	7.9991 bar	-0.0009 bar	±0.0200 bar
12.00043 bar	12.0004 bar	0.0000 bar	±0.0200 bar
16.00090 bar	16.0013 bar	0.0004 bar	±0.0200 bar
20.00066 bar	20.0007 bar	0.0000 bar	±0.0200 bar
16.00087 bar	16.0014 bar	0.0005 bar	±0.0200 bar
12.00038 bar	12.0006 bar	0.0002 bar	±0.0200 bar
7.99998 bar	8.0000 bar	0.0000 bar	±0.0200 bar
3.99986 bar	3.9980 bar	-0.0019 bar	±0.0200 bar
0.00012 bar	0.0001 bar	0.0000 bar	±0.0200 bar

Signed : ____________ Stamp : GE D190 ____________ Date: 14 June 2019

Notes

[1] This certificate provides traceability of measurement to recognised national standards and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories.
[2] Actual recorded values. For specification see Permissible Deviation column.
[3] Deviation calculated from reading minus actual applied value.
[4] Non linearity, hysterisis and repeatability.

Druck Ltd, Fir Tree Lane, Groby, Leicestershire LE6 0FH
PS1206 V2.8.1

Druck

CALIBRATION CERTIFICATE

Page 1 of 1

UNIT UNDER TEST (UUT)

Manufacturer : Druck
Type : DPI705
Serial Number : 70591268
Works Order ID : 1131972
Calibration Date : 14 June 2019
Calibrated By : A.Fernandes

Ambient Conditions

Ambient Temperature : 23.4°C

Comments

Calibrator Information

Instrument	Serial Number	Calibrated Against [1]	Medium	Uncertainty
DPI515	51502655	UKAS Lab.0221	Air	±0.025% Rdg

Performance Data

Parameter Range 0.0 to 20.0 bar g

Applied	Reading [2]	Deviation [3]	Permissable [4] Deviation
0.00008 bar	0.0000 bar	-0.0001 bar	±0.0200 bar
3.99982 bar	3.9980 bar	-0.0018 bar	±0.0200 bar
8.00003 bar	7.9991 bar	-0.0009 bar	±0.0200 bar
12.00043 bar	12.0004 bar	0.0000 bar	±0.0200 bar
16.00090 bar	16.0013 bar	0.0004 bar	±0.0200 bar
20.00066 bar	20.0007 bar	0.0000 bar	±0.0200 bar
16.00087 bar	16.0014 bar	0.0005 bar	±0.0200 bar
12.00038 bar	12.0006 bar	0.0002 bar	±0.0200 bar
7.99998 bar	8.0000 bar	0.0000 bar	±0.0200 bar
3.99986 bar	3.9980 bar	-0.0019 bar	±0.0200 bar
0.00012 bar	0.0001 bar	0.0000 bar	±0.0200 bar

Signed : ____________ Stamp : GE D190 ____________ Date: 14 June 2019

Notes

[1] This certificate provides traceability of measurement to recognised national standards and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories.
[2] Actual recorded values. For specification see Permissible Deviation column.
[3] Deviation calculated from reading minus actual applied value.
[4] Non linearity, hysterisis and repeatability.

Druck Ltd, Fir Tree Lane, Groby, Leicestershire LE6 0FH
PS1206 V2.8.1

14 Appendix 3: SUMMARY OF FIELD CHEMISTRY DATA FY20

Site	FY20 average			Historical range		FY20 average
	No. of records	EC25 (µS/cm)	pH	5th percentile	95th percentile	above 95th percentile
Beatrice Bore HBS004	1	4374	8.58	3264	4448.7	
Boocaltaninna	2	1568	7.05	1290.5	1805.5	
Bopeechee HBO004	1	4012	7.91	3490	4690	
Bopeechee HBO007	1	6904	8.5	3491	6373.8	TRUE
Bopeechee HBO011	1	4378	7.83	3526	6046	
Callanna	2	3262	7.95	2573	3576	
Cannuwaukaninna	2	1827	7.07	1672.5	2341.6	
CHAPALANNA2	1	1795	7.78	1659.25	2642.5	
Charles Angus	2	2912	7.4	2549	3322	
Boocaltaninna	2	1568	7.05	1290.5	1805.5	
Clayton #1	0			1668.5	2340.3	No record in FY20 - Pastoralist requested well not be opened
Clayton #2	1	1845	7.83	1643.2	2232	
CLAYTONDAM2	1	2650	7.57	2605	2965	
Cooranna	3	2389	7.99	2159.9	2670.5	
Cooryaninna	2	1617	7.44	1216.5	2020	
Coward CBC001	1	7446	7.6	6240	7800	
Coward CBC002	1	5493	7.04	3013	5606	
Coward CBC013	1	5742	6.7	4744	5800	
D2	5	1767	7	1694.55	2132.9	
D3	5	2091	7.49	1923	2444	
Davenport WDS001	1	3741	7.71	3000	4200	
Davenport WDS042	1	4711	8.43	2967.5	4898.85	
Davenport WDS052	1	3820	7.83	2552	5620	
Dead Boy HDB004	1	4209	7.83	2710	4697.5	
Dead Boy HDB005	1	4068	8.07	3210	5100	
Dulkaninna	2	1753	7.17	1535.9	2074.45	
Emerald LES001	1	4055	8.33	3078	4696	
Fred LFE001	1	4938	9.13	2800	4515	TRUE
Fred LFE006	1	3616	7.61	2600	4880	

Site	FY20 average			Historical range		FY20 average
	No. of records	EC25 (µS/cm)	pH	5th percentile	95th percentile	above 95th percentile
GAB001	4	5400	7.32	4407.5	5680	
GAB2	0					No samples. Well non-artesian in FY20
GAB005A	4	2965	7.88	2674.5	3300	
GAB006	3	3693	7.09	3149	3955	
GAB006A	3	3623	7.18	3192	3964	
GAB007	4	3278	7.16	3000	3680	
GAB008	4	3323	7.2	2998	3938	
GAB010	4	2940	7.16	2622	3402	
GAB011	3	3330	7.33	2950	3700	
GAB012	4	3765	7.15	3265	4094	
GAB012A	3	3473	7.16	3287.5	3907.5	
GAB014	3	3577	7.12	3132.5	3777.5	
GAB016	4	3835	7.16	3293.5	3950.5	
GAB016A	3	3560	7.1	3440	3995.5	
GAB17	1					No samples. Well non-artesian in FY20
GAB018	1	4450	7.04	3440	4523	
GAB019	4	3043	7.17	2769.5	3482	
GAB021	4	4830	7.1	3350.3	4877.3	
GAB022	3	3547	7.16	3240	3950	
GAB23	1					No samples. Well non-artesian in FY20
GAB024	4	3630	7.05	3056.4	3956	
GAB030A	4	3503	7.03	3110	3820	
GAB031A	4	3283	7.09	3038.5	3703	
GAB033A	4	4020	7.19	3620	4532	
GAB051	4	2605	7.22	2507.5	3186.5	
GAB052	4	2553	7.09	2426	3132	
GAB053	4	2463	7.12	2420	3060	
GEORGIA2	4	2120	6.83	2079	2652	
Gosse LGS002	1	2996	7.82	2700	3200	
Gosse LGS004	1	3005	7.97	2517	3103	

Site	***FY20 average***			***Historical range***		***FY20 average***
	No. of records	***EC25 (µS/cm)***	***pH***	***5th percentile***	***95th percentile***	***above 95th percentile***
Hermit Hill HHS028	1	3468	8.47	2973	5502	
Hermit Hill HHS035	1	4205	9.13	2930	6721	
Hermit Hill HHS125A	1	3596	8.8	2184	3790	
Hermit Hill HHS137	1	3696	8.56	2732	5132	
Hermit Hill HHS170	1	2948	8.72	2611	3745	
HH001	4	2995	7.42	2741	3458	
HH002	4	3280	7.16	2805	3615	
HH004	4	2990	7.48	2863	5392	
Highway	2	3397	7.86	2984.5	3828	
Jackboot	5	3894	6.88	4010	4890	
Jewellery Creek	1	1549	7.42	1413.2	1916.8	
Kopperamanna	2	1687	7.07	1538.25	2083.75	
Lake Billy #2	4	5905	7.05	4959	6560	
Lake Harry	2	2275	7.51	2117	2649	
Marion	3	2368	7.65	2056.5	2604.5	
Maynards	2	3443	7.64	2750	3764	
MB001	4	2870	7.29	2432.3	3100	
MB02	0					No sample. Well Sub artesian
MB005	4	3898	7.09	3607	4440	
MB006	4	6840	6.66	6257.5	7593.5	
MB007	5	2535	6.99	2370	2935	
MB008	5	2550	7.13	2292.1	2957	
McLachlan LMS004B	1	3194	8.51	2685	3607	
Morphetts	2	3775	7.62	3294	4108	
Morris Creek	2	3019	7.25	2539	3301.5	
Muloorina	3	2593	7.46	2395	2951	
New Years Gift	4	4935	7.54	3787	5202.5	
OB001	5	2656	7.73	2328	2850	
OB003	5	2792	7.69	2585.5	3078.45	
OB006	5	2702	7.6	2489	2970	
Old Finniss HOF004	1	3592	8.3	2361	4616	
Old Finniss HOF033	1	11210	8.83	3940	12700	
Old Finniss HOF081	1	3217	7.88	3000	4745	
Old Finniss HOF096	1	3207	8.3	2935	3542.4	

Site	***FY20 average***			***Historical range***		***FY20 average***
	No. of records	***EC25 (µS/cm)***	***pH***	***5th percentile***	***95th percentile***	***above 95th percentile***
Old Woman HOW009	1	10140	7.83	7287	10792.5	
Old Woman HOW015	1	5525	8.92	3984	8620	
Old Woman HOW025	1	4094	8.13	2701.5	5036	
Peachawarrina	2	2500	7.29	2384	3081	
Peters	2	2365	7.81	2068.8	2518.2	
S001	4	2798	7.62	2482.5	3053.5	
S002	4	3533	7.85	2947	3830	
S003A	4	2278	7.66	2055	2500	
S004	5	2567	7.46	2351.5	2924.5	
S005	4	2025	7.47	1955.8	2476	
Sinclair	2	1991	7.52	1727.1	2213.05	
Sulphuric HSS011	1	3952	8.55	3163	4003	
Sulphuric HSS012	1	3754	7.74	3077	5001	
Sulphuric HSS024	1	4131	8.5	2700	4500	
Old Woman HOW009	1	10140	7.83	7287	10792.5	
Tarkanina #2	5	1991	7.55	1890	2326	
Venables	0					No samples. Well non-artesian in FY20
WCB01	4	2890	7.87	2586	3134	
WCB02	5	2359	7.89	2154	2606	
Welcome WWS001	1	6314	8.51	4191.5	7555.05	
Welcome WWS002	1	8692	7.48	6250	9100	
Welcome WWS004	1	3624	7.94	3500	4210	
Welcome WWS013	1	8107	8.43	2630	7699.6	TRUE
Well Creek #2	4	2580	7.77	2178	2790.5	
West Finniss HWF002	1	3865	8.17	3082.8	5400	
West Finniss HWF003	1	4413	9.09	3082	5750	
West Finniss HWF048	1	3668	8.45	2830	5640	
Wirringinna Spring MWI001	0					Stagnant water – no sample taken
Yarra Hill	2	2057	7.89	1720.75	2358	

15 Appendix 4: PRESSURE TREND DATA

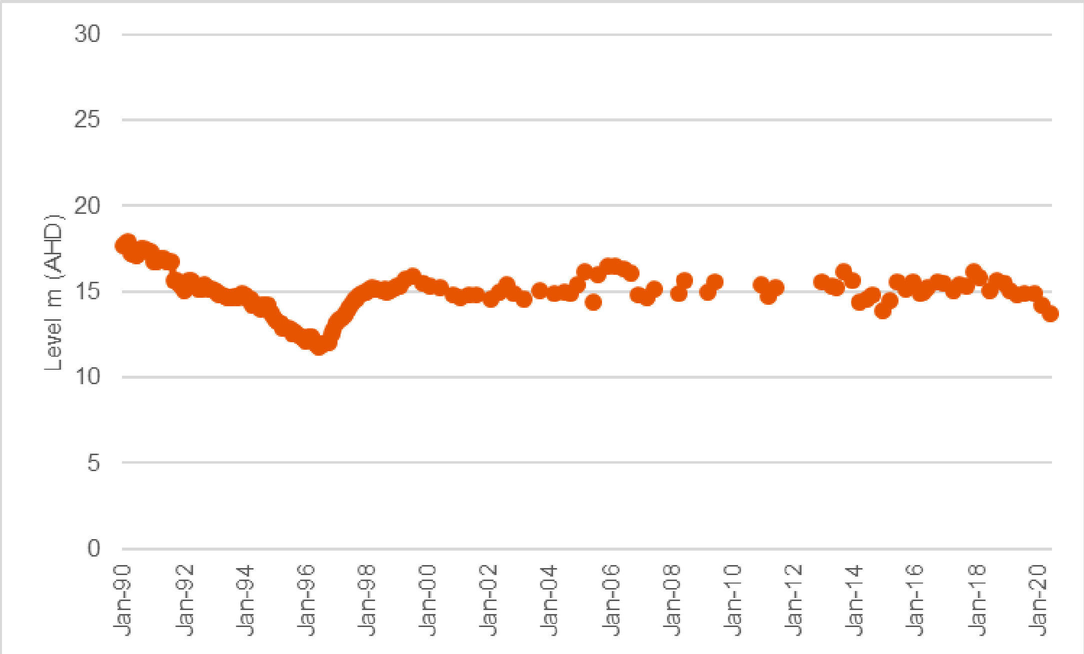


Figure 15-1 Groundwater Level for GAB2

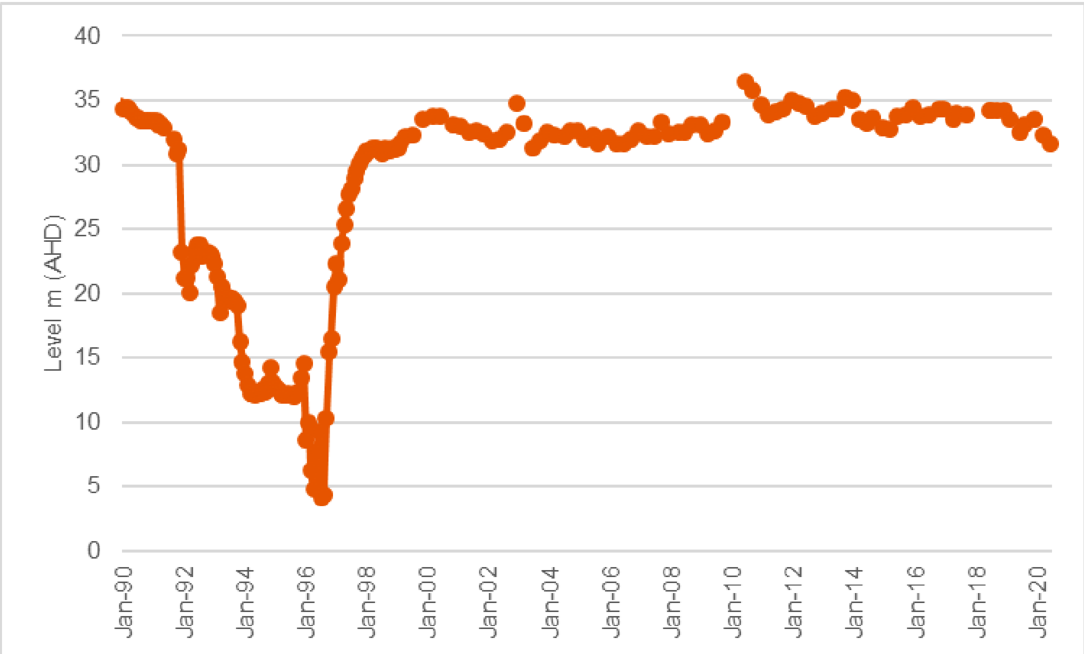


Figure 15-2 Groundwater Level for GAB24

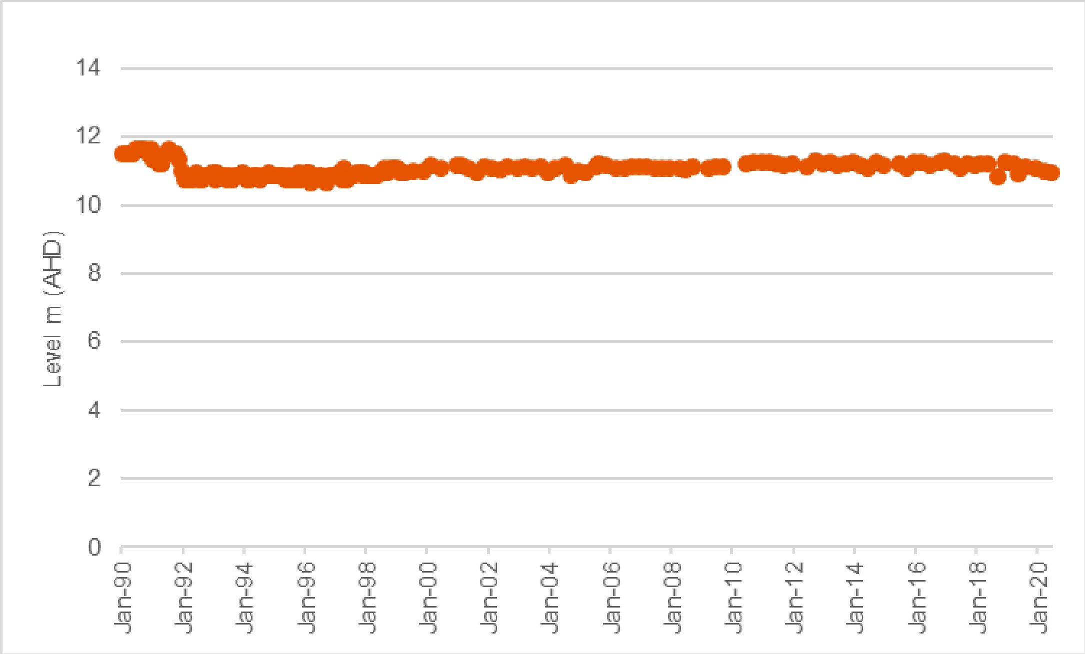


Figure 15-3 Groundwater Level for HH1

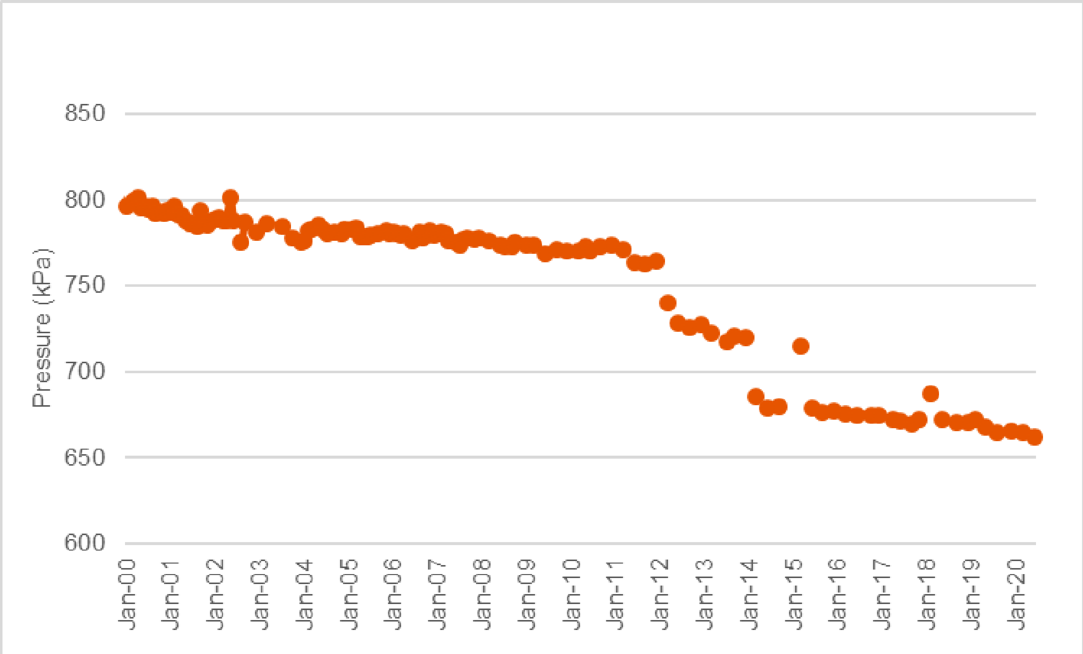


Figure 15-4 Groundwater Pressure for D2

* 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.

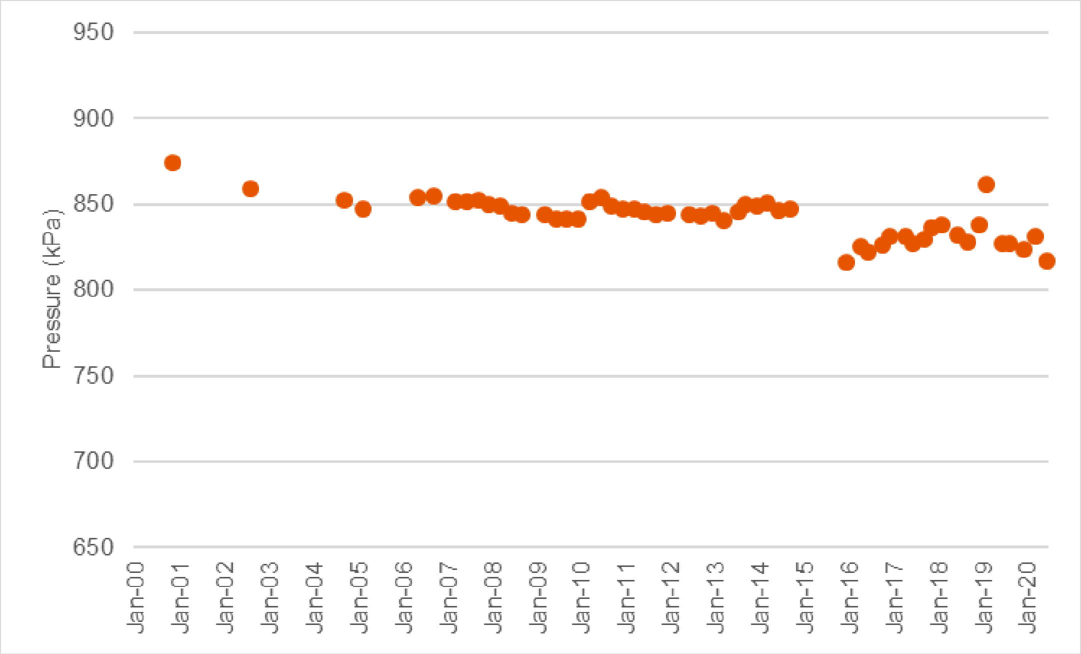


Figure 15-5 Groundwater Pressure for Georgia/Georgia 2

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

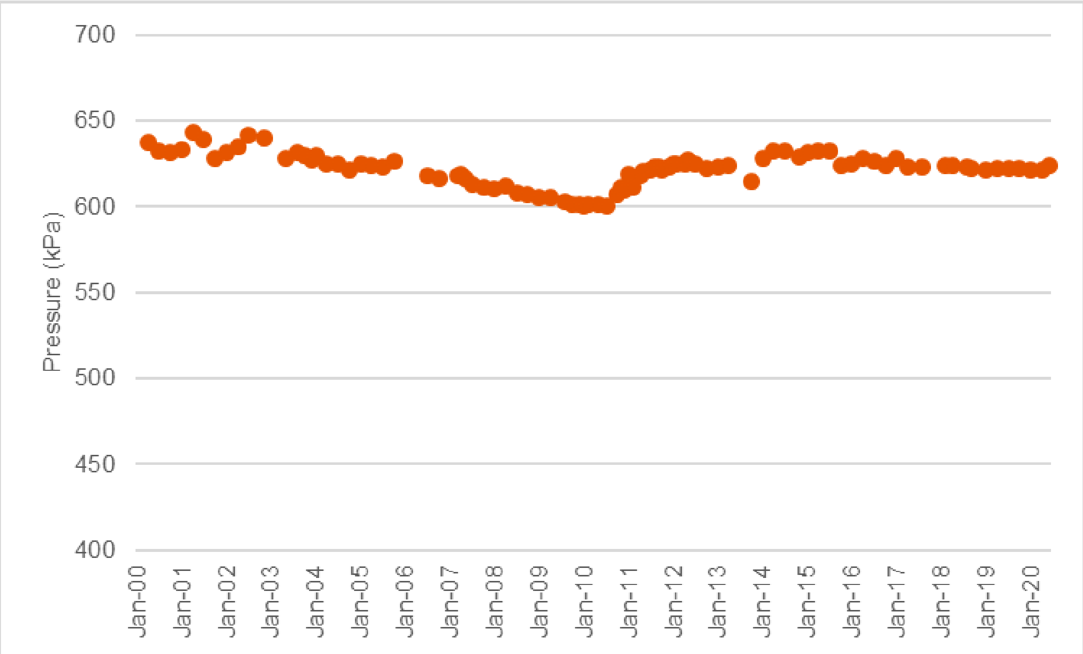


Figure 15-6 Groundwater Pressure for Jackboot

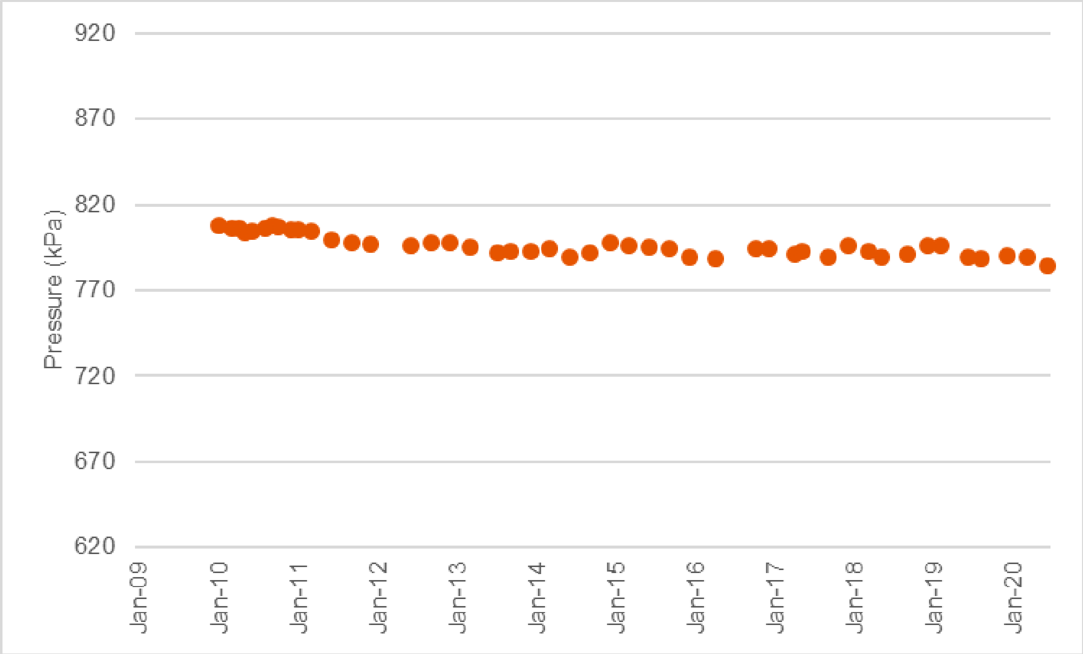


Figure 15-7 Groundwater Pressure for MB8

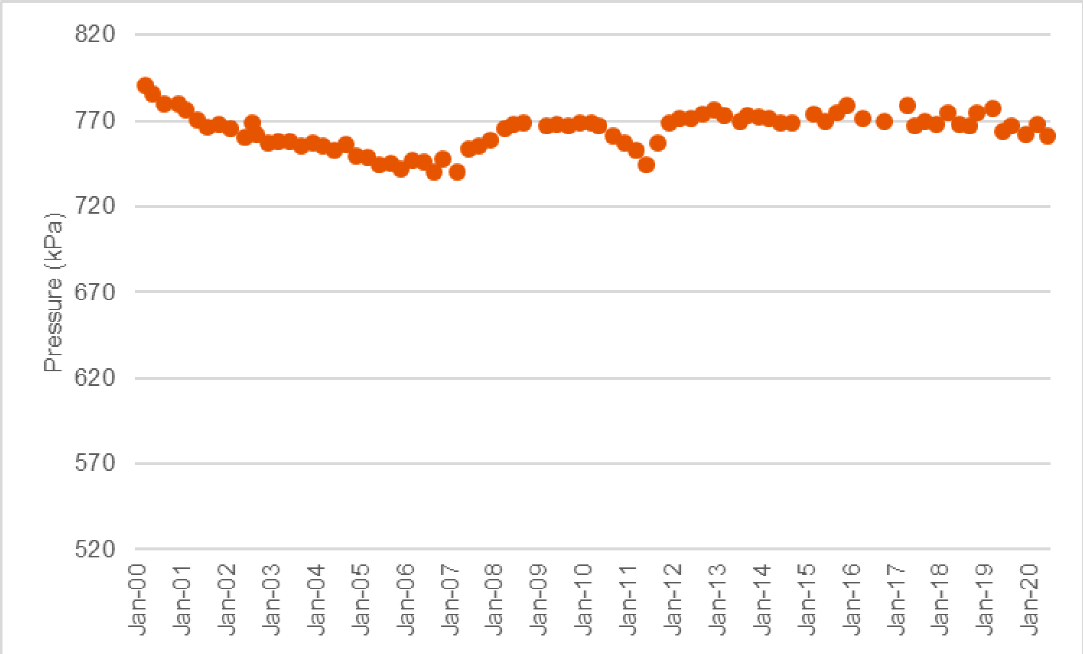


Figure 15-8 Groundwater Pressure for OB3

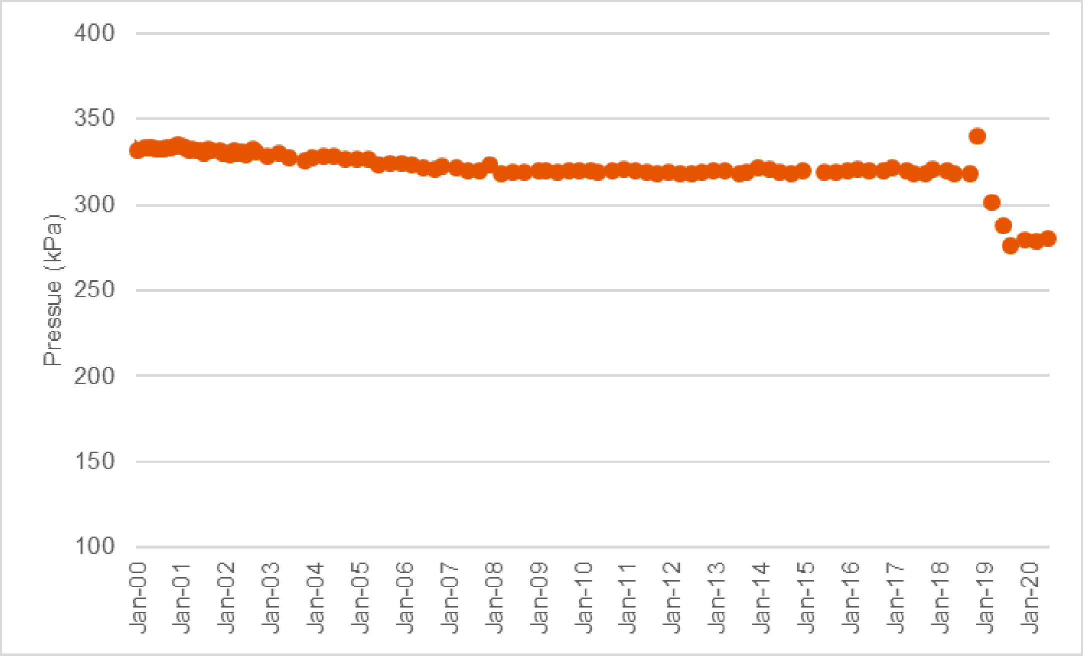


Figure 15-9 Groundwater Pressure for S1

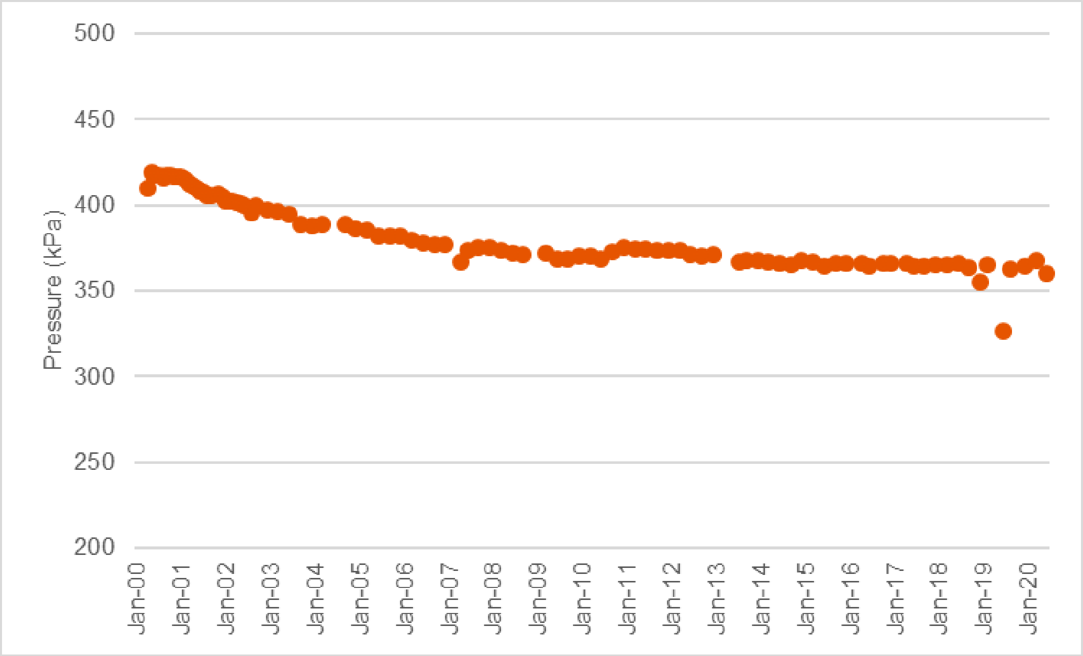


Figure 15-10 Groundwater Pressure for S3A

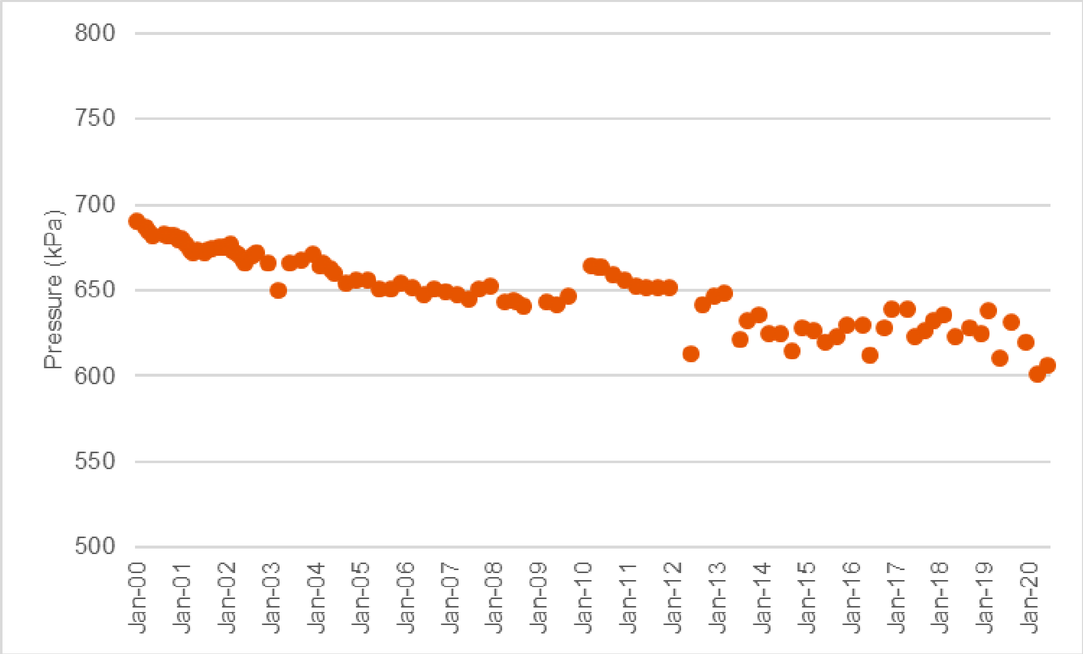


Figure 15-11 Groundwater Pressure for S5

16 Appendix 5: CONDUCTIVITY TREND DATA

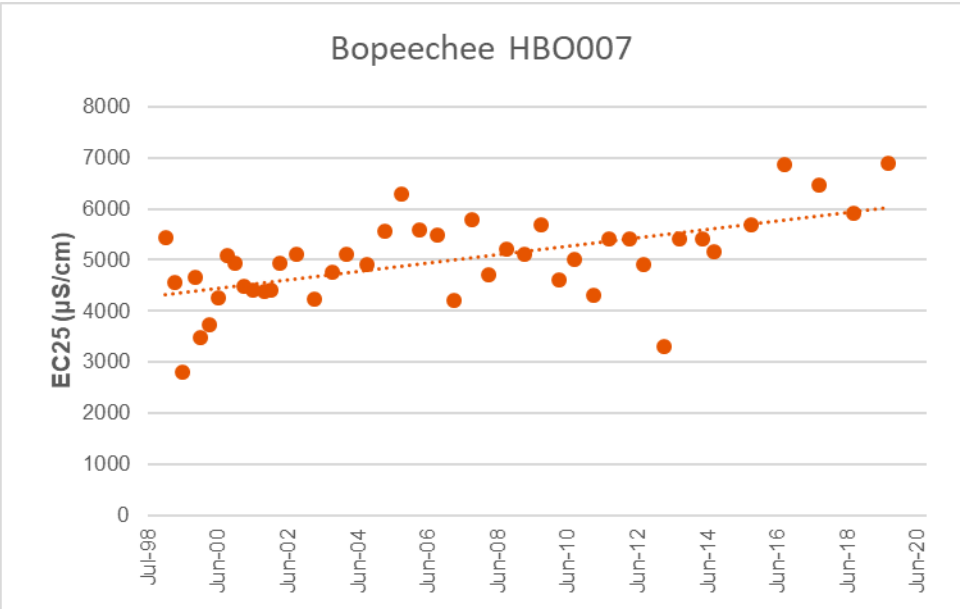
Conductivity trend graphs are provided here for:

- 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 FY20 that is greater than the 95th percentile for that bore or spring.

Refer to Section 8 for discussion of these data.

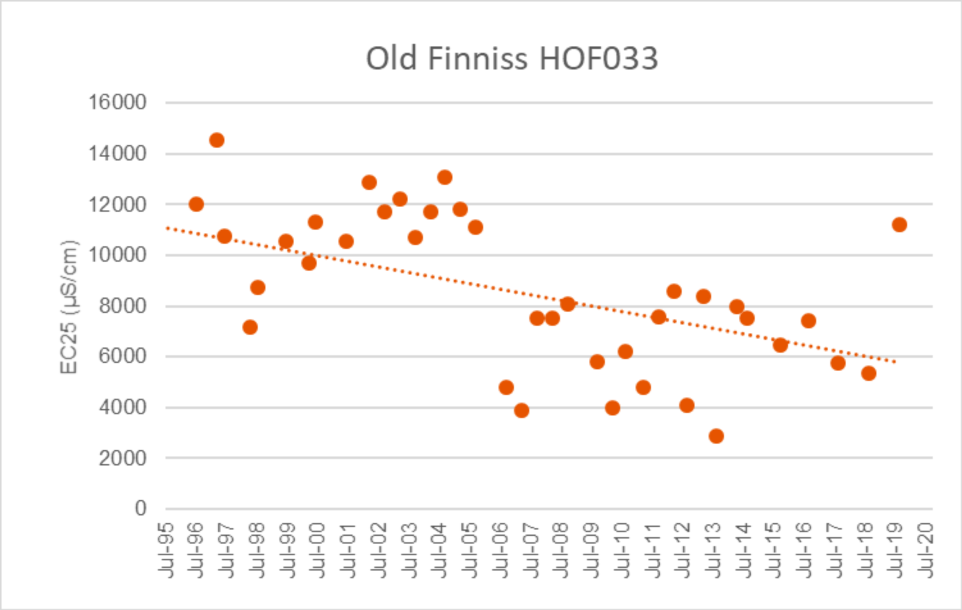
The following statistics are provided for each graph in this section:

n	The number of data points used in the regression calculation.
F	Overall F test value for null hypothesis H0:m=0 versus the alternative Ha:m≠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.



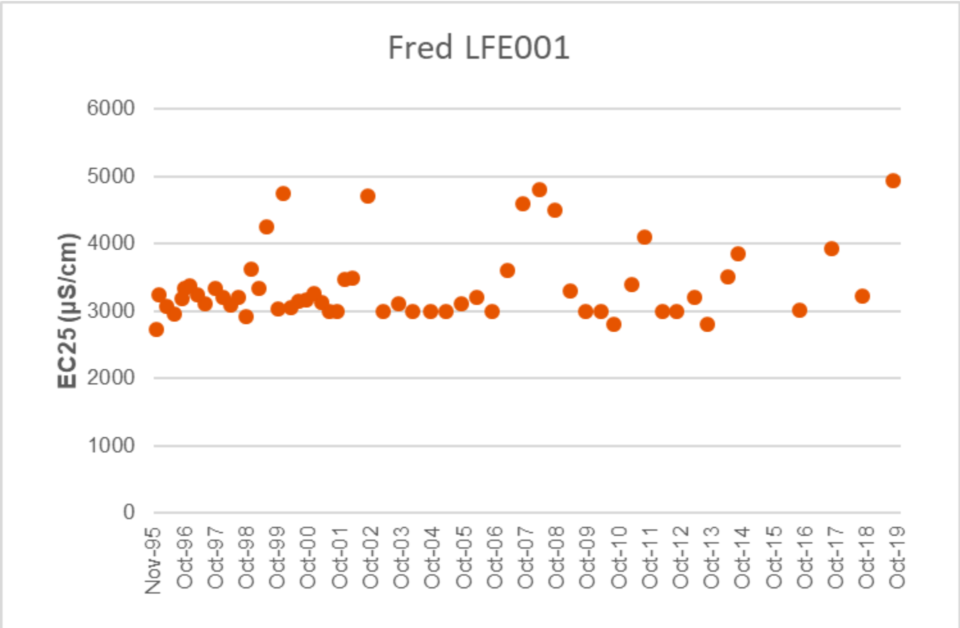
- n = 44, F = 21.2, p= 0.0003, r^2 = 0.33, significant (P<0.05) trend, FY20 measurement exceeds 95%-ile

Figure 16-1 Conductivity trend for Bopeechee HBO007



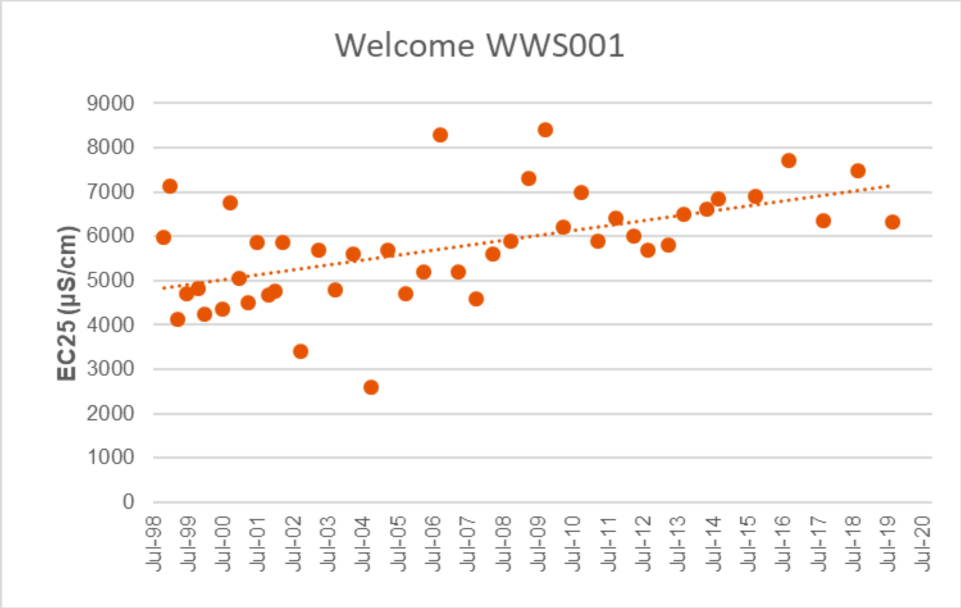
- n = 40, F = 17.72, p = 0.0001, r^2 = 0.31, significant (P<0.05) trend

Figure 16-2 Conductivity trend for Old Finniss HOF033



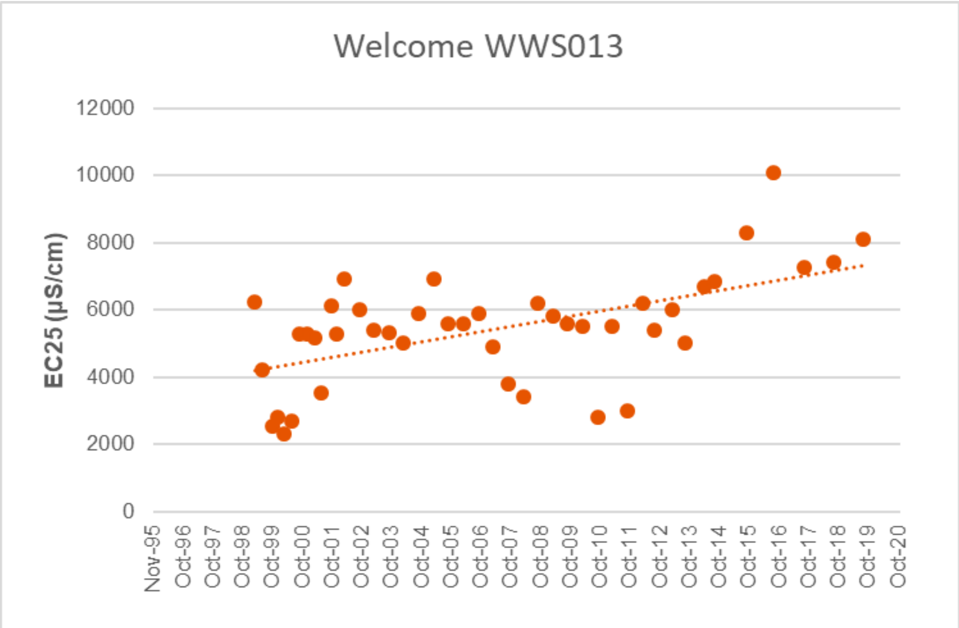
- FY20 measurement exceeds 95%-ile

Figure 16-3 Conductivity trend for Fred LFE001



- n = 44, F = 17.42, p= 0.0001, r^2 = 0.293, significant (P<0.05) trend,

Figure 16-4 Conductivity trend for Welcome WWS001



- n = 43, F = 18.41, p= 0.0001, r^2 = 0.310, significant (P<0.05) trend, FY20 measurement exceeds 95%-ile

Figure 16-5 Conductivity trend for Welcome WWS013

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
2020	2.8	8.6	22.1	33.4	5.0	28.4
2021	2.8	7.8	20.4	31.0	5.0	26.0
2022	3.5	9.7	26.3	39.5	5.0	34.5
2023	4.3	9.1	28.3	41.7	5.0	36.7
2024	4.3	9.1	28.3	41.7	5.0	36.7
2025	4.3	9.1	28.3	41.7	5.0	36.7
2026	4.3	9.1	28.3	41.7	5.0	36.7
2027	4.3	9.1	28.3	41.7	5.0	36.7
2028	4.3	9.1	28.3	41.7	5.0	36.7
2028	4.3	9.1	28.3	41.7	5.0	36.7
2029	4.3	9.1	28.3	41.7	5.0	36.7
2030	4.3	9.1	28.3	41.7	5.0	36.7

Notes:

- As provided to the Minister for Mineral Resources Development in January 2020. An updated schedule will be provided by 1 January 2021.

18 Appendix 7: PASTORAL BORES IN THE WELLFIELD AREA

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