Barwon Water

Annual Bulk Entitlement Report

Anglesea groundwater 2018-2019

Barwon Water

Contents

1. Introduction

The Anglesea Borefield is operated to supplement Geelong's surface water storages. The Anglesea Borefield extracts groundwater from the Lower Eastern View Formation in the Jan Juc Groundwater Management Area and contains seven production bores that are licensed to extract a total of 40 ML/day. Extraction first commenced in October 2009 and ceased in June 2012, with a total of 7,618 ML pumped during that period. During the 2018–2019 period the borefield was not operated and no groundwater was extracted.

Groundwater from the Anglesea Borefield is initially pre-treated at the Anglesea Pre-Treatment Plant before it is transferred to Wurdee Boluc Reservoir, where it is stored and eventually undergoes full treatment before being supplied to customers.

Barwon Water operates the Anglesea Borefield under the *Bulk Entitlement (Anglesea Groundwater) Order 2009* (the Order), which requires Barwon Water to prepare an annual report called the Annual Bulk Entitlement Report (Anglesea Groundwater). This annual report is provided to Department of Environment, Land, Water and Planning (DELWP) at the same time as a copy is provided to the Minister as required under *Clause 16.3*. It will include information on groundwater extraction rates, water quality sampling, trigger levels and any issues or difficulties in complying with the order. The annual report will be provided to the public, free of charge.

Under the Order, Barwon Water is also required to undertake periodic reviews of the *Bulk Entitlement (Anglesea Groundwater) Order 2009*. The review conducted in 2013 identified a number of areas of the monitoring and assessment program (MAP) that should continue to be monitored, as well as areas that are no longer considered to be dependent on groundwater from the Lower Eastern View Formation and therefore could be subject to reduced monitoring. As a result of the 2013 review, a revised MAP was established and subsequently approved by the minister in September 2014. Barwon Water has since implemented the revised MAP 2014 and has been operating in accordance with the MAP 2014 since March 2015.

In accordance with the order, Barwon Water has prepared an annual report that covers groundwater extraction rates, water quality sampling and any difficulties in compliance with the MAP 2014 over the reporting period of 1 July 2018 to 30 June 2019.

2. Groundwater extraction (Clauses 16.2 A, 16.2 B and 16.2 C)

Barwon Water is licensed to extract a maximum of 40 ML in any one day; 10,000 ML in any one year; and a maximum of 35,000 ML in any five-year period. The Anglesea Borefield was not operational during 2018–2019 and has not extracted groundwater since June 2012. Table 1 and Table 2 show the extraction rates of the Anglesea Borefield during 2018–2019.

Table 1: Total daily/ monthly groundwater extraction 2018–2019

Groundwater extraction rates (ML)												
Date	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018	Jan 2019	Feb 2019	Mar 2019	Apr 2019	May 2019	Jun 2019
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prog. total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max. flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Min. flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ave. flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2: Annual groundwater extraction by bore 2018-2019

Production bores ID	Bulk entitlement ID	Licence no. (WLE)	Groundwater extraction (ML)
Southern borefield			
GW220 (Bore 1)	SPB1	9035749	0
GW221 (Bore 2)	N/A	WLE046288	0
GW222 (Bore 3)	SPB3	WLE046291	0
GW223 (Bore 4)	SPB4	9031314	0
GW224 (Bore 5)	N/A	9038314	0
Northern borefield			
GW211A (Bore 6)	NPB6	9031316	0
GW225 (Bore 7)	NPB7	9035751	0
Annual total			**0**

3. Water quality sampling (Clause 16.2 D)

3.1 Groundwater quality

The 2014 MAP stipulates that groundwater salinity is to be measured twice a year at five deep observation bores (between 165 – 490m) as well as ten shallow observation bores (less than 80m depth). The deep observation bores monitor the Upper Eastern View Formation and the Lower Eastern View Formation, while the shallow observation bores mostly monitor the perched water table, with one bore screening the Upper Eastern View formation and two bores screening the Lower Eastern View formation. The objective of this groundwater sampling is to detect any potential change in groundwater quality in the aquifers as a result of groundwater extraction and in particular any changes associated with potential inter-aquifer flow and saline intrusion.

The field readings taken for the electrical conductivity (EC) are conducted during the bore purging process. Both the total dissolved solids (TDS) and EC are taken to measure the salinity in groundwater samples. The TDS readings are taken in controlled laboratory conditions by weighing the residual solids that remain after the water from the sample is evaporated. This method is proven to be much more accurate than the EC readings, where an electrical current is passed through the sample and measured. Since TDS yields more accurate results, it has been used to analyse groundwater salinity. A linear trend line has been fit to the historic TDS data for each site. The trend lines show the general direction TDS levels are heading. A significant deviation from the trend line could flag an error in recording or actual changes to the water quality.

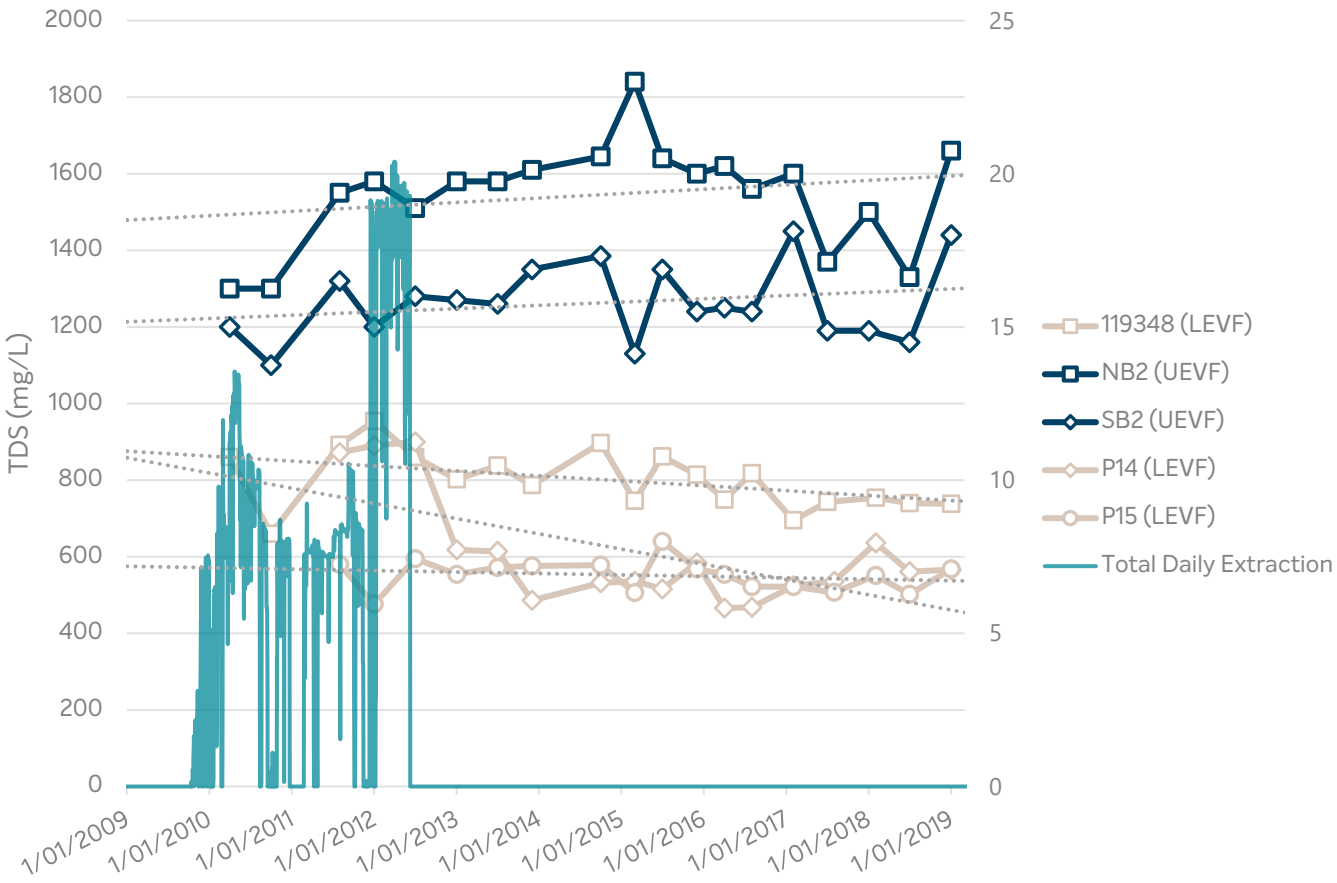
Deep observation bores

The 2018-2019 groundwater salinity results from the deep observation bores are provided in Table 3, while the results over the whole monitoring period (from April 2010 onwards) have been provided graphically in Figure 1. This figure depicts the salinity measurements against the groundwater extraction and recovery periods. A full suite of laboratory testing also occurs at these groundwater bores and the tabulated results have been provided in Appendix E.

Table 3: Groundwater quality results – deep observation bores

				Field parameters			Lab result	
Bore ID	Aquifer	Depth (m)	Date	Temp °C	pH	EC (µS/cm)	EC (µS/cm)	TDS (mg/L)
119348	LEVF	280+	Jul-18	14.0	8.4	1334	1140	740
			Jan-19	19.5	8.6	1353	1280	738
SB2	UEVF	229	Jul-18	15.0	5.7	2091	2050	1160
			Jan-19	17.7	5.7	2490	2380	1440
NB2	UEVF	165	Jul-18	13.2	5.9	2423	2410	1330
			Jan-19	19.2	5.8	2455	2280	1660
P14	LEVF	504	Jul-18	15.2	6.4	1023	1110	561
			Jan-19	18.3	6.1	1037	989	566
P15	LEVF	466	Jul-18	11.5	5.2	892	920	502
			Jan-19	23.2	5.1	887	760	568

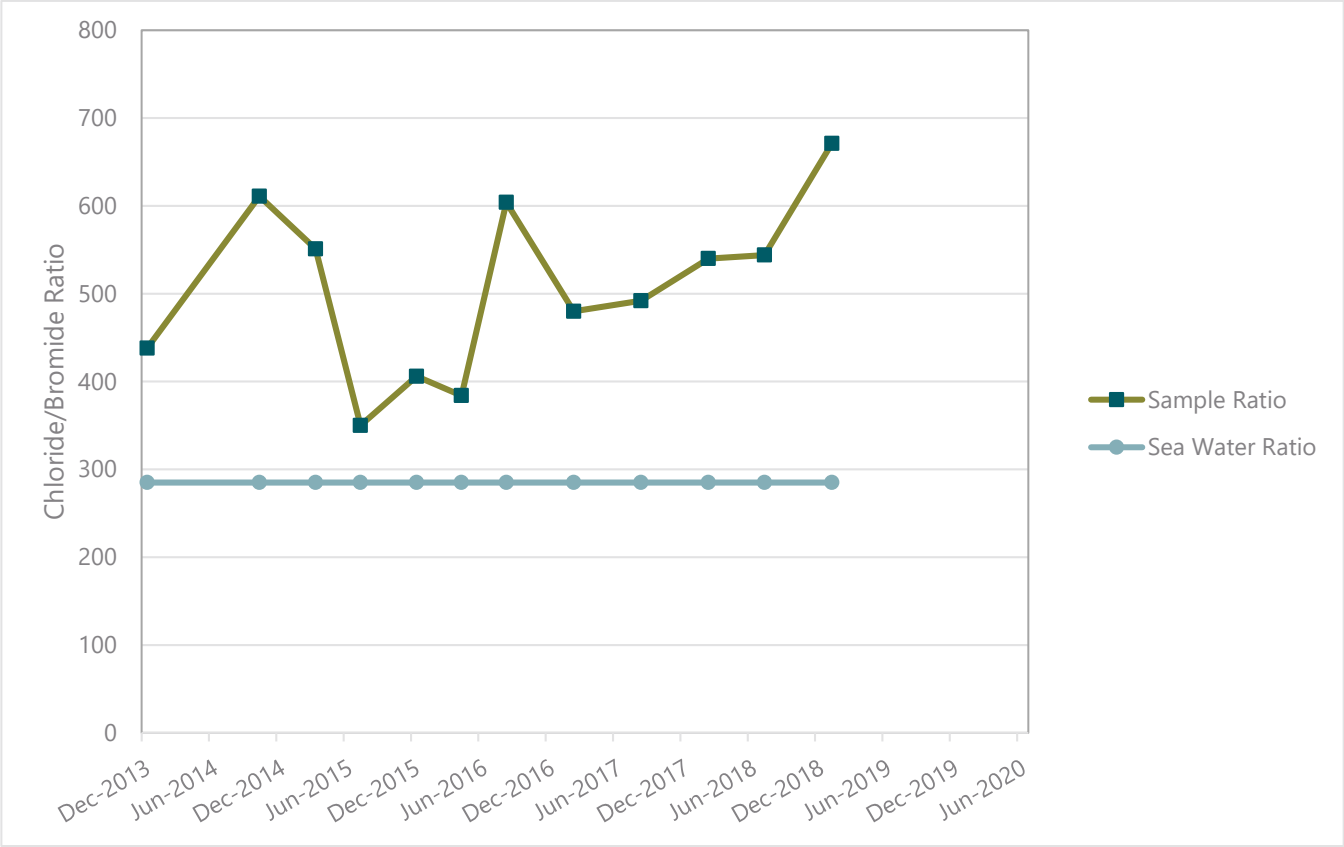
Figure 1: Groundwater quality results – deep observation bores



Bromide observation

P14 is also tested for chloride and bromide to monitor seawater intrusion. Seawater in an open ocean has a constant chloride/bromide ratio of approximately 285g/1g (285:1). Therefore, a decreasing chloride/bromide ratio, in conjunction with rising salinity can be indicative of saline intrusion. Figure 2 2 illustrates the chloride/bromide ratios overtime. The trend remains above the 285:1 ratio associated with seawater. Hence there continues to be no indication of saline intrusion at P14 to date.

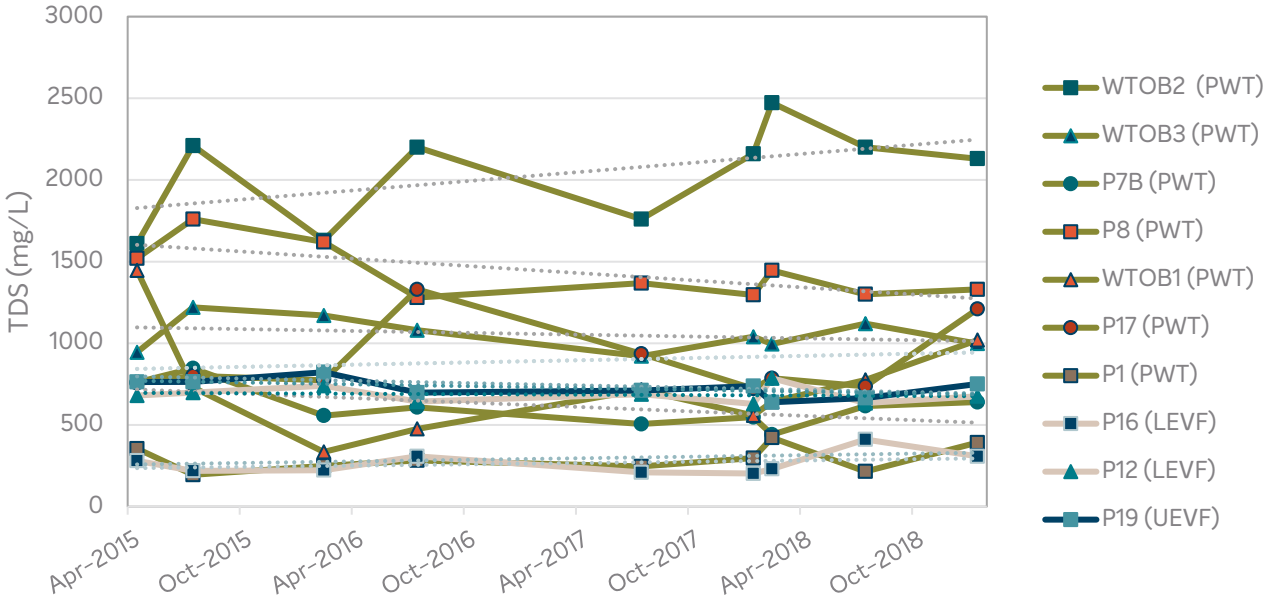
Figure 2: P14 Chloride/Bromide Ratio



Shallow observation bores

The 2018–2019 groundwater salinity results from the shallow observation bores are provided in Table 4. Groundwater salinity monitoring at the shallow observation bores commenced in April 2015. Figure 3 below shows the trend of each shallow observation bore over time. To date, overall the trends appear to be relatively stable. WTOB2 shows some signs of increasing, and will be monitored for a continued trend in coming years. A full suite of laboratory testing also occurs at these groundwater bores and the tabulated results have been provided in Appendix E.

Figure 3: Groundwater quality results – shallow observation bores



Barwon Water

Table 4: Groundwater quality results – shallow observation bores

				Field parameters			Lab result	
		Depth (m)	Date	Temp °C	pH	EC (µS/cm)	EC (µS/cm)	TDS (mg/L)
Anglesea River Catchment								
WTOB3	**PWT**	**13.4**	Jul-18	14.5	5.51	1633	1540	1120
			Jan-19	15.7	5.43	1637	1580	998
P7B	**PWT**	**3.3**	Jul-18	12.2	3.95	835	810	616
			Jan-19	15.5	3.66	849	739	460
P8	**PWT**	**3.62**	Jul-18	10	5.16	2135	2110	1300
			Jan-19	16.5	5.17	2128	1950	1330
P19	**UEVF**	**22**	Jul-18	15.1	5.93	1224	1190	665
			Jan-19	16.5	5.66	1230	1010	715
P12	**LEVF**	**87**	Jul-18	18.9	6.01	1152	1130	634
			Jan-19	19.5	5.78	1164	1050	676
WTOB2	**PWT**	**6.6**	Jul-18	11.3	4.22	3548	3900	2200
			Jan-19	14.6	4.05	3236	3150	2130
Salt Creek Catchment								
P16	**LEVF**	**2.86**	Jul-18	12.3	4.65	485	556	411
			Jan-19	18.7	5.36	355	306	308
P17	**PWT**	**5.37**	Jul-18	13	6.71	1323	1350	736
			Jan-19	16	6.47	1304	1110	1210
P1	**PWT**	**5.89**	Jul-18	12.1	5.57	304	338	215
			Jan-19	14.7	5.78	519	392	392
WTOB1	**PWT**	**13.7**	Jul-18	14.8	5.43	1103	1200	776
			Jan-19	16.1	5.22	1023	997	1020

3.2 Surface water quality – field testing

As outlined in the MAP 2014, Barwon Water monitors surface water quality at the sites listed in Table 5. The objective of this sampling is to:

- monitor baseline surface water quality, and monitor for any potential quality changes over time
- assist in the assessment of groundwater and surface water interactions in many areas, by reviewing the water quality data collected over time, in conjunction with groundwater and surface water level monitoring
- assist in the assessment of the process of acid generation in the catchments.

The water quality parameters tested are electrical conductivity (EC), total dissolved solids (TDS), pH, dissolved oxygen (DO) and temperature. The location of the surface water sites has been provided in Appendix B and the results of the water quality testing is provided in Appendix C.

Table 5: Surface water quality sites – field testing

Catchment	BW ID	Site ID	SINo.	Site description	Monitoring frequency
Salt Creek	SV3	GS7	235274A	Breakfast Creek Tributary @ V notch	Monthly
	SV1	GS1	235273A	Breakfast Creek @ Road Bridge	Monthly
	SV4	GS2	235276A	Salt Creek @ Denhams Track	Monthly
	SV2	GS3	235222A	Salt Creek (Encoder) @ Alcoa	Monthly
	SGP2-B (pool)	N/A	235275A	Salt Creek (Pool) above swamp @ Denham Track	Monthly
Anglesea River	AGP1-B (pool)	N/A	235271A	Upper Anglesea River @ AARC	Monthly
	AV1	GS4	235270A	Upper Anglesea River @ AARC (V Notch)	Monthly
	AV3	GS6	235277A	Anglesea River @ Gumflats Road	Monthly
	ASP7 (pool)	N/A	235280A	Anglesea Swamp @ Vegetation Site P7	Monthly
	AGP2 (pool)	N/A	235272A	Anglesea Wetlands @ Allardyne Track	Monthly
	AV2	GS5	235260A	Anglesea River (Marshy Creek) @ Alcoa	Monthly

3.3 Surface water quality – laboratory testing

Barwon Water conducts laboratory sampling at all sites listed in Table 6 as outlined in the MAP 2014. This sampling is conducted biannually and the tested parameters include: major cations and anions, salinity and pH. Water samples are taken by Ventia and then sent to Australian Laboratory Services (ALS) to be independently tested. The results from the laboratory testing of surface water sites are provided in Appendix D.

It should be noted that pH was not recorded in the laboratory as lag time from the field to the laboratory results in a deterioration of pH and, therefore, lab results are not reflective of the pH in the field.

Table 6: Surface water quality sites – laboratory testing

Catchment	BW ID	Site ID	SINo.	Site description
Salt Creek	SV3	GS7	235274A	Breakfast Creek Tributary @ V notch
	SV1	GS1	235273A	Breakfast Creek @ Road Bridge
	SV4	GS2	235276A	Salt Creek @ Denhams Track
	SV2	GS3	235222A	Salt Creek (Encoder) @ Alcoa
Anglesea River	AV1	GS4	235270A	Upper Anglesea River @ AARC (V Notch)
	AV3	GS6	235277A	Anglesea River @ Gumflats Road
	AV2	GS5	235260A	Anglesea River (Marshy Creek) @ Alcoa

3.4 Trends

The following trends have been identified from the surface water quality results taken from the field and laboratory testing:

- As the water flows downstream through the swamp the salinity levels have been observed to increase, with the highest levels recorded at the downstream monitoring sites AV2 and SV2. The higher surface water salinities recorded at the downstream ends of both catchments reflects the storage and concentration of salts in the main swamps through evapotranspiration. The salts then remain stored in the swamps until sufficient rainfall is generated to flush the salts downstream into the Anglesea Estuary.

- pH values have been observed to decrease as water flows downstream through the swamps, with the lowest pH value being recorded at the downstream end of the Anglesea and Salt Creek catchments. These results are consistent with the current understanding that the source of acidity in the catchments is the presence of naturally occurring sulphides (pyrites). When the catchment is subjected to wetting and drying cycles the pyritic sediments are oxidised which causes acid generation in the swamps. The acid is released from the swamp when a large rainfall event flushes the stored acid from the downstream end of the swamp to the estuary. The water quality results show no correlation between the values observed and groundwater extraction periods. These results indicate that the acid generation and subsequent acid events that occur in the Anglesea estuary are naturally occurring events.

- The surface water quality results have been compared to the results taken since the establishment of the MAP. There has been no correlation identified between the extraction period and the water quality results.

4. Groundwater trigger levels (Clause 16.2 E)

The groundwater trigger levels were revised in 2014 following the Bulk Entitlement review. The revised Bulk Entitlement's groundwater trigger levels were established with the objective of maintaining groundwater levels in the perched water table to within the likely range of natural variation to ensure there is no significant drawdown recorded in the Anglesea Swampland perched water table associated with pumping from the Anglesea Borefield.

If the perched water table is maintained within these natural variations, then impacts to surface water flow, acid generation processes and therefore ecology should not occur as a result of groundwater extraction from the Lower Eastern View Formation.

The groundwater trigger levels are set for the two bores in the Anglesea Swampland:

- Bore P19: Monitoring the Upper Eastern View Formation
- Bore P8: Monitoring the Perched Water Table

The trigger mechanism accounts for the seasonal variation in the groundwater levels through bore P17. These trigger levels use daily recorded values, which are converted to a monthly average and are calculated based on the following formulae:

$$P8 = 0.3131 * P17 + 9.4666 - 2\ Standard\ Deviations\ of\ Error$$

$$P19 = 0.2391 * P17 \mp 16.82 - 2\ Standard\ Deviations\ of\ Error^{*}$$

* Amended typographical error of minus "-16.82" to "+16.82" in the 2014 Amendment Order.

The trigger levels are shown in Figure 4 and Figure 5. At all times during 2018-2019 the groundwater levels were above the required trigger levels.

Figure 4: P19 Groundwater trigger levels

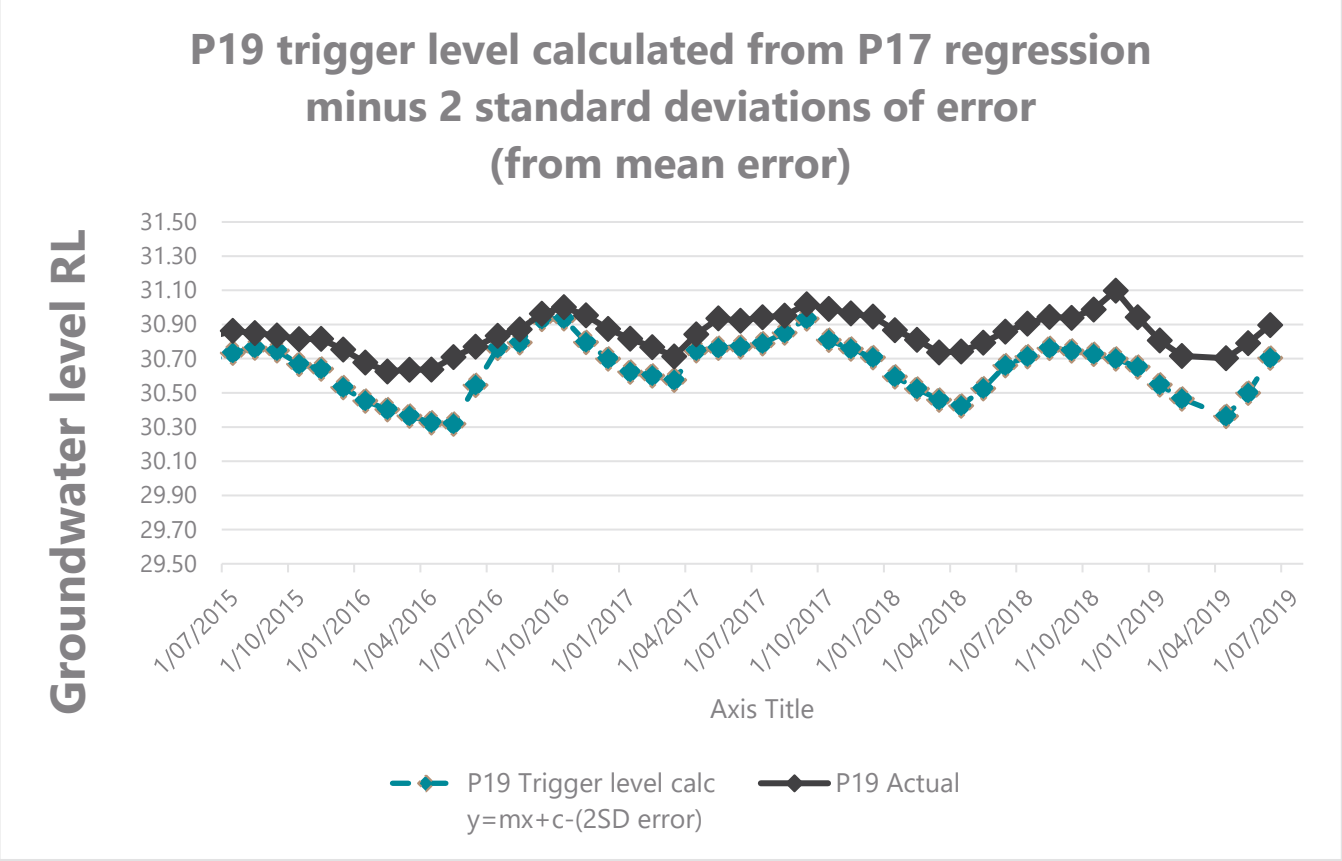
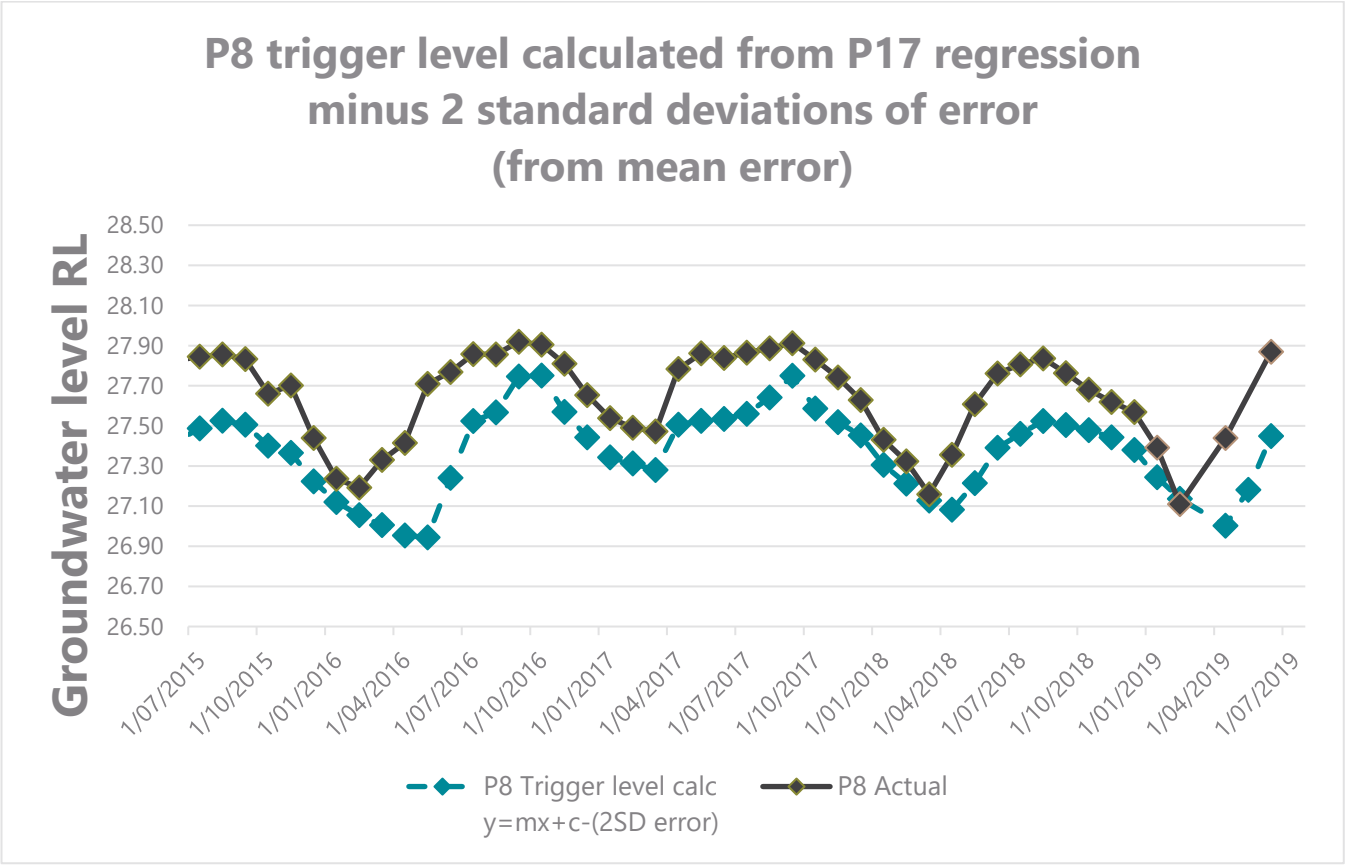


Figure 5: P8 Groundwater trigger levels



5. Issues in implementing the program or restoring groundwater levels (Clause 16.2 F)

5.1 Water quality sampling

Monthly water quality sampling is conducted at eleven sites to observe pH, temperature, DO and EC. Some of the sampling sites were dry for a period of time during the past year. Water quality sampling could not be completed when a sampling site was dry.

5.2 Amendment to the monitoring and assessment program

There have been no amendments to the monitoring and assessment program in 2018–19.

6. Arrangements with existing groundwater users (Clause 16.2 G)

There have been no arrangements entered into that would trigger this clause.

7. Independent Arbitration (Clause 16.2 H)

Independent arbitration has not been necessary.

8. Difficulties in compliance with the order (Clause 16.2 I)

8.1 Observation bores 115868 (UEVF) and 119349 (UEVF)

DELWP has advised that observation bores 115868 and 119349 are in poor condition and are scheduled for decommissioning. Following notification of the planned decommissioning, a condition assessment was undertaken on each bore in July 2019 and independently reviewed by Barwon Water's consultants. The recommendation was that both bores are beyond refurbishment and should be decommissioned. These bores have been determined by Barwon Water to be required for ongoing monitoring of groundwater levels and therefore Barwon Water plans to replace these bores.

8.2 Access to bores located within Alcoa's Anglesea Power Station site

Barwon Water has experienced issues maintaining constant access to the three bores (WB4, WB5 & WB12) within the Alcoa site due to the power station and coalmine remediation works occurring onsite. With the majority of Alcoa's demolition works now complete, we do not expect to have the same level of access issues going forward.

9. Monitoring and assessment program

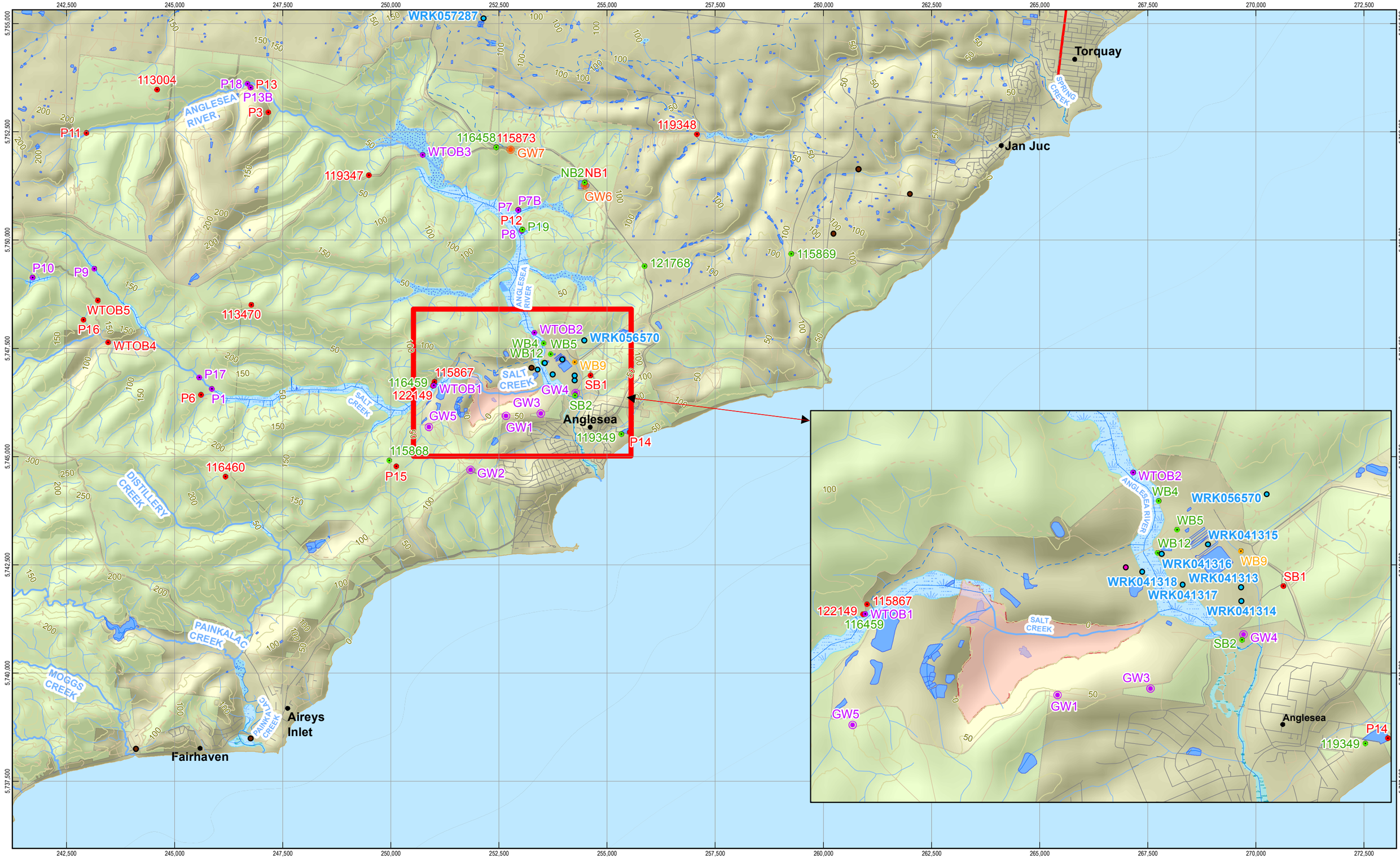
9.1 Monitoring and assessment program update

A requirement of the *Bulk Entitlement (Anglesea Groundwater) Order 2009* is that Barwon Water must not take any groundwater under this Order unless it has in place a monitoring and assessment program (MAP) approved by the Minister for Water.

Appendix F provides an update on the status of the MAP that was approved by the Minister in 2014.

Appendix A

Observation bore locations



1:80,000 Paper Size A3

0 0.375 0.75 1.5 2.25 3

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

Legend

- Towns
- Highway (38)
- Sealed Road (Arterial & Local) (1,359)
- Unsealed Road (1,062)
- Unsealed Track (271)
- River
- Stream
- Channel / Drain
- Connector
- Estuary
- Lake
- Flat
- Swamp
- pondage
- Alcoa
- DSE
- Cont
- Licensed Groundwater Bores (SRW)
- GMS Bores
- Stock & Domestic Bores
- Northern Bore Field
- Southern Bore Field

Bulk Entitlement Monitoring Bores

Aquifer Monitored

- PWT
- UEVF
- LEVF
- UEVF_LEVF

Barwon Water

Anglesea Borefield
Numerical Modelling and Recalibration

Groundwater Monitoring Bore Locations

Job Number 31-32669
Revision A
Date 12 Jun 2015

Figure 1

G:\31\32669\GIS\Maps\Deliverables\0001_Anglesea_Monitoring_2014_MonitoringBores.mxd

Data source: VicMap 2011 (rivers, roads, contours), GHD 2011 (monitoring locations), GMS 2011 (GMS Bore Locations) Created by:jlearmonth

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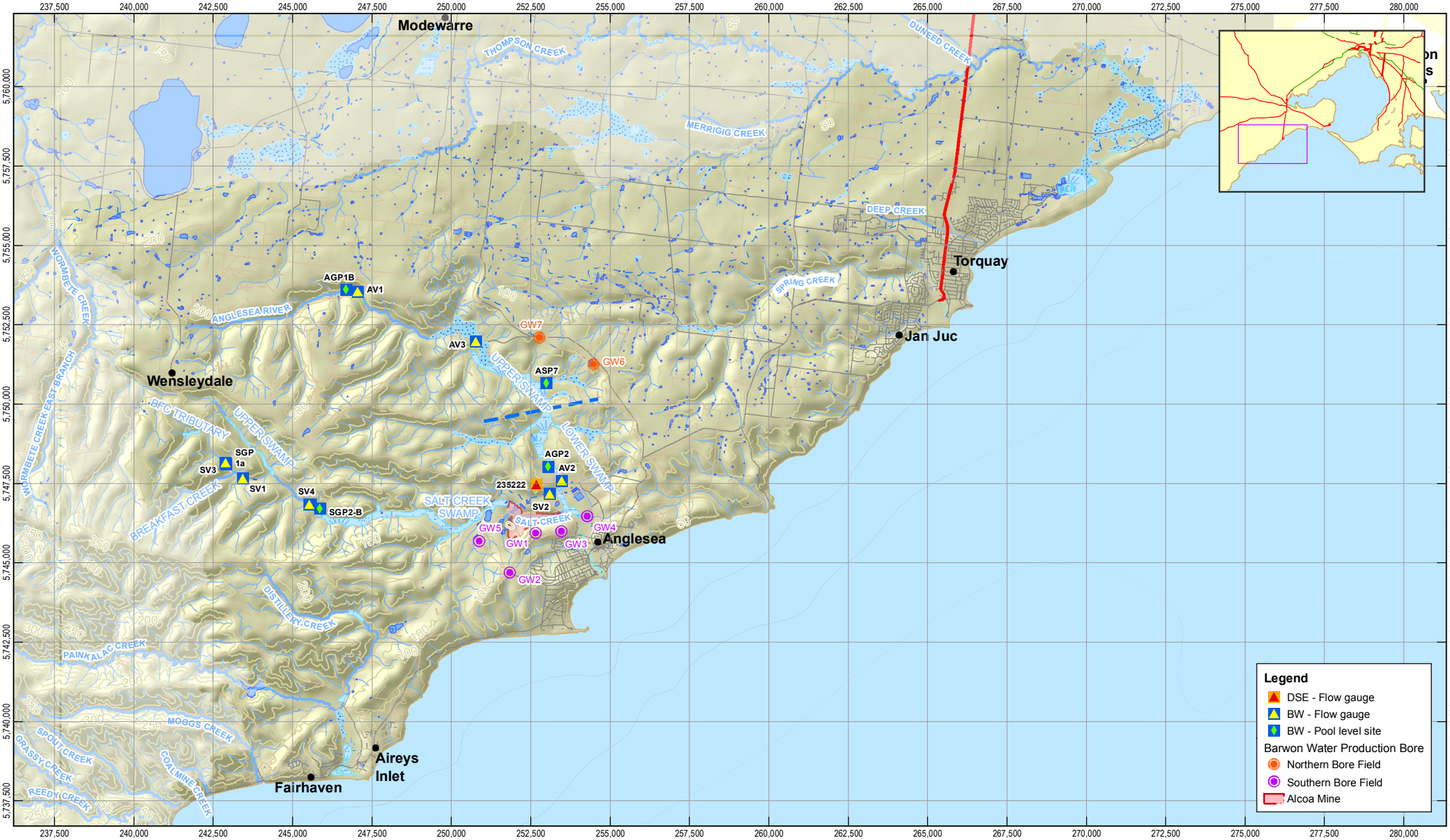
Appendix B

Surface water monitoring locations



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0 0.5 1 2 3 4 5

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

LEGEND

- Towns
- Highway
- Sealed Road (Arterial & Local)
- Unsealed Road
- Unsealed Track
- Estuary
- Lake
- Flat
- Swamp
- pondage
- River
- Stream
- Channel / Drain
- Connector
- Contours (50m)

Barwon Water

Anglesea Borefield
Numerical Modelling and Recalibration

Surface Water
Monitoring Locations

Job Number 31-32669
Revision A
Date 12 Jun 2015

Figure 2

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Data source: VicMap, DSE, ABARES, Corangamite CMA, DPI, Barwon Water, BOM and SILO Created by:jlearmonth

Appendix C

Surface water quality results – field testing

Name Breakfast Creek Tributary @ V notch
GHD/BW ID SV3
SINo. 235274A
BE Map ID GS7

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Flow at V notch	General weather conditions	Comments
18/07/2018	11:35	0.127	404	250.48	9.2	9.2	5.64	9.5	n/a	<0.1	Sunny	Air temp 8.8 Water clear.Photo and sample taken
13/08/2018	13:05	0.16	381	236.22	7.56	7.56	5.81	11.2	n/a	2.05	Cloudy	Air temp 11.2 Water clear.
25/09/2018	11:30	0.112	280	173.6	8.2	8.2	4.9	9.4	n/a	<0.1	Light rain	Air temp 11.5 Water clear.
18/10/2018	9:30	0.107	277	171.74	6.5	6.5	4.6	11.5	n/a	<0.1	Light rain	Air temp 15.6 Water clear.
8/11/2018	9:00	0.107	258	159.96	7.7	7.7	5	10.8	n/a	<0.1	Cloudy	Air temp 13.0 Water clear.
13/12/2018	9:20	0.087	249	154.38	3.9	3.9	5.5	14	n/a	<0.1	Overcast / Raining	Air temp 15.0 Water clear. Debris caught in V-Notch
21/01/2019	10:00	0.03	255	158.1	0.8	0.8	6	16.2	n/a	0.00	Overcast	Air temp 21.5 Water clear.
12/02/2019	11:55	Dry	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	Overcast	Air temp 13.1
14/03/2019	9:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	Cloudy	Air temp 15.0
8/04/2019	13:50	Dry	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	Cloudy	Air temp 17.0, Photos
27/05/2019	10:20	0.06	531	329.22	5.2	5.2	4.3	11.1	n/a	<0.1	Cloudy	Air temp 11.0,
19/06/2019	9:55	0.122	459	284.58	7.5	7.5	4.6	9.7	n/a	<0.1	Cloudy	Air temp 7.0,
30/07/2019	10:30	0.121	362	224.44	7.5	7.5	4.5	9.4	n/a	<0.1	Overcast / Drizzle	Air temp 10,

Name Breakfast Creek @ Road bridge
GHD/BW ID SV1 - Bridge
SINo. 235273A
BE Map ID GS1

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Pool conditions	General weather conditions	Comments
18/07/2018	11:00	0.14	381	236	3.71	3.71	5.75	7.6	7.5	Flowing	Sunny	Water clear , Rustic coloured algae in water, Sample and photo taken
13/08/2018	12:30	0.221	477	296	6.9	6.9	6.8	9.5	11.3	Flowing	Cloudy	Water clear , Rustic coloured algae in water
25/09/2018	10:15	0.131	336	208	4.8	4.8	5.2	9.9	11	Flowing	Cloudy	Water clear , Rustic coloured algae in water. Backed-up over control by downstream build up, silt removed, GH will fall, await next data to se how much by.
18/10/2018	7:45	0.111	350	217	1.9	1.9	5.3	13.8	14.7	Flowing	Cloudy	Water clear , Rustic coloured algae in water.
7/11/2018	8:00	0.095	348	216	1.6	1.6	5.8	13.8	12	Flowing	Cloudy	Water clear , Rustic coloured algae in water. Ants in cabinet, Almost stopped flowing.
13/12/2018	8:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	15	dry	Overcast / Raining	No WQ
21/01/2019	8:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	20	dry	Overcast	No WQ
12/02/2019	10:50	Dry	n/a	n/a	n/a	n/a	n/a	n/a	11.3	dry	Overcast	No WQ
14/03/2019	8:00	Dry	n/a	n/a	n/a	n/a	n/a	n/a	8	dry	Cloudy	No WQ
8/04/2019	13:15	Dry	n/a	n/a	n/a	n/a	n/a	n/a	17	dry	Cloudy	No WQ
27/05/2019	9:15	Dry	n/a	n/a	n/a	n/a	n/a	n/a	10	dry	Drizzle rain	No WQ , Tree branch fallen on hut, minor damage to door (photos)
18/06/2019	15:00	0.167	534	331	5.8	5.8	5.5	10.1	10	Flowing	Drizzle rain	Water clear.
30/07/2019	9:30	0.177	437	271	7.2	7.2	5.8	8.1	9	Flowing	Overcast	Water clear.

Name Salt Creek @ Denhams Track
GHD/BW ID SV4
SINo. 235276A
BE Map ID GS2

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Pool conditions	General weather conditions	Comments
18/07/2018	12:45	0.160	230	142.6	7.32	7.32	6.75	9.1	10.3	Flowing	Cloudy	Water clear dark tanin stain, Photo and sample taken
13/08/2018	13:55	0.249	380	235.6	8.38	8.38	5.68	10.1	11.2	Flowing	Cloudy	Water clear dark tanin stain
25/09/2018	13:45	0.130	275	170.5	5.1	4.9	5.3	9.1	11.9	Flowing	Cloudy	Water clear dark tanin stain
18/10/2018	9:45	0.139	260	161.2	4.9	4.9	5.2	11.8	17	Flowing	Cloudy	Water clear dark tanin stain. Changed Battery and disconnected solar.
8/11/2018	10:50	0.118	247	153.14	4.5	4.5	5.4	10.9	14	Flowing	Cloudy	Water clear dark tanin stain. Changed Battery
13/12/2018	11:30	BELOW	323	200.26	2.3	2.3	5.6	14.5	17.3	Stagnant	Overcast / Raining	Water clear dark tanin stain. Changed Battery
21/01/2019	12:30	Dry	n/a	n/a	n/a	n/a	n/a	n/a	25	Dry	Overcast	Changed Battery
13/02/2019	8:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	10	Dry	Overcast	Changed Battery
14/03/2019	10:30	Dry	n/a	n/a	n/a	n/a	n/a	n/a	18	Dry	Cloudy	Changed Battery . Changed Level sensor.
9/04/2019	10:15	Dry	n/a	n/a	n/a	n/a	n/a	n/a	13	Dry	Cloudy	Changed Battery . Photos
27/05/2019	12:00	0.130	222	137.64	3.9	3.9	5.2	11.5	9	Flowing	Cloudy	Changed Battery .Changed logger. Clear water
19/06/2019	8:45	0.183	298	184.76	6.7	6.6	5.2	8.1	5	Flowing	Overcast	Reset level, Water clear.
30/07/2019	12:15	0.187	323	200.26	6.8	6.8	5.2	7.8	11	Flowing	Overcast	Water Clear

Name Salt Creek (Encoder) @ Alcoa
GHD/BW ID SV2
SINo. 235222A
BE Map ID GS3

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Pool conditions	General weather conditions	Comments
19/07/2018	11:45	BELOW	232	143.84	10.1	10.1	4.98	9.1	11	Clear	Sunny	Dry, Photo taken
14/08/2018	8:45	BELOW	239	148.18	8.09	8.09	4.81	10.6	8.2	Clear	Cloudy	Water clear
24/09/2018	11:15	BELOW	308	190.96	11	11	4.2	13.8	10.8	Clear	Cloudy	Water slightly turbid
17/10/2018	8:15	BELOW	390	241.8	8.6	8.6	4	17	16	Clear	Cloudy	Water clear
7/11/2018	10:15	BELOW	488	302.56	10.1	10.1	3.9	18.3	13	Clear	Cloudy	Water clear
12/12/2018	9:30	DRY	n/a	n/a	n/a	n/a	n/a	n/a	26.8	Dry	Sunny	Dry
18/01/2019	8:00	DRY	n/a	n/a	n/a	n/a	n/a	n/a	22	Dry	Overcast	Dry
12/02/2019	8:05	DRY	n/a	n/a	n/a	n/a	n/a	n/a	14	Dry	Overcast	Dry
13/03/2019	9:00	DRY	n/a	n/a	n/a	n/a	n/a	n/a	14	Dry	Cloudy	Dry
8/04/2019	9:15	DRY	n/a	n/a	n/a	n/a	n/a	n/a	15	Dry	Sunny	Dry, Photos
24/05/2019	10:45	Below	120	74.4	7	7	4.4	13.2	14	Brown	Overcast	No Flow, muddy brown water
18/06/2019	10:00	-0.020	119	73.78	7.3	7.3	4.9	9.6	12	No Flow	Overcast	Muddy light brown water
29/07/2019	10:15	-0.030	163	101.06	8.8	8.8	4.6	8.5	13	No Flow	Sunny	Muddy light brown water

Name Salt Creek (Pool)above swamp @ Denham Track (new downstream site)
GHD/BW ID SGP2-B
SINo. 235275A
BE Map ID

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{O}C)	Pool conditions	General weather conditions	Comments
18/07/2018	13:00	GH 2.011	237	146.94	6.88	6.88	6.43	9.9	Flowing	Sunny	Air temp 8.8 Dark tanin stain, Photo taken and sample
13/08/2018	13:45	GH 2.112	496	307.52	8.07	8	6.23	8	Flowing	Cloudy	Air temp 11.1 Dark tanin stain
25/09/2018	14:45	GH 1.998	419	259.78	5	2.8	5.8	8.8	Flowing	Cloudy	Air temp 11.0 Dark tanin stain
18/10/2018	10:30	GH 1.990	251	155.62	4.04	0.8	4.8	12	Flowing	Cloudy	Air temp 16.0 Dark tanin stain
8/11/2018	9:55	GH 1.960	249	154.38	4	1.1	5.2	11.4	Flowing	Cloudy	Air temp 14.0 Dark tanin stain. Troll logger replaced (drifting)
13/12/2018	11:00	GH 1.710	287	177.94	2.3	0.7	5.5	17.8	Stagnant	Overcast / Raining	Air temp 17.0 Dark tanin stain
21/01/2019	12:20	GH1.205	415	257.3	0.7	0.5	5.9	15.7	Stagnant	Sunnny	Air temp 25.5 Dark tanin stain
13/02/2019	8:20	GH0.833	276	171.12	0.6	0.6	5.8	12.9	Stagnant	Overcast	Air temp 10.1 Dark tanin stain
14/03/2019	10:10	Below	325	201.5	0.4	0.4	5.9	11.6	Stagnant	Cloudy	Air temp 17.0, Water has turned brown. Photo taken. WQ sample taken
9/04/2019	10:00	Below	333	206.46	0.9	0.9	5.9	12	Stagnant	Cloudy	Air temp 13.0, Water has turned brown.
27/05/2019	11:25	1.958	226	140.12	3.9	0.7	5.2	10.5	Stagnant	Cloudy	Air temp 8.0, Water is clear and is almost blue. Turbidity = 1.8. "Bottom readings EC=384.PH=6.0"
19/06/2019	8:20	2.022	330	204.6	6.4	6.6	5.2	9.5	Flowing	Overcast	Air temp 6.0, Water is clear with slight tanin. Turbidity = 1.6. "Bottom readings EC=297.T=8.4, pH=5.2, TB=2.7"
30/07/2019	12:30	2.020	323	200.26	7.1	6.8	5.2	7.9	Flowing	Overcast, Drizzle	Air temp 10.5, Water is clear with slight tanin. Turbidity = 2.5. "Bottom readings EC=323.T=7.8, pH=5.2, TB=2.3"

Name Upper Anglesea River (Pool) @ Australian Automotive Research Centre - (New downstream pool site)
GHD/BW ID AGP1-B
SINo. 235271A
BE Map ID

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Pool conditions	General weather conditions	Comments
18/07/2018	10:15	GH 0.541	883	547	4.72	4.11	7.2	6.4	Stagnant	Sunny	Air temp 5.6, Photo taken and sample
13/08/2018	11:15	GH 1.216	1026	636	6.37	4.21	5.7	11.4	Stagnant	Cloudy	Air temp 11.2
24/09/2018	14:30	GH 1.799	1353	839	6.2	0.5	5.7	13.1	Stagnant	Cloudy	Air temp 11.3. Water tannin stained.
17/10/2018	12:45	GH 1.937	1382	857	2	0.7	5.7	15	Stagnant	Cloudy	Air temp 21. Water tannin stained.
7/11/2018	13:45	GH 1.975	1313	814	4.4	0.2	5.9	14.2	Stagnant	Cloudy	Air temp 18. Water tannin stained.
12/12/2018	12:30	GH 1.772	1440	892.8	2	0.2	6.1	28	Stagnant	Cloudy	Water has a dark tannin. Air temp 28.
21/01/2019	8:00	GH 1.412	1450	899	1.1	0.4	6.2	17.5	Stagnant	Overcast	Air temp 21.5. Water tannin stained.
13/02/2019	10:50	GH 1.093	1478	916.36	1.4	0.4	6.0	13.8	Stagnant	Overcast	Air temp 13.9. Water tannin stained.
13/03/2019	13:15	RecH 0.722	1530	948.6	0.7	0.6	5.7	14.7	Stagnant	Cloudy	Air temp 20.0. Water mainly brown. Photo taken. WQ sample taken
8/04/2019	12:30	RecH 0.496	1545	957.9	0.7	0.7	6.0	14.3	Stagnant	Cloudy	Air temp 17.0. Water mainly brown. Very windy, Photos
24/05/2019	13:10	RecH 0.661	1035	641.7	4.6	0.5	4.9	12.6	Stagnant	Cloudy	Air temp 17.0. Water tanin stained.
18/06/2019	14:05	2.553	532	329.84	5.2	0.6	5.3	8.5	Flowing	Cloudy	Air temp 10.0. Water light brown. (Bottom readings EC 1060, Temp 9.0, Ph 5.3) Turbidity 47
29/07/2019	14:55	2.450	754	467.48	4	0.4	5.6	7.4	Flowing	Overcast	Air temp 13.0. Water almost grey colour. (Bottom readings EC 1710, Temp 8.0, Ph 5.6) Turbidity 12.3

Name Upper Anglesea River @ AARC (V notch site)
GHD/BW ID AV1
SINo. 235270A
BE Map ID GS4

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Pool conditions	General weather conditions	Comments
18/07/2018	9:55	DRY	n/a	n/a	n/a	n/a	n/a	n/a	5.9	Dry	Sunny	River dry no sampling, Photo taken
13/08/2018	11:25	0.212	771	478	4.32	4.32	6.34	9.9	11.5	Flow	Cloudy	Water clear
24/09/2018	14:10	Below	848	526	2.35	2.35	4.9	10.4	12.8	Stagnant	Cloudy	Water clear
17/10/2018	12:30	Dry	n/a	n/a	n/a	n/a	n/a	n/a	21	Dry	Cloudy	Dry
7/11/2018	12:10	Dry	n/a	n/a	n/a	n/a	n/a	n/a	18	Dry	Cloudy	Dry
12/12/2018	12:20	Dry	n/a	n/a	n/a	n/a	n/a	n/a	27	Dry	Cloudy	Dry
18/01/2018	12:20	Dry	n/a	n/a	n/a	n/a	n/a	n/a	23	Dry	Overcast	Dry
13/02/2019	10:30	Dry	n/a	n/a	n/a	n/a	n/a	n/a	14.2	Dry	Overcast	Dry
13/03/2019	13:00	Dry	n/a	n/a	n/a	n/a	n/a	n/a	20	Dry	Cloudy	Dry
8/04/2019	12:10	Dry	n/a	n/a	n/a	n/a	n/a	n/a	20	Dry	Cloudy	Dry
24/05/2019	12:55	Dry	n/a	n/a	n/a	n/a	n/a	n/a	17	Dry	Cloudy	Dry
18/06/2019	13:55	0.19	467	290	5.7	5.7	5.4	9.1	9	Flowing	Overcast	Water Milky clear.
29/07/2019	14:30	0.182	482	299	6	6	5.4	8.6	13	Flowing	Overcast, Drizzle	Water Milky clear.

Name Anglesea River @ Gumflats Road
GHD/BW ID AV3
SINo. 235277A
BE Map ID GS6

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{O}C)	Air Temperature (^{O}C)	Pool conditions	General weather conditions	Comments
18/07/2018	13:55	DRY	X	X	X	X	X	X	8.4	dry	SUNNY	No Sampling as pool dry. No flow. Photo taken
13/08/2018	10:45	DRY	X	X	X	X	X	X	7.2	dry	CLOUDY	No Sampling as pool dry. No flow.
24/09/2018	12:45	DRY	X	X	X	X	X	X	13.2	dry	CLOUDY	No Sampling as pool dry. No flow.
17/10/2018	13:25	DRY	X	X	X	X	X	X	20	dry	CLOUDY	No Sampling as pool dry. No flow.
7/11/2018	13:20	DRY	X	X	X	X	X	X	19	dry	CLOUDY	No Sampling as pool dry. No flow.
12/12/2018	13:25	DRY	X	X	X	X	X	X	31	dry	SUNNY	No Sampling as pool dry. No flow.
18/01/2019	13:00	DRY	X	X	X	X	X	X	32	dry	CLOUDY	No Sampling as pool dry. No flow.
12/02/2019	10:10	DRY	X	X	X	X	X	X	11.2	dry	CLOUDY	No Sampling as pool dry. No flow.
13/03/2019	14:10	DRY	X	X	X	X	X	X	17	dry	SUNNY	No Sampling as pool dry. No flow.
9/04/2019	8:40	DRY	X	X	X	X	X	X	10	dry	Overcast	No Sampling as pool dry. No flow. Photos
24/05/2019	13:55	DRY	X	X	X	X	X	X	18	dry	Overcast	No Sampling as pool dry. No flow.
18/06/2019	13:00	0.132	982	609	8.9	8.9	4	9.5	11	Flowing	Raining	Water clear
29/07/2019	13:30	0.137	804	498	9.6	9.6	4.1	9.2	15	Flowing	Cloudy	Water clear

Name Anglesea Swamp @ Vegetation Site P7
GHD/BW ID ASP7
SINo. 235280A
BE Map ID

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Pool conditions	General weather conditions	Comments
19/07/2018	10:45	BELOW	2720	1686	7.95	7.95	3.76	9.3	8.2	STAGNANT	SUNNY	WATER CLEAR
13/08/2018	10:20	BELOW	2811	1743	5.3	5.3	3.71	8.1	7.2	STAGNANT	CLOUDY	WATER CLEAR
25/09/2018	9:50	BELOW	2814	1745	6.3	6.3	3.2	12.1	11	STAGNANT	CLOUDY	WATER VERY CLEAR
17/10/2018	11:15	BELOW	n/a	n/a	n/a	n/a	n/a	n/a	18.5	STAGNANT	CLOUDY	WATER VERY CLEAR. Pool too small to take sample. Sensor out of water.
7/11/2018	14:00	BELOW	n/a	n/a	n/a	n/a	n/a	n/a	19	STAGNANT	CLOUDY	WATER VERY CLEAR. Pool too small to take sample. Sensor out of water.
12/12/2018	12:00	Dry	n/a	n/a	n/a	n/a	n/a	n/a	26	Dry	SUNNY	NO SAMPLING- SWAMP DRY
18/01/2019	10:00	Dry	n/a	n/a	n/a	n/a	n/a	n/a	23	Dry	Overcast	NO SAMPLING- SWAMP DRY
12/02/2019	9:40	Dry	n/a	n/a	n/a	n/a	n/a	n/a	12.5	Dry	Overcast	NO SAMPLING- SWAMP DRY
13/03/2019	11:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	16	Dry	Overcast	NO SAMPLING- SWAMP DRY
8/04/2019	10:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	17	Dry	Sunny	NO SAMPLING- SWAMP DRY
24/05/2019	14:15	Dry	n/a	n/a	n/a	n/a	n/a	n/a	19	Dry	Overcast	NO SAMPLING- SWAMP DRY
18/06/2019	12:00	Below	2886	1789	6.5	6.5	3	11	11	STAGNANT	Rain	Water clear. Sensor out of water
29/07/2019	12:45	Below	2324	1441	7.1	7.1	3.2	12.6	14	STAGNANT	Overcast, Drizzle	Water clear. Sensor out of water

Name Anglesea Wetlands @ Allardyne Track
GHD/BW ID AGP2
SINo. 235272A
BE Map ID

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Pool conditions	General weather conditions	Comments
19/07/2018	12:15	DRY	n/a	n/a	n/a	n/a	n/a	n/a	11.1	Dry	Cloudy	Swamp dry
14/08/2018	9:30	0.223	2781	1724	5.21	5.21	3.27	8.5	11.1	Flowing	Cloudy	Water clear,
24/09/2018	12:00	0.14	3828	2373	7	7	2.9	13.3	13.5	Flowing	Cloudy	Water clear,
17/10/2018	8:55	Below	n/a	n/a	n/a	n/a	n/a	n/a	19.4	Small	Cloudy	Small Puddle, not sampled
7/11/2018	10:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	13	Dry	Cloudy	Dry
12/12/2018	10:00	DRY	n/a	n/a	n/a	n/a	n/a	n/a	24	Dry	Cloudy	Dry
18/01/2019	8:48	Dry	n/a	n/a	n/a	n/a	n/a	n/a	22	Dry	Overcast	Dry
12/02/2019	8:45	Dry	n/a	n/a	n/a	n/a	n/a	n/a	9.9	Dry	Overcast	Dry
13/03/2019	10:00	Dry	n/a	n/a	n/a	n/a	n/a	n/a	16	Dry	Cloudy	Dry
8/04/2019	9:50	Dry	n/a	n/a	n/a	n/a	n/a	n/a	16	Dry	Sunny	Dry, Photos
24/05/2019	11:20	Dry	n/a	n/a	n/a	n/a	n/a	n/a	15	Dry	Overcast	Dry, The infrastructure holding the sensor in place is severely rusted
18/06/2019	10:40	0.232	4716	2924	3.5	3.5	2.7	10.5	11	Flowing	Overcast	Pool is filling, Water clear.
29/07/2019	11:00	0.32	4250	2635	7.9	7.9	2.7	8.5	14	Flowing	Sunny	Pool is filling, Water clear.

Name Anglesea River (Marshy Creek) @ Alcoa
GHD/BW ID AV2
SINo. 235260A
BE Map ID GS5

Date	Time (EST)	Gauge Height	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (^{o}C)	Air Temperature (^{o}C)	Pool conditions	General weather conditions	Comments
19/07/2018	11:30	DRY	n/a	n/a	n/a	n/a	n/a	n/a	7.4	Dry	Cloudy	Swamp dry
14/08/2018	8:35	DRY	n/a	n/a	n/a	n/a	n/a	n/a	11	Dry	Cloudy	Swamp dry
24/09/2018	10:45	0.112	5546	3438.52	9.1	9.1	2.7	12.9	11.8	Flowing	Cloudy	Water clear, dark tannin colour.
17/10/2018	7:45	0.075	5210	3230.2	6.3	6.3	2.6	16.6	15	Flowing	Cloudy	Water clear, dark tannin colour. Debris removed from D/S control causing water level to fall.
7/11/2018	9:00	0.025	4688	2906.56	7.3	7.3	2.6	15.3	12	Flowing	Cloudy	Water clear, dark tannin colour.
12/12/2018	8:30	Below	6140	3806.8	1.5	1.5	2.7	20.4	22	No Flow	Cloudy	EC sensor re-installed after repair. Dark Tannin colour.
18/01/2019	7:45	Below	6664	4131.68	0.3	0.3	2.7	21.3	22	No Flow	Overcast, light drizzle	Water clear, dark tannin colour. Small Pool, Water level below EC sensor
12/02/2019	7:45	DRY	n/a	n/a	n/a	n/a	n/a	n/a	9.9	Dry	Overcast	Cover put on PH probe to prevent drying
13/03/2019	8:45	DRY	n/a	n/a	n/a	n/a	n/a	n/a	13	Dry	Cloudy	Topped up solution in PH cover
8/04/2019	9:00	DRY	n/a	n/a	n/a	n/a	n/a	n/a	13	Dry	Sunny	Topped up solution in PH cover, Photos
24/05/2019	10:30	DRY	n/a	n/a	n/a	n/a	n/a	n/a	14	Dry	Overcast	Topped up solution in PH cover,
18/06/2019	9:36	Below	5790	3589.8	1.9	1.9	3.2	12.6	11.5	Filling	Overcast	pH cover removed. Clear water.
29/07/2019	9:45	0.117	6266	3884.92	6	6	2.9	12.1	12.5	Flowing	Sunny	Black Tanin water. (Turbidity 1.9)

Appendix D

Surface water quality results – laboratory testing

							Alkalinity			Anions by IC		Nutrients	Total Metals by ICP				pH	
Catchment	Site	Date	Time (EST)	Sample No.	TDS (mg/L)	EC (µS/cm)	Total Alkalinity (mg $CaCO_3$ / L)	Bicarbonate Alkalinity (mg $CaCO_3$ / L)	Carbonate Alkalinity (mg $CaCO_3$ / L)	Chloride (mg/L)	Sulphate (mg/L)	Nitrate as N (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	pH (Lab)	pH (Field
Salt Creek	SV3	18/07/2018	11:30	EM1811540-002	200	340	2	2	<1	67	44	0.02	<1	11	<1	43		5.64
		13/02/2019		dry														
	SV1	18/07/2018	11:00	EM1811540-004	236	373	4	4	<1	78	54	<0.01	3	12	2	47		5.75
		13/02/2019		dry														
	SV4	18/07/2018	12:40	EM1811540-003	137	220	4	4	<1	60	5	<0.01	1	4	2	32		6.75
		13/02/2019		dry														
	SV2	19/07/2018	11:45	EM1811540-005	139	211	<1	<1	<1	26	38	0.06	3	6	3	24		4.98
		13/02/2019		dry														
Anglesea River	AV1	18/07/2018	9:55	dry														
		13/02/2019		dry														
	AV3	18/07/2018	13:55	dry														
		13/02/2019		dry														
	AV2	19/07/2018	11:30	dry														
		13/02/2019		dry														
	AGP1-B	6/02/2018	11:15	EM1802634-001	708	1280	23	23	<1	430	26	<0.01	4	26	7	174		4.5
		13/02/2019		EM1902029	1,220	1,400	22	22	<1	534	17		6	30	10	207		6
		18/07/2018	10:15	EM1811540-001	616	929	16	16	<1	301	26	0.02	5	15	6	133		7.2

Notes:

AGP1-B was sampled whenever AV1 was dry. AGP1-B is a pool located in close proximity to the AV1 Gauge

It should be noted that pH was not recorded in the laboratory as lag time from the field to the laboratory results in a deterioration of pH and therefore lab results are not reflective of the pH in the field.

Appendix E

Groundwater quality results – laboratory testing

						Alkalinity						Dissolved Major Cations				Ionic Balance		
Bore	Date	pH	EC (µS/cm)	TDS (mg/L)	Bromide	Hydroxide Alkalinity as CaCO3 (mg/L)	Carbonate Alkalinity as CaCO3 (mg/L)	Bicarbonate Alkalinity as CaCO3 (mg/ L)	Total Alkalinity as CaCO3 (mg/L)	Sulphate as SO4 (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Total Anions (meq/L)	Total Cations (meq/l)	Ionic Balance
Inter-aquifer Flow Monitoring																		
119348	Jul-2018	7.69	1,440	740	0	<1	<1	132	132	<1,000	405	13	9	209	26	14.1	11.1	11.6
	Jan-2019	8.33	1,280	738	0	<1	3	110	112	<1,000	423	11	7	227	25	14.2	11.6	9.81
NB2	Jul-2018	6.10	2,410	1,330	0	<1	<1	81	81	122,000	744	74	52	280	21	25.1	20.7	9.72
	Jan-2019	6.40	2,280	1,660	0	<1	<1	68	68	116,000	804	72	48	257	20	26.4	19.2	15.8
SB2	Jul-2018	6.22	2,050	1,160	0	<1	<1	55	55	130,000	659	18	48	229	37	22.4	15.8	17.4
	Jan-2019	5.22	2,380	1,440	0	<1	<1	3	3	150,000	779	21	52	267	38	25.2	17.9	16.8
P15	Jul-2018	5.57	920	502	0	<1	<1	15	15	59,000	264	4	18	114	15	8.98	7.02	12.2
	Jan-2019	6.00	760	568	0	<1	<1	22	22	60,000	271	5	18	127	14	9.33	7.61	10.2
Saline Intrusion Monitoring																		
P14	Jul-2018	6.74	1,110	561	0.513	<1	<1	154	154	1,000	272	16	10	144	37	10.8	8.83	9.89
	Jan-2019	7.13	989	566	0.424	<1	<1	132	132	2,000	288	13	9	156	35	10.8	9.07	8.72
Coastal Bore (119349)	Jul-2018																	
	Jan-2019																	
Swamp GDE																		
WTOB3	Jul-2018	6.01	1,540	1,120	0	<1	<1	26	26	74,000	533	5	28	242	3	17.1	13.2	13.0
	Jan-2019	5.99	1,580	998	0	<1	<1	17	17	67,000	546	5	28	270	3	17.1	14.4	8.76
P7B	Jul-2018	4.57	810	616	0	<1	<1	<1	<1	50,000	251	6	14	117	3	8.12	6.62	10.2
	Jan-2019	3.96	739	460	0	<1	<1	<1	<1	45,000	261	5	13	115	2	8.30	6.37	13.1
P8	Jul-2018	4.98	2,110	1,300	0	<1	<1	2	2	128,000	666	41	50	268	15	21.5	18.2	8.29
	Jan-2019	4.21	1,950	1,330	0	<1	<1	<1	<1	131,000	683	40	46	282	16	22.0	18.4	8.74
WTOB2	Jul-2018	4.13	3,900	2,200	0	<1	<1	<1	<1	570,000	934	71	76	416	29	38.2	28.6	14.3
	Jan-2019	4.23	3,150	2,130	0	<1	<1	<1	<1	507,000	857	70	70	410	28	34.7	27.8	11.1
P17	Jul-2018	6.68	1,350	736	0	<1	<1	133	133	66,000	328	34	23	162	4	13.3	10.7	10.6
	Jan-2019	6.84	1,110	1,210	0	<1	<1	142	142	<1,000	363	26	18	154	4	13.1	9.58	15.4
P1	Jul-2018	4.75	338	215	0	<1	<1	<1	<1	24,000	77	3	6	44	2	2.67	2.61	1.20
	Jan-2019	5.89	392	392	0	<1	<1	20	20	18,000	124	3	5	70	2	4.27	3.66	7.76
WTOB1	Jul-2018	5.60	1,200	776	0	<1	<1	33	33	52,000	332	7	19	165	4	11.1	9.19	9.43
	Jan-2019	5.59	997	1,020	0	<1	<1	37	37	53,000	327	6	17	170	3	11.1	9.17	9.37
Upper Anglesea Swamp and Trigger Level Site																		
P8	Jul-2018	4.98	2,110	1,300	0	<1	<1	2	2	128,000	666	41	50	268	15	21.5	18.2	8.29
	Jan-2019	4.21	1,950	1,330	0	<1	<1	<1	<1	131,000	683	40	46	282	16	22.0	18.4	8.74
P19	Jul-2018	6.38	1,190	665	0	<1	<1	62	62	18,000	397	11	16	164	23	12.8	9.59	14.4
	Jan-2019	6.38	1,010	715	0	<1	<1	44	44	18,000	398	9	14	161	23	12.5	9.19	15.2
P12	Jul-2018	6.67	1,130	634	0	<1	<1	80	80	8,000	371	11	13	159	25	12.2	9.17	14.3
	Jan-2019	6.75	1,050	676	0	<1	<1	64	64	8,000	365	8	11	155	24	11.7	8.66	15.1
Breakfast Creek Tributary																		
P16	Jul-2018	4.67	556	411	0	<1	<1	<1	<1	78,000	112	13	13	59	2	4.78	4.34	4.90
	Jan-2019	5.18	306	308	0	<1	<1	3	3	17,000	94	3	7	48	3	3.06	2.89	2.94

Appendix F

Monitoring and assessment program update

1 Purpose

The purpose of the monitoring and assessment program (MAP) is to provide data and information about the long term sustainability of groundwater resources in the Jan Juc Groundwater Management Area and protect the environmental values and health of groundwater dependent ecosystems.

2 Groundwater level monitoring

Barwon Water did not operate the Anglesea Borefield during 2018–2019. Groundwater level monitoring has therefore been conducted at a monthly frequency at 42 observation bores. For the three trigger bores P8, P17 and P19 Barwon Water has maintained daily monitoring although not required through the MAP. Barwon Water is currently investigating telemetry for P8, P17, and P19.

3 Groundwater quality monitoring

The requirement for groundwater quality monitoring when not pumping requires two sampling runs per year. For 2018–2019 this sampling was completed in July 2018 and January 2019.

Field and laboratory parameters required under the MAP were recorded during this sampling in 2018–2019.

4 Surface water flow & level monitoring

The monitoring and assessment program has seven flow monitoring sites, with four in the Salt Creek catchment and three in the Anglesea River catchment. All sites have permanent data loggers recording on a daily frequency.

Water level is also monitored through a logger in Salt Creek and 3 sites in the Anglesea River, two of which have loggers and one that is recorded during the field sampling on a monthly basis.

5 Surface water quality monitoring

The MAP has identified 11 monitoring sites across the Salt Creek and Anglesea River catchments. The frequency of monitoring consists of twice-yearly sampling through a laboratory and monthly field sampling. The frequency of this does not change in relation to activation of the borefield and has all been completed throughout 2018–2019.

6 Aquatic ecology monitoring

The aquatic ecology monitoring is made up of two components in the MAP, including macroinvertebrate and Southern Pygmy Perch sampling.

Macroinvertebrate sampling is required in Spring every third year at 11 sites across the catchment. This was last conducted in 2018, so is not due again until 2021.

A combination of Southern Pygmy Perch and Macroinvertebrate sampling is also required to be conducted on an annual basis at a select number of sites across the catchment. This monitoring was completed during 2018–2019.

If Barwon Water commences operation of the borefield, this component of the MAP is amended by adding six additional monitoring sites to the Anglesea Swamp.

7 Terrestrial ecology monitoring

Terrestrial ecology monitoring also comprises two components, monitoring both frog assemblages and vegetation.

When not taking groundwater the MAP requires monitoring of frogs every two years. Frog surveys were last conducted in Spring 2017 and are next scheduled for Spring 2019.

For vegetation monitoring, when not taking groundwater, Barwon Water is required to undertake vegetation assessments in Spring of every second year at four sites in the Anglesea Estuary. This was last conducted in Spring 2017 with the next scheduled assessment in Spring 2019.

If Barwon Water commences operation of the borefield, this component of the MAP is amended by adding six additional monitoring sites to the Anglesea Swamp.

8 Acid sulfate investigations

Monash University has been contracted by Barwon Water to undertake soil sampling for potential acid sulfate soils in the Anglesea catchment. This report is currently being finalised by Monash University and expected for completion in 2019–2020.

9 Land level surveying

Land level surveying is in place to measure any potential land subsidence (settling or sinking of the ground surface) resulting from operation of the Anglesea Borefield.

Barwon Water has 30 survey monitoring points covering the area of likely drawdown of groundwater levels in the Lower Eastern View Formation (LEVF). This regional subsidence network is surveyed annually.

10 Rainfall gauging

Rainfall is recorded via rain gauges at three sites across the catchment. This data is downloaded on a monthly basis and maintained in accordance with approved Bureau of Meteorology standards.

11 Failure of monitoring infrastructure

As per Section 8 of the main report.