

5. Results

5.1 Site conditions

During the 2017 monitoring period, all eleven monitoring bores were observed to be in working order.

The shallow monitoring bores SE1S – SE10S, were not sampled during the monitoring period due to insufficient water to provide a representative sample. Although gauging detected the presence of water in some of the shallow bores (at the base of well), the data available is considered unreliable and not representative of a shallow aquifer and may be attributable to condensation build up or stormwater ingress. It is noted that the shallow groundwater bores have typically been observed to be dry in recent sampling events.

5.2 Groundwater elevation and flow direction

Water level gauging data and corrected groundwater elevations (m AHD) for each monitoring event are included in Table 4 below with contours presented on Figure 2. As per Figure 2, groundwater flow is inferred to be in a westerly direction, which is consistent with previous investigations and monitoring events.

Groundwater elevation ranged from the following:

- March: 34.438 mAHD (Well ID) to 56.937 mAHD (Well ID)
- October: 35.231 mAHD (Well ID) to 56.831 mAHD (Well ID).

Table 4 Groundwater elevation March and October 2017

Well ID	Monitoring Event	Easting	Northing	TOC elevation (mAHD)	Groundwater depth (m bTOC)	Groundwater elevation (mAHD)
SE1D	March 2017	38348	6300786	74.36	34.78	39.58
	Oct 2017	38348	6300786	74.36	34.76	39.60
SE3D	March 2017	387248	6300402	73.10	37.87	35.23
	Oct 2017	387248	6300402	73.100	37.66	35.43
SE4D	March 2017	387171	6300237	71.70	36.60	35.10
	Oct 2017	387171	6300237	71.70	36.34	35.36
SE5D	March 2017	388021	6300376	103.99	47.05	56.94
	Oct 2017	388021	6300376	103.99	47.16	56.83
SE6D	March 2017	387099	6300773	63.98	28.47	35.51
	Oct 2017	387099	6300773	63.98	28.44	35.55
SE7D	March 2017	387095	6300625	67.01	31.63	35.39
	Oct 2017	387095	6300625	67.01	31.40	35.61
SE8D	March 2017	387128	6300437	67.05	-	-

	Oct 2017	387128	6300437	67.05	-	-
SE9D	March 2017	386942	6300285	63.89	26.32	37.57
	Oct 2017	386942	6300285	63.89	26.04	37.86
SE10D	March 2017	386942	6300232	64.43	27.24	37.20
	Oct 2017	386942	6300232	64.43	26.60	37.83
CCBH1	March 2017	386586	6300487	52.00	17.23	34.77
	Oct 2017	386586	6300487	52.00	16.77	35.23
CCBH2	March 2017	386712	6300747	53.50	19.06	34.44
	Oct 2017	386712	6300747	53.50	18.62	34.88

5.3 Groundwater parameters

Groundwater at the Site was generally observed as turbid but becoming clear during purging with no odour or sheen observed. Water quality parameters observed during the 2017 monitoring events are presented in Table 5 below.

Table 5 Field parameters March and October 2017

Sample ID	Date	pH	EC (µS/cm)	TDS (mg/L)	REDOX (mV)	Dissolved oxygen (mg/L)	Temp
SE1D	22/03/20	4.57	501	357.5	-12.7	3.71	20.5
	19/10/20	4.55	445	-	325.4	2.56	21.0
SE3D	22/03/20	4.39	454	317.5	30.8	4.08	21.2
	19/10/20	4.60	650	-	356.0	2.40	21.1
SE4D	22/03/20	4.23	218	154.5	32.8	5.04	20.8
	19/10/20	4.38	242	-	367.7	4.91	20.7
SE5D	23/03/20	4.17	1058	741.0	51.1	4.89	21.2
	18/10/20	4.40	106	-	329.6	4.57	19.0
SE6D	22/03/20	5.11	254	181.4	-1.9	5.37	20.2
	19/10/20	4.57	264	-	362.9	4.04	20.3
SE7D	22/03/20	4.49	243	172.3	21.7	5.55	20.7
	20/10/20	5.08	285	-	212.8	5.11	19.8
SE8D	22/03/20	4.53	318	226.2	28.5	5.23	20.5
	20/10/20	5.08	285	-	212.8	5.11	19.8
SE9D	22/03/20	4.15	332	236.6	39.4	4.89	20.4
	19/10/20	4.27	357	-	393.4	4.15	19.7
	22/03/20	4.14	314	224.9	42.8	5.25	20.0

Sample ID	Date	pH	EC (µS/cm)	TDS (mg/L)	REDOX (mV)	Dissolved oxygen (mg/L)	Temp
SE10D	19/10/20	4.37	344	-	363.2	3.36	19.6
CCBH1	23/03/20	6.48	490	343.9	-7.6	2.82	21.1
	18/10/20	5.45	306	-	132.8	3.27	18.9
CCBH2	23/03/20	5.45	214	152.1	46.5	6.25	20.5
	18/10/20	5.40	165	-	210.9	4.20	19.0

A summary of the main observations from Table 5 is provided below:

- The recorded pH measurements from all of the measured aquifer bores indicated that the groundwater was slightly acidic and ranged between a pH of 4.14 in March (SE10D) and 6.48 in March (CCBH1).
- Field EC ranged from 106 µS/cm in October (SE5D) to 1,058 µS/cm in March (SE5D). This equates to a high TDS in March (687.7 mg/L) and a low TDS in October (68.9 mg/L) for SE5D using a conversion factor of 0.65. This range is indicative of a 'fresh' water quality.
- REDOX ranged from -12.7 mV in March (SE1D) to 393.4 mV in October (SE9D)
- Dissolved oxygen concentrations ranged between 2.40 mg/L in October (SE3D) to 6.25 mg/L in March (CCBH2). It is noted that due to the depth to water and sampling methodology, the water may have been disturbed and therefore not represent in situ dissolved oxygen concentration.

5.4 Laboratory results March and October 2017

The detailed analytical results for the March and October 2017 GMEs are presented in Appendix D – Table 1. Laboratory Certificates of Analysis are included in Appendix E.

Exceedances of the adopted assessment criteria are summarised in Tables 6 and 7 below. It is noted that no BTEX, PAH, Phenols, PCBs, OCP or OPP compounds (monitored in the October event only) were reported above the LOR for either of the biannual sampling events.

Concentrations of PFAS and TRH (NEPM 2013 fractions) were reported above the LOR at CCBH2 and also at SE3 (PFAS only). The detections of PFAS and TRH compounds were below the adopted assessment criteria.

Table 6 Exceedances of adopted criteria March 2017

Location		Assessment criteria			
Location Context	Sample ID	DWER 2014 Drinking water health	DWER 2014 Fresh Waters	DWER 2014 Long-term irrigation	DWER 2014 Non-potable Groundwater Use (NPUG)
Cross Gradient	SE1D	-	Zn	Fe	Fe
Down Gradient (Primary Leachate Pond)	SE3D	-		Fe	Fe

Upgradient (Leachate Evaporation Ponds)	SE4D	-	Al	-	-
Upgradient (site)	SE5D	-	Al	-	Cl
Down Gradient (Crystal Pigment Cell 1)	SE6D	-	-	-	-
	SE7D	-	Cu, Zn	-	-
	SE8D	-	-	-	-
Down Gradient (Leachate Evaporation Ponds)	SE9D	-	Al, Cu	Fe	-
	SE10D	-	Al	Fe	Fe
Down Gradient	CCBH1	-	Cu	Fe, P (total)	Fe
	CCBH2	-	Cu	Fe, P (total), N (total)	Fe

Table 7 Exceedances of adopted criteria October 2017

<u>Location</u>		Assessment criteria			
Location Context	Sample ID	DWER 2014 Drinking water health	DWER 2014 Fresh Waters	DWER 2014 Long- term irrigation	DWER 2014 Non-potable Groundwater Use (NPUG)
Cross Gradient	SE1D	-	Zn	Fe	Fe
Down Gradient (Primary Leachate Pond)	SE3D	-	Al	-	-
Upgradient (Leachate Evaporation Ponds)	SE4D	-	Al	-	-
Upgradient (site)	SE5D	-	Al, Cu	Fe	Al, Fe, Cl
Down Gradient (Crystal Pigment Cell 1)	SE6D	-	Al, Zn	N (total)	-
	SE7D	-	Al, Cu, Zn	-	-
	SE8D	-	Al	-	-
Down Gradient (Leachate Evaporation Ponds)	SE9D	-	Al	-	-
	SE10D	-	Al	-	-
Down Gradient	CCBH1	-	Cu	Fe	Fe

5.5 Quality assurance / quality control evaluation

5.5.1 Relative percentage difference

Table 8 outlines the blind duplicate and field split samples that were collected for groundwater monitoring in 2017 during both events.

Table 8 Duplicate samples collected for the 2017 biannual monitoring

Primary sample	Date	Duplicate sample ID	Split sample ID
SE6	22/03/17	FD01	FS01
SE4	19/10/17	FD01	FS01

The precision of the results for each analyte between the primary sample and the field duplicate/split is determined by calculating the relative percentage difference (RPD). A quantitative measure of the accuracy of the analytical results reported is made by calculating the RPDs in accordance with the procedure described in AS 4482.1 – 2005 (Standards Australia, 2005). RPD calculations are presented in Appendix D – Table 2.

RPDs exceeding the acceptable range specified are summarised in Table 9 below. An RPD limit of 30% has been adopted for this investigation (whilst 50% is generally considered an acceptable limit).

Table 9 Summary of RPDs exceeding acceptable ranges

Primary sample	Date	QC sample	Analyte	RPD (%)
SE6D	22/03/2017	"FD01"	TOC	100
SE6D	22/03/2017	"FD01"	Ammonia as N	67
SE6D	22/03/2017	"FD01"	Nitrogen (total)	50
SE6D	22/03/2017	"FD01"	Phosphorus (total)	40
SE6D	22/03/2017	"FS01"	Ammonia as N	67
SE6D	22/03/2017	"FS01"	Nitrogen (total)	40
SE4D	20/10/2017	"FS01"	Aluminium	46
SE4D	20/10/2017	"FS01"	Iron (total)	109

The exceeding RPDs outlined in Table 9 are the result of the concentrations of one or both or samples being very low concentrations or marginally above the LOR which exaggerates the resultant RPD calculation. The concentrations of both sample pairs are considered to be of very similar orders of magnitude and the exaggerated RPD calculations in Table 9 are not considered to represent a reproducibility issue within the laboratory analysis.

5.5.2 Blank analytical results

Field, rinsate and trip blanks were collected during the March and October monitoring events. A summary of blank sample results is provided in Appendix D, Table 3.

The analysis of the blank samples indicated that all analytes were below the relevant LORs. The absence of detectable concentrations in the blank samples suggests that the transportation process, the ambient conditions onsite and the use of equipment on multiple locations has not introduced contamination to the samples collected.

5.5.3 Laboratory QA/QC

A review of laboratory holding times, method blanks, duplicates, control outliers and matrix spikes was completed, with the following items identified as being outside the acceptable range:

- March 2017 – Report EP1702812
 - Internal QC frequency: Total metals – QC frequency not met.
 - Matrix spikes: Ammonia as N – outside acceptable range.
- October 2017 – Report EP1711747
 - Holding time: Major cations – 3 days over holding time for two samples (CCBH1, CCBH2)
 - Internal QC frequency: OC pesticides, PCBs, total metals – QC frequency not met.
 - Matrix spikes: Sulfate as SO₄ – outside acceptable range.

5.5.4 Data quality review summary

A review of field and laboratory QA/ QC data and procedures confirms an acceptable level of compliance with the general project requirements. As such, there is an acceptable level of confidence in the data upon which the conclusions in this report will be made.