



COTERRA  
ENVIRONMENT

## **Water Monitoring Report 2020-21**

### **Austral Bricks – Shale Road**

Revision 0

March 2021



CALIBRE | COMMITMENT | COLLABORATION

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**Report Version:** Revision 0  
**Date:** March 2021

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## Contents

<b>1</b>	<b>Introduction.....</b>	<b>5</b>
1.1	Site Location and Surrounds .....	5
1.2	Planning and Approvals History .....	5
1.2.1	EPA Assessment .....	5
1.2.2	Extractive Industries Licence .....	5
1.2.3	Associated Investigations – Water Management Plan.....	5
1.2.4	Associated Investigations – Groundwater.....	6
1.2.5	Associated Investigations – Flocculation Treatment.....	6
1.3	Previous Relevant Reports .....	6
<b>2</b>	<b>Monitoring Program and Methods .....</b>	<b>8</b>
2.1	Objectives.....	8
2.2	Surface Water Monitoring Method.....	8
2.2.1	Sampling Frequency .....	8
2.2.2	Sample Locations.....	8
2.2.3	Surface Water Quality Parameters.....	8
2.3	Groundwater Monitoring Method .....	9
2.3.1	Sampling Frequency .....	9
2.3.2	Sample Locations.....	9
2.3.3	Groundwater Quality Parameters .....	9
<b>3</b>	<b>Monitoring Results and Discussion .....</b>	<b>11</b>
3.1	Surface Water .....	11
3.1.1	Rainfall Analysis.....	11
3.1.2	2015 Pond Expansion .....	12
3.1.3	Pond Level Monitoring .....	13
3.1.4	Reassessment of the Drainage Strategy.....	14
3.2	Groundwater .....	15
3.2.1	Groundwater Levels .....	15
3.2.2	Groundwater Quality .....	18
<b>4</b>	<b>Conclusions.....</b>	<b>23</b>
4.1	Surface Water .....	23
4.2	Groundwater .....	23
<b>5</b>	<b>References .....</b>	<b>24</b>

## Tables

Table 3-1	Total Annual Rainfall 2012-2020 .....	11
Table 3-2	In-Situ Groundwater Quality for 2020/21 .....	19
Table 3-3	Laboratory Groundwater Quality for 2020/21.....	20

## Plates

Plate 3-1	Average and Actual Rainfall Across the Monitoring Year .....	12
Plate 3-2	Old (a) and New (b) Pond Layouts.....	13
Plate 3-3	Lower Pond (SHA04) Water Level during October 2020 .....	14
Plate 3-4	Groundwater Levels at SGW01 .....	15
Plate 3-5	Groundwater Levels at SGW02a, b & c .....	16
Plate 3-6	Groundwater Levels at SGW03 .....	17
Plate 3-7	Groundwater Levels at SGW07 .....	18

## Figures

Figure 1	Site Location
Figure 2	Surface Water Sampling Locations
Figure 3	Groundwater Sampling Locations

## Appendices

Appendix 1	Extractive Industry Licence
Appendix 2	Water Management Plan Approval
Appendix 3	Correspondence with Shire
Appendix 4	Pond Water Level Photos
Appendix 5	Groundwater Levels
Appendix 6	Groundwater Quality



# 1 Introduction

## 1.1 Site Location and Surrounds

Shale Road Pit is a resource extraction facility located at Lot 31 Kiln Road, Cardup (the site). The site is located approximately 10 km south of Armadale and approximately 35 km southeast of Perth (Figure 1) within the Shire of Serpentine Jarrahdale (the Shire).

Resource extraction has been undertaken at the site since the 1970s. Extraction is currently occurring within stages 1 to 3 (approximately 5 ha). The proposed future extraction area (stages 4 to 8) comprises a further 25 ha.

The site is primarily surrounded by cleared grazing land. An ephemeral stream (North Creek) traverses part of the site on the western boundary and another stream, (Southern Stream) is located along the southern boundary.

The Shale Road Landfill (in operation since 1999) is located immediately south of the site and is licensed to accept Class II waste which includes most municipal, commercial and industrial solid waste. A stormwater treatment pond associated with the landfill activities has been constructed and has been in operation for several years. This pond intersects the natural flow path of the southern stream, upstream of the Austral Bricks stormwater discharge point.

## 1.2 Planning and Approvals History

### 1.2.1 EPA Assessment

During November 2011 the site underwent a formal assessment by the Environmental Protection Authority (EPA). The EPA set the level of assessment as 'Not Assessed - Public Advice Given'. This determination was appealed, and the appeal was dismissed by the Minister for the Environment in May 2012.

### 1.2.2 Extractive Industries Licence

Extraction of shale and clay is currently undertaken at the site under an Extractive Industries Licence (EIL) granted by the Shire of Serpentine Jarrahdale (SSJ) in June 2012 for Stages 1-3. The licence conditions and expiry date were appealed to the State Administrative Tribunal (SAT) who ordered that the licence would be valid for 10 years commencing 1 January 2013. As such, the licence expires on 1 January 2023.

A copy of the licence and SAT order is provided in Appendix 1.

### 1.2.3 Associated Investigations – Water Management Plan

A Water Management Plan (WMP) was prepared by Coterra Environment in 2010 to satisfy a condition of an earlier EIL. This WMP also accompanied the application for the current EIL. An update to the WMP was required under condition 9 of the current EIL:

Condition 9 of EIL ref P05917/06:

*The landowner shall submit to the Shire an updated Water Management Plan by 31 December 2012. Once approved by the Director Engineering, the Water Management Plan is to be implemented in its entirety.*

In order to satisfy condition 9, Revision 2 of the WMP was submitted to the SSJ in December 2012. The updated WMP incorporated comments provided by the Department of Water (DoW) and was independently reviewed by Syrinx Environmental.

A further update of the WMP, Revision 3, was submitted to SSJ in 2013. This revision incorporates comments provided as part of the independent review undertaken by Syrinx Environmental. Revision 3 also

incorporated the previously separate Flocculation Assessment Report (Coterra Environment, 2013) which outlined the proposed flocculation treatment of the site's stormwater ponds.

Revision 4 of the WMP (submitted to SSJ in 2014) incorporated one minor wording change following community consultation on the Revision 3 report. The Revision 4 report was independently reviewed by Stass Environmental.

The WMP was further updated (Revision 5) and submitted to SSJ in 2014. This report incorporated the comments provided as part of the Stass Environmental independent review. The issues raised have all been addressed in consultation with the Shire and Andre Stass. Revision 5 of the WMP was approved by the Shire in April 2015. The approval letter is provided in Appendix 2.

#### **1.2.4 Associated Investigations – Groundwater**

The (then) Department of Water (DoW) provided comments on the Water Management Plan (2011) as part of the EPA assessment undertaken in November 2011. A meeting was held with DoW officers in January 2012 to discuss these comments. One of the outcomes of this meeting was the commitment to monitor groundwater levels between May and October prior to excavation commencing to accurately determine groundwater levels, the separation distances required and minimum levels for excavation.

The outcomes of this meeting were incorporated in the updated WMP Revision 2 (Coterra, 2013). The groundwater monitoring program was amended in the WMP Revision 5 to further extend the monitoring.

#### **1.2.5 Associated Investigations – Flocculation Treatment**

Flocculation was proposed within the site's stormwater treatment ponds as a method of reducing turbidity and suspended sediment in runoff discharging from the ponds to the southern stream. A Flocculation Assessment Report was prepared in 2012 to describe the proposed methodology and monitoring and to demonstrate that the treatment would not result in adverse water quality impacts. The report included an ex-situ trial using a pond water sample in laboratory tests. This trial provided positive results.

An in-situ trial within the ponds was approved for the winter of 2014 (*pers. comm. email*, Craig Wansbrough, 23/06/14. Appendix C). The trial was undertaken in August 2014 and following favourable results, the pond water was discharged. The results of this investigation are discussed in the 2014 Water Monitoring Report (Coterra Environment, 2014) and the WMP Revision 5 (Coterra Environment, 2015).

The requirements for whether flocculation was required this year is discussed in Section 3.1.

### **1.3 Previous Relevant Reports**

The following reports have been prepared for the site and should be read in conjunction with this water monitoring report.

- Water Management Plan - Shale Road Pit, Rev 1 (Coterra Environment, 2010).
- Stormwater Discharge Assessment Report – Shale Road Pit (Coterra Environment, 2011).
- Surface Water Monitoring Report 2011 – Shale Road Extractive Pit (Coterra Environment, 2011a).
- Water Sampling Program (Coterra Environment, 2011b).
- Flocculation Assessment Report – Shale Road Extractive Pit (Coterra Environment, 2012).
- Water Management Plan, Rev 2 – Shale Road Pit (Coterra Environment, 2012a).
- Surface Water Monitoring Report 2012 – Shale Road Extractive Pit (Coterra Environment, 2012b).

- Water Management Plan, Rev 3 - Shale Road Pit (Coterra Environment, 2013).
- Water Management Plan, Rev 4 – Shale Road Pit (Coterra Environment, 2014a).
- Water Management Plan, Rev 5 – Shale Road Pit (Coterra Environment, 2014b).

## 2 Monitoring Program and Methods

### 2.1 Objectives

The current surface and groundwater monitoring program is based on the commitments of the WMP (Revision 5).

Sections 2 and 3 of this water monitoring report present data collected in accordance with requirements of the WMP, and the outcomes of the 2020-21 sampling regime.

### 2.2 Surface Water Monitoring Method

#### 2.2.1 Sampling Frequency

In accordance with the requirements of the WMP Revision 5, surface water monitoring is required to be undertaken prior to and during discharge from the stormwater settlement ponds when discharge is required. As such, the frequency of sampling is dependent on the rainfall frequency and runoff volume during the monitoring year and hence whether a discharge is required.

In the WMP Revision 5 it was estimated that, under the original pond configuration (2015), a controlled discharge may need to occur up to three times per year:

- Prior to the winter period (March/April) – in the case of an extreme summer event to ensure the maximum pond capacity is available prior to the onset of winter.
- During winter – when the maximum pond capacity is approached.
- End of winter (September/October) – if the lower pond is near maximum capacity to ensure capacity is available to accommodate summer storms. No discharge is required if pond levels are minimal.

#### 2.2.2 Sample Locations

When sampling is required, the WMP Revision 5 requires that the sampling be undertaken at the following locations:

Prior to discharge:

- SHA02: Southern stream – Upstream of Austral Bricks discharge point but downstream of Landfill stormwater pond discharge pipes.
- SHA04: Settlement pond 1 (southern pond).
- SHA05: Settlement pond 2 (middle pond).

During discharge:

- SHA02: Southern stream – Upstream of Austral Bricks discharge but downstream of Landfill stormwater pond discharge pipes.
- SHA03: Southern stream – Downstream of Austral Bricks discharge point.
- SHA06: At settlement pond discharge pipe (only applicable when discharge is occurring).

The sampling locations are shown in Figure 2.

#### 2.2.3 Surface Water Quality Parameters

The WMP Revision 5 requires that the following parameters be sampled when sampling is undertaken prior to and during discharge:

*In-Situ Analysis:*

- pH
- Temperature
- Dissolved Oxygen (DO)
- Total Dissolved Solids (TDS)
- Redox (ORP)
- Electrical Conductivity (EC)

#### *Laboratory Analysis:*

The following parameters will be analysed by a NATA accredited laboratory;

- Total Petroleum Hydrocarbons (TPH)
- Total Suspended Solids (TSS)
- Turbidity
- Total Aluminium

## **2.3 Groundwater Monitoring Method**

### **2.3.1 Sampling Frequency**

The WMP Revision 5 identified the groundwater monitoring to be undertaken on site. This is outlined below:

- Monthly monitoring for groundwater levels and in-situ quality parameters (from March 2020 to February 2021). Report submitted in March each year.
- Twice annual monitoring for water quality laboratory analysis (in June and September each year).

The results of this monitoring are discussed in Section 3.

### **2.3.2 Sample Locations**

Monitoring was undertaken in nine bores at seven locations within the site (Figure 3). The SGW02 location is a nested bore containing three piezometers (SGW02a, SGW02b and SGW02c) to varying depths.

### **2.3.3 Groundwater Quality Parameters**

Groundwater monitoring was conducted at the nine bores for levels and quality in line with the specified guidelines (*Hydrogeological Reporting Associated with a Groundwater Well Licence. Appendix C4: Comprehensive Analysis*).

#### **2.3.3.1 In-Situ Analysis**

At each sample location, the following parameters were analysed *in-situ*:

- Appearance
- Temperature (°C)
- pH
- Electrical Conductivity (EC)
- Total Dissolved Solids (TDS)
- Dissolved Oxygen (DO)

- Redox (ORP)

### 2.3.3.2 Laboratory Analysis

The following parameters were analysed by a NATA accredited laboratory:

- *Ions* (mg/L): Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Ammonia (NH<sub>3</sub>), Carbonate (CO<sub>3</sub>), Bicarbonate (HCO<sub>3</sub>), Chloride (Cl), Sulphate (SO<sub>4</sub>), Silica (SiO<sub>2</sub>).
- *Metals* (mg/L): Aluminium (Al), Arsenic (As), Cadmium (Cd), Chromium (Cr), Iron (Fe<sup>2+</sup>), Lead (Pb), Manganese (Mn), Mercury (Hg), Selenium (Se), Zinc (Zn).
- *Nutrients*: total nitrogen (TN), ammonia-N, total kjeldahl nitrogen (TKN), nitrate/nitrite-N, total phosphorus (TP) and filtered reactive phosphorus (FRP).

In order to address quality assurance and quality control (QAQC) requirements, two QAQC samples were collected and analysed during each monitoring event.

## 3 Monitoring Results and Discussion

### 3.1 Surface Water

#### 3.1.1 Rainfall Analysis

A total of 1,020.0 mm of rainfall was recorded at the Jarrahdale station during the 2020 calendar year. This represents a decrease of 12.8% from the annual average rainfall since 1979 at this station. The 2020 rainfall was closer to the short-term average rainfall (since monitoring began in 2012) which is 1,041 mm. This data is represented in Table 3-1 below.

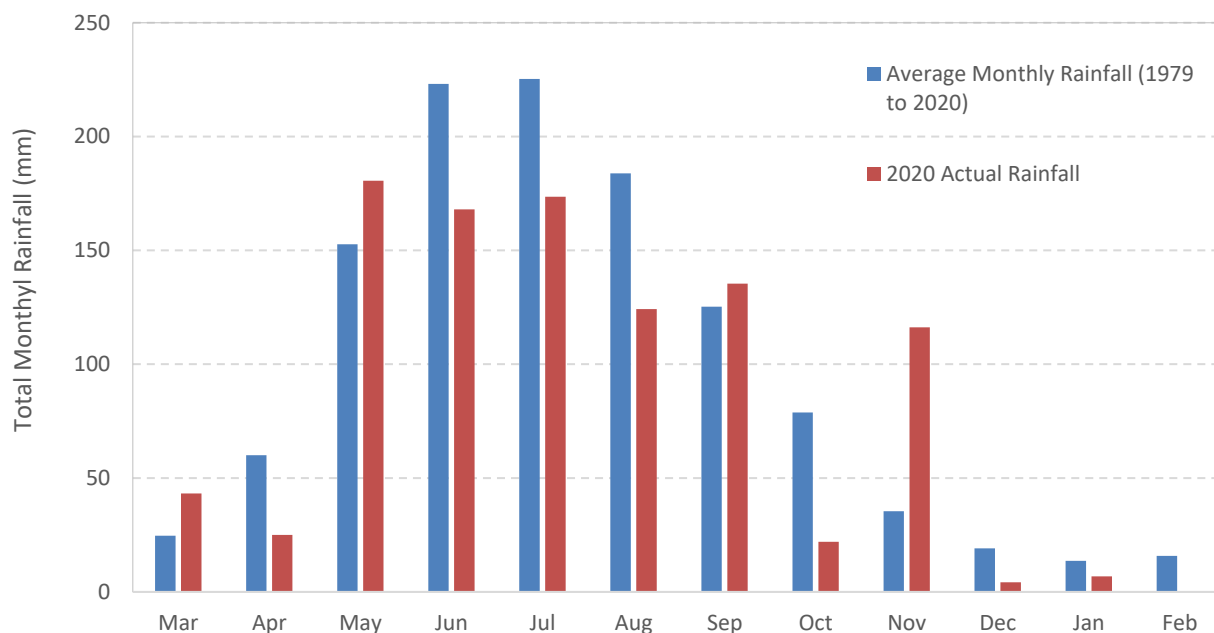
**Table 3-1 Total Annual Rainfall 2012-2020**

Calendar Year	Total Annual Rainfall (mm)*
2012	1,021
2013	1,136
2014	1,018
2015	796
2016	1,091
2017	1,197
2018	1,212
2019	876.6
2020	1,020
<i>Average annual (1882-2021)</i>	<i>1,170</i>
<i>Average over monitoring period (2012-2021)</i>	<i>1,041</i>

\*Jarrahdale Rainfall Station. BoM, 2020.

Temporal distribution of rainfall during this monitoring year (March 2020 – February 2021) saw relatively dry conditions throughout winter, with 8 months recording below average rainfall. November 2020 recorded significantly above average rainfall, with the other months showing average to below average rainfall. Of particular note was the reduced winter rainfall, which recorded 166.4 mm less (approximately 26% less) than the average winter rainfall typically recorded in those months. November rainfall was 3.3 times greater than the monthly average expected in November, however this was still lower than previous winter months. The monthly rainfall is shown in Plate 3-1 below.





**Plate 3-1 Average and Actual Rainfall Across the Monitoring Year**

Source: Jarrahdale station number 9023 (BOM, 2020)

### 3.1.2 2015 Pond Expansion

The WMP Revision 5 identified the option of increasing the settlement pond volumes to increase the retention of stormwater within the extraction areas (Section 5.4.1 of WMP). Increasing the volumes able to be retained minimises the requirement for any controlled discharge. If no discharge occurs, then flocculation and/or surface water monitoring is not required.

The pond expansion was undertaken prior to the winter of 2015, with the addition of another settlement pond (shown in Plate 3-2 B). These works involved the re-contouring of the settlement pond SHA05 (Figure 2- formerly the upper pond) and the creation of an additional pond to the east. Under the new configuration the new pond receives the initial catchment runoff, and discharges to the SHA05 pond via an overflow channel between the two ponds. When the SHA05 pond reaches capacity the runoff will then discharge to the lower pond (SHA04). Discharge to the southern stream would occur when the capacity of the lower pond (SHA04) is exceeded.

In accordance with the WMP Revision 5, expansion of the ponds was undertaken in a north-easterly direction and has not encroached towards the southern stream. The old and new pond layout is shown in Plate 3-2 below. The new pond added approximately 3,000 m<sup>3</sup> of capacity to the existing system.



A) Old pond layout. Image Date 6-11-2014.

B) New pond layout. Image Date 25-8-2015.

## **Plate 3-2      Old (a) and New (b) Pond Layouts.**

### **3.1.3      Pond Level Monitoring**

The water levels in each of the three settlement ponds were checked during groundwater monitoring, monthly and more frequently by onsite staff during winter. Pond levels were recorded photographically throughout the monitoring period to determine if a controlled discharge to the southern stream was required. Photos showing the pond water levels over this period are provided in Appendix 4.

Plate 3-3 shows the water level in the lower pond during the October monitoring event when pond levels were at their highest. In the previous monitoring years, a peak water level in the lower pond was usually recorded in September, however the reduced winter rainfall may have extended the peak to October during this monitoring year. Plate 3-3 shows the water level below the outlet pipe, with no discharge to the southern stream.



**Plate 3-3      Lower Pond (SHA04) Water Level during October 2020**

### **3.1.4      Reassessment of the Drainage Strategy**

Although there was no adverse impact on the water quality in the stream as no discharge occurred this year, recent realignment of access roads and excavation activity may alter the current drainage of the site. As such, further investigation will be undertaken to reassess the current pond capacities, runoff conditions, configurations, and flow routes to prepare a new management plan better suited to the new site conditions.

This includes:

- Reassessing the catchments and water flow paths;
- Reassessing any increased runoff areas and possible impact on pond capacities;
- Assessing the integrity of the current ponds and their outflow points including overflow mechanisms and levels;
- Providing revised catchment management advice;
- Assessing the water usage requirements for the site (for dust suppression) and determining whether a flocculation discharge is required; and/or
- If necessary, undertaking an approved flocculation discharge with the required sampling.

In addition, a staff gauge has been installed in the lower pond (which overflows to the stream). A marker has been put on the staff gauge to indicate when pumping to the upper ponds should occur to redistribute stormwater to ensure an unexpected discharge does not occur from the southern pond. This appeared to have been working well during this monitoring year, as the pond level photos show pumping from the middle ponds during the peak level event had occurred to prevent discharge to the stream (Appendix 4).

If all the ponds are at capacity and the water level in the southern pond approaches the marker on the staff gauge, then a flocculation treatment and discharge will be organised as per the Water Management Plan (Coterra, 2015) requirements. This did not occur during this monitoring year.

## 3.2 Groundwater

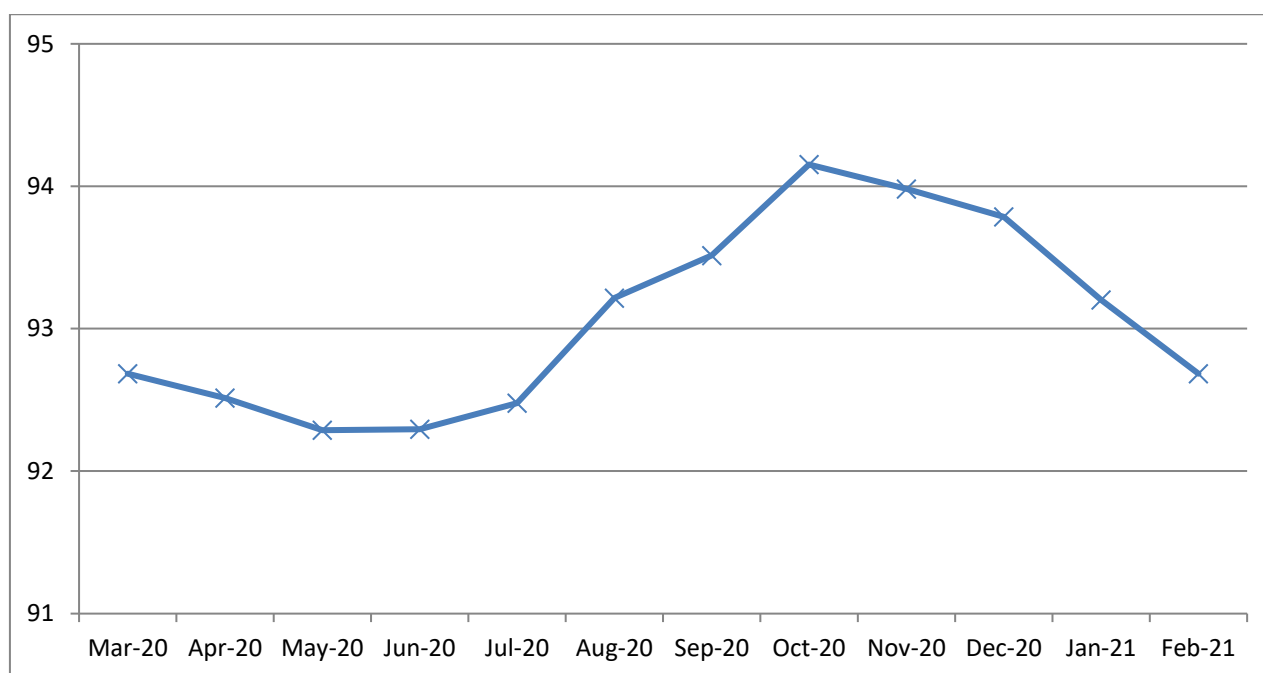
### 3.2.1 Groundwater Levels

The onsite monitoring bore network consists of nine bores at seven locations (SGW02 consists of three bores which act as a nested piezometer). Of these bores, six bores recorded water during the monitoring period (March 2020 – February 2021). No groundwater was encountered in SGW04 to SGW06 and is typical for these bores.

In South-West Australia, groundwater levels are typically lowest during late autumn, and reach maximum levels during mid to late spring following the winter rains (typically September/October). Analyses of the groundwater levels at the individual bores over the 2020-21 monitoring year are discussed further below. The full set of results is provided in Appendix 5.

#### 3.2.1.1 SGW01

Groundwater levels at bore SGW01 during 2020 -21 monitoring year are presented in Plate 3-4 below.



**Plate 3-4 Groundwater Levels at SGW01**

Groundwater levels in SGW01 are representative of a potentiometric surface (release of confined or pressurised groundwater) associated with localised confined systems, as determined as part of the hydrogeological investigation (Hydroconcept, 2012).

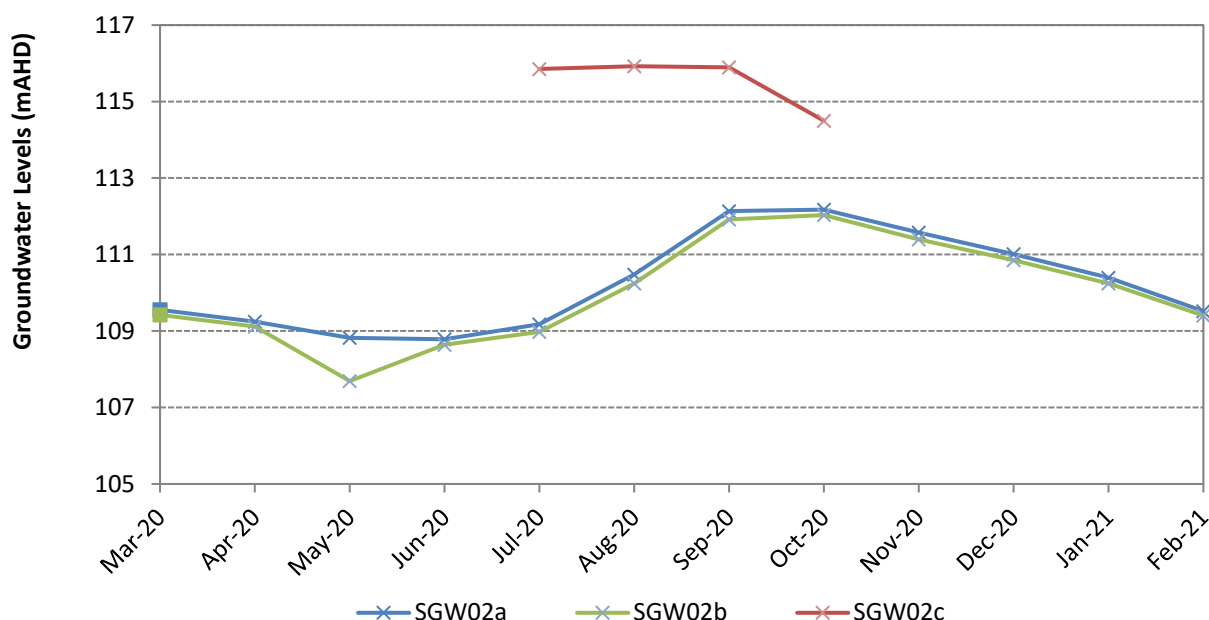
Consistent with typical seasonal groundwater trends, reaching a minimum level of 92.288 mAHd in May 2020. Groundwater levels then increased throughout winter to the end of spring with a maximum in October at 94.153 mAHd. Levels declined for the rest of the monitoring period.

The maximum groundwater level (MGL) recorded at SGW01 during this monitoring year (94.153 mAHd) is similar to the Average Annual Maximum Groundwater Level (AAMGL) recorded since monitoring began in 2012 (94.355 mAHd).

SGW01 is located adjacent to the lower settlement pond (SHA04) and as such, the rise in groundwater levels from June to November may be locally influenced by infiltration from the pond, in addition to rainfall recharge.

### 3.2.1.2 SGW02

Groundwater levels in the nested Bores SGW02a, 2b & 2c are presented in Plate 3-5 below.



**Plate 3-5 Groundwater Levels at SGW02a, b & c**

Three groundwater monitoring bores have been installed at the SGW02 location. These bores are installed at different depths to measure water levels within different layers, and as such act as a nested piezometer. The bores are 15 m deep, 11 m deep and 4 m deep at SGW02a, SGW02b and SGW02c respectively.

Similarly to SGW01, recorded water levels in SGW02a and 2b are representative of a potentiometric surface (release of confined or pressurised groundwater) associated with localised confined systems, as determined as part of the hydrogeological investigation (Hydroconcept, 2012). Water levels between SGW02a and SGW02b are similar throughout the year indicating a hydraulic connection between the two.

SGW02b is approximately 4 m shallower than SGW02a and is screened within the confining clay layer. SGW02c is the shallowest of the three bores and is considered to measure shallow perched groundwater. The groundwater levels in this bore vary from the levels in bores SGW02a and SGW02b indicating that the perched groundwater is not in hydraulic connection with the underlying aquifer.

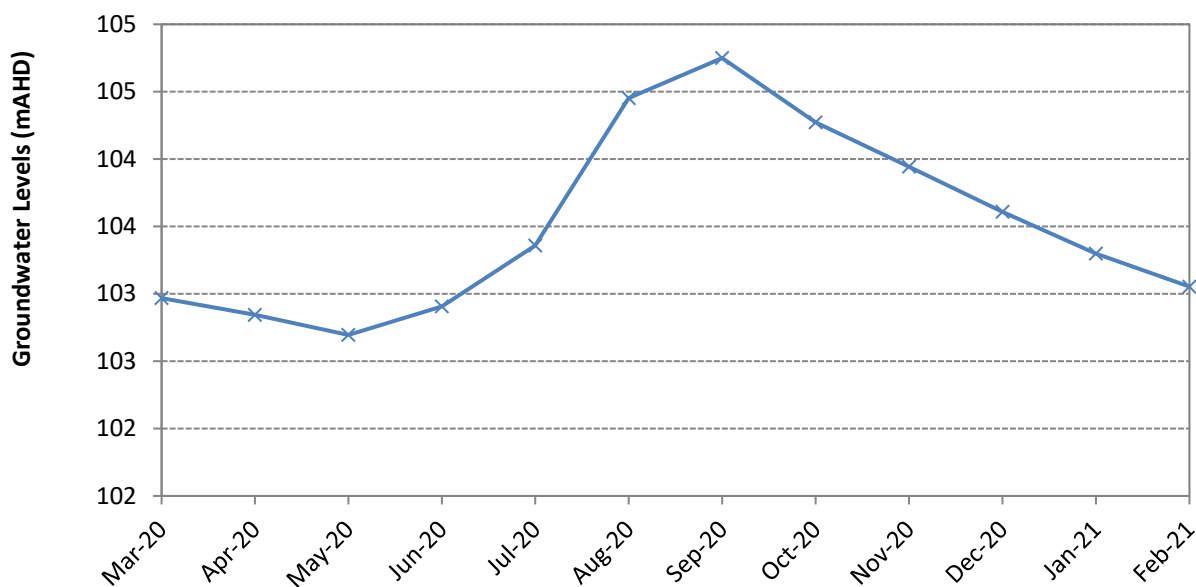
This year displayed:

- SGW02a recorded a minimum level of 108.783 mAHD in June, and MGL of 113.255 mAHD in October. This is slightly lower than the AAMGL of 114.538 mAHD.
- SGW02b recorded a minimum level of 107.690 mAHD in May, and MGL of 112.033 mAHD in October. This is slightly lower than the AAMGL of 114.277 mAHD.
- SGW02c was dry for most of the year from March to June 2020, and November to the end of the monitoring year. SGW02c displayed higher groundwater levels from July to September, which may be attributed to perched water being more reflective of rainfall and the higher-than-average rainfall in May and September in particular (Plate 3.1), with a September maximum of 115.927 mAHD which is similar to the 2c AAMGL of 115.492 mAHD. Although rainfall received in November was 3.3 times the average, October was very dry in comparison, and the November rainfall was still below the

monthly rainfall received in May to September which may explain why the peak did not continue to November following rainfall trends.

### 3.2.1.3 SGW03

Groundwater levels at bore SGW03 are presented in Plate 6 below.



**Plate 3-6 Groundwater Levels at SGW03**

No water was encountered during the installation of SGW03 in 2012. The bore was drilled to the bedrock 30 m below the surface. The geology encountered was comprised of a clayey weathering profile that is unlikely to be conducive to large groundwater resources and productive aquifer systems (Hydroconcept, 2012). Therefore current water levels may be indicative of a shale fracture or a discrete and localised system.

During this monitoring year, minimum groundwater levels occurred in May 2020 (102.695 mAHD), increasing to a maximum level in September 2020 (104.749 mAHD). This MGL is the second lowest since construction of this bore in 2012, and below the AAMGL for this bore (105.878 mAHD).

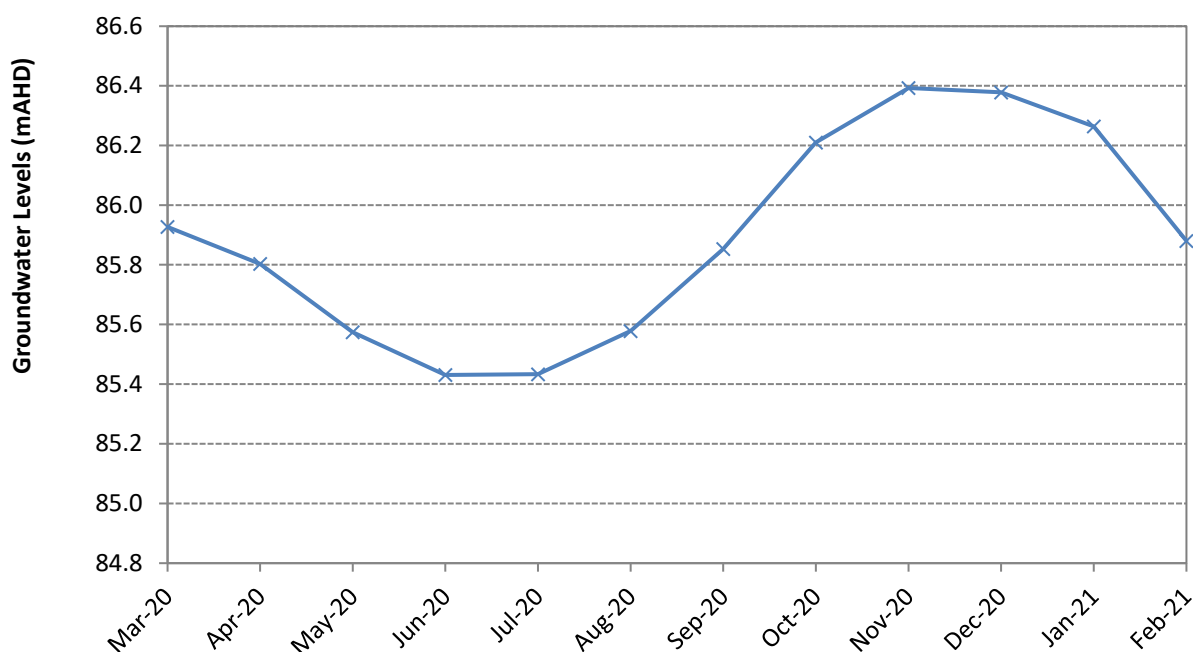
### 3.2.1.4 SGW04, SGW05 and SGW06

All three bores were dry throughout this monitoring period, as is typical for these bores.



### 3.2.1.5 SGW07

Groundwater levels recorded at bore SGW07 are presented in Plate 7 below.



#### Plate 3-7 Groundwater Levels at SGW07

Similarly to SGW03, water was not encountered during drilling and installation of this bore. The bore was drilled to the bedrock 26 m below surface. The geology encountered at this site was weathered clay. This material is not considered to be conducive to large groundwater resources and productive aquifer systems (Hydroconcept, 2012) therefore the current water levels may be indicative of a shale fracture or a discrete and localised system.

Groundwater levels declined from March to June 2020. Groundwater then increased to a late peak in November (86.393 mAHD). This is similar to the AAMGL of the bore which is 86.815mAHD. This bore has historically recorded later maximums than seasonally expected, usually occurring in November/ December as was also recorded during this year. It should be noted that the TOC level for this bore is ground level, and it does not have a cap. Direct runoff into the bore may have caused the late groundwater level peak as a result of a very wet November (rainfall during November was a magnitude of 3.3 times the average monthly rainfall, please see Plate 3-1).

### 3.2.2 Groundwater Quality

Groundwater quality was analysed twice over the monitoring period, in June and September for a comprehensive suite of parameters.

A summary of the water quality results are presented in Table 3-2 and Table 3-3, and discussed below.



**Table 3-2 In-Situ Groundwater Quality for 2020/21**

Bores		SGW01		SGW02A		SGW02B		SGW02C		SGW03		SGW07	
ANZECC FW Guideline	Parameter	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20
	Appearance	Clear	Clear	S. Turbid	Clear	Turbid	Turbid	DRY	S. Turbid	S. Turbid	S. Turbid	S. Turbid	Turbid
	Colour	Clear	Clear	L. Brown	Clear	L. Brown	L. Brown		L. Brown	L. Brown	L. Brown	Brown	Brown
	Temp (°C)	21.3	20.3	21.4	21.6	21.7	21.8		20.3	22.2	20.6	24	21
6.5-8	pH	5.66	6.07	5.78	6.38	5.68	6.44		7.72	5.85	6.34	7.4	6.43
	EC (µS/cm)	246.8	311	327.7	415.3	330.4	366.4		599	1400	1577	79.6	179.2
	TDS (mg/l)	176.15	202.15	228.8	269.75	229.45	237.9		390	962	1027	53.3	116.35
	Redox (mV)	186.3	86.1	191.7	101.6	184.8	106.9		91.2	18.2	109.7	-68	72.6
	DO (%)	10.9	34.4	49.3	51.4	56.2	53.4		45.5	32.7	40.2	25.4	34.4

*Highlighted are concentrations that exceed ANZECC (2000) Guidelines.*

**Table 3-3 Laboratory Groundwater Quality for 2020/21**

Bore			SGW01		SGW02A		SGW02B		SGW02C		SGW03		SGW07	
Parameter (mg/L)		ANZECC Guideline	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20
Metals	Calcium		0.8	0.5	8.9	9.9	8.9	8.6	DRY	4.2	12	10	3.6	7.5
	Magnesium		1.4	1.2	10	15	10	12		13	45	56	2	18
	Sodium		47	56	47	57	47	53		120	190	220	8	130
	Potassium		0.4	0.4	0.9	1.3	0.9	1.2		0.4	2.2	3.1	6.5	8.9
	Aluminium	0.055	3.2	0.05	0.22	<0.01	0.2	0.02		0.05	<0.01	<0.01	0.03	<0.01
	Arsenic	0.024	<0.001	0.002	<0.001	0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001
	Cadmium	0.002	<0.0001	<0.0001	<0.0001	<0.003	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Chromium		0.001	<0.001	0.001	<0.001	0.002	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001
	Lead	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01		<0.001	<0.001	<0.001	<0.001	<0.001
	Manganese	1.9	<0.01	0.01	<0.01	<0.01	<0.01	<0.01		<0.01	0.46	0.7	0.01	0.15
	Mercury	0.06	<0.0001	<0.0001	<0.0003	<0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Selenium	0.0055	<0.001	0.008	<0.001	0.005	0.001	0.004		0.018	<0.001	0.001	<0.001	<0.001
	Zinc	0.008	<0.005	<0.005	<0.005	0.015	<0.005	0.038		<0.005	0.008	0.056	<0.005	<0.005
	Iron	0.3	0.86	<0.01	0.36	<0.01	0.47	<0.01		<0.01	0.05	<0.01	0.47	9.7
	Ferrous Iron		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	0.05	<0.05	0.25	9.7
Inorganics	Chloride		47	55	35	50	34	38	DRY	51	380	400	25	230
	Sulphate		21	22	21	23	23	24		27	34	34	3	31
	Reactive Silica		54	54	42	38	39	38		37	23	22	2.4	33
	Alkalinity (mgCaCO <sub>3</sub> /L)		77	21	77	79	80	75		190	130	110	32	59

Bore			SGW01		SGW02A		SGW02B		SGW02C		SGW03		SGW07	
Parameter (mg/L)		ANZECC Guideline	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20	Jun-20	Sep-20
	Bicarbonate (mgCaCO <sub>3</sub> /L)		77	21	77	79	80	75		190	130	110	32	59
	Carbonate (mgCaCO <sub>3</sub> /L)		<5	<5	<5	<5	<5	<5		<5	<5	<5	<5	<5
Nutrients	TN	0.45	0.4	<0.2	8.3	5.3	8.8	5.1		2.8	1.3	1	8.3	3.2
	TKN		0.3	<0.2	3.4	<0.2	4.1	<0.2		<0.2	0.9	0.9	8.3	3.1
	TP	0.02	0.59	0.11	0.63	0.13	18	1.3		0.06	0.47	0.17	0.65	0.38
	FRP	0.01	0.05	<0.01	0.1	0.06	0.06	0.04		0.01	0.03	<0.01	0.19	<0.01
	Ammonia-N	0.9	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		0.02	0.12	0.013	1.2	2.1
	Nitrate-N		0.05	0.17	4.9	5.3	4.7	5.1		2.7	0.33	0.06	0.03	0.1
	NOx-N	0.2	0.08	0.17	4.9	5.3	4.7	5.1		2.7	0.36	0.06	0.04	0.12
	Nitrite-N		0.03	<0.01	0.02	<0.05	0.03	<0.01		<0.01	0.03	<0.01	0.01	0.02

Highlighted are concentrations that exceed ANZECC (2000) Guidelines.

The results show the following;

- All heavy metal concentrations are below the ANZECC (2000) guidelines, with the exception of aluminium, selenium, iron, and zinc. This is similar to previous years. Elevated iron, zinc and aluminium levels are considered to be a result of the geology of the site. Aluminium is known to occur naturally as a result of the clay component of the geology while iron occurs within the rock formation.
- Selenium was found to be elevated at SGW01 and SGW02c. The nested bores at SGW02 are closest to current excavation and is the shallowest of the three bores. Selenium was also found at the other nested bores in the SGW02 location.
  - Soils formed on sedimentary rocks that contain high amounts of organic matter typically have high selenium concentrations (Cuvardic, 2003). Total Se content in soil is predominantly determined by its content in the native substrate so the detectable reading of Se this year may be as a result of ground disturbing works in the Stage 3 area and the interaction with the natural substrates.
  - Selenium is also an essential micronutrient for animals but is toxic in large quantities. Selenium has been found in previous years in a number of the bores, at very low concentrations.
- Most inorganics are at or below the concentrations previously recorded at all bores. SGW03 has historically recorded elevated inorganics concentrations, and although these results are elevated in comparison to water quality in the other bores, this is normal for SGW03 and typical of fractured rock aquifer systems to display different water quality concentrations across short distances.
- Nutrient concentrations are generally above the ANZECC (2000) guidelines for TN (excluding SGW01), and TP (for all bores). This is similar to concentrations in previous years, except in SGW02b and c.
  - The nutrient levels are considered indicative of historical regional groundwater quality and the current surrounding agricultural land uses (cattle farming).
  - TP levels were higher than usual in SGW2, and one event at SGW07 although the previous monitoring year also recorded elevated TP concentrations at SGW02b. This may have been a result of the excavation work occurring during winter this year in Stage 3 (close to SGW2 bores). The ground disturbing works close to this bore may have mobilised phosphorus bound to the soil particles in the existing soils from the previous land use (cattle grazing). High TP in SGW07 may be a result of the direct runoff this bore receives which may contain nutrients due as the site is also used for cow pasture.

The full set of groundwater quality results are provided in Appendix 6.

## **4 Conclusions**

### **4.1 Surface Water**

There was no discharge to the streams during this monitoring year, therefore no flocculation was required for discharge to the southern stream. A re-evaluation of the drainage strategy is to be considered in the near future.

### **4.2 Groundwater**

Minimum levels were recorded in May and June 2020, occurring in months similar to historical minimums for all bores. Maximum groundwater levels occurred in October for most bores, except SGW02c, SGW03 and SGW07 which peaks in August, September, and November, respectively. Most bores were slightly below the AAMGLs.

Groundwater quality monitoring was undertaken in June and September 2020, and indicates the quality is generally within ANZECC guidelines for heavy metals, excluding aluminium, iron, and zinc, and two instances of selenium (SGW01 and SGW02c) close to the new Stage 3 excavation. The concentrations were similar to previous years and considered to be a result of local geology.

Groundwater nutrient levels exceeded the ANZECC (2000) guidelines, however these concentrations are generally historical and considered to be a result of regional water quality and land use (pastoral grazing).

## 5 References

ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

Bureau of Meteorology (2020). Daily Rainfall Data Jarrahdale [Online] [www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p\\_nccObsCode=139&p\\_display\\_type=dataFile&p\\_startYear=&p\\_c=&p\\_stn\\_num=009023](http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=009023)

Coterra Environment (2010) Water Management Plan - Shale Road Pit (Rev 0). Prepared for Austral Bricks, November 2010.

Coterra Environment (2011) Stormwater Discharge Assessment Report (Rev 0). Prepared for Austral Bricks, April 2011.

Coterra Environment (2011a) Water Monitoring Report 2011 – Shale Road Extractive Pit (Rev 0). Prepared for Austral Bricks, December 2011.

Coterra Environment (2011b) Water Sampling Program - Shale Road Pit. Prepared for Austral Bricks, May 2011.

Coterra Environment (2012) Flocculation Assessment Report – Shale Road Extraction Pit (Rev 1). Prepared for Austral Bricks, August 2012.

Coterra Environment (2012a) Water Management Plan - Shale Road Pit (Rev 2). Prepared for Austral Bricks, December, 2012.

Coterra Environment (2012b) Water Monitoring Report 2012 – Shale Road Extractive Pit (Rev 0). Prepared for Austral Bricks, December 2012.

Coterra Environment (2013) Water Management Plan - Shale Road Pit (Rev 3). Prepared for Austral Bricks, June 2013.

Coterra Environment (2014a) Water Management Plan - Shale Road Pit (Rev 4). Prepared for Austral Bricks, June 2014.

Coterra Environment (2014b) Water Management Plan - Shale Road Pit (Rev 5). Prepared for Austral Bricks, December 2014.

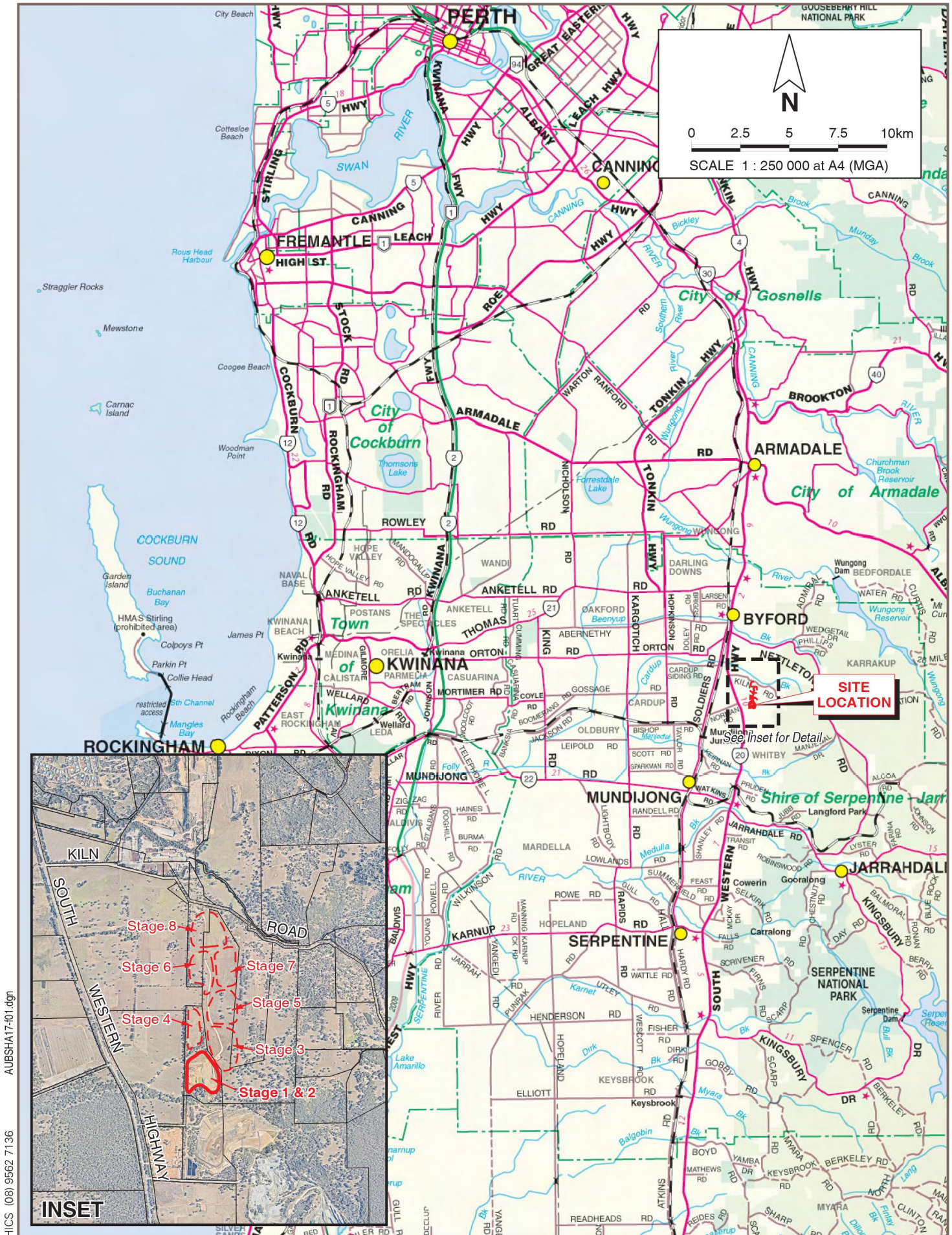
Cuvaradic M S (2003). Selenium in Soil. Proceedings for Natural Sciences, Matica Srpska Novi Sad, 104, 23-37.

Hydroconcept (2012). Groundwater Resource Assessment of the Shale Road Pit, Cardup. Prepared for Austral Bricks.

## Figures

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COTERRA  
ENVIRONMENT

Austral Bricks  
WATER MONITORING REPORT  
SHALE ROAD PIT

## SITE LOCATION

Drawn: C. Hopkirk Date: 22 Feb 2017

Job: AUBSHA18 Revision: A





AERIAL PHOTOGRAPH SOURCE: NearMap, flown November 2015.

**COTERRA**  
ENVIRONMENT

Austral Bricks  
WATER MONITORING REPORT  
SHALE ROAD PIT

Drawn: C. Hopkirk

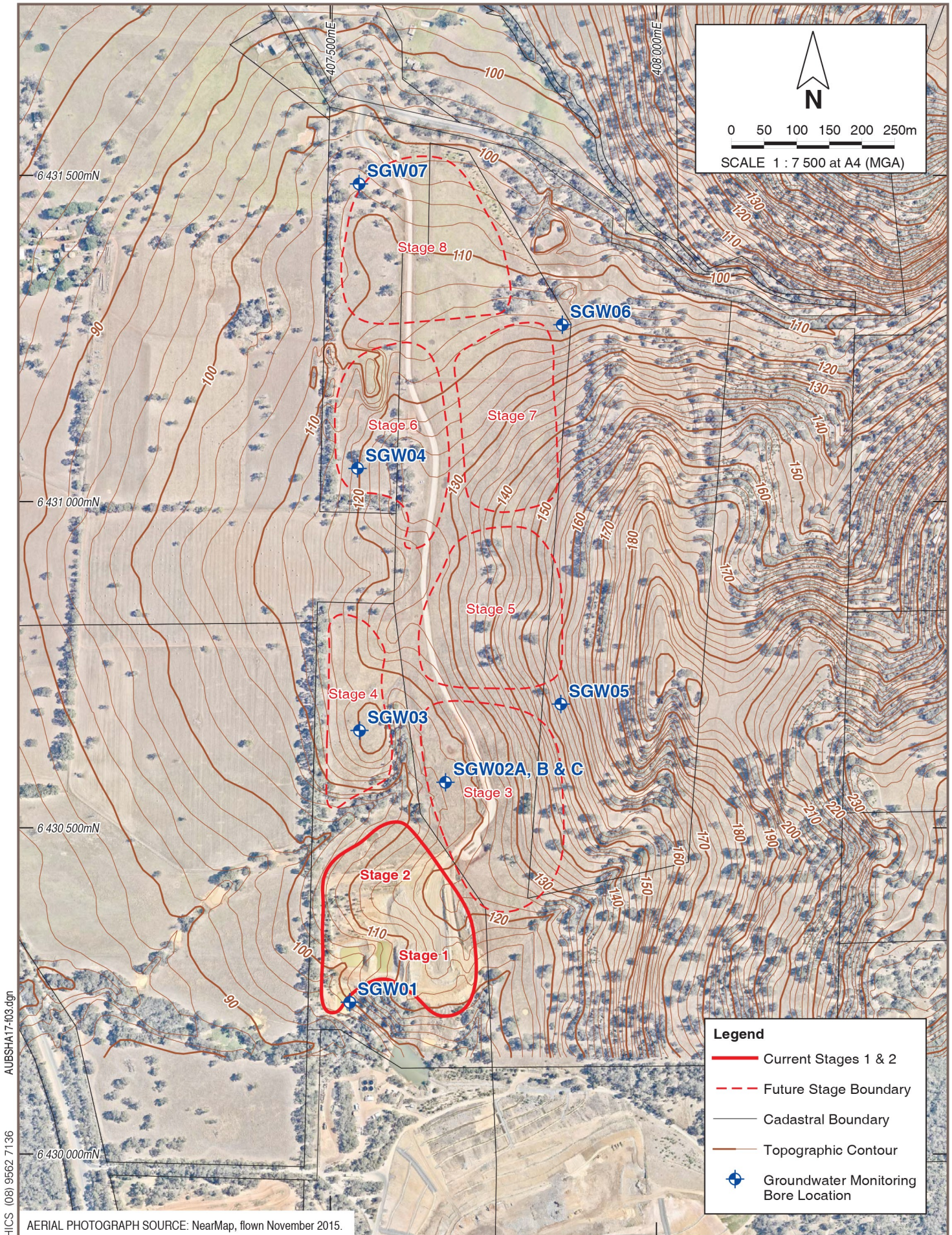
Date: 22 Feb 2017

Job: AUBSHA18

Revision: A

## SURFACE WATER SAMPLING LOCATIONS





AERIAL PHOTOGRAPH SOURCE: NearMap, flown November 2015.

**COTERRA**  
ENVIRONMENT

Austral Bricks  
WATER MONITORING REPORT  
SHALE ROAD PIT

Drawn: C. Hopkirk

Date: 22 Feb 2017

Job: AUBSHA18

Revision: A

## GROUNDWATER MONITORING BORE LOCATIONS



## **Appendix 1      Extractive Industry Licence**

---



20 June 2012

Statewest Planning  
PO Box 1377  
MIDLAND WA 6936

Dear Sir/Madam

**APPLICATION FOR DEVELOPMENT APPROVAL & EXTRACTIVE INDUSTRY  
LICENCE - LOT 6 SHALE ROAD, LOTS 3 & 50 KILN ROAD, CARDUP**

I refer to your application for development approval in respect of the above property. The Shire is pleased to advise that the application has been carefully considered and the Shire has been able to support the proposal, with an approval decision notice attached for your information and future reference.

Should you wish to proceed with the development, it is important that you review the various conditions that have been imposed. The conditions have been imposed due to the various regulatory requirements that exist in Western Australia and ultimately to ensure that the expectations of the community will be achieved into the future. While every effort has been made to ensure that the requirements are clear, please do not hesitate contact the relevant officers of the Shire should you require any additional information or wish to clarify the requirements of the conditions.

Should you be aggrieved by any of the conditions, you may have the right under the Planning and Development Act 2005 to have the decision reviewed by the State Administrative Tribunal. Applications for review must be submitted to the Tribunal within 28 days of the date on the decision notice. Further information can be obtained by calling the Tribunal on (08) 9219 3111 or by visiting their website at [www.sat.justice.wa.gov.au](http://www.sat.justice.wa.gov.au)

The Shire is endeavouring to provide a high level of customer service and is always keen to receive feedback on how we can improve our services. Should you have any feedback that you would like to provide to the Shire, please do not hesitate to send us an email to [planning@sjshire.wa.gov.au](mailto:planning@sjshire.wa.gov.au).

Thank you again for lodging a development application with the Shire and we look forward to working with you again in the future.

Yours faithfully

Michael Daymond  
Senior Planner

6 Paterson Street  
Mundijong 6123  
Western Australia



Telephone: 9526 1111  
Facsimile: 9525 5441  
Web: [www.sjshire.wa.gov.au](http://www.sjshire.wa.gov.au)  
Email: [info@sjshire.wa.gov.au](mailto:info@sjshire.wa.gov.au)

## FORM 2 PLANNING APPROVAL TOWN PLANNING SCHEME NO. 2

---

<b>PROPERTY FILE:</b>	P05917/06	<b>DOCUMENT NO:</b>	OC12/7499
<b>APPLICANT:</b>	Statewest Planning PO Box 1377 MIDLAND WA 6936		
<b>OWNER:</b>	Bristle Holdings C/- Austral Bricks Locked Bag 100 MIDLAND WA 6936		
<b>PROPERTY:</b>	Lot 6 Shale Road, Lots 3 & 50 Kiln Road, Cardup		
<b>DEVELOPMENT:</b>	Extractive Industry – Shale & Clay		
<b>USE CLASS:</b>	Industry - Extractive		
<b>APPROVAL DATE:</b>	11 June 2012		
<b>AUTHORITY:</b>	OCM/165/06/12		

Application for approval to commence development as per application form dated 17 January 2011 and accompanying plans is **APPROVED** under the above authority subject to the following conditions:

### GENERAL

1. This approval expires 31 December 2017.
2. Operating hours are restricted to 6am to 5pm Monday to Saturday and are not permitted to occur on Sundays and Public Holidays.

### COMPLIANCE

3. The landowner shall submit an annual report to the Shire's Director Development Services by 31 March each year. The annual report shall include an internal compliance audit of all the development and licence approval conditions and management plans. The annual report shall also provide details relating to complaints and complaint responses.
4. The proponent shall within 90 days of this approval prepare a Compliance Assessment Plan and Audit Table utilising the frameworks detailed in the Environmental Protection Authority document Guidelines for Proponents: Preparing a

Compliance Assessment Plan. This plan is to be submitted for approval by the Director Development Services.

#### DUST

5. The proponent shall within 90 days of the date of this approval prepare and submit to the Shire for assessment a Dust Management Plan (DMP), in accordance with the Department of Environment and Conservation's A Guideline for Managing the Impacts of Dust and Associated Contaminates from Land Development Sites, Contaminated Sites Remediation and Other Related Activities document dated March 2011 (DEC Guide). Once approved, the Dust Management Plan is to be implemented in its entirety. Council may agree, following submission of an application in writing, to vary the approved Dust Management Plan.

#### NOISE

6. The proponent shall prepare and submit to the Shire for assessment a Noise Impact Assessment and Noise Report prepared by a suitably qualified acoustic consultant by 30 June 2013, following the first full excavation campaign. Once approved by the Director Development Services, the Noise Report shall be implemented in its entirety.

#### STAKEHOLDER ENGAGEMENT

7. The landowner is to submit to the Shire within 12 months of this approval a plan for a Community Consultation Framework. The plan shall include, but not be limited to, the relevant land owner, community and government agency representatives, terms of reference for the Community Consultation Group and the frequency of the meetings. Once approved by the Director Development Services the plan is to be implemented in its entirety.
8. A Compliance Assessment Report for the approved Community Consultation Framework must be lodged with the local government by 31 March each year, or by such other time as may be agreed by the local government, following the approval of the Community Consultation Framework. The Compliance Assessment Report shall report in summary on:
  - (i) The community engagement activities carried out during the preceding year;
  - (ii) The stakeholder interaction carried out during the year, including the number and nature of any complaints made and the response to those complaints; and
  - (iii) The meetings of the Community Consultation Group.

Any records kept by the operator pursuant to the Community Consultation Framework, including the minutes of the Community Consultation Group meetings, must be provided to the local government if requested in writing. The annual Compliance Assessment Report and records kept pursuant to the Community Consultation Framework are to be made publicly available.

#### WATER RESOURCES

9. The landowner shall submit to the Shire an updated Water Management Plan by 31 December 2012. Once approved by the Director Engineering, the Water Management Plan is to be implemented in its entirety.



## TRAFFIC

10. Signs are to be erected at the intersections of the internal haulage roads and Kiln Road warning "Caution – Trucks Using Road" during times of cartage.
11. The landowner shall implement the approved Traffic Management Plan prepared by McDowall Affleck and received by the Shire on 20 January 2011 to the satisfaction of the Director Engineering.
12. Kiln Road being widened as per the plans attached to and forming part of this approval to the satisfaction of the Shire. Prior to the completion of the widening of Kiln Road, traffic safety controls are to be implemented to the satisfaction of the Director Engineering.
13. Kiln Road to be upgraded to the satisfaction of the Director Engineering. Construction works on Kiln Road (including earthworks) are not to commence until Council has approved detailed engineering plans and specifications of the works, including earthworks, retaining walls, roads and paths, drainage, clearing, landscaping/rehabilitation and soil stabilisation measures, that apply both during and after construction.

## EMERGENCY MANAGEMENT

14. An 'All Hazards Risks Assessment' in accordance with AS/NZS ISO 31000, 31010 and State Planning Policy 3.4 Natural Hazards and Disasters and associated mitigation plans, being prepared, approved and thereafter implemented to the satisfaction of the Director Engineering.

## HAZARDOUS CHEMICALS

15. To prevent any spilled fuel entering the ground the applicant will use bunded hardstand refuelling areas or alternatively an industry best practice method to the requirements of the Director Development Services.
16. No on-site fuel storage and major servicing of equipment shall take place on site.
17. The operator shall ensure that:
  - (i) All trucks accessing the site and all mechanical equipment used on-site shall be fitted with or carry a spill kit containing absorbent booms, granules and pads and heavy duty waste bag, sufficient to clean up the accidental spill of the volume of fuel and other hydrocarbons (for example, hydraulic fluids) from each truck or piece of equipment;
  - (ii) Spill kits are replenished immediately following a spill event and contaminated soils removed and appropriately disposed of;
  - (iii) Any fuel or other hydrocarbon leakages or spills shall be cleaned up immediately and in any event within 12 hours of a leak or spill; and
  - (iv) The operator of any mechanical equipment used onsite shall, prior to commencement of extraction activity on the site and throughout the term of this approval, undergo practical instruction and training in the use of the spill kit.
18. The landowner shall keep a register of the extent, location, environmental implications and remedial actions taken for any accidental contamination of soil or water resources

in a logbook to be kept on-site and available for immediate inspection by the Shire of Serpentine Jarrahdale.

19. The landowner shall ensure that no chemicals or potential liquid contaminants are disposed of on-site.

#### BIODIVERSITY, LANDSCAPE AND VISUAL IMPACT MANAGEMENT

20. An updated Visual and Rehabilitation Management Plan being submitted for approval to the satisfaction of Director Strategic Community Planning within 90 days of the date of this approval. In carrying out the development the approved Visual and Rehabilitation Management Plan must be complied with at all times.
21. The landowner shall control declared and environmental weeds throughout the site to the satisfaction of the Director Strategic Community Planning.
22. Where extractive industry activities, including stockpiling and haulage, are occurring within close proximity (30 metres) to remnant vegetation or rehabilitated areas, the applicant shall utilise post and wire fencing flagged with brightly coloured survey tape or flags or some other means approved in writing by the Director Strategic Community Planning, to prevent encroachment by machinery.
23. The excavation activities are to be restricted to a level no lower than 2 metres above the highest known water table.

#### MINE CLOSURE

24. A Mine Closure Plan to be submitted to the Shire for approval within 12 months of the date of this approval. The Mine Closure Plan shall be prepared in accordance with the Department of Mines and Petroleum and Environmental Protection Authority draft 'Guidelines for Preparing Mine Closure Plans' (June 2011) document (as amended). Once approved by the Director Strategic Community Planning, the closure plan shall be implemented in its entirety. Council may agree, following submission of an application in writing, to vary the approved closure plan.

**The Advice Notes attached form part of this approval.**

#### APPEAL RIGHTS

The applicant may have the right under the Planning and Development Act 2005 to have the decision reviewed by the State Administrative Tribunal (SAT). Applications for review must be submitted to the SAT within 28 days of the date on the decision notice. Further information can be obtained by calling SAT on (08) 9219 3111 or by visiting their website at [www.sat.justice.wa.gov.au](http://www.sat.justice.wa.gov.au)

Michael Daymond  
**Senior Planner**  
MD/gl

**FORM 2**  
**PLANNING APPROVAL**  
**SERPENTINE JARRAHDALE SHIRE**  
**TOWN PLANNING SCHEME NO. 2**

**ADVICE NOTES**

1. The Dust Management Plan may contain the following key components not excluding provision of the Department of Environment and Conservation's Guide:
  - (i) Recognised criteria for 'maximum dust emission levels';
  - (ii) Trigger levels with relevant mitigation responses as contingencies for when dust criteria are exceeded on individual, multiple and ongoing occasions; and
  - (iii) An ongoing monitoring program that verifies the effectiveness of operational mitigations and contingencies.
  - (iv) A complaints registration, response and reporting process;
  - (v) A summary communication strategy that outlines community consultation for significant events and changes in the operation and staging of the quarry
2. The Mine Closure Plan shall:
  - (i) Be site specific representing the characteristics of the area impacted;
  - (ii) Will document stakeholder consultation and how stakeholder concerns have been addressed;
  - (iii) Show that material and site characterisation has been undertaken to identify potential closure issues;
  - (iv) Define closure outcomes including final land use(s) and objectives, closure criteria and where applicable, performance indicators and milestones;
  - (v) Identify closure issues – with workable management measures proposed or in place to address those issues;
  - (vi) Show application of experience from other mine sites (where applicable);
  - (vii) Show that appropriate plans are in place for further research and trials to increase confidence in closure outcomes (where applicable);
  - (viii) Show that there are appropriate plans in place for progressive rehabilitation;
  - (ix) Show that there are appropriate plans proposed or in place for closure monitoring and maintenance; and
  - (x) Show that there are appropriate plans proposed or in place for unplanned closure or temporary closure (on care and maintenance).
3. A Building Licence is to be obtained for the construction or placement of any permanent or temporary structures on site such as a site office.
4. Separate approval may need to be obtained from the Department of Water for a bore licence.
5. The landowner shall ensure that truck operators comply with the conditions of approval and ensure that their operations do not adversely impact on the community by way of truck speeds, control of litter and following designated truck routes.
6. The landowner is advised to seek the necessary approvals from the Department of Environment for any clearing of native vegetation on site.
7. The updated Visual and Rehabilitation Management Plan should incorporate the requirements of the Visual Landscape Planning in WA (WAPC November 2007)

document and include additional screening along the northern and eastern property boundaries.

8. Outside lighting shall be angled to avoid light impacts on neighbouring properties.

SHIRE OF SERPENTINE-JARRAHDALE  
**PLANNING APPROVAL**  
Date: 11/06/12 File No P05917/06  
  
Signed  
(Authorised Officer)



SUBJECT TO SURVEY



LEGEND

- EXCAVATION ACTIVITY BOUNDARY
- PROPOSED SCREENING VEGETATION
- PROPOSED NEW ACCESS ROUTE

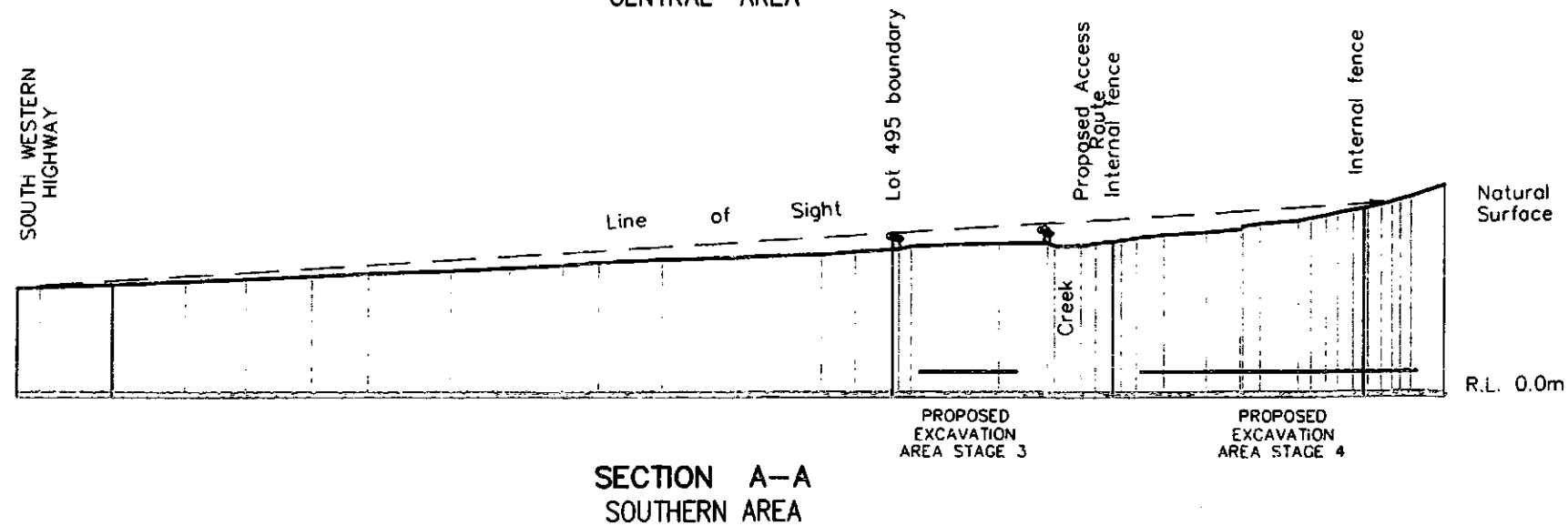
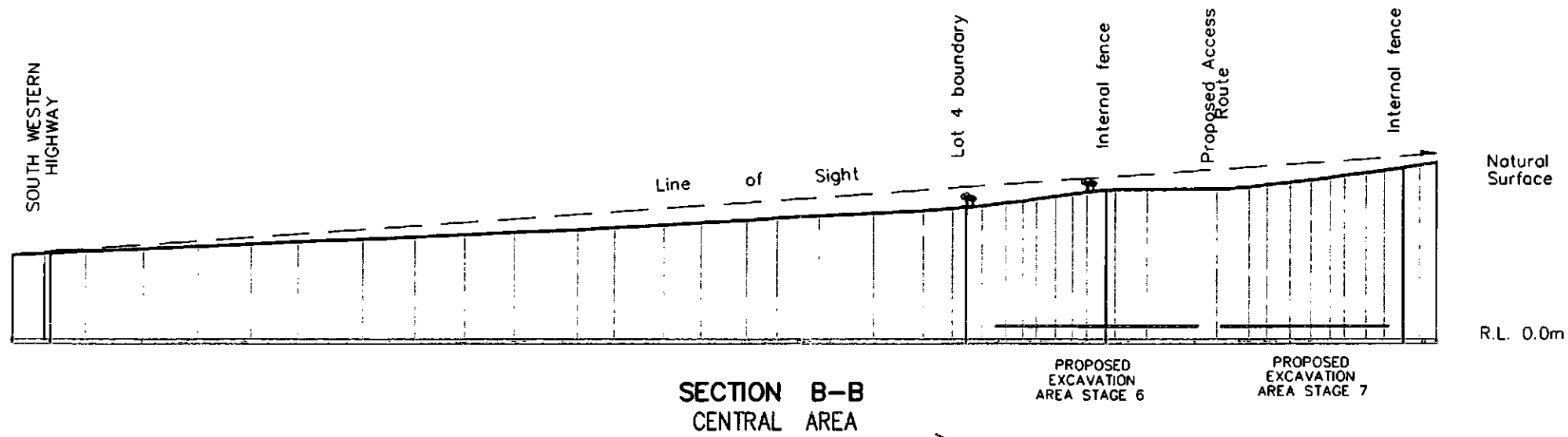
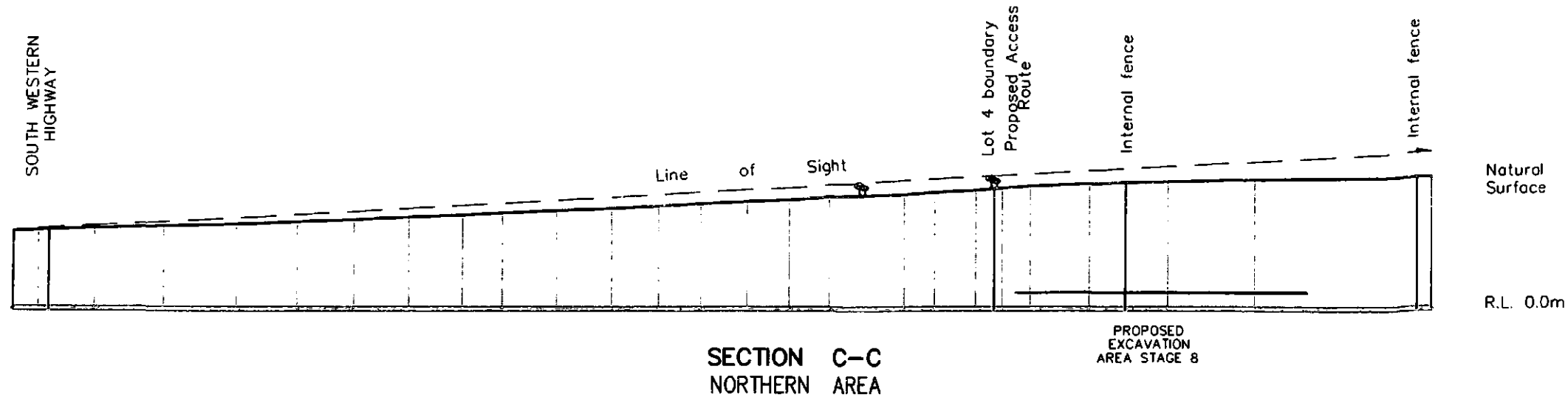
PLAN 3

STATEWEST SURVEYING & PLANNING

Licensed Surveyors & Town Planners  
Partners R.J.M.Rogers & S.E.O'Hara Associate P. Incerti  
Midland House P.O. Box 1377, Midland W.A. 6936 69 Great Northern Highway, Midland  
Telephone (08)9274 3198 Facsimile (08) 9274 3878 Email [statewest@statewest.net](mailto:statewest@statewest.net)  
Website <http://www.statewest.net>

PROPOSED PLANNING APPROVAL FOR EXTRACTIVE  
INDUSTRY LICENCE  
LOTS 3 & 50 KILN RD & LOT 6 SHALE RD,  
CARDUP-SCREENING

SCALE 1:10000	DATE 1-09-10	DRAWN T.C.	CHECKED	REFERENCE 14737	SHEET No. 2 of 3
------------------	-----------------	---------------	---------	--------------------	---------------------



CROSS SECTIONS 1

**SHIRE OF SERPENTINE-JARRAHDALE**  
**PLANNING APPROVAL**  
Date: 11/06/12 File No P05917/06  
  
Signed  
(Authorised Officer)

# STATEWEST SURVEYING & PLANNING

Licensed Surveyors & Town Planners  
Partners R.J.M.Rogers & S.E.O'Hara Associate P. Incerti  
Midland House P.O. Box 1377, Midland W.A. 6936 69 Great Northern Highway, Midland  
Telephone (08)9274 3198 Facsimile (08) 9274 3878 Email [statewest@statewest.net](mailto:statewest@statewest.net)  
Website <http://www.statewest.net>

**PROPOSED PLANNING APPROVAL FOR EXTRACTIVE  
INDUSTRY LICENCE**  
LOTS 3 & 50 KILN ROAD & LOT 6 SHALE RD, CARDUP  
CROSS SECTIONS FROM SOUTH WESTERN HIGHWAY

SCALE	DATE	DRAWN	CHECKED	REFERENCE	SHEET No.
1:5000	1-09-10	T.C.		14737	3 of 3

## Appendix 2      Water Management Plan Approval

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All enquiries to Craig Wansbrough on 9526 11178  
Our ref: P05917/06  
Electronic ref: OC15/6624  
Your ref: IN14/25221



Shire of  
Serpentine  
Jarrahdale

Sustainable. Connected. Thriving!

2 April 2015

Rebecca Epworth  
Director  
Coterra Environment  
2 / 460 Roberts Road  
SUBIACO WA 6008

Dear Rebecca

**Shale Road, Cardup (L6) & Kiln Road, Cardup (L3 & L50) – Extractive Industry –  
Water Management Plan – Revision 5 – Stages 1 to 3 – Shale Road Excavation Pit –  
Shire of Serpentine Jarrahdale Engineering Services Letter of Acceptance**

Thank you for the revised Water Management Plan (Revision 5) for Stage 1 to 3 of the  
Shale Road Excavation Pit.

The Shire's Engineering Services has assessed the report against the relevant policies,  
standards and guidelines and confirms it meets the requirements of:

- Condition 9 of the Extractive industry Licence (EIL) issued on the 20 June 2012  
(Ref. P05917/06).

If you have any queries about this matter please contact Craig Wansbrough (Project  
Manager – Water Sensitive Urban Design) or the undersigned on (08) 9526 1111.

Yours sincerely

**Gordon Allan**  
**Director Engineering**





# SAT

State  
Administrative  
Tribunal

Western Australia

Matter No: DR 249 of 2012  
Contact Officer: Fletcher  
Your Ref:

Austral Bricks  
Locked bag 100  
MIDLAND WA 6936



Dear Sir/Madam

**Austral Bricks Pty Ltd v Shire of Serpentine Jarrahdale**

Please find enclosed the final order in this matter, made on 7 January 2013.

If you have enquiries, please contact the Tribunal on (08) 9219 3111.

Yours sincerely

for **EXECUTIVE OFFICER**

8 January 2013

cc: McLeods Barristers & Solicitors

cc: Algeri Planning & Appeals



# SAT

State  
Administrative  
Tribunal

Western Australia

*Local Government Act 1995*

IN THE MATTER OF:

**Austral Bricks**

Applicant

-and-

**Shire of Serpentine Jarrahdale**

Respondent

**Matter Number: DR 249 2012**

**Application Lodged: 16 July 2012**

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## ORDER

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By consent of the parties, it is on 7 January 2013 ordered that:

1. The review is allowed.
2. The extractive industry licence granted by the respondent Shire on 20 June 2012 is varied by deleting condition 1 and substituting the following condition:

'1. (a) The extractive industry licence is for a total period of ten years, consisting of two consecutive five year periods commencing on 1 January 2013. Between three and six months prior to expiry of the first five year period the licensee shall submit an independent audit ('Audit') of its compliance with:

- (i) the conditions of this licence;
- (ii) the conditions of the planning approval dated 11 June 2012 issued by the Shire in respect of the extractive industry ("Planning Approval"); and
- (iii) the management plans required by the conditions of the Planning Approval ("Management Plans"), including details relating to complaints and complaint responses and the results of environmental monitoring undertaken during the first five year term, such Audit to be prepared at the cost of the licensee by a suitably qualified consultant appointed by the licensee, subject to approval by the Shire.



(b) If the Audit demonstrates to the satisfaction of the Shire that:

- (i) the licensee has complied with all licence conditions, Planning Approval conditions and Management Plan requirements; and
- (ii) the results of environmental monitoring undertaken by the licensee confirm, having regard to water quality standards set out in the licensee's approved Water Management Plan, that the extractive industry operations have not adversely affected ground and surface water quality; and
- (iii) the available evidence indicates that the operational impacts from the extractive industry are satisfactorily addressed by the Management Plans, then the second five year term of the licence shall proceed without amendment to the Management Plans and the Shire shall notify the licensee in writing of its approval of the Audit.

(c) If the Audit does not demonstrate to the satisfaction of the Shire that the requirements set out in clause 1(b)(i)-(iii) have been met, then the Licensee shall within 60 days of receipt of written notice from the Shire amend the relevant Management Plans in accordance with any recommendation of the Audit and to the satisfaction of the Shire.

(d) The Licensee shall comply with the Management Plans as amended in accordance with condition 1(c).

(e) If the second five year period of the licence has commenced prior to the Shire approving the Audit pursuant to clause 1(b) or requiring the Applicant to amend the Management Plans pursuant to clause 1(c), then the existing Management Plans shall continue to apply until such time as the licensee amends the Management Plans in accordance with clause 1(c).'

3. There is no order as to costs.



Senior Member Peter McNab



I certify the foregoing to be a true and correct copy of the original



State Administrative Tribunal

Date: 8.1.18

## Appendix 3 Correspondence with Shire

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## Rebecca Epworth

---

**From:** Craig Wansbrough <[cwansbrough@sjshire.wa.gov.au](mailto:cwansbrough@sjshire.wa.gov.au)>  
**Sent:** Monday, 23 June 2014 4:47 PM  
**To:** Rebecca Epworth  
**Subject:** RE: Flocculation treatment

Hi Rebecca,

As discussed, please proceed with the in-situ flocculation trial at Shale Road.

Kind regards,

**Craig Wansbrough**

*Project Manager, Water Sensitive Urban Design*

e: [cwansbrough@sjshire.wa.gov.au](mailto:cwansbrough@sjshire.wa.gov.au)

a: 6 Paterson Street, Mundijong, WA 6123

t: +618 9526 1178 | f: +618 9525 5441 | m: +61 448 795 864

w: [www.sjshire.wa.gov.au](http://www.sjshire.wa.gov.au)



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**From:** Rebecca Epworth [<mailto:rebecca.epworth@coterra.com.au>]  
**Sent:** Sunday, 22 June 2014 11:21 PM  
**To:** Craig Wansbrough  
**Cc:** Glenn Moore ([Glenn.Moore@australbricks.com.au](mailto:Glenn.Moore@australbricks.com.au))  
**Subject:** Flocculation treatment

Hi Craig,

Following on from our conversation on Friday regarding the Shire go ahead for the flocculation trial at Shale Road. I know you're busy so just thought I would send you a reminder email regarding the written permission to progress.

Thanks, Bec

Rebecca Epworth

Director



Ph: 9381 5513 | Fax: 9381 5514 | Mobile: 0437 707 472  
2/460 Roberts Road, SUBIACO WA 6008 | [www.coterra.com.au](http://www.coterra.com.au)

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## Rebecca Epworth

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**From:** Rebecca Epworth  
**Sent:** Monday, 25 August 2014 4:09 PM  
**To:** Craig Wansbrough  
**Cc:** Craig Oconnor (Craig.OConnor@australbricks.com.au); Paul Cougan (PaulC@limeindustries.com.au)  
**Subject:** Shale Rd - Flocculation results  
**Attachments:** 14-5618-[R01].pdf

Hi Craig,

Following on from your approval to undertake the flocculation treatment at Shale Road settlement ponds this winter. Just letting you know that we have finished the flocculation dosing at Shale Road and have got the lab results back (attached). The flocculation has worked well; significantly reducing the TSS and turbidity. Please find a summary below;

- The TSS in the ponds is very low at 7mg/l and <5mg/l (SHA04 and SHA05). The ponds are well below the immediate upstream value (26mg/l) and below the alternative recommended WMP trigger value (equivalent derived value from ANZECC turbidity; of 25mg/l).
- The turbidity readings in the ponds are good (32 and 46 NTU). These are slightly above the ANZECC guidelines (20 NTU) however it is below the immediate upstream value witnessed in the stream (52 NTU at SW02). Given the concentration in the pond water is an improvement of the receiving stream, the concentrations are considered appropriate for discharge.
- The pH levels in the ponds are at 7.2 and 7.5 . These are within the ANZECC guidelines and similar to the immediate upstream value (7.1 at SHA02).
- The total aluminium in the ponds are at 0.84mg/l and 0.93mg/l. These are below the DEC 1mg/l guide referenced in the FlocMP and they are below the immediate upstream value (1.1 at SHA02).

Given the above results, we consider the water quality to be acceptable for discharge and anticipate to start discharging from Wednesday.

If you have any queries, please do not hesitate to contact me.

Thanks, Bec

Rebecca Epworth  
Director

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ENVIRONMENT

Ph: 9381 5513 | Fax: 9381 5514 | Mobile: 0437 707 472  
2/460 Roberts Road, SUBIACO WA 6008 | [www.coterra.com.au](http://www.coterra.com.au)

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## **Appendix 4      Pond Water Level Photos**

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March 2020



Upper pond



Middle pond



Lower Pond

April 2020



Upper pond



Middle pond



Lower Pond



May 2020



Upper pond



Middle pond



Lower Pond

June 2020



Upper pond



Middle pond



Lower Pond



July 2020



Upper pond



Middle pond



Lower Pond

August 2020



Upper pond



Middle pond



Lower Pond



September 2020



Upper pond (at capacity, new outlet pipe indicated)



Middle pond (not discharging)



Lower Pond (not discharging)

October 2020



Upper pond, with pumping pipe



Middle pond, pumping equipment shown



Lower Pond (not discharging)



**November 2020**



Upper pond



Middle pond



Lower Pond

**December 2020**



Upper pond



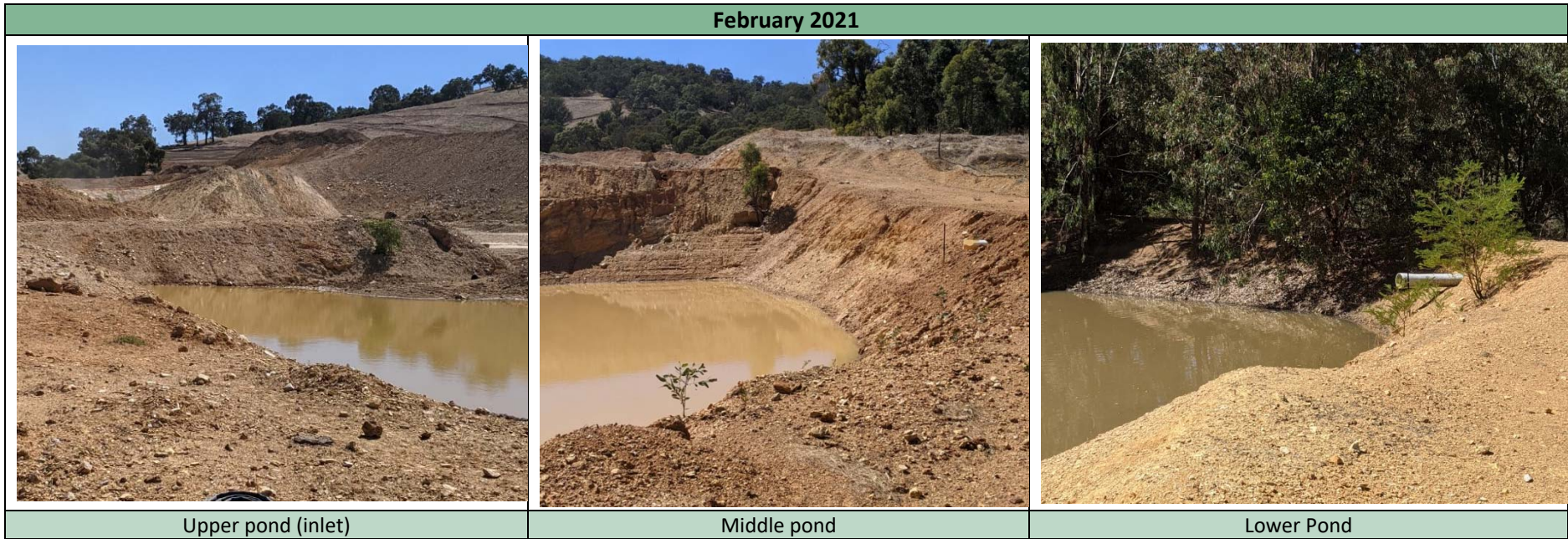
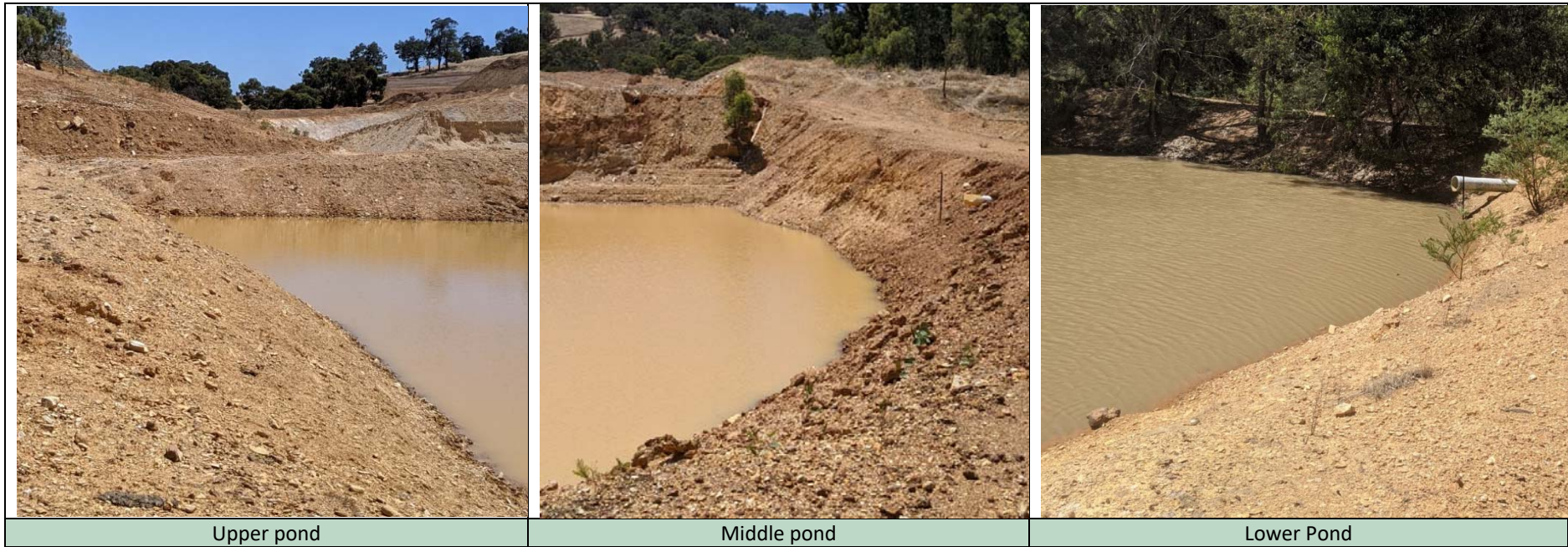
Middle pond



Lower Pond

**January 2021**





## Appendix 5      Groundwater Levels

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## GROUNDWATER LEVELS 2020-2021

Metres below top of collar (mbtoc)									
Date	SGW01	SGW02a (15m depth)	SGW2b (11m depth)	SGW2c (4m depth)	SGW03	SGW04	SGW05	SGW06	SGW07
Mar- 20	3.6	7.6	7.4	DRY	17.6	DRY	DRY	DRY	20.5
Apr- 20	3.8	7.9	7.7	DRY	17.7	DRY	DRY	DRY	20.6
May- 20	4.0	8.3	8.1	DRY	17.9	DRY	DRY	DRY	20.8
Jun- 20	4.0	8.3	8.2	DRY	17.7	DRY	DRY	DRY	21.0
Jul- 20	3.9	8.0	7.8	1.3	17.2	DRY	DRY	DRY	21.0
Aug- 20	3.1	6.7	6.6	1.2	16.1	DRY	DRY	DRY	20.8
Sep- 20	2.8	5.0	4.9	1.3	15.8	DRY	DRY	DRY	20.6
Oct- 20	2.2	5.0	4.8	2.7	16.3	DRY	DRY	DRY	20.2
Nov- 20	2.3	5.6	5.4	Damp at base	16.6	DRY	DRY	DRY	20.0
Dec- 20	2.5	6.1	5.9	Damp at base	17.0	DRY	DRY	DRY	20.0
Jan- 21	3.1	6.7	6.5	DRY	17.3	DRY	DRY	DRY	20.1
Feb- 21	3.6	7.6	7.4	DRY	17.5	DRY	DRY	DRY	20.5
Metres below ground level (mbgl)									
Date	SGW01	SGW02a (15m depth)	SGW2b (11m depth)	SGW2c (4m depth)	SGW03	SGW04	SGW05	SGW06	SGW07
TOC Stick Up (m)	0.38	0.266	0.280	0.400	0.330	0.377	0.308	0.56	0.00
	0.07								
Mar- 20	3.573	7.312	7.09	Damp at 3.892	17.263	DRY	DRY	DRY	20.476
Apr- 20	3.744	7.622	7.393	DRY	17.387	DRY	DRY	DRY	20.600
May- 20	3.969	8.046	8.819	DRY	17.536	DRY	DRY	DRY	20.829
Jun- 20	3.963	8.083	7.871	DRY	17.325	DRY	DRY	DRY	20.972
Jul- 20	3.780	7.691	7.533	0.899	16.873	DRY	DRY	DRY	20.970
Aug- 20	3.042	6.389	6.270	0.823	15.779	DRY	DRY	DRY	20.825
Sep- 20	2.743	4.732	4.590	0.854	15.482	DRY	DRY	DRY	20.550
Oct- 20	2.104	4.690	4.476	2.253	15.959	DRY	DRY	DRY	20.193
Nov- 20	2.276	5.291	5.113	Damp at base	16.288	DRY	DRY	DRY	20.010
Dec- 20	2.472	5.857	5.659	Damp at base	16.623	DRY	DRY	DRY	20.025
Jan- 21	3.055	6.473	6.265	DRY	16.933	DRY	DRY	DRY	20.139
Feb- 21	3.573	7.348	7.107	DRY	17.178	DRY	DRY	DRY	20.523
GW levels (mAHD)									
Date	SGW01	SGW02a (15m depth)	SGW2b (11m depth)	SGW2c (4m depth)	SGW03	SGW04	SGW05	SGW06	SGW07
Ground level (mAHD)	96.257	116.866	116.509	116.75	120.231	115.536	139.958	117.242	106.403
Mar- 20	92.684	109.554	109.419	DRY	102.968	DRY	DRY	DRY	85.927
Apr- 20	92.513	109.244	109.116	DRY	102.844	DRY	DRY	DRY	85.803
May- 20	92.288	108.820	107.690	DRY	102.695	DRY	DRY	DRY	85.574
Jun- 20	92.294	108.783	108.638	DRY	102.906	DRY	DRY	DRY	85.431
Jul- 20	92.477	109.175	108.976	115.851	103.358	DRY	DRY	DRY	85.433
Aug- 20	93.215	110.477	110.239	115.927	104.452	DRY	DRY	DRY	85.578
Sep- 20	93.514	112.134	111.919	115.896	104.749	DRY	DRY	DRY	85.853
Oct- 20	94.153	112.176	112.033	114.497	104.272	DRY	DRY	DRY	86.210
Nov- 20	93.981	111.575	111.396	Damp at base	103.943	DRY	DRY	DRY	86.393
Dec- 20	93.785	111.009	110.850	Damp at base	103.608	DRY	DRY	DRY	86.378
Jan- 21	93.202	110.393	110.244	DRY	103.298	DRY	DRY	DRY	86.264
Feb- 21	92.684	109.518	109.402	DRY	103.053	DRY	DRY	DRY	85.880
0.07	SGW01 Bore damaged. Bore repaired and new top of casing from July13 events onwards								
0.00	Bore knocked over and cut off at ground level (no stick up								

## Appendix 6      Groundwater Quality

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	Bore	SGW01											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	Clear	S. Turbid	Clear	Clear	S. Turbid	Clear	Clear	Clear	Clear	Clear	Clear	Clear
	Colour	Clear	White	Clear	Clear	Whiteish	Clear	Clear	Clear	Clear	Clear	Clear	Clear
	Temp (°C)	21.6	22.1	21.5	21.3	20.7	20	20.3	19.3	19.5	20.1	20.5	21.9
6.5-8	pH	5.81	6.47	5.24	5.66	5.64	5.88	6.07	5.99	6.67	5.53	4.92	6.01
	EC (µS/cm)	236.9	247.4	258.2	246.8	283.9	297.7	311	259.9	276.8	270.5	260.9	305.8
	TDS (mg/l)	165.1	170.3	180.05	176.15	184.6	193.7	202.15	189.15	200.85	193.7	185.25	211.9
	Redox (mV)	54.6	122	132.6	186.3	181.7	100	86.1	252.1	173.2	159.3	200.8	74.7
	DO (%)	66.3	19.8	35.2	10.9	41	48	34.4	49.3	26.7	25.7	19.3	27.2
	Calcium				0.8				0.5				
	Magnesium				1.4				1.2				
	Sodium				47				56				
	Potassium				0.4				0.4				
0.055	Aluminium				3.2				0.05				
0.024	Arsenic				<0.001				0.002				
0.002	Cadmium				<0.0001				<0.0001				
	Chromium				0.001				<0.001				
0.0034	Lead				<0.001				<0.001				
1.9	Manganese				<0.01				0.01				
0.06	Mercury				<0.0001				<0.0001				
0.0055	Selenium				<0.001				0.008				
0.008	Zinc				<0.005				<0.005				
0.3	Iron				0.86				<0.01				
0.45	TN				0.4				<0.2				
	TKN				0.3				<0.2				
0.02	TP				0.59				0.11				
	Chloride				47				55				
	Sulphate				21				22				
	Reactive Silica				54				54				
0.01	FRP				0.05				<0.01				
0.9	Ammonia-N				<0.02				<0.02				
	Nitrate-N				0.05				0.17				
0.2	NOx-N				0.08				0.17				
	Nitrite-N				0.03				<0.01				
	Ferrous Iron				<0.05				<0.05				
	Alkalinity (mgCaCo3/L)				77				21				
	Bicarbonate (mgCaCo3/L)				77				21				
	Carbonate (mgCaCo3/L)				<5				<5				

	Bore	SGW02 (a) Deep											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	S. Turbid	Turbid	Clear	S. Turbid	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
	Colour	L. Brown	White	Clear	L. Brown	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
	Temp (°C)	21.1	21.3	21.1	21.4	21.1	21.4	21.6	21.7	21.3	21.6	24.3	21.6
6.5-8	pH	5.93	6.1	5.65	5.78	5.95	6.36	6.38	6.94	6.57	6.13	6.26	6.69
	EC (µS/cm)	309.8	310.6	319.8	327.7	372.4	398.1	415.3	373.4	367	364.5	371.1	373.9
	TDS (mg/l)	214.75	217.1	224.9	228.8	241.8	258.7	269.75	258.7	256.75	253.5	235.4	260.8
	Redox (mV)	66.1	108.4	159	191.7	192.5	134.7	101.6	229.4	182.9	191.2	64.9	75.4
	DO (%)	96.9	60.1	55.9	49.3	56.5	62.3	51.4	85.4	47.8	82.4	33.2	67.6
	Calcium				8.9				9.9				
	Magnesium				10				15				
	Sodium				47				57				
	Potassium				0.9				1.3				
0.055	Aluminium				0.22				<0.01				
0.024	Arsenic				<0.001				0.001				
0.002	Cadmium				<0.0001				<0.003				
	Chromium				0.001				<0.001				
0.0034	Lead				<0.001				<0.001				
1.9	Manganese				<0.01				<0.01				
0.06	Mercury				<0.0003				<0.0001				
0.0055	Selenium				<0.001				0.005				
0.008	Zinc				<0.005				0.015				
0.3	Iron				0.36				<0.01				
0.45	TN				8.3				5.3				
	TKN				3.4				<0.2				
0.02	TP				0.63				0.13				
	Chloride				35				50				
	Sulphate				21				23				
	Reactive Silica				42				38				
0.01	FRP				0.1				0.06				
0.9	Ammonia-N				<0.02				<0.02				
	Nitrate-N				4.9				5.3				
0.2	NOx-N				4.9				5.3				
	Nitrite-N				0.02				<0.05				
	Ferrous Iron				<0.05				<0.05				
	Alkalinity (mgCaCo3/L)				77				79				
	Bicarbonate (mgCaCo3/L)				77				79				
	Carbonate (mgCaCo3/L)				<5				<5				



	Bore	SGW02 (b) Medium											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	S. Turbid	Turbid	Turbid	Turbid	Turbid
	Colour	L. Brown	L. Brown	L. Brown	L. Brown	L. Brown	L. Brown	L. Brown	White	L. Brown	L. Brown	L. Brown	L. Brown
	Temp (°C)	21.1	21.4	21.1	21.7	21.1	21.4	21.8	21.6	21.1	21.7	22	21.4
6.5-8	pH	6.09	6.05	5.89	5.68	6	6.34	6.44	6.47	6.24	5.91	6.22	6.63
	EC (µS/cm)	306.4	313.4	320.4	330.4	329.3	359.1	366.4	325.1	322.9	327.5	338.2	349.6
	TDS (mg/l)	215.15	218.4	224.9	229.45	214.15	233.35	237.9	226.2	226.85	226.86	233.3	244.4
	Redox (mV)	69.3	95.3	147.1	184.8	196.9	134.5	106.9	221.9	179.7	173.3	69.2	81.4
	DO (%)	109.9	57.7	66	56.2	53.6	63	53.4	65.8	37.7	70.3	50.5	56.4
	Calcium				8.9				8.6				
	Magnesium				10				12				
	Sodium				47				53				
	Potassium				0.9				1.2				
0.055	Aluminium				0.2				0.02				
0.024	Arsenic				<0.001				<0.001				
0.002	Cadmium				<0.0001				<0.0001				
	Chromium				0.002				<0.001				
0.0034	Lead				<0.001				<0.01				
1.9	Manganese				<0.01				<0.01				
0.06	Mercury				<0.0001				<0.0001				
0.0055	Selenium				0.001				0.004				
0.008	Zinc				<0.005				0.038				
0.3	Iron				0.47				<0.01				
0.45	TN				8.8				5.1				
	TKN				4.1				<0.2				
0.02	TP				18				1.3				
	Chloride				34				38				
	Sulphate				23				24				
	Reactive Silica				39				38				
0.01	FRP				0.06				0.04				
0.9	Ammonia-N				<0.02				<0.02				
	Nitrate-N				4.7				5.1				
0.2	NOx-N				4.7				5.1				
	Nitrite-N				0.03				<0.01				
	Ferrous Iron				<0.05				<0.05				
	Alkalinity (mgCaCo3/L)				80				75				
	Bicarbonate (mgCaCo3/L)				80				75				
	Carbonate (mgCaCo3/L)				<5				<5				

	Bore	SGW02 ( c ) Shallow											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	DRY	DRY	DRY	DRY	Clear	Clear	S. Turbid	S. Turbid	DRY	DRY	DRY	DRY
	Colour					Clear	Clear	L. Brown	L. Brown				
	Temp (°C)					19.8	18.9	20.3	20.1				
6.5-8	pH					6.72	7.47	7.72	7.42				
	EC (µS/cm)					374.8	498.1	599	692				
	TDS (mg/l)					243.75	323.7	390	494				
	Redox (mV)					174.5	128	91.2	229.5				
	DO (%)					83.6	81.2	45.5	72.4				
	Calcium							4.2					
	Magnesium							13					
	Sodium							120					
	Potassium							0.4					
0.055	Aluminium							0.05					
0.024	Arsenic							<0.001					
0.002	Cadmium							<0.0001					
	Chromium							<0.001					
0.0034	Lead							<0.001					
1.9	Manganese							<0.01					
0.06	Mercury							<0.0001					
0.0055	Selenium							0.018					
0.008	Zinc							<0.005					
0.3	Iron							<0.01					
0.45	TN							2.8					
	TKN							<0.2					
0.02	TP							0.06					
	Chloride							51					
	Sulphate							27					
	Reactive Silica							37					
0.01	FRP							0.01					
0.9	Ammonia-N							0.02					
	Nitrate-N							2.7					
0.2	NOx-N							2.7					
	Nitrite-N							<0.01					
	Ferrous Iron							<0.05					
	Alkalinity (mgCaCo3/L)							190					
	Bicarbonate (mgCaCo3/L)							190					
	Carbonate (mgCaCo3/L)							<5					

	Bore	SGW03											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	S. Turbid	S. Turbid	Turbid	S. Turbid	Clear	Clear	S. Turbid	Clear	Clear	Clear	Clear	Clear
	Colour	L. Brown	L. Brown	L. Brown	L. Brown	Clear	Clear	L. Brown	Clear	Clear	Clear	Brownish	Clear
	Temp (°C)	21.3	21.7	21.2	22.2	21.1	21.2	20.6	21.5	21.2	21.7	21.9	21.8
6.5-8	pH	5.95	6.17	5.9	5.85	6.01	6.05	6.34	6	5.62	5.29	5.29	5.7
	EC (µS/cm)	1305	1334	1368	1400	1487	1539	1577	1344	1339	1382	1408	1488
	TDS (mg/l)	910	923	962	962	968.5	1001	1027	936	942.5	962	975	1033.9
	Redox (mV)	-124.9	-66.3	26.9	18.2	38.4	38.8	109.7	145.1	31.8	18	58.3	-27.8
	DO (%)	39.7	47.6	14.9	32.7	28.2	23.7	40.2	85.2	31.1	33.3	26.4	18.7
	Calcium				12				10				
	Magnesium				45				56				
	Sodium				190				220				
	Potassium				2.2				3.1				
0.055	Aluminium				<0.01				<0.01				
0.024	Arsenic				<0.001				<0.001				
0.002	Cadmium				<0.0001				<0.0001				
	Chromium				<0.001				<0.001				
0.0034	Lead				<0.001				<0.001				
1.9	Manganese				0.46				0.7				
0.06	Mercury				<0.0001				<0.0001				
0.0055	Selenium				<0.001				0.001				
0.008	Zinc				0.008				0.056				
0.3	Iron				0.05				<0.01				
0.45	TN				1.3				1				
	TKN				0.9				0.9				
0.02	TP				0.47				0.17				
	Chloride				380				400				
	Sulphate				34				34				
	Reactive Silica				23				22				
0.01	FRP				0.03				<0.01				
0.9	Ammonia-N				0.12				0.013				
	Nitrate-N				0.33				0.06				
0.2	NOx-N				0.36				0.06				
	Nitrite-N				0.03				<0.01				
	Ferrous Iron				0.05				<0.05				
	Alkalinity (mgCaCo3/L)				130				110				
	Bicarbonate (mgCaCo3/L)				130				110				
	Carbonate (mgCaCo3/L)				<5				<5				

	Bore	SGW04											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	Colour												
	Temp (°C)												
6.5-8	pH												
	EC (µS/cm)												
	TDS (mg/l)												
	Redox (mV)												
	DO (%)												
	Calcium												
	Magnesium												
	Sodium												
	Potassium												
0.055	Aluminium												
0.024	Arsenic												
0.002	Cadmium												
	Chromium												
0.0034	Lead												
1.9	Manganese												
0.06	Mercury												
0.0055	Selenium												
0.008	Zinc												
0.3	Iron												
0.45	TN												
	TKN												
0.02	TP												
	Chloride												
	Sulphate												
	Reactive Silica												
0.01	FRP												
0.9	Ammonia-N												
	Nitrate-N												
0.2	NOx-N												
	Nitrite-N												
	Ferrous Iron												
	Alkalinity (mgCaCo3/L)												
	Bicarbonate (mgCaCo3/L)												
	Carbonate (mgCaCo3/L)												

	Bore	SGW05											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	Colour												
	Temp (°C)												
6.5-8	pH												
	EC (µS/cm)												
	TDS (mg/l)												
	Redox (mV)												
	DO (%)												
	Calcium												
	Magnesium												
	Sodium												
	Potassium												
0.055	Aluminium												
0.024	Arsenic												
0.002	Cadmium												
	Chromium												
0.0034	Lead												
1.9	Manganese												
0.06	Mercury												
0.0055	Selenium												
0.008	Zinc												
0.3	Iron												
0.45	TN												
	TKN												
0.02	TP												
	Chloride												
	Sulphate												
	Reactive Silica												
0.01	FRP												
0.9	Ammonia-N												
	Nitrate-N												
0.2	NOx-N												
	Nitrite-N												
	Ferrous Iron												
	Alkalinity (mgCaCo3/L)												
	Bicarbonate (mgCaCo3/L)												
	Carbonate (mgCaCo3/L)												



	Bore	SGW06											
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21
	Appearance	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
	Colour												
	Temp (°C)												
6.5-8	pH												
	EC (µS/cm)												
	TDS (mg/l)												
	Redox (mV)												
	DO (%)												
	Calcium												
	Magnesium												
	Sodium												
	Potassium												
0.055	Aluminium												
0.024	Arsenic												
0.002	Cadmium												
	Chromium												
0.0034	Lead												
1.9	Manganese												
0.06	Mercury												
0.0055	Selenium												
0.008	Zinc												
0.3	Iron												
0.45	TN												
	TKN												
0.02	TP												
	Chloride												
	Sulphate												
	Reactive Silica												
0.01	FRP												
0.9	Ammonia-N												
	Nitrate-N												
0.2	NOx-N												
	Nitrite-N												
	Ferrous Iron												
	Alkalinity (mgCaCo3/L)												
	Bicarbonate (mgCaCo3/L)												
	Carbonate (mgCaCo3/L)												

	Bore	SGW07												Z1		Z2	
ANZECC Guidelines	Date	18-Mar-20	8-Apr-20	13-May-20	9-Jun-20	15-Jul-20	12-Aug-20	9-Sep-20	12-Oct-20	10-Nov-20	10-Dec-20	8-Jan-21	22-Feb-21	9-Jun-20	9-Sep-20	9-Jun-20	9-Sep-20
	Appearance	Turbid	Turbid	Turbid	S. Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	Turbid	Blank of SGW01	Blank of SGW01	Blank (June)	Blank (Sept)
	Colour	Brown	Brown	Yellow	Brown	Brown	Brown	Brown	L. Brown	Brown	Brown	Brown	Brown				
	Temp (°C)	21.4	21.6	21.3	24	21	21	21	21.5	21.2	21.5	26.6	21.5				
6.5-8	pH	5.75	5.82	5.78	7.4	6.06	6.01	6.43	6.17	6.08	5.84	6.08	6.39				
	EC (µS/cm)	93.8	333.2	765	79.6	43.5	79.7	179.2	361.1	159.1	438.5	887	1142				
	TDS (mg/l)	65.65	364	533	53.3	28.6	52	116.35	251.55	111.8	305.5	617.5	793				
	Redox (mV)	-74.5	-140.1	-23.2	-68	59	-37.5	72.6	-78	-56.8	-98.8	-55.8	-88				
	DO (%)	53.6	12.3	16.8	25.4	65.8	78.9	34.4	46	21	9	12.1	20.9				
	Calcium	(note - SGW07 is at GL without a cap. Would receive rainfall runoff from some areas in June.			3.6				7.5				0.6	0.5	<0.1	<0.1	
	Magnesium				2				18				1.4	1.2	<0.1	<0.1	
	Sodium				8				130				47	56	<0.1	<0.1	
	Potassium				6.5				8.9				0.4	0.4	<0.1	<0.1	
0.055	Aluminium				0.03				<0.01				3.2	0.05	<0.01	<0.01	
0.024	Arsenic				<0.001				<0.001				<0.001	<0.001	<0.001	<0.001	
0.002	Cadmium				<0.0001				<0.0001				<0.0001	<0.0001	<0.0001	<0.0001	
	Chromium				<0.001				<0.001				0.001	<0.001	<0.001	<0.001	
0.0034	Lead				<0.001				<0.001				<0.001	<0.001	<0.001	<0.001	
1.9	Manganese				0.01				0.15				<0.01	0.01	<0.01	<0.01	
0.06	Mercury				<0.0001				<0.0001				<0.0001	<0.0001	<0.0001	<0.0001	
0.0055	Selenium				<0.001				<0.001				<0.001	<0.001	<0.001	<0.001	
0.008	Zinc				<0.005				<0.005				<0.005	<0.005	<0.005	<0.005	
0.3	Iron				0.47				9.7				0.87	<0.01	<0.01	<0.01	
0.45	TN				8.3				3.2				0.3	0.2	<0.2	<0.2	
	TKN				8.3				3.1				0.2	<0.2	<0.2	<0.2	
0.02	TP				0.65				0.38				0.65	0.06	<0.01	<0.01	
	Chloride				25				230				46	63	<5	<5	
	Sulphate				3				31				21	21	<1	<1	
	Reactive Silica				2.4				33				54	48	<0.1	<0.1	
0.01	FRP				0.19				<0.01				0.05	<0.01	<0.01	<0.01	
0.9	Ammonia-N				1.2				2.1				<0.02	<0.02	<0.02	<0.02	
	Nitrate-N				0.03				0.1				0.1	0.18	<0.01	<0.01	
0.2	NOx-N				0.04				0.12				0.12	0.18	<0.01	<0.01	
	Nitrite-N				0.01				0.02				0.02	<0.01	<0.01	<0.01	
	Ferrous Iron				0.25				9.7				<0.05	<0.05	<0.05	<0.05	
	Alkalinity (mgCaCo3/L)				32				59				26	21	<5	<5	
	Bicarbonate (mgCaCo3/L)				32				59				26	21	<5	<5	
	Carbonate (mgCaCo3/L)				<5				<5				<5	<5	<5	<5	