



Gerroa Sand Resource Annual Environmental Management Report

Period 01 July 2018 – 30 June 2019

Cleary Bros (Bombo) Pty Ltd

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Title Block


Name of operation	Gerroa Sand Resource
Name of operator	Cleary Bros (Bombo) Pty Ltd
Development consent #	05/0099
Name of holder of development consent	Cleary Bros (Bombo) Pty Ltd
AEMR start date	1/7/2018
AEMR end date	30/6/2019
<p>I, Helen Cleary, certify that this audit report is a true and accurate record of the compliance status of the Gerroa Sand Resource for the period 1 July 2018 to 30 June 2019 and that I am authorised to make this statement on behalf of Cleary Bros (Bombo) Pty Ltd.</p> <p><i>Note</i></p> <p>a) <i>The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000.</i></p> <p>b) <i>The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or \$22,000, or both).</i></p>	
Name of authorised reporting officer	Helen Cleary
Title of authorised reporting officer	Executive General Manager
Signature of authorised reporting officer	
Date	17/7/2019

Table of Contents

1. Introduction	4
1.1. Statement of Compliance	4
1.2. Background	4
1.3. Objectives of the Annual Environmental Management Report	4
2. Site Description and Activities	6
2.1. Site Identification	6
3. Key Licence Issues	7
3.1. Environmental Protection Licence Annual Reports	7
3.2. Development Consent	9
3.3. Standards and Performance Measures that apply	9
3.4. Works Carried Out in Reporting Period	9
3.5. Works to be Carried Out in the Next Period	9
4. Review of Environmental Performance	11
4.1. Meteorological Monitoring	11
4.2. Groundwater Management	11
4.3. Surface Water Management	29
4.4. Air Quality	35
4.5. Noise Monitoring	36
4.6. Community	36
4.7. Rehabilitation & Vegetation Management	37
4.8. Acid Sulphate Monitoring	38
4.9. General Environmental Management & Reporting	39
4.10. Traffic Management	40
4.11. Independent Environmental Audit	40
5. Conclusion	42

Annexures

Annexure A	Department of Trade and Investment, Resources and Energy Return 2017/2018
Annexure B	Environmental Monitoring Locations
Annexure C	Environmental Monitoring Results
Annexure D	11 th Annual Report – Flora and Fauna Monitoring Survey

Abbreviations

AEMR	Annual Environmental Management Report
CB	Cleary Bros (Bombo) Pty Ltd
DC	Development Consent (PA 05/0099)
EPA	Environmental Protection Authority
DP	Deposited Plan
DP&E	Department of Planning and Environment
EPL	Environmental Protection Licence
LEC	Land & Environment Court
MW	Monitoring Well
QEMP	Quarry Environmental Management Plan

Internal Document Control

Version	Description	Prepared By	Approved By	Prepared Date
1	Initial Draft	M Hammond		16/7/2019
2	Final	M Hammond	H Cleary	17/7/2019

1. Introduction

1.1. Statement of Compliance

Were all conditions of the relevant approvals complied with?	
Development consent #05/0099	Yes
Environmental Protection Licence #4146	Yes

1.2. Background

Sand has been extracted from Cleary Bros (CB) sand quarry at Gerroa for approximately 60 years. The works have been authorised by a succession of development approvals.

On 2 September 2008 the Land and Environment Court granted the current project approval to Cleary Bros (Bombo) Pty Ltd for "Extension and Continuation of Gerroa Sand Quarry". Sand extraction by dredging on the property is licensed by the Environment Protection Authority (EPA).

CB currently operates in accordance with the site's Quarry Environmental Management Plan (QEMP) in accordance with the requirements of the sites EPL and Development Consent (DC), which was most recently approved by the Department of Planning and Environment (DP&E) on 1 February 2017. The location of the property is shown on Figure 1.

1.3. Objectives of the Annual Environmental Management Report

Condition 4 of Schedule 5 in Land and Environment Court Consent number 10801 of 2007 requires CB to submit an Annual Environmental Management Report (AEMR). The condition requires the AEMR to:

- Identify the standards and performance measures that apply to the project.
- Describe the works carried out in the last 12 months.
- Describe the works that will be carried out in the next 12 months.
- Include a summary of the complaints received during the past year, and compare this to the complaints received in previous years.
- Include a summary of the monitoring results for the project during the past year.
 - Include an analysis of these monitoring results against the relevant:
 - Impact assessment criteria/limits.
 - Monitoring results from previous years.
 - Predictions in the Environmental Assessment (EA).
- Include an evaluation of the effectiveness of the environmental protection requirements and procedures in the AEMR.
- Identify any trends in the monitoring results over the life of the project.
- Identify any non-compliance during the previous year.
- Describe what actions were, or are being taken to ensure compliance.



Figure 1 - Locality Plan

2. Site Description and Activities

2.1. Site Identification

The site comprises all of Lot A DP 185785 and part of Lot 2 DP 1111012. The property is owned by Bridon Pty Ltd, a member of the Cleary Bros group of companies.

The site lies across a local government boundary with approximately two thirds being contained within Kiama Municipal Councils area of governance and approximately one third lying within Shoalhaven City Councils area of governance. The operational area is contained within a small portion of the site in an area totalling approximately 27.5 hectares. The operational area fronts Crooked River Road and Berry Beach Road. The remainder of the property is used for agricultural activities.

The quarrying process involves dredging the sand mixed with water by suction based on a barge and piped back to the wet sorter located on the western edge of the dredge pond. In the wet sorter the gravel and larger materials such as shells are removed from the sand before the sand is sent to the cyclone which removes any remaining silt. From here the sand is deposited into stockpile and the removed silt and excess water are returned to the dredge pond. When the sand stockpile is of sufficient size, it is re-stockpiled away from the wet sorter and cyclone systems to dry. The sand is eventually transferred to the processing area away from the dredging area for storage and sale to the Cleary Bros concrete plants and to the public.

3. Key Licence Issues

3.1. Environmental Protection Licence Annual Reports

The Environment Protection Authority (EPA) has issued an Environmental Protection Licence (Licence No. 4146) for the dredging works on site, which was most recently updated on 9 December 2011.

The licence, issued under s55 of the Protection of the Environment Operations Act 1997, requires an annual return to be submitted to the EPA, for the reporting period of 2nd February to 31st January.

The EPA Annual Returns for 2005 to 2018 reporting periods were reviewed to provide a background to this report. These Annual Returns can be summarised as follows:-

01 February 2005 to 31 January 2006

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2006 to 31 January 2007

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2007 to 31 January 2008

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil

01 February 2008 to 31 January 2009

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2009 to 31 January 2010

- B1. Pollution complaints - Nil.¹
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2010 to 31 January 2011

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

¹ One other complaint was reported to CB from DoP as a letter dated 2 December 2009 relating to the extent of clearing. This was investigated and found not to be factual (refer CB letter to DoP dated 15 December 2009).

01 February 2011 to 31 January 2012

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2012 to 31 January 2013

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2013 to 31 January 2014

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2014 to 31 January 2015

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2015 to 31 January 2016

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.
- C2. Details of non-compliance – Nil.

01 February 2016 to 31 January 2017

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.

01 February 2017 to 31 January 2018

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.

01 February 2018 to 31 January 2019

- B1. Pollution complaints - Nil.
- B2. Concentration monitoring summary – None required.
- B3. Volume or mass monitoring summary - None required.
- C1. Compliance with licence condition – All conditions complied with.

3.2. Development Consent

The Development Consent (DC) was approved by the Land and Environment Court (LEC) on 02 September 2008 and is the primary consent relevant to sand quarrying operations.

As a requirement of the DC the first AEMR must be completed within 12 months of the aforementioned approval date (which has been complied with) and subsequent AEMRs must be completed annually thereafter.

3.3. Standards and Performance Measures that apply

The Development Consent (DC) was approved by the Land and Environment Court (LEC) on 02 September 2008 and is the primary consent relevant to sand quarrying operations. The Environmental Assessment dated October 2006 outlines the predicted impacts of the most recent extension of the operation. The Gerroa Sand Resource is also licenced by the Environmental Protection Authority under Environmental Protection License 4146. These documents contain the standards and performance measures for the Gerroa Sand Resource, which are identified separately in Section 4.

3.4. Works Carried Out in Reporting Period

The total sand transported from site during the 2018/2019 reporting year was 55,784 tonnes. In the current reporting period, sand was extracted from previously dredged parts, with the current dredge able to extract to a greater depth than the previously used dredge. The previous year's return (2017/2018) to the Department of Trade and Investment, Resources and Energy is included as Annexure A for 49,128 tonnes. The return for the 2018/2019 is due in November 2019 to the Department of Trade and Investment, Resources and Energy and will be included in next year's AEMR.

Other works undertaken during the 2018/2019 reporting period included the reconfiguration of product stockpile areas, to allow for the full extraction of the approved sand resource.

3.5. Works to be Carried Out in the Next Period

The dredge will continue into the eastern extents of the stockpile areas, which have been identified in the geotechnical report contained in the Gerroa Sand Resource Environmental Impact Statement. As such the dredge will be operating in the area described in Figure 2.

Other works that may be undertaken during the 2019/2020 reporting period include the early works associated with the modification of the current consent. Any works for this purpose are dependent on passage of the modification, which is currently being assessed by the DP&E.

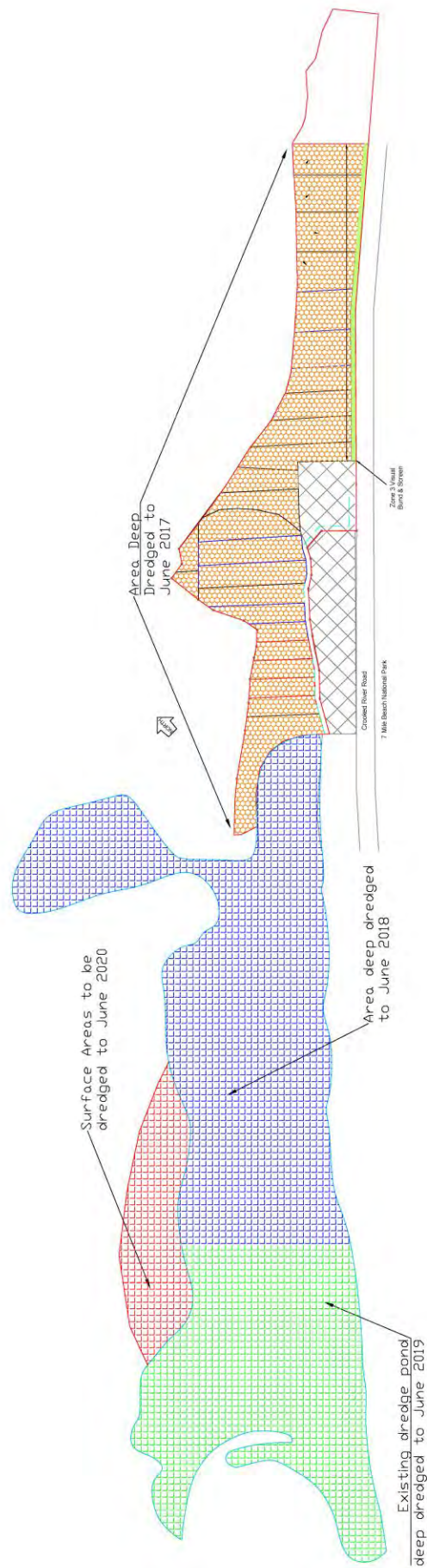


Figure 2 – Description of works

4. Review of Environmental Performance

4.1. Meteorological Monitoring

4.1.1. Licence Requirements

The DC requires Cleary Bros to maintain a meteorological station on site.

4.1.2. Compliance Assessment

A meteorological station is maintained onsite that provides information on rainfall, air temperature, solar radiation and wind speed via mobile telemetry to an online portal. The current weather station was installed in September 2016.

4.1.3. Meteorological Monitoring

The current reporting period has been defined by sustained below average rainfall. The below graph shows that the site received approximately 70% of the average rainfall for the year, with 844mm falling for the 12 month period. This is following an even drier 12-month prior period, such that over the last 3 years since the installation of the current weather station, a 1300mm rainfall has been experienced. Furthermore, only 8 of 34 months have recorded rainfall totals at or above the monthly average. This extended rainfall deficit has led to a reduction in water levels recorded in the dredge pond and groundwater monitoring bores around the site, which will be addressed in the following sections.

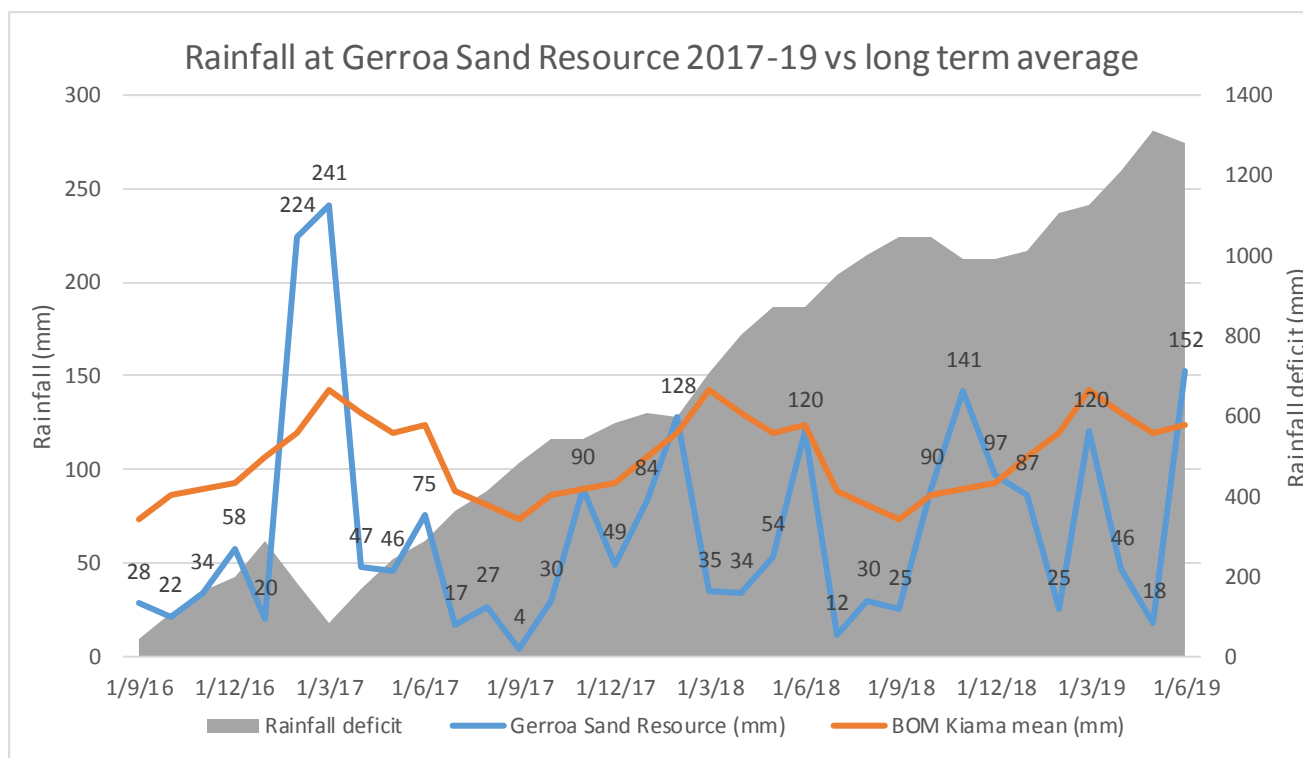


Figure 3 – Rainfall measured on site FY17-19 against long term average

4.2. Groundwater Management

4.2.1. Standards and Performance Measures

There are no specific criteria for groundwater quality in the sites EPL.

The groundwater monitoring requirements from the DC are realised by the sites QEMP. Section 8.6 of the QEMP details the groundwater testing requirements and specifies that 13 boreholes on site require monthly water level readings and quarterly analyte testing. The tabulated results of groundwater monitoring are included in Annex B. The EA predicted that the project is not expected to result in variation in the range of groundwater levels previously experienced in the monitoring bores on the site. Furthermore, the EA identified that existing low pH levels in groundwater bores to be relatively benign, signifying natural impacts from naturally occurring pyrites and organic acids, with sand extraction not predicted to lead to any deterioration of the groundwater quality.

The groundwater quality objectives which CB should “aim to meet” from the DC (and adopted in the QEMP) are as follows:-

Analyte	Units	Objective
pH	pH	6.0 – 8.5
Electrical Conductivity	µS/cm	<1,500
Total Phosphorus	µg/L	<30
Total Nitrogen	µg/L	<350
Chlorophyll-A	µg/L	<5
Faecal Coliforms	Median No./100 mL	<1,000
Enterococci	Median No./100 mL	<230
Sodium	mg/L	<400
Potassium Ion	mg/L	<50
Magnesium Ion	mg/L	<50
Chloride Ion	mg/L	<300
Sulphate Ion	mg/L	<250
Bicarbonate Ion	mg/L	<750
Soluble Iron Ion	mg/L	<6
Ammonium Ion	mg/L	<20

However, the target for groundwater dependant ecosystems extracted from the QEMP is that no discernible deterioration of ecosystems or vegetation, attributable to measured changes in groundwater levels or quality.

4.2.2. Environmental Performance

CB has implemented the Groundwater Monitoring Program and Acid Sulphate Soils Management Plan to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to conduct quarterly sampling and testing of the groundwater monitoring sites, as well as monthly testing of the groundwater depths and the leachate from sand extracted by the dredging operation for Total Oxidisable Sulphur.

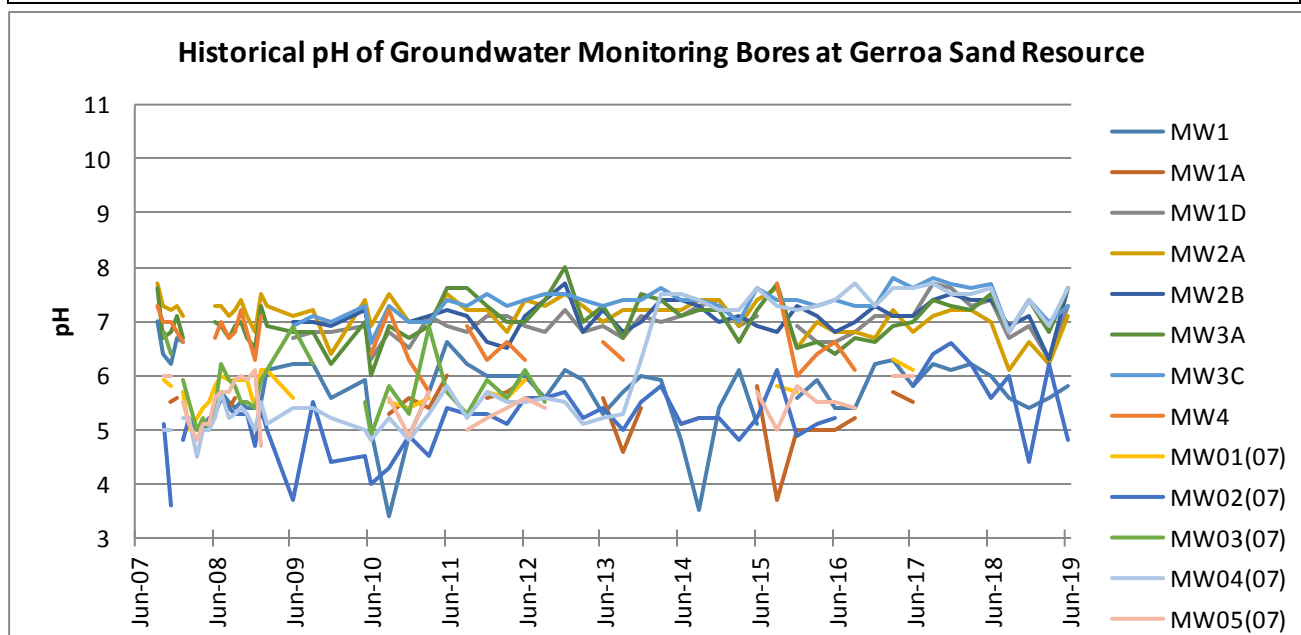
4.2.3. Groundwater Monitoring

A summary of groundwater monitoring results for the period is displayed in this section, separated into the different analytes required to be monitored as per the DC. For each analyte, the range and average of the current period's monitoring are displayed, alongside the historical range and average, objectives as described in the Development Consent, and any EA predictions. Where groundwater monitoring results trend outside of the historical range or DC objectives, these are highlighted in the summary with discussion into these results below. For each analyte, a historical graph is also included showing the variations in measurements for each groundwater bore throughout the historical monitoring period.

pH (pH units)

BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	5.4	5.6	5.8	3.4	5.8	7.0	6.0 - 8.5	N/A
MW1A	5.6	5.6	5.6	3.7	5.4	6.3	6.0 - 8.5	N/A
MW1D	6.3	6.8	7.3	6.3	7.0	7.7	6.0 - 8.5	N/A
MW2A	6.1	6.5	7.1	6.4	7.1	7.7	6.0 - 8.5	N/A
MW2B	6.3	7.0	7.6	6.5	7.1	7.7	6.0 - 8.5	N/A
MW3A	6.8	7.2	7.6	6.0	7.0	8.0	6.0 - 8.5	N/A
MW3C	6.8	7.1	7.4	6.6	7.4	7.8	6.0 - 8.5	N/A
MW4	Dry/insufficient water for sample			5.6	6.6	7.7	6.0 - 8.5	N/A
MW01(07)	Dry/insufficient water for sample			5.0	5.7	6.3	6.0 - 8.5	N/A
MW02(07)	4.4	5.4	6.2	3.6	5.2	6.6	6.0 - 8.5	N/A
MW03(07)	Dry/insufficient water for sample			4.9	5.8	6.9	6.0 - 8.5	N/A

BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW04(07)	6.8	7.2	7.6	4.5	6.0	7.7	6.0 - 8.5	N/A
MW05(07)	Dry/insufficient water for sample			4.7	5.5	6.1	6.0 - 8.5	N/A

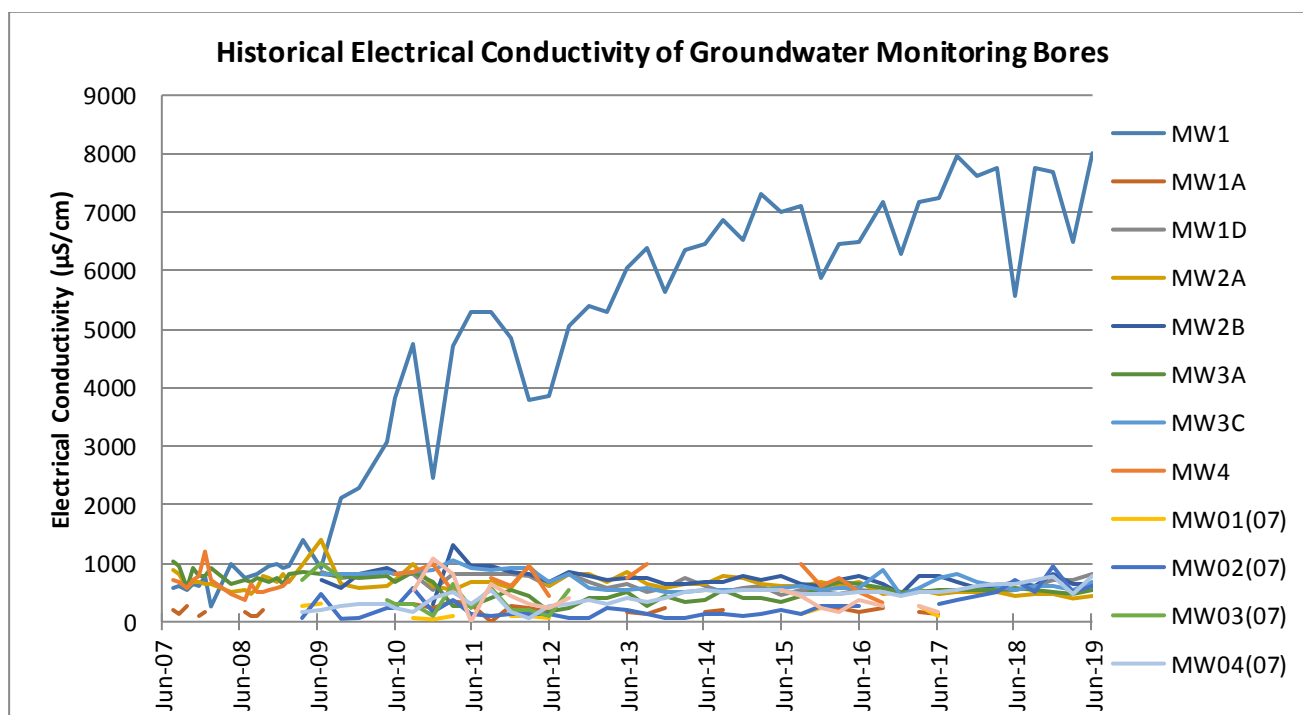


The pH values over the past 12 months have exhibited variability similar to that observed across the historical record. Most groundwater bores recorded pH levels in line with historical averages, with only MW2A and MW2B recording values marginally below the historical range but still within the groundwater quality objectives, which is likely to reflect natural small-scale fluctuations in groundwater quality. The extended rainfall deficit has meant that four of the bores were unable to be sampled during the reporting period, while one bore could only be sampled on one occasion. All other bores were sampled at each quarterly interval.

Bores MW1, MW02(07) have continued to exhibit mildly acidic groundwater in line with historical results. Dredging has now progressed through the area of the new (2007) monitoring bores, with pH relatively unchanged as a consequence of dredging. The mildly acidic groundwater in certain bores appears to be a result of natural conditions, rather than as a result of dredging operations.

Electrical Conductivity ($\mu\text{S}/\text{cm}$)

BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	6490	7490	8010	260	4030	7950	< 1500	N/A
MW1A	244	244	244	90	195	350	< 1500	N/A
MW1D	626	717	813	457	636	850	< 1500	N/A
MW2A	397	442	467	460	670	1400	< 1500	N/A
MW2B	615	681	808	300	733	1310	< 1500	N/A
MW3A	467	520	553	176	592	1030	< 1500	N/A
MW3C	530	598	663	453	696	1050	< 1500	N/A
MW4	Dry/insufficient water for sample			327	688	1200	< 1500	N/A
MW01(07)	Dry/insufficient water for sample			40	142	310	< 1500	N/A
MW02(07)	493	647	948	50	218	730	< 1500	N/A
MW03(07)	Dry/insufficient water for sample			100	419	1000	< 1500	N/A
MW04(07)	483	690	775	60	408	647	< 1500	N/A
MW05(07)	Dry/insufficient water for sample			158	438	1080	< 1500	N/A

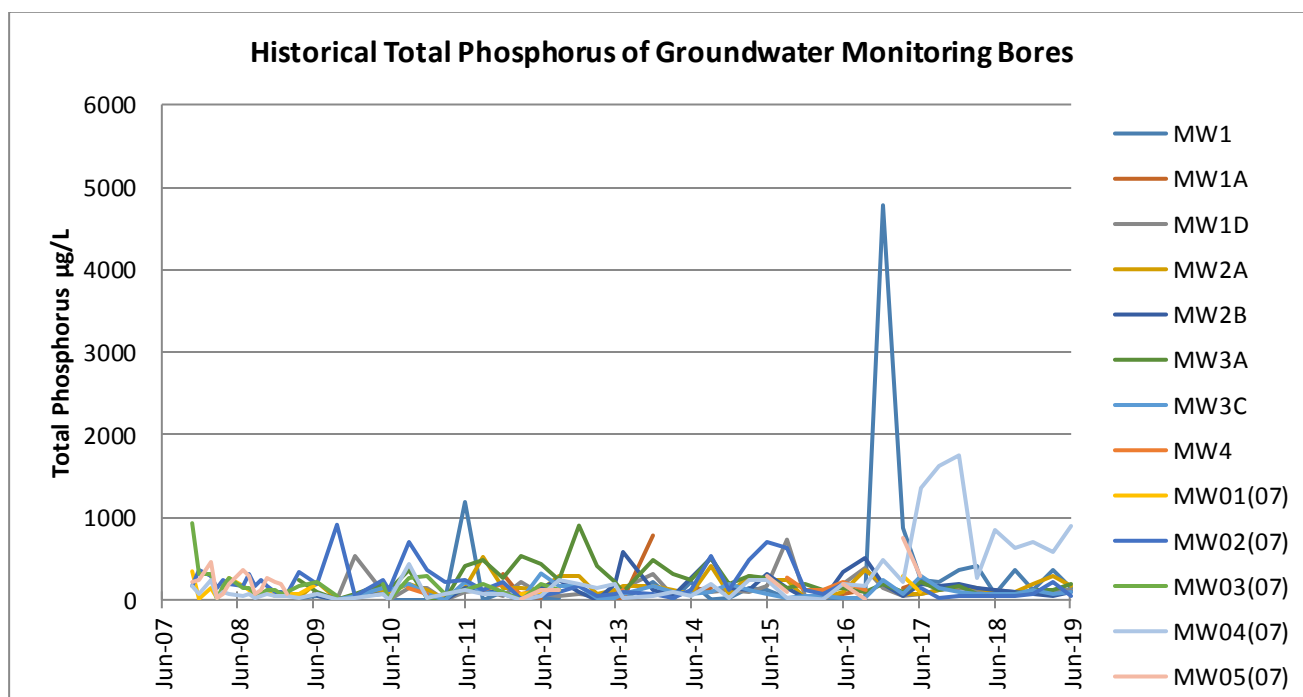


The results over the 12 month period show that the Electrical Conductivity (EC) of the groundwater in the boreholes is generally consistent with the historical values, with the exception of MW1. The EC of all other bores were within the DC objectives. The brackish groundwater in MW1 has not been observed at any other bore or within the dredge pond, indicating a localised saline influence. A review of historical data for this bore back to 1993 has identified large fluctuations consistent with that observed over the past ten years. For example, EC of 6470 $\mu\text{S}/\text{cm}$ was observed in this bore in April 1998, with fluctuations of up to 5000 $\mu\text{S}/\text{cm}$ observed within a one month period. CB will continue to monitor the EC in this bore as part of the groundwater monitoring programme to track any changes in EC within the local groundwater.

During the reporting year, a consistent increase in EC was observed in certain bores across the monitoring network, with both MW02(07) and MW04(07) recording EC values above the historical range. This can be explained by the ongoing rainfall deficit previously described, and mirrors the response of the dredge pond to this rainfall deficit. All measurements were within the DC objectives (with the exception of MW1), and do not reflect a deterioration in water quality, but rather the natural variability seen within the shallow groundwater system associated with an extended rainfall deficit.

Total Phosphorus ($\mu\text{g}/\text{L}$)

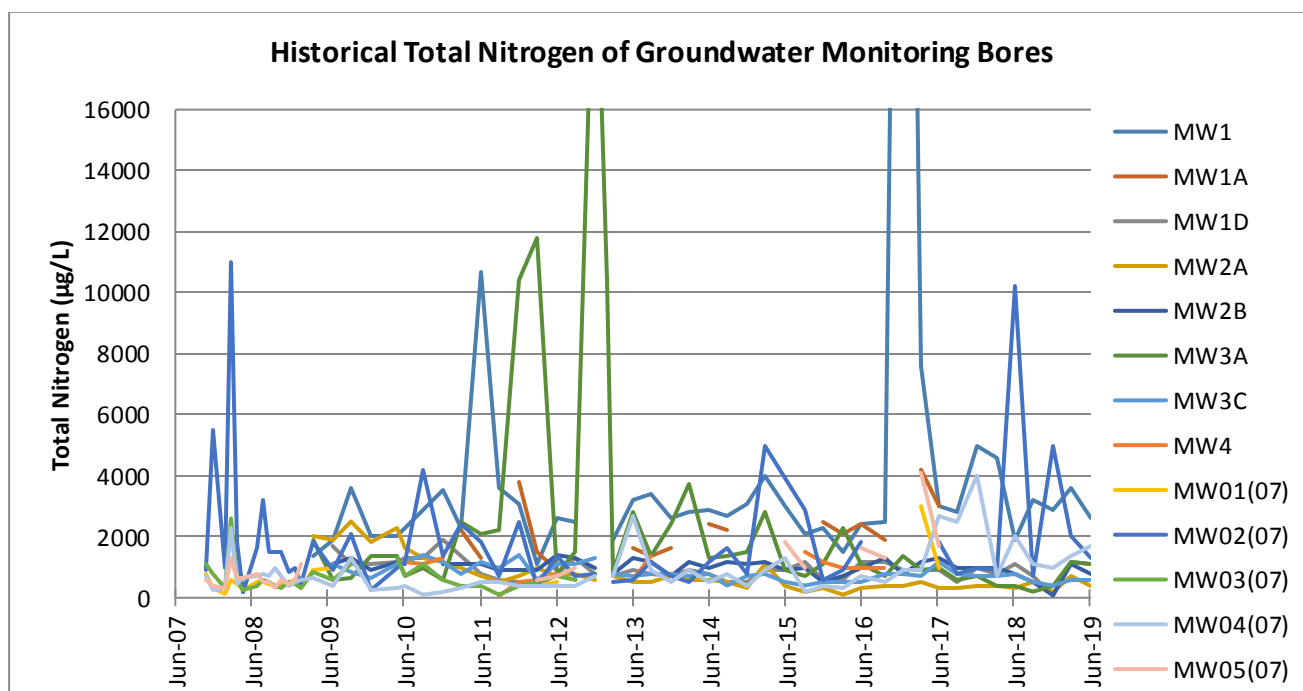
BORE HOLE	2018-19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	130	253	370	<10	257	4780	< 30	N/A
MW1A	210	210	210	<10	166	780	< 30	N/A
MW1D	70	98	120	<10	137	730	< 30	N/A
MW2A	90	188	290	10	152	520	< 30	N/A
MW2B	40	80	100	<10	152	580	< 30	N/A
MW3A	80	130	200	<10	237	900	< 30	N/A
MW3C	80	90	110	<10	100	320	< 30	N/A
MW4	Dry/insufficient water for sample			70	215	1290	< 30	N/A
MW01(07)	Dry/insufficient water for sample			12	117	346	< 30	N/A
MW02(07)	40	95	220	10	209	910	< 30	N/A
MW03(07)	Dry/insufficient water for sample			8	172	929	< 30	N/A
MW04(07)	570	695	890	<10	206	1750	< 30	N/A
MW05(07)	Dry/insufficient water for sample			10	184	750	< 30	N/A



Concentrations of total phosphorus in the boreholes were generally above the groundwater quality objective, however they were all within the historical range for their respective bores. During the reporting period, the concentration of total phosphorus in the dredge pond was generally less than that measured in all bores, suggesting the extensive agricultural land uses surrounding the Gerroa Sand Resource may have contributed to the measurements of total phosphorus in all bores.

Total Nitrogen (µg/L)

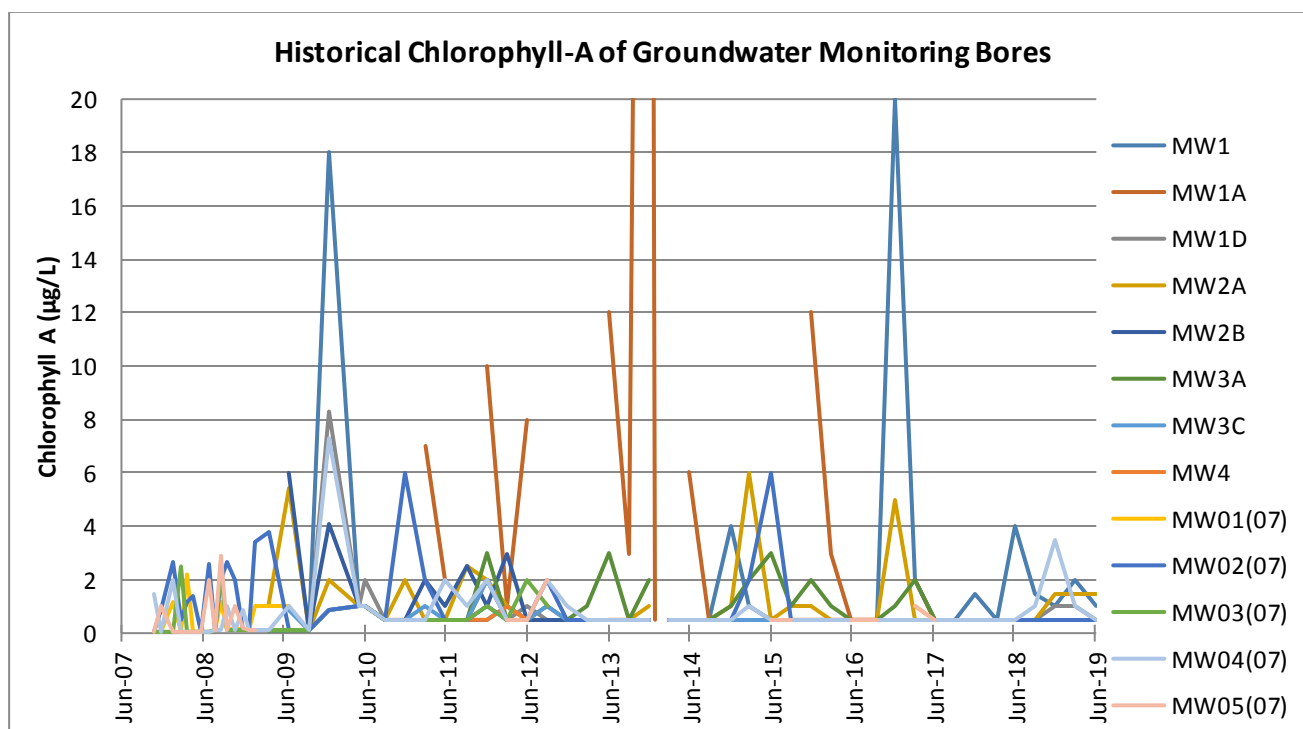
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	2600	3075	3600	1100	4376	51100	< 350	N/A
MW1A	7600	7600	7600	900	2189	4200	< 350	N/A
MW1D	70	768	1200	400	938	1900	< 350	N/A
MW2A	200	450	700	300	800	2500	< 350	N/A
MW2B	80	620	1100	700	1042	1400	< 350	N/A
MW3A	200	725	1200	600	2653	23200	< 350	N/A
MW3C	400	525	600	400	848	1400	< 350	N/A
MW4	Dry/insufficient water for sample			60	1579	10400	< 350	N/A
MW01(07)	Dry/insufficient water for sample			130	620	3000	< 350	N/A
MW02(07)	700	2250	5000	180	1907	11000	< 350	N/A
MW03(07)	Dry/insufficient water for sample			100	645	2600	< 350	N/A
MW04(07)	1000	1300	1700	100	822	4000	< 350	N/A
MW05(07)	Dry/insufficient water for sample			330	959	4100	< 350	N/A



The concentrations of Total Nitrogen in all groundwater monitoring bores have consistently exceeded the objective levels since monitoring of groundwater quality began. In the current reporting period, nitrogen concentrations were recorded at or below the historical range in five bores, while the single result for bore MW1A was above the previous historical range. The presence of Total Nitrogen at those levels recorded in the bores are likely to be related to the presence of extensive agricultural activities in the area surrounding the Gerroa Sand Resource. This is supported by an analysis of water quality within the dredge pond, which shows that nitrogen concentrations in the pond are generally consistently lower than that recorded in the groundwater monitoring bores.

Chlorophyll A (µg/L)

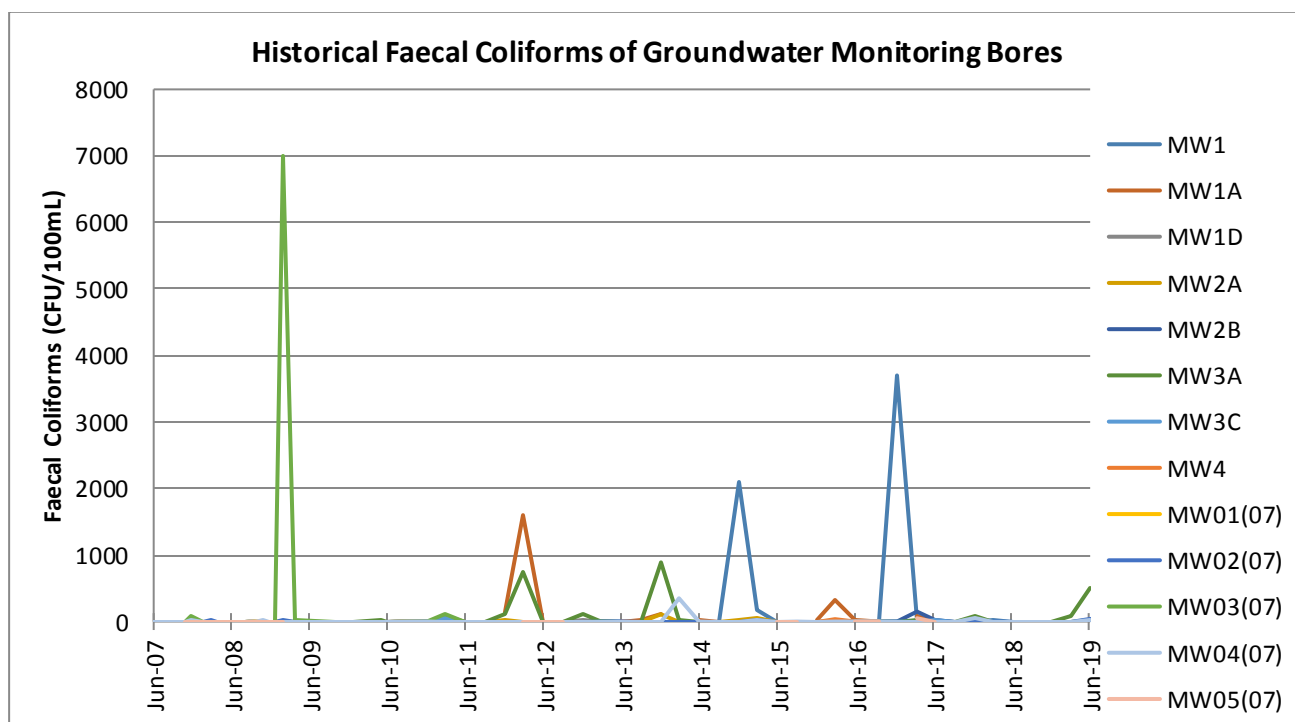
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1	1	<4	<1	2	20	< 5	N/A
MW1A	<1	<1	<1	<1	8	90	< 5	N/A
MW1D	<1	1	<2	<1	1	8	< 5	N/A
MW2A	<1	1	<3	<1	1	6	< 5	N/A
MW2B	<1	<1	<1	<1	1	6	< 5	N/A
MW3A	<1	<1	<1	<1	1	3	< 5	N/A
MW3C	<1	<1	<1	<1	1	2	< 5	N/A
MW4	Dry/insufficient water for sample			<1	1	2	< 5	N/A
MW01(07)	Dry/insufficient water for sample			<1	1	2	< 5	N/A
MW02(07)	<1	<1	<1	<1	1	6	< 5	N/A
MW03(07)	Dry/insufficient water for sample			<1	1	3	< 5	N/A
MW04(07)	<1	2	<7	<1	1	7	< 5	N/A
MW05(07)	Dry/insufficient water for sample			<1	1	7	< 5	N/A



Chlorophyll-A can fluctuate greatly with plant materials being flushed into the system and any results away from the low levels generally observed can be attributed to tree and leaf matter after windy or rainy periods. The chlorophyll-A levels for the reporting period are below the limit of reporting for all bores in each monitoring period.

Faecal Coliforms (median number/100mL)

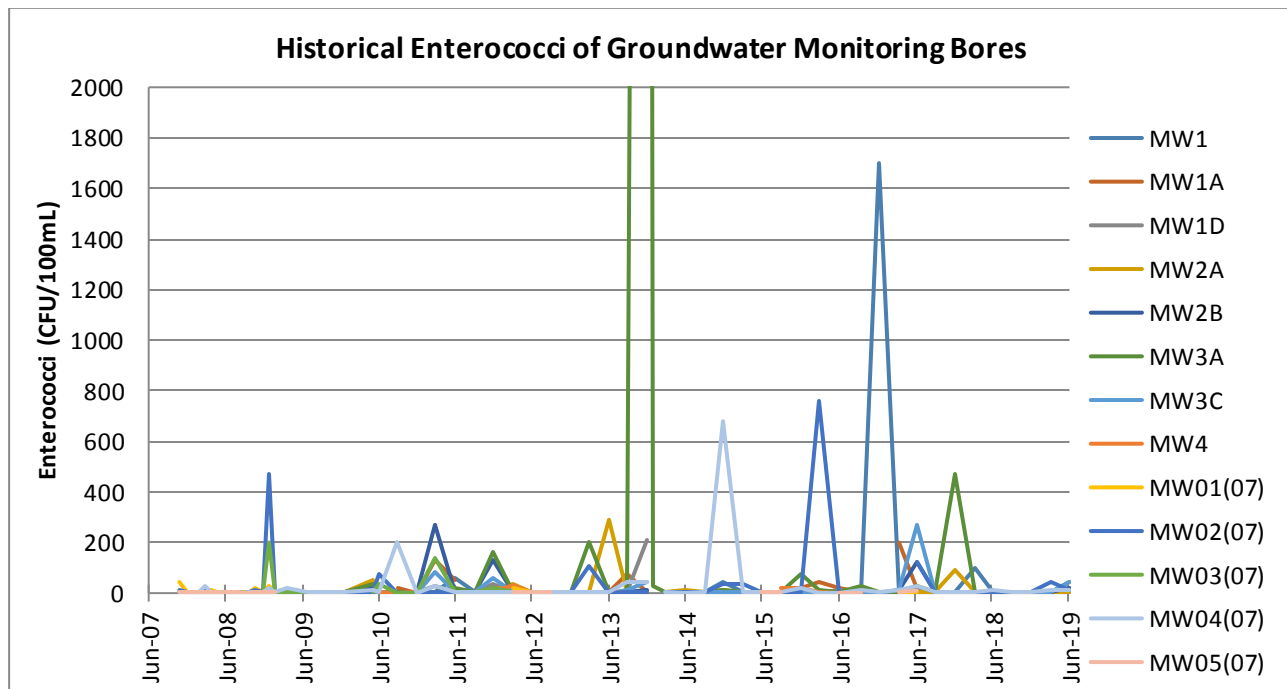
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<2	2	4	<1	162	3700	<1000	N/A
MW1A	880	880	880	<1	129	1600	<1000	N/A
MW1D	<2	3	6	<1	2	18	<1000	N/A
MW2A	<2	6	22	<1	7	110	<1000	N/A
MW2B	<2	3	8	<1	6	150	<1000	N/A
MW3A	<2	146	500	<1	55	890	<1000	N/A
MW3C	<2	6	22	<1	3	52	<1000	N/A
MW4	Dry/insufficient water for sample			<1	3	36	<1000	N/A
MW01(07)	Dry/insufficient water for sample			<1	2	10	<1000	N/A
MW02(07)	<2	11	40	<1	3	30	<1000	N/A
MW03(07)	Dry/insufficient water for sample			<1	250	7000	<1000	N/A
MW04(07)	<2	10	36	<1	10	350	<1000	N/A
MW05(07)	Dry/insufficient water for sample			<1	3	50	<1000	N/A



Faecal coliforms were within the objective levels during the reporting period for all monitoring bores. All samples with the exception of a single sample for MW02(07) were within the historical ranges for the respective bores.

Enterococci (median number/100mL)

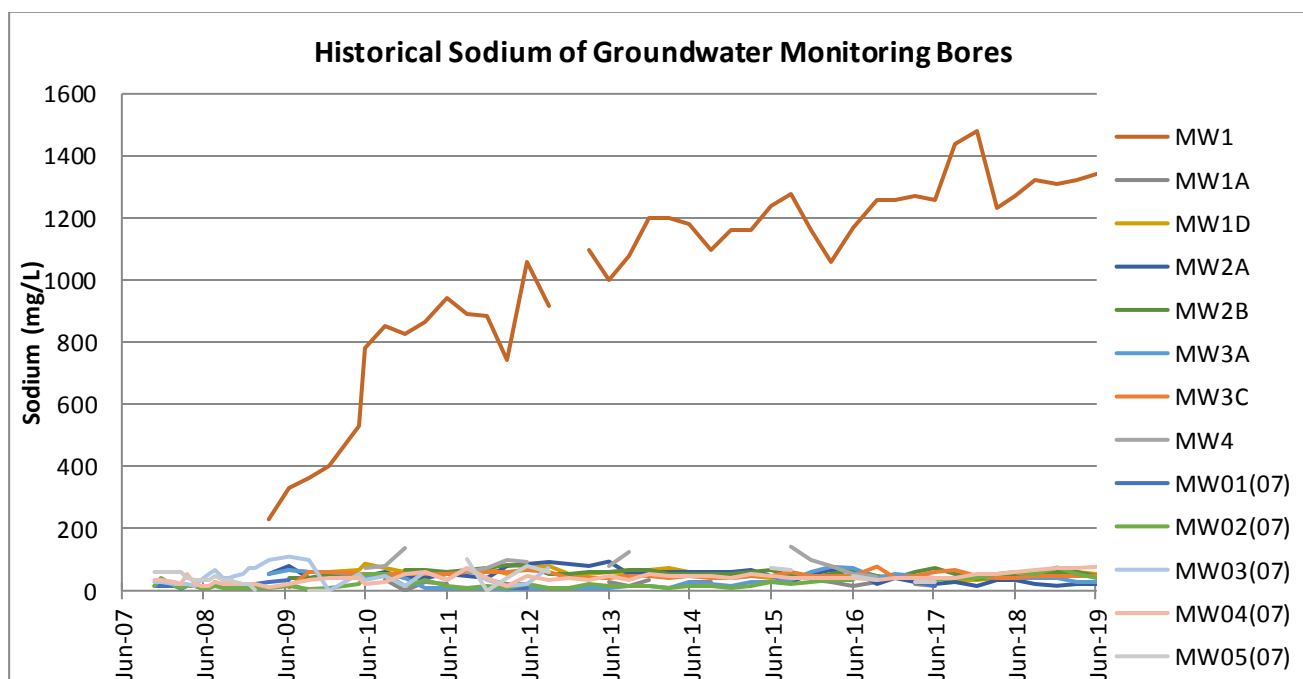
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<2	<2	1	<1	53	1700	<230	N/A
MW1A	100	100	100	<2	35	200	<230	N/A
MW1D	<2	3	8	<2	11	210	<230	N/A
MW2A	<2	2	4	<1	15	290	<230	N/A
MW2B	<2	6	20	<1	18	270	<230	N/A
MW3A	<2	11	42	<1	414	15000	<230	N/A
MW3C	<2	12	44	<1	15	270	<230	N/A
MW4	Dry/insufficient water for sample			<1	7	32	<230	N/A
MW01(07)	Dry/insufficient water for sample			<1	7	44	<230	N/A
MW02(07)	<2	15	44	<1	34	760	<230	N/A
MW03(07)	Dry/insufficient water for sample			<1	15	200	<230	N/A
MW04(07)	<2	6	10	<1	23	680	<230	N/A
MW05(07)	Dry/insufficient water for sample			<1	2	10	<230	N/A



Enterococci concentrations were within the objective levels and the historical ranges during the reporting period.

Sodium (mg/L)

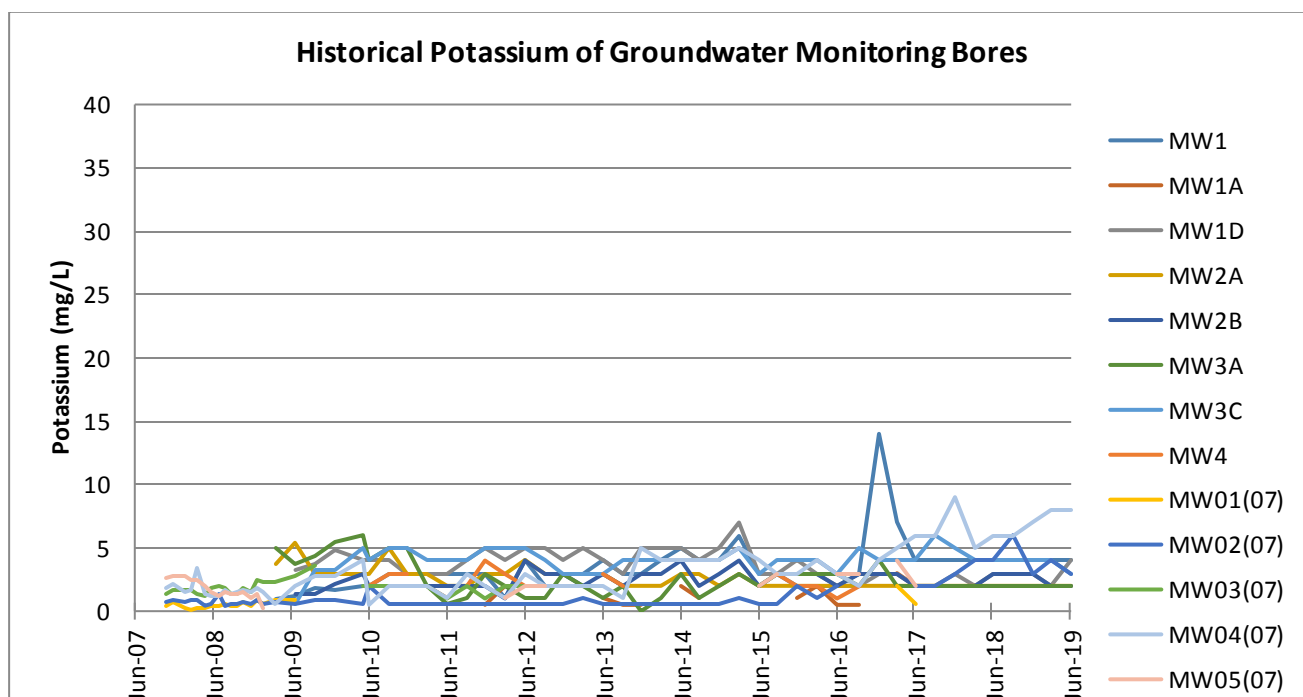
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1310	1323	1340	230	1005	1480	< 400	N/A
MW1A	27	27	27	14	26	36	< 400	N/A
MW1D	54	57	58	33	54	87	< 400	N/A
MW2A	16	20	24	18	53	94	< 400	N/A
MW2B	42	52	60	38	57	83	< 400	N/A
MW3A	28	34	40	4	34	77	< 400	N/A
MW3C	45	47	49	11	51	78	< 400	N/A
MW4	Dry/insufficient water for sample			45	92	173	< 400	N/A
MW01(07)	Dry/insufficient water for sample			6.2	16	33	< 400	N/A
MW02(07)	42	55	75	5.4	20	63	< 400	N/A
MW03(07)	Dry/insufficient water for sample			17	48	110	< 400	N/A
MW04(07)	67	74	77	11	37	75	< 400	N/A
MW05(07)	Dry/insufficient water for sample			5.5	50	154	< 400	N/A



With the exception of borehole MW1, all sodium concentrations recorded in the boreholes are within the DC objectives, and consistently at a low level. Two bores (MW02(07), MW04(07)) recorded sodium concentrations marginally above the historical ranges for the respective bores. These mirrored the EC recorded in the bores, and are likely reflective of the extended rainfall deficit experienced over the last 3 years.

Potassium Ion (mg/L)

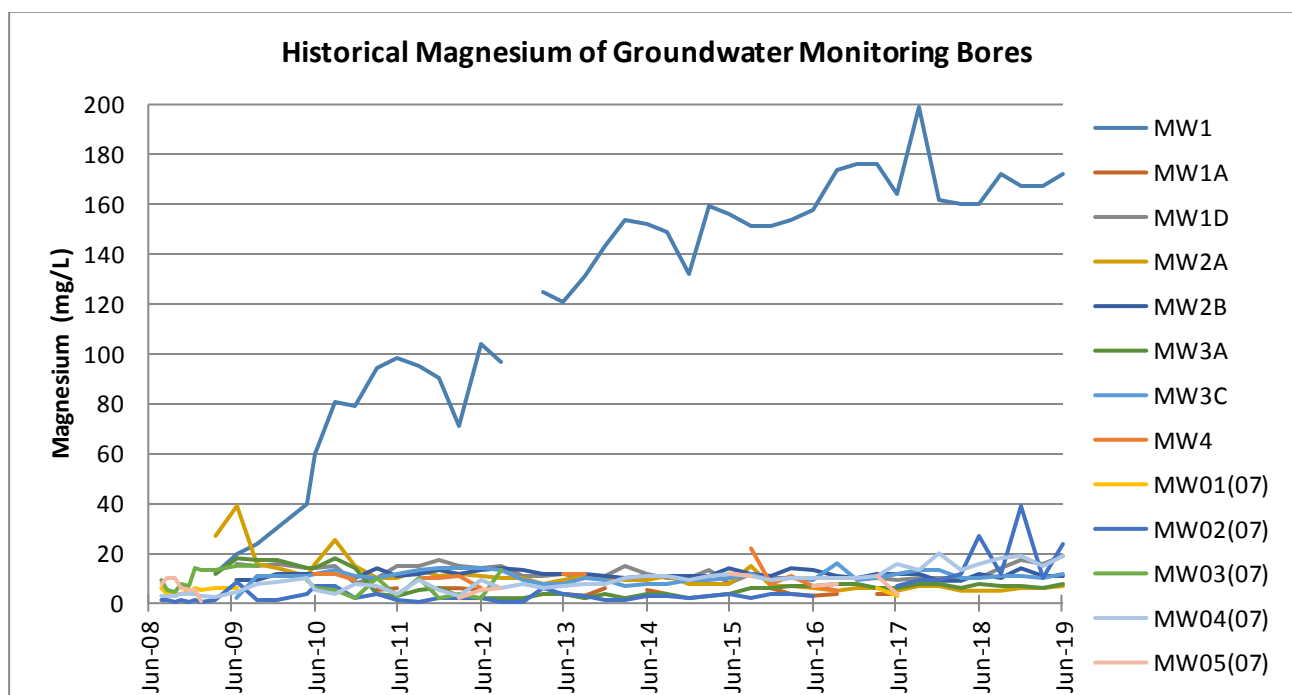
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	4	4	4	<1	3	14	< 50	N/A
MW1A	5	5	5	<1	1	3	< 50	N/A
MW1D	2	3	4	2	4	7	< 50	N/A
MW2A	2	2	2	2	3	5.4	< 50	N/A
MW2B	2	3	3	1	2	4	< 50	N/A
MW3A	2	2	2	<1	3	6	< 50	N/A
MW3C	3	4	4	<1	4	6	< 50	N/A
MW4	Dry/insufficient water for sample			1	3	7	< 50	N/A
MW01(07)	Dry/insufficient water for sample			<1	1	2	< 50	N/A
MW02(07)	3	4	6	<1	1	4	< 50	N/A
MW03(07)	Dry/insufficient water for sample			1	2	3.6	< 50	N/A
MW04(07)	6	7	8	<1	3	9	< 50	N/A
MW05(07)	Dry/insufficient water for sample			<1	2	4	< 50	N/A



Potassium ion concentrations have remained well below DC objective levels during the reporting period. All samples were within the historical range for their respective sites with the exception of a single sample in each of bores MW1A and MW02(07). Each of these samples are marginally above the historical range, which has traditionally been very low. The monitoring results indicate no deterioration in groundwater quality related to potassium ion concentrations in the current reporting year.

Magnesium Ion (mg/L)

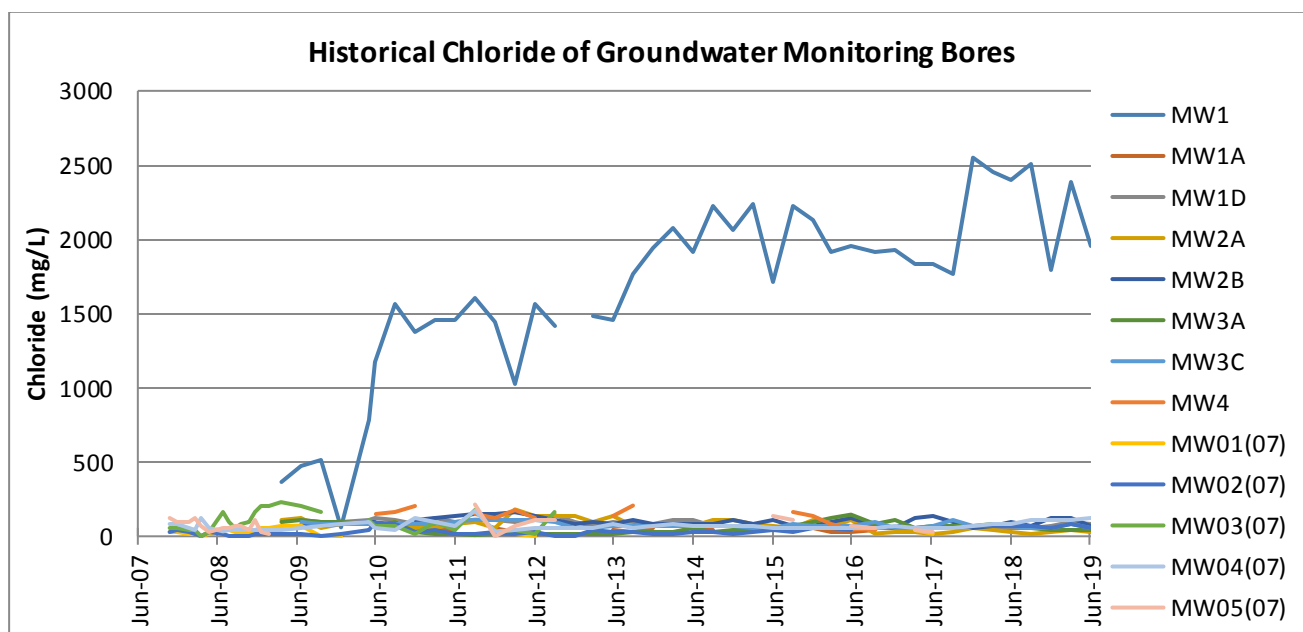
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	167	170	172	12	119	199	< 50	N/A
MW1A	6	6	6	3	5	7	< 50	N/A
MW1D	14	17	19	8	12	17	< 50	N/A
MW2A	5	6	7	5	11	39	< 50	N/A
MW2B	10	12	14	9	12	14	< 50	N/A
MW3A	6	7	8	2	7	18	< 50	N/A
MW3C	10	11	12	2.1	11	16	< 50	N/A
MW4	Dry/insufficient water for sample			5	11	22	< 50	N/A
MW01(07)	Dry/insufficient water for sample			2	4	6.1	< 50	N/A
MW02(07)	10	21	39	<1	4	27	< 50	N/A
MW03(07)	Dry/insufficient water for sample			2	8	15	< 50	N/A
MW04(07)	15	18	19	2.5	8	20	< 50	N/A
MW05(07)	Dry/insufficient water for sample			0.79	7	12	< 50	N/A



All magnesium ion concentrations were within DC objective levels with the exception of MW1, which has followed similar trends as for conductivity and sodium. As for conductivity and sodium, magnesium ion concentrations appear to be relatively stable in the current reporting period. All samples were within the historical range for their respective sites with the exception of a single sample in each of bores MW1D and MW02(07) marginally above their respective historical ranges. These variations are expected at times, and do not represent a deterioration in groundwater quality.

Chloride Ion (mg/L)

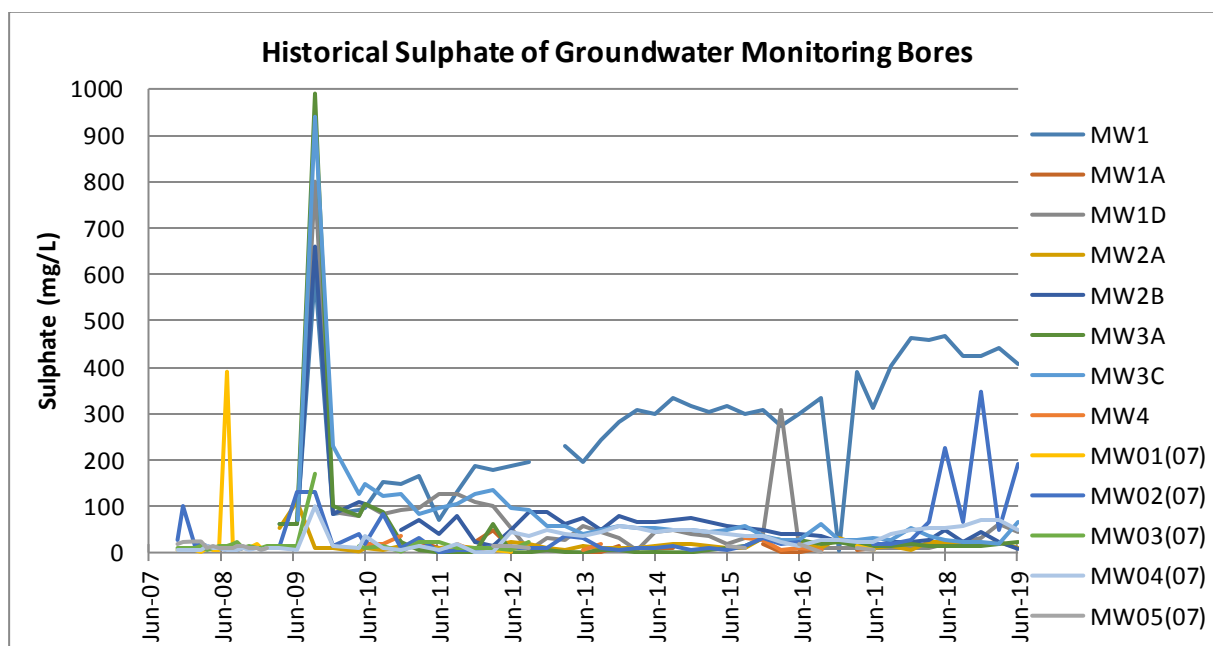
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1790	2163	2510	60	1583	2550	< 300	N/A
MW1A	44	44	44	18	37	56	< 300	N/A
MW1D	62	77	102	48	84	142	< 300	N/A
MW2A	21	29	46	18	80	181	< 300	N/A
MW2B	67	98	128	57	99	162	< 300	N/A
MW3A	42	47	57	8	58	146	< 300	N/A
MW3C	60	65	77	55	77	112	< 300	N/A
MW4	Dry/insufficient water for sample			47	141	256	< 300	N/A
MW01(07)	Dry/insufficient water for sample			<1	30	72	< 300	N/A
MW02(07)	52	66	86	<1	30	93.2	< 300	N/A
MW03(07)	Dry/insufficient water for sample			<1	98	230	< 300	N/A
MW04(07)	104	111	119	33	64	172	< 300	N/A
MW05(07)	Dry/insufficient water for sample			11	92	286	< 300	N/A



As for sodium, the concentration of chloride in all groundwater bores were within DC objectives with the exception of MW1. Chloride concentrations in MW1 have been variable within the reporting period, consistent with results from recent years. All samples from other bores were measured within the respective historical ranges during the current reporting period. There was no indication of any deterioration in groundwater quality during the current reporting period.

Sulphate Ion (mg/L)

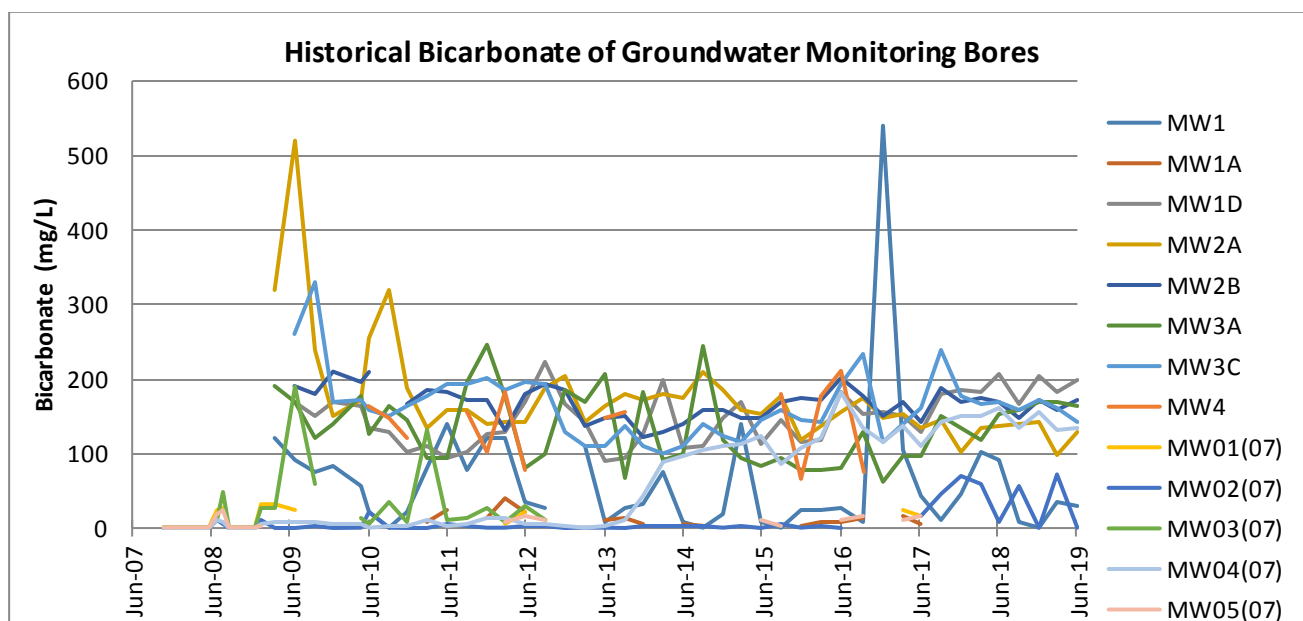
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	405	423	440	4	244	600	< 250	N/A
MW1A	6	6	6	<1	11	48	< 250	N/A
MW1D	24	41	60	5	76	800	< 250	N/A
MW2A	9	15	22	1	17	110	< 250	N/A
MW2B	8	24	44	15	72	660	< 250	N/A
MW3A	13	18	24	<1	52	990	< 250	N/A
MW3C	19	32	66	25	94	940	< 250	N/A
MW4	Dry/insufficient water for sample			2	15	36	< 250	N/A
MW01(07)	Dry/insufficient water for sample			1	24	390	< 250	N/A
MW02(07)	50	163	347	<1	27	226	< 250	N/A
MW03(07)	Dry/insufficient water for sample			2	18	170	< 250	N/A
MW04(07)	47	62	72	<1	26	100	< 250	N/A
MW05(07)	Dry/insufficient water for sample			1	15	42	< 250	N/A



The concentration of sulphate in all groundwater bores were within DC objectives with the exception of MW1. Sulphate concentrations in MW1 appear to have followed the trend of other major ions, with all samples within the historical range of measurements. All samples were within the historical ranges for the respective bores with the exception of a single sample from MW02(07) which was above the historical range for this bore, and single samples in MW2B and MW3C which were below their historical ranges. There was no indication of any deterioration in groundwater quality related to sulphate ion concentrations during the current reporting period. Similarly, the generally low sulphate levels indicate a low risk of acid sulphate soils developing, despite the continued rainfall deficit.

Bicarbonate Ion (mg/L)

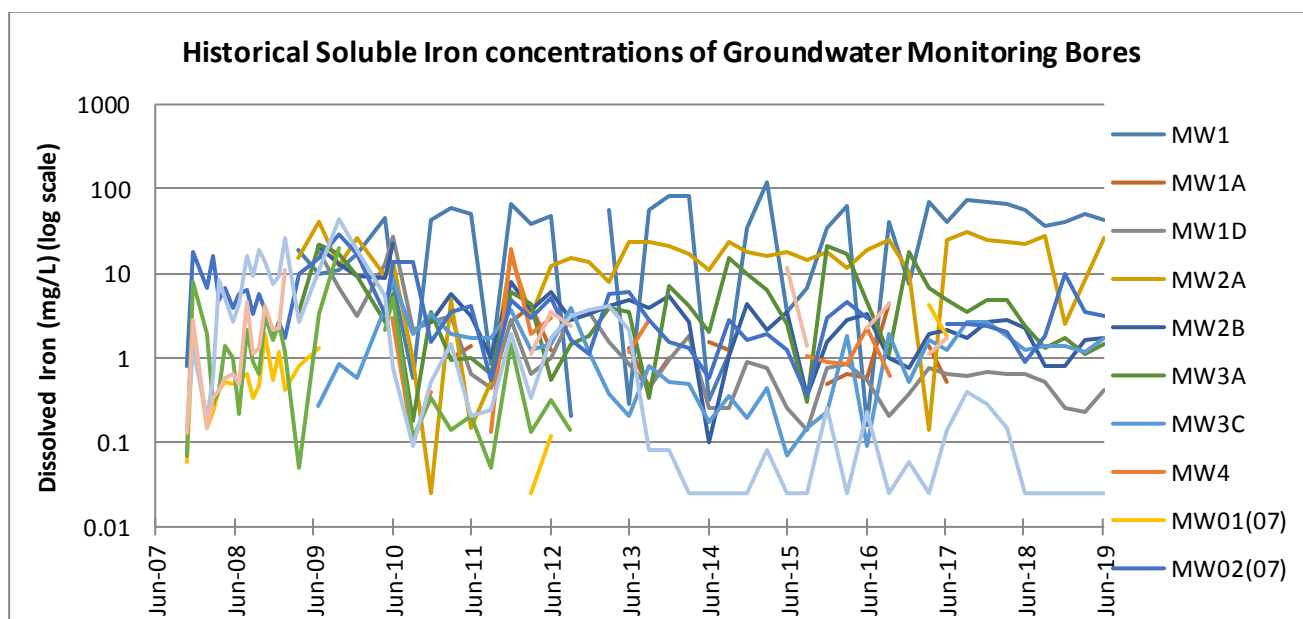
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<1	18	34	<1	68	540	< 750	N/A
MW1A	5	5	5	3	13	40	< 750	N/A
MW1D	167	189	205	90	144	223	< 750	N/A
MW2A	98	127	142	102	181	520	< 750	N/A
MW2B	148	162	172	122	168	210	< 750	N/A
MW3A	159	166	170	62	132	246	< 750	N/A
MW3C	141	158	172	100	165	330	< 750	N/A
MW4	Dry/insufficient water for sample			66	150	230	< 750	N/A
MW01(07)	Dry/insufficient water for sample			<2	11	32	< 750	N/A
MW02(07)	<1	32	72	<1	6	69	< 750	N/A
MW03(07)	Dry/insufficient water for sample			<2	24	190	< 750	N/A
MW04(07)	132	140	157	<1	47	182	< 750	N/A
MW05(07)	Dry/insufficient water for sample			<2	7	24	< 750	N/A



Bicarbonate concentrations remained below the objective level in all groundwater bores during the current reporting year. All bores have remained relatively stable, with only bore MW02(07) recording bicarbonate ion concentrations slightly above the historical range in a single sample, and one sample in MW2A slightly below the historical range. These are within expected and historical variabilities, and as such does not reflect a deterioration in groundwater quality.

Soluble Iron Ion (mg/L)

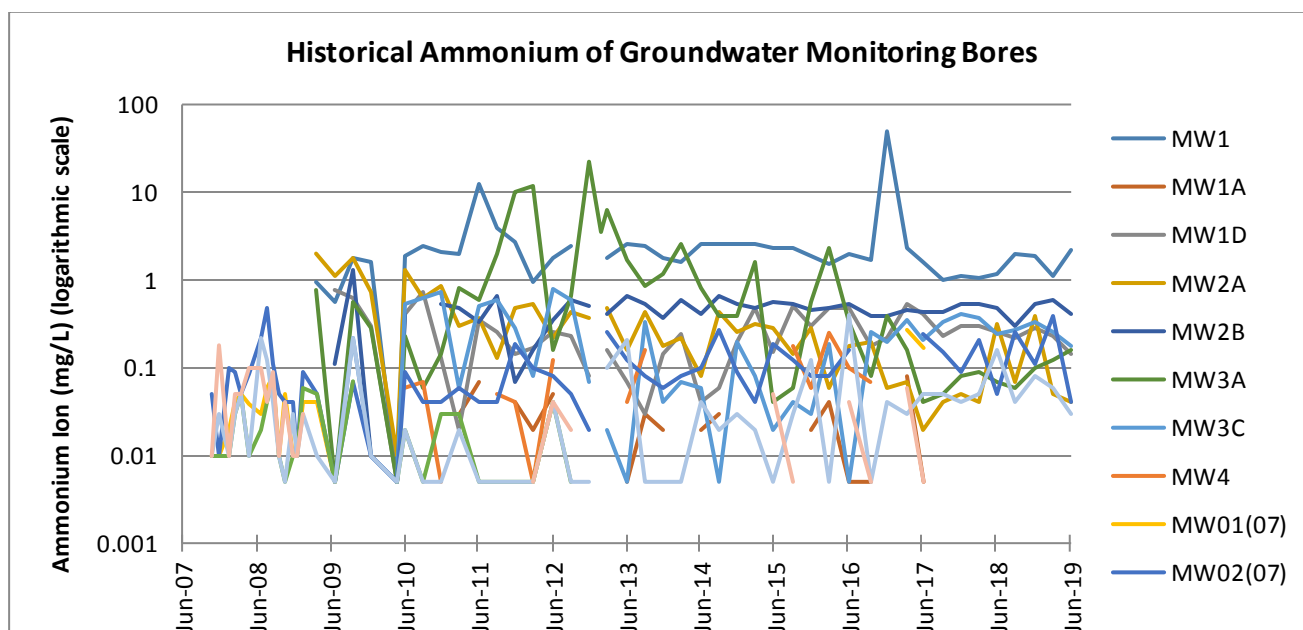
BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	35.5	42.5	50.3	0.16	37.4	120	< 6	N/A
MW1A	0.4	0.4	0.4	0.46	1.6	4.4	< 6	N/A
MW1D	0.23	0.4	0.53	0.14	2.8	27.3	< 6	N/A
MW2A	2.53	16.1	27.6	<0.05	15.6	41	< 6	N/A
MW2B	0.79	1.2	1.76	0.1	4.6	22.5	< 6	N/A
MW3A	1.1	1.4	1.75	0.18	5.9	22	< 6	N/A
MW3C	1.18	1.4	1.73	0.07	1.5	8.57	< 6	N/A
MW4	Dry/insufficient water for sample			0.1	2.5	19.5	< 6	N/A
MW01(07)	Dry/insufficient water for sample			<0.05	0.8	4.23	< 6	N/A
MW02(07)	1.81	4.6	10	0.36	5.3	29	< 6	N/A
MW03(07)	Dry/insufficient water for sample			0.05	2.0	20	< 6	N/A
MW04(07)	<0.05	<0.05	<0.05	<0.05	4.4	44	< 6	N/A
MW05(07)	Dry/insufficient water for sample			0.13	2.6	11.7	< 6	N/A



With the exception of groundwater bores MW1, MW2A and MW02(07), the dissolved iron concentrations were below the objective levels during this reporting period. These groundwater bores have historically exhibited higher, and wildly fluctuating dissolved iron concentrations since the commencement of the monitoring programme, and are consistent with results in the in the historical record of monitoring. Furthermore, pH is relatively neutral in each of these bores suggesting minimal opportunities for further mobilisation of metals. The concentrations of dissolved iron in all bores for the reporting period are within the historical range for the respective bores with the exception of the single sample in bore MW1A, which was slightly below the historical range. This indicates no deterioration in groundwater quality as evident by soluble iron concentration across the monitoring network. Similarly, the concentration of dissolved iron generally remains below the limit of reporting in the dredge pond.

Ammonium Ion (mg/L)

BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1.13	1.8	2.17	<0.01	3.44	49.5	< 20	N/A
MW1A	0.02	0.0	0.02	<0.01	0.03	0.08	< 20	N/A
MW1D	0.14	0.2	0.28	<0.01	0.28	0.77	< 20	N/A
MW2A	0.04	0.1	0.38	0.01	0.41	2	< 20	N/A
MW2B	0.3	0.5	0.59	<0.01	0.45	1.3	< 20	N/A
MW3A	0.06	0.1	0.16	<0.01	1.89	22.3	< 20	N/A
MW3C	0.18	0.3	0.34	<0.01	0.23	0.79	< 20	N/A
MW4	Dry/insufficient water for sample			<0.01	0.39	5.07	< 20	N/A
MW01(07)	Dry/insufficient water for sample			<0.01	0.05	0.27	< 20	N/A
MW02(07)	0.04	0.2	0.38	<0.01	0.10	0.48	< 20	N/A
MW03(07)	Dry/insufficient water for sample			<0.01	0.02	0.07	< 20	N/A
MW04(07)	0.03	0.1	0.08	<0.01	0.05	0.4	< 20	N/A
MW05(07)	Dry/insufficient water for sample			<0.01	0.04	0.18	< 20	N/A

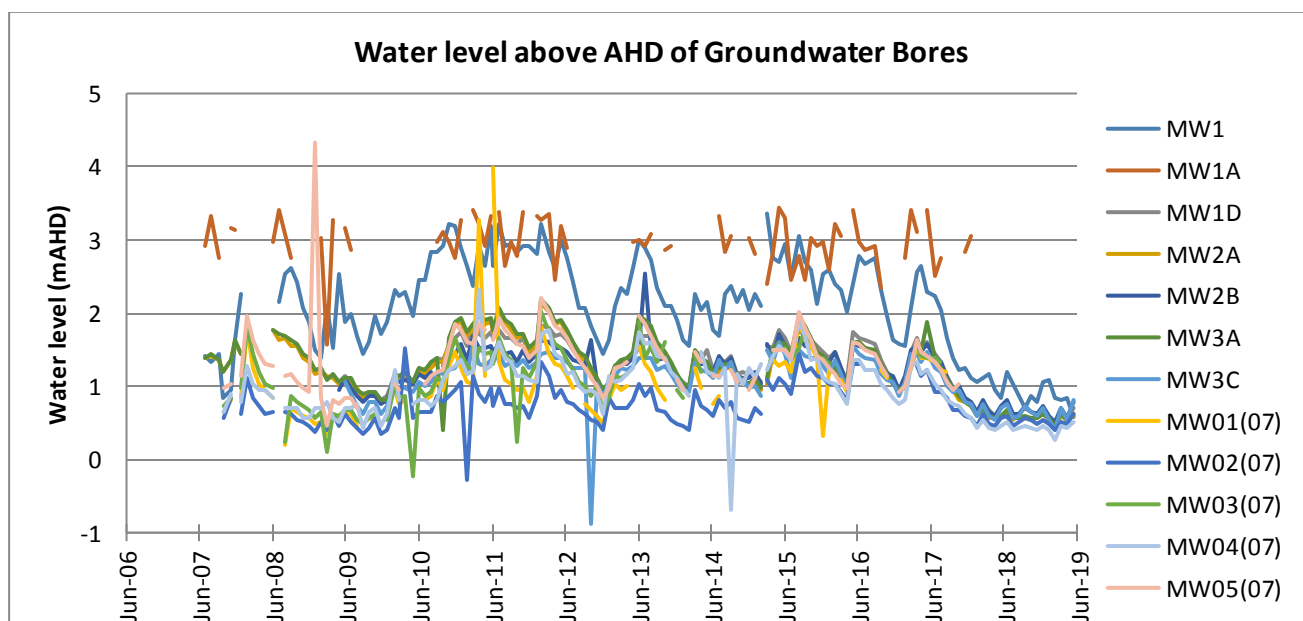


Ammonium ion concentrations were below the objective levels and within the historical ranges for all samples collected during the current reporting period.. This indicates that there is no deterioration in groundwater quality as a result of dredging operations, and the low levels recorded give a strong indication that minimal human influence has been imparted on the groundwater system at the Gerroa Sand Resource.

Depth (m)

The depths of the borehole are reported as Australian Height Datum

BORE HOLE	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	0.58	0.89	1.19	0.84	2.20	3.36	N/A	N/A
MW1A	2.93	3.07	3.14	1.57	2.97	3.44	N/A	N/A
MW1D	0.44	0.64	0.79	0.6	1.34	1.83	N/A	N/A
MW2A	0.44	0.57	0.66	0.56	1.33	2.14	N/A	N/A
MW2B	0.51	0.66	0.8	0.59	1.27	2.54	N/A	N/A
MW3A	0.47	0.58	0.68	0.4	1.36	2.19	N/A	N/A
MW3C	0.39	0.63	0.8	-0.88	1.14	1.6	N/A	N/A
MW4	0.45	0.47	0.55	0.43	1.43	6.95	N/A	N/A
MW01(07)	Dry			0.2	1.06	3.99	N/A	N/A
MW02(07)	0.39	0.52	0.62	-0.28	0.76	1.52	N/A	N/A
MW03(07)	Dry			-0.23	1.12	2.02	N/A	N/A
MW04(07)	0.28	0.43	0.52	-0.69	1.04	2.32	N/A	N/A
MW05(07)	0.96	1.12	1.32	0.46	1.36	4.33	N/A	N/A



Groundwater levels have exhibited a trend closely aligned to rainfall throughout the reporting period. Groundwater levels have largely steadied within this period close to the water level of Blue Angle Creek, which represents the base level of the system. Small increases in groundwater level have been observed during average and wet months (Oct-Nov-Dec 2018 and June 2019), however the overwhelming effects of the below average rainfall have meant these increases are short lived. Four bores (MW1, MW1D, MW2A, and MW2B) recorded levels below their historical ranges, while five bores were recorded as dry at some time during the reporting period. All bores are following a similar pattern, which is closely aligned to rainfall patterns, suggesting climate is the predominant driver of groundwater levels within each bore across the monitoring network.

4.1.4 Groundwater Monitoring Results Interpretation

From the data gathered above as part of the groundwater monitoring programme for the Gerroa Sand Resource, groundwater quality has remained relatively stable during the current reporting period, despite the continued rainfall deficit experienced throughout the year. This reflects no deterioration in groundwater quality as a result of dredging operations, as predicted by the Gerroa Sand Quarry Extension Environmental Assessment (2006).

Monitoring bore MW1 continues to be influenced by a saline water source, with EC and concentrations of major ions elevated compared with the remainder of the groundwater monitoring network. This bore is likely to receive inflows from the Berry Siltstone aquifer associated with the adjacent high to the south of the site. An examination of the geological mapping for the area supports this view, with this bore likely constructed in the Permian age bedrock, while the other bores including the shallower MW1A are constructed in the overlying recent alluvial deposits. Furthermore a recent review of groundwater monitoring records sampled from this bore prior to the current approval shows that the EC measured in this bore is typically highly variable, with measurements of around 6000 μ S/cm recorded as far back as 1993. What these records show is that many of the water quality objectives in the Development Consent are not appropriate for this bore, given the inherent natural variability at this interface. Nevertheless, the current monitoring programme is well placed to both monitor any variations in groundwater quality as a result of this saline intrusion over time, as well as monitoring the spatial distribution of any saline influence in the vicinity of the dredging operation.

One of the key observations made during previous annual reviews revolved around the shortcomings of the current groundwater quality objectives and their applicability to the natural groundwater regime of the site. This is highlighted by the natural presence of iron sulphides in the local geology, which was contributed to a number of bores regularly and naturally recording pH levels below the objective range, and soluble iron concentrations above the objective level. Similarly, concentrations of nitrogen and phosphorus in the groundwater are regularly higher than the objective levels, despite no forms of these substances used or brought on to site as part of extraction activities. Nitrogen and phosphorus concentrations in the surface water of the dredge pond are typically below standard laboratory detection levels, supporting determinations that extraction activities are not contributing to the observed concentrations of these analytes in the groundwater. For these reasons, the objective levels of these analytes do not suitably reflect the natural groundwater regime, and assessment against

individual historical results provides a far better method for detecting any adverse impacts on groundwater resources as a result of dredging and associated activities.

The current groundwater monitoring programme is sufficient in monitoring for any spatial or temporal changes in the groundwater quality and quantity in the local environment. Current procedures allow for an accurate representation of any longer term trends in groundwater quality and availability.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to groundwater in the 2018-2019 reporting period.

4.3. Surface Water Management

4.3.1. Standards and Performance Measures

There are no specific requirements for surface water quality in the sites EPL other than with regard to discharges from the site, as detailed below:

<i>Water and land</i>			
EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1		Discharge to waters	The end of the "Overflow Pipe" from the dredge pond as labelled on the map titled "Gerroa Sand Resource" dated 7/12/11 and held on EPA file 281283A8.

The overflow pipe indicated is licenced in case of extreme wet weather in which flood water would be allowed to drain to the adjacent Foy's Swamp. To date the pond water has never required use of the overflow pipe.

The surface water monitoring requirements from the DC are realised by the sites QEMP. Section 8.5 of the QEMP details the surface water testing requirements and specifies that the dredge pond and main channel require water level readings and the dredge pond requires quarterly analyte testing. The EA predicted that the project is not predicted to lead to any deterioration of the water quality of the dredge pond, or the surrounding area.

The groundwater quality objectives which CB should "aim to meet" from the DC (and adopted in the QEMP) are as follows:-

Analyte	Units	Objective
Turbidity	NTU	5 - 20
pH	pH	6.0 – 8.5
Salinity	µS/cm	<1,500
Dissolved Oxygen	mg/L	>6
Total Phosphorus	µg/L	<30
Total Nitrogen	µg/L	<350
Chlorophyll-A	µg/L	<5
Faecal Coliforms	Median No./100 mL	<1,000
Enterococci	Median No./100 mL	<230
Algae & BGA	No. Cells/mL	<15,000
Sodium	mg/L	<400
Potassium	mg/L	<50
Magnesium	mg/L	<50
Chloride	mg/L	<300
Sulphate	mg/L	<250
Bicarbonate	mg/L	<750
Soluble Iron	mg/L	<6
Ammonium	mg/L	<20

4.3.2. Environmental Performance

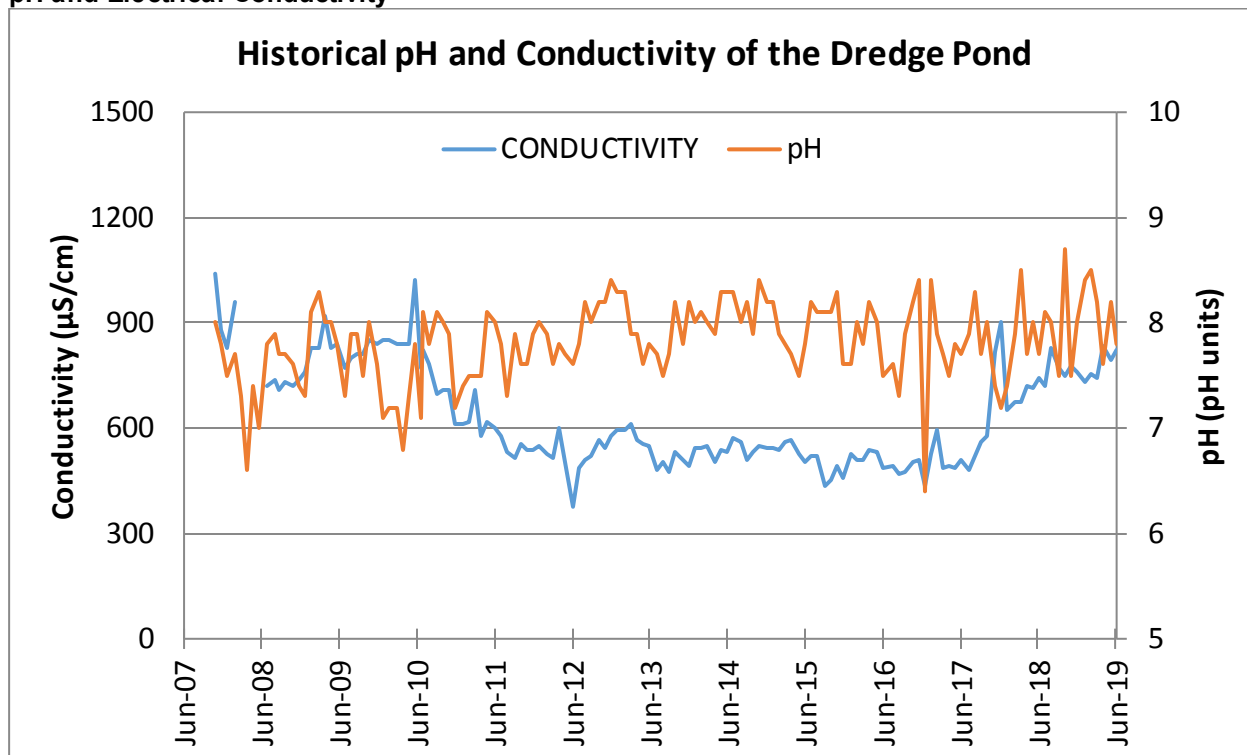
CB has implemented the Surface Water Monitoring Program and Acid Sulphate Soils Management Plan to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to conduct monthly sampling and testing of the water in the dredge pond for pH and Electrical Conductivity and of the leachate from sand extracted by the dredging operation for Total Oxidisable Sulphur, as well as quarterly testing of the dredge pond water for the larger suite of water quality parameters listed in Section 4.3.1 above.

4.3.3. Surface Water Monitoring

A summary of surface water monitoring results for the period is tabulated in this section, with the range and average of each analyte displayed alongside the historical range and average, objectives as described in the Development Consent, and any EA predictions. Units of reporting are listed in the table in Section 4.3.1. Graphs are also included to show trends in all analytes over the historical period of monitoring in the dredge pond. Where surface water monitoring results trend outside of the historical range or DC objectives, these are discussed after each graph.

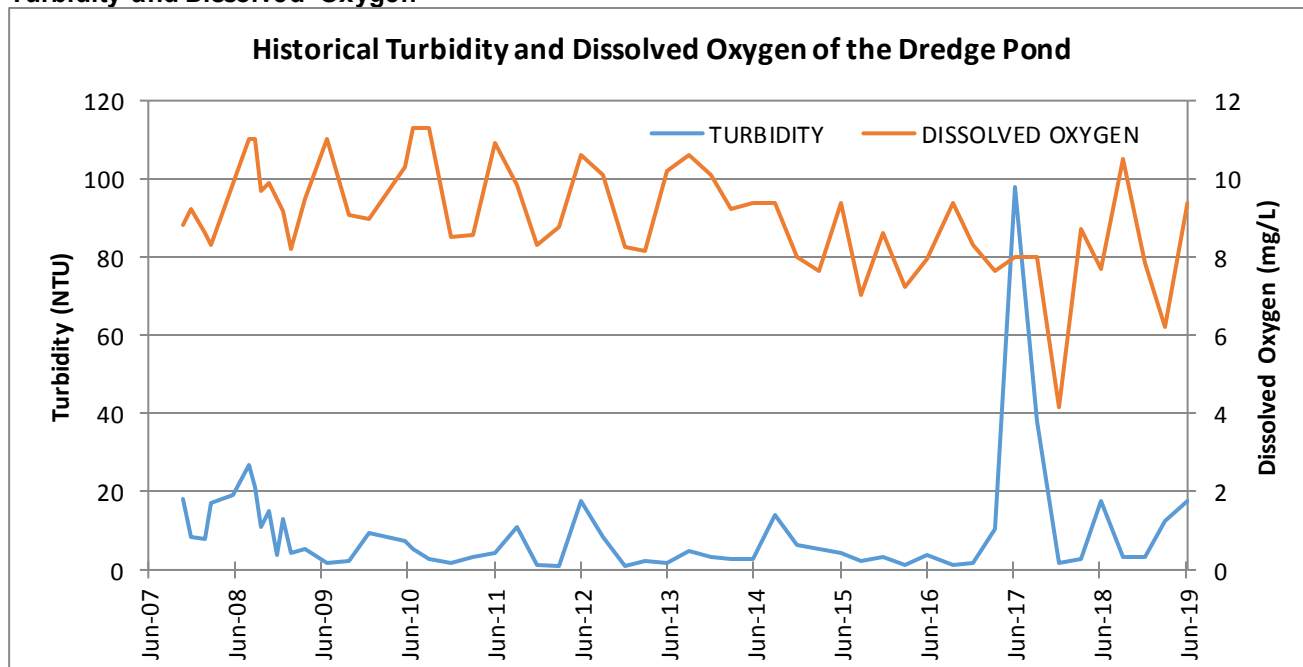
Analyte	2018/19 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
Conductivity	721	774	835	376	628	1040	< 1,500	N/A
pH	7.5	8.0	8.7	6.4	7.8	8.5	6 - 8.5	N/A
Total Algae	730	635433	2070000	525	84171	1000000	< 15,000	N/A
Cyanophyta	3	633251	2070000	0	55637	438000	< 15,000	N/A
Total phosphorus	5	16	30	<5	50	790	< 30	N/A
Total nitrogen	300	625	1100	40	611	6900	< 350	N/A
Chlorophyll-a	5	13	22	<0.1	5	41	< 5	N/A
Faecal coliforms	22	104	200	1	125	2100	< 1000	N/A
Enterococci	10	41	80	<1	45	690	< 230	N/A
Sodium	73	76	81	33	51	73	< 400	N/A
Potassium ion	6	7	7	3	5	8	< 50	N/A
Magnesium ion	17	19	20	9	13	21	< 50	N/A
Chloride	103	109	115	16	77	140	< 300	N/A
Sulphate ion	66	81	109	25	111	1300	< 250	N/A
Bicarbonate ion	121	138	157	<2	88	313	< 750	N/A
Soluble iron ion	<0.05	0.04	0.08	<0.01	0.09	0.77	< 6	N/A
Ammonium ion	<0.01	0.10	0.36	<0.01	0.03	0.12	< 20	N/A
Turbidity	3	9	18	1	10	98	5 - 20	N/A
DO (mg/L)	6.2	8.5	10.5	4.2	9.1	11.3	> 6	N/A
DO (%)	73	89	107	52	100	125	> 80-90%	N/A

pH and Electrical Conductivity



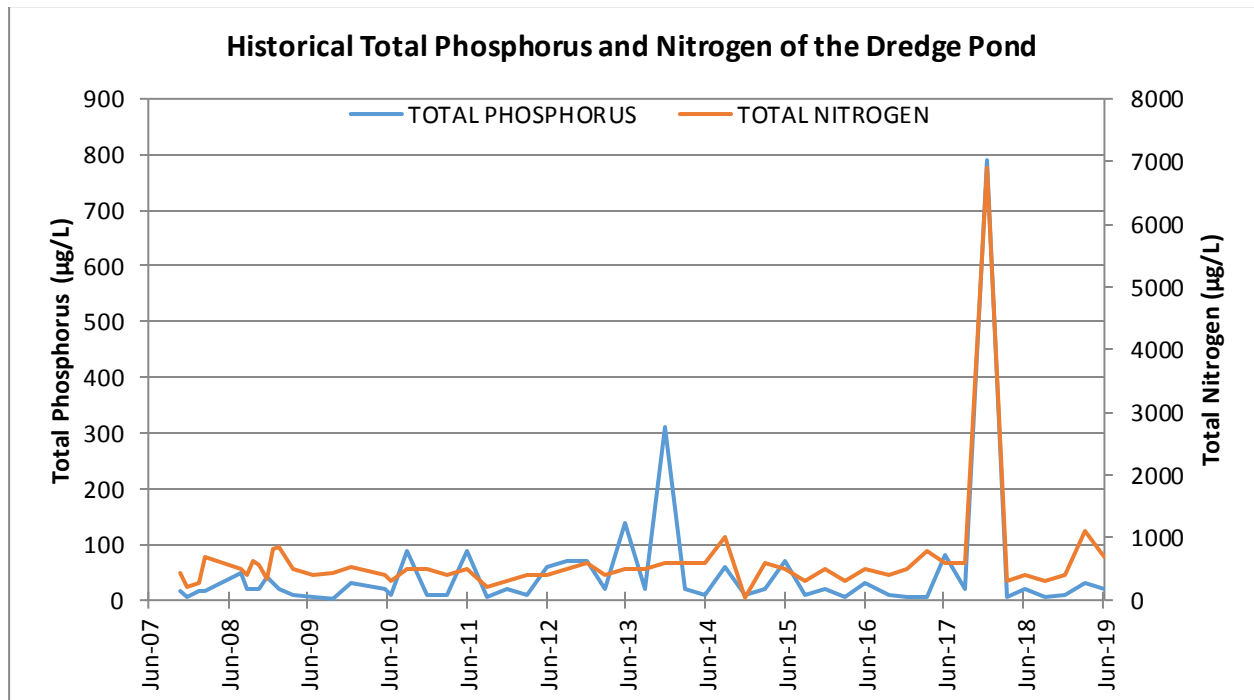
In the current reporting period, the dredge pond pH has fluctuated around historical levels and within the surface water quality objectives with the exception of a single measurement of 8.7 in October 2018. Electrical Conductivity has shown a slow increase over the past 24 months, which is attributable to the significant rainfall deficit that has reduced the replenishment of the dredge pond with rainwater. Despite this slow increase, the EC has remained within both the historical range and water quality objectives throughout the reporting period.

Turbidity and Dissolved Oxygen



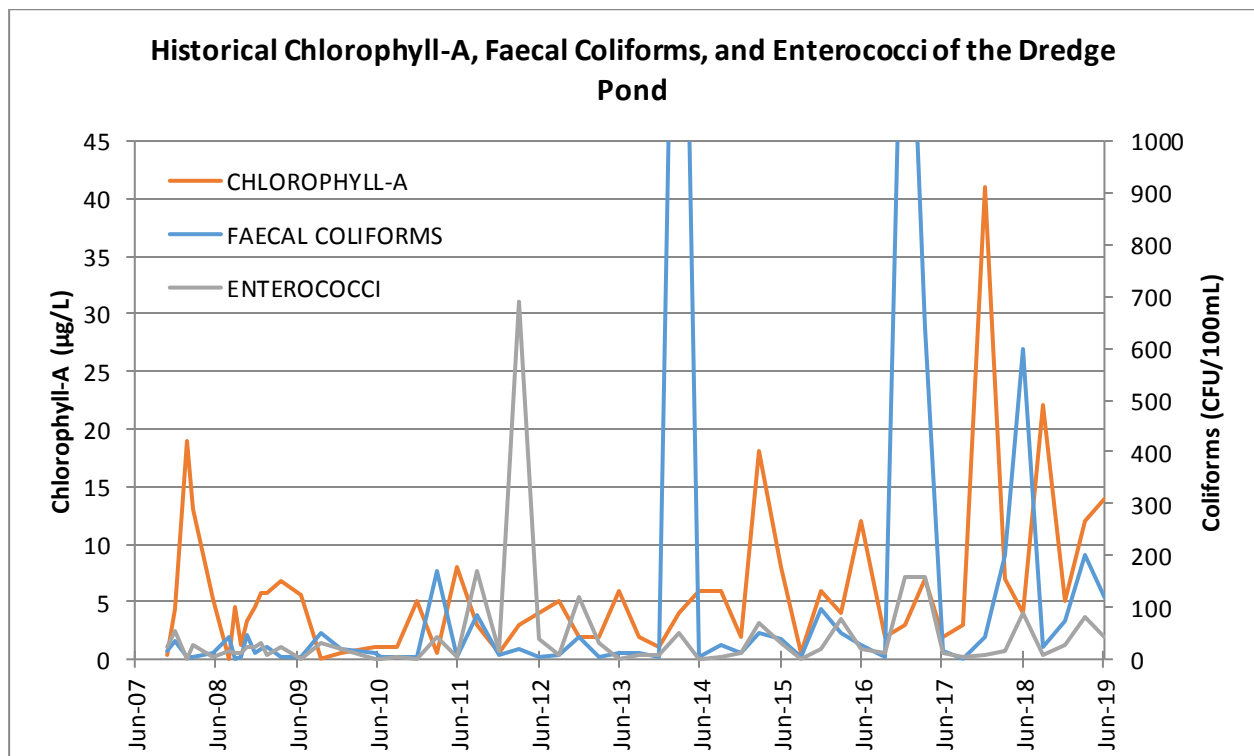
Turbidity and dissolved oxygen have remained within their historical ranges in the current reporting period. One sample recorded slightly below the percent saturation objective level for DO, however this sample met the mg/L objective level, and returned to 87% saturation in the following monitoring period. Two samples were below lower limit of the turbidity objectives, however this does not reflect a decline in water quality.

Total Phosphorus and Nitrogen



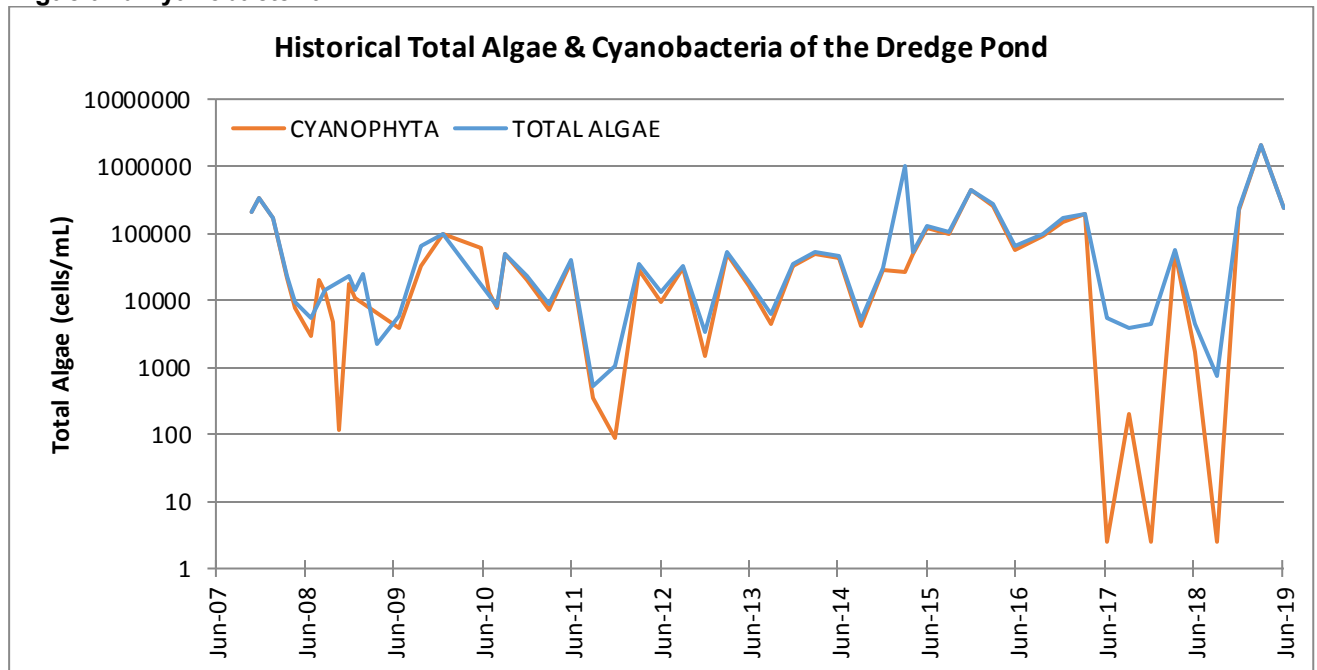
All nitrogen and phosphorus samples remained within the historical ranges for these analytes in the current reporting period, while phosphorus also met the objective levels in all samples. Nitrogen was recorded above the objective level in the reporting period, however the graph above shows levels very consistent with the long term trends. This is reflective of the agricultural land use prevalent in the district, and unrelated to dredging operations.

Chlorophyll-A, Faecal Coliforms, and Enterococci



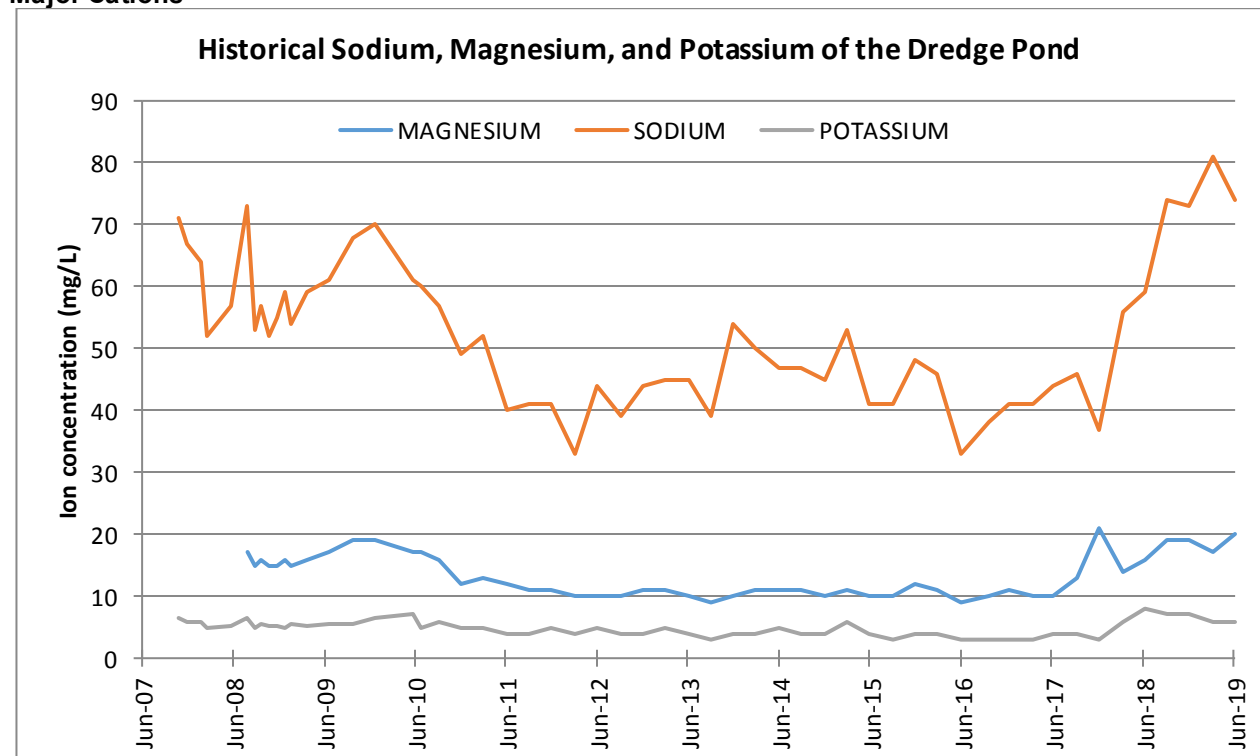
All chlorophyll-A, faecal coliform, and enterococci results were within the historical ranges for the respective analytes. All faecal coliform and enterococci results were also within the objective levels for the site. While chlorophyll-A concentrations were above the objective levels for most of the year, this is a common occurrence and is expected on a large standing water body of high quality water.

Algae and Cyanobacteria



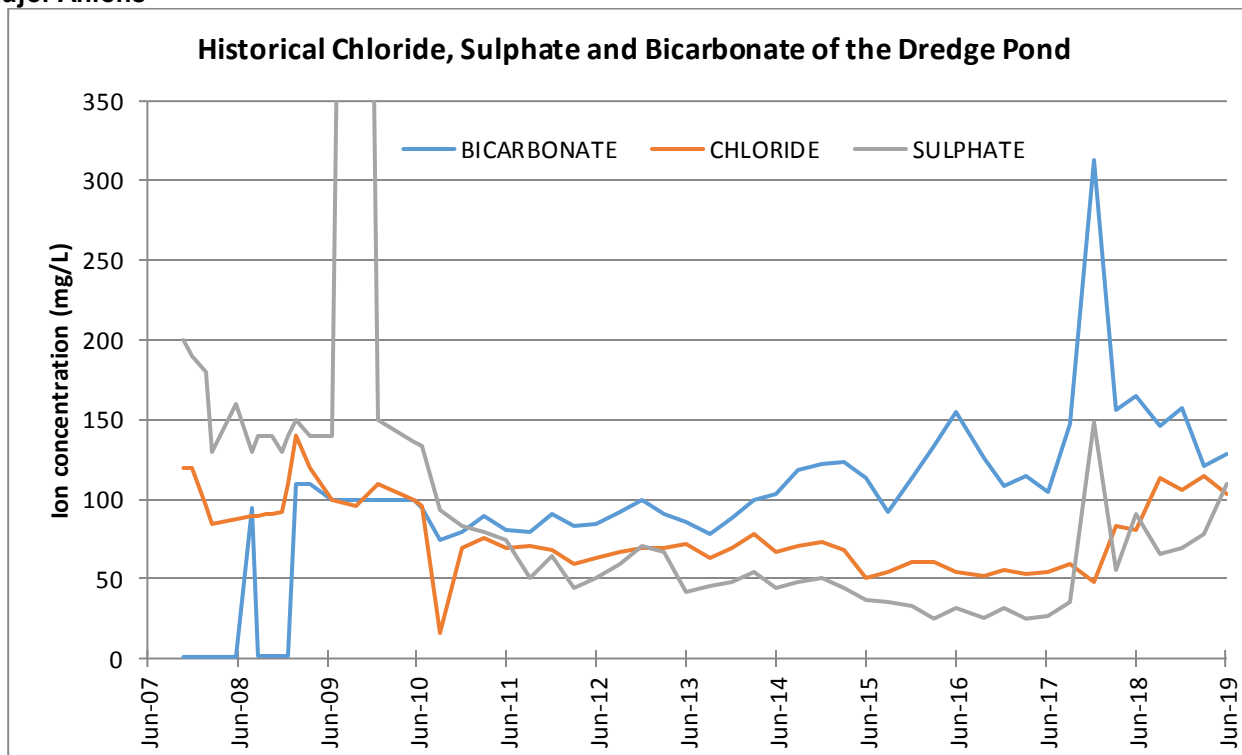
Total algae and cyanobacteria concentrations followed historical patterns, with a spike observed in summer and low levels observed during the cooler months. Concentrations in March were above the historical range of these analytes, which is likely due to the absence of dredging over the summer period, with the lack of water movement likely encouraging the growth of algae within the dredge pond. It is expected that with the resumption of dredging in winter 2019, combined with the natural seasonal fluctuations, the concentrations of these analytes will decline into the September 2019 sample.

Major Cations



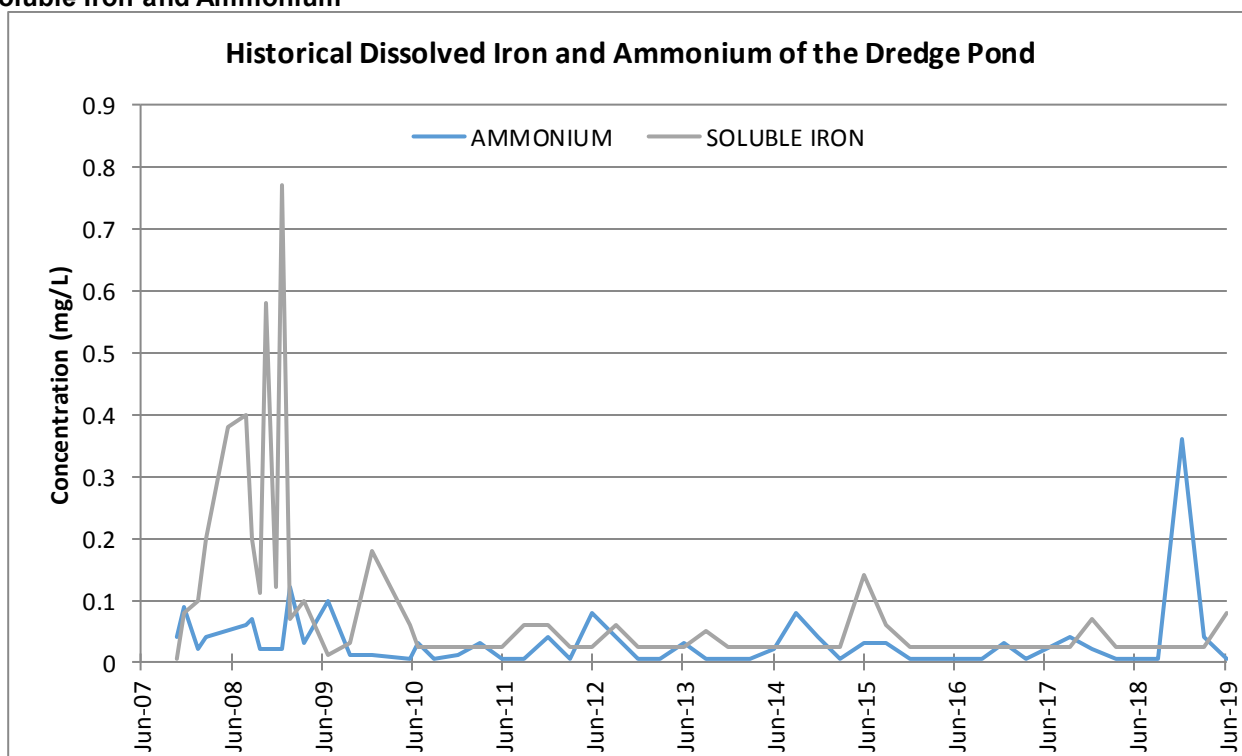
Sodium, magnesium, and potassium ion concentrations have followed the recent trends in electrical conductivity, with a gentle rise over the past two years. This is related to the extended rainfall deficit, with evaporation in the past two years exceeding rainfall on site. All analytes remain within the objective levels for the site, while sodium concentrations are marginally above historical results.

Major Anions



Concentrations of chloride, sulphate, and bicarbonate have remained well below the objective levels during the current reporting period and are consistent with historical levels. Concentrations of chloride and sulphate have exhibited a minor increasing trend over the past two years, consistent with the extended rainfall deficit.

Soluble Iron and Ammonium



Soluble iron concentrations have remained stable at very low levels and consistently below surface water quality objectives. A spike in ammonium concentrations was observed in the December 2018 sample, however this was within the water quality objectives, and following samples returned to the historical range for this analyte.

4.3.4. Surface Water Monitoring Results Interpretation

The dredge pond continues to represent a surface water body of excellent water quality, with the median physicochemical parameters measured either within the surface water quality objectives for the project, and/or

within the ANZECC Guideline trigger levels for freshwater lakes and reservoirs. However, concentrations of algae and cyanobacteria continue to be present at levels generally above these guidelines at times.

The cyanobacteria concentrations identified in the dredge pond during the reporting period follow a trend largely in line with seasonal expectations (summer spike). This may have been exacerbated in the current reporting period by the extended rainfall deficit (and thus low water level), and lack of active dredging within the dredge pond at this time, which may assist in circulating the water. Concentrations of algae have decreased in the most recent sample, with concentrations likely to fall further through winter, and with the recommencement of active dredging.

The current surface water monitoring programme is sufficient in monitoring for any changes in the water quality of the dredge pond. Current procedures allow for an accurate representation of any longer term trends in surface water quality and any potential impacts on surface and groundwater quality of the wider area.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to surface water in the 2018-2019 reporting period.

4.4. Air Quality

4.4.1. Standards and Performance Measures

There are no specific requirements for air quality in the sites EPL.

The air quality monitoring requirements from the Development Consent are realised by the sites QEMP. Section 8.4 of the QEMP details the air quality testing requirements and specifies that 3 dust gauges are to be tested on site. The contribution from site operations to annual average dust deposition must not cause additional exceedances of the following criteria at any residence on privately owned land or on more than 25% of any privately owned land:-

- 2g/m²/month, maximum increase in deposited dust level; and
- 4g/m²/month, maximum annual average deposited dust level.

4.4.2. Environmental Performance

CB has implemented the Air Quality Monitoring Program to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to service the three depositional dust gauges on a monthly basis, in line with *AS/NZS 3580.10.1-2003: Methods for Sampling and Analysis of Ambient Air – Determination of Particulates – Deposited Matter – Gravimetric Method*. In addition, Cleary Bros has sealed the first 200 metres of the site entrance and utilised a water truck on the unsealed sections to minimise the generation of dust from unsealed roads.

4.4.3. Air Quality Monitoring

The following table provides Total Insoluble Solids concentrations (in g/m²/month) recorded in the three dust depositional gauges at the Gerroa Sand Resource.

Dust Gauge Units: g/m ² /month	2018/19 Reporting Period			Historical Results		
	Min	Average	Max	Min	Average#	Max
1A	0.5	2.1	5.5	0.1	2.3	20.1
2A	1.1	2.9	4.9	0.1	1.7	49.7
3A	0.3	1.2	2.8	0.1	1.4	220.0
DC Criteria / EA Predictions		< 4			< 4	

Average excluding samples contaminated or tampered with

4.4.4. Air Quality Monitoring Results Interpretation

The results indicate that the activities associated with the Gerroa Sand Resource are having very little effect on local dust deposition, with levels consistent with the historical performance and well below the total annual average deposition criteria. Dredging operations at the site commenced in the 1960's, well before depositional dust monitoring commenced, and as such the incremental impact of the project cannot be accurately

determined. Therefore monitoring will continue to focus on measuring compliance with the total annual average deposition criteria.

The depositional dust monitoring results demonstrate that the measures to control dust generation associated with the Gerroa Sand Mine are effective in minimising any dust impacts from activities on site, and in maintaining a high standard of air quality in the local area. The air quality monitoring programme currently in place is sufficient to monitor any potential impacts on air quality to surrounding receivers.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to air quality in the 2018-2019 reporting period.

4.5. Noise Monitoring

4.5.1. Standards and Performance Measures

There are no specific requirements for noise monitoring in the sites EPL.

The noise monitoring requirements from the Development Consent are realised by the site's QEMP. Section 8.3 of the QEMP details the noise testing requirements and specifies that noise testing is required within 3 months of commencement of operations on the extension site. Subsequent noise monitoring will only be required if there are exceedances or a significant change to operations or machinery likely to have noise implications.

4.5.2. Environmental Performance

CB has constructed the visual and acoustic bund along the northern, eastern, and southern boundaries of the dredging operation. A preventative maintenance programme is in place to ensure all equipment employed at the site are maintained in accordance with manufacturers' specifications, with no changes to equipment in operation at the site during the current reporting period. Dredging operations were restricted to the approved hours during the current reporting period.

4.5.3. Noise Monitoring

There was no requirement to conduct noise monitoring during this reporting period as there were no exceedances or any significant change to operations or machinery likely to have noise implications.

4.5.4. Noise Findings

Current strategies described above to minimise noise impacts on surrounding receivers have been effective during the current reporting year, which is supported by the continued absence of any noise related complaints related to the site.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to noise in the 2018-2019 reporting period.

4.6. Community

4.6.1. Licence Requirement

Licence condition M4 of the site's EPL provides that Cleary Bros must keep records of all complaints received for the site including any action taken regarding the complaint.

The Development Consent has no direct requirements for complaint handling however, the QEMP dedicates chapter 7 to Complaints Management, which describes the process for recording and responding to community complaints. Furthermore, Cleary Bros held two Community Consultative Committee meetings during the reporting period. Minutes of these meetings have been sent to the DPE and are also available on the Cleary Bros website.

4.6.2. Tabulated Results

No complaints were received in relation to the Gerroa Sand Resource in 2018/2019, which is in line with number of complaints received in previous years.

Year	Environmental Complaints
2005/2006	0
2006/2007	0
2007/2008	0
2008/2009	0
2009/2010	0**
2010/2011	0
2012/2013	0

Year	Environmental Complaints
2013/2014	0
2014/2015	0
2015/2016	0
2016/2017	0
2017/2018	0
2018/2019	0

**One complaint was reported to Cleary Bros from DoP as a letter dated 2 December 2009 relating to the extent of clearing. This was investigated and found not to be factual (refer Cleary Bros letter to DoP dated 15 December 2009).

4.6.3. Environmental Complaints Results Interpretation

The absence of any environmental complaints since 2005 reinforces the low environmental and amenity impact of the Gerroa Sand Resource, and demonstrates that the site is functioning in harmony with the surrounding residents.

4.7. Rehabilitation & Vegetation Management

4.7.1. Standards and Performance Measures

There are no specific requirements for rehabilitation or vegetation management in the sites EPL.

The DC and QEMP set out long and short term requirements and objectives regarding rehabilitation and vegetation management. These objectives are included in the Land and Environment Court approved Landscape and Rehabilitation Management Plan. For the purposes of this AEMR only conditions required to be completed within the eleventh year of operation will be reviewed. The eleventh year requires routine maintenance only in all areas as required, including weed control, maintenance of fences, pest control, and the replacement of dead plants. The QEMP requires that Cleary Bros inspect the planting and conservation works quarterly and that a qualified ecologist monitors the entire area annually. Quarterly inspections of the plantings and the conservation works are carried out by site personnel. Ecologists from Niche Environment and Heritage carried out the eleventh annual survey in June 2019 and it is attached as Annexure C.

4.7.2. Summary of Quarterly Inspections of Plantings and Conservation Areas

The quarterly inspections were carried out in September 2018, December 2018, March 2019 and June 2019.

All plantings are now completed for all areas of revegetation and maintenance of these areas is continuing and ongoing. Infill planting in Zone 2C.1 was undertaken during the reporting period with 1230 trees planted, including a mix of tubestock and advanced plantings.

The batters of the dredge pond foreshore are stable on both the east and west sides with no erosion evident. The sections of the batter that were planted in earlier years have established very well with significant growth and cover now evident.

The main focus of management efforts during the reporting period centred on weed control. The main weeds targeted included the ongoing suppression of lantana and Rhodes grass, while also controlling localised patches of other environmental weeds that have re-emerged at times such as bitou bush, privet, blackberry, and coral tree. Approximately 190 hours of weed control was undertaken across the management areas during the reporting period, with efforts concentrated during the warmer months.

4.7.3. Success of the Northern Corridor

The flora and fauna surveys over the first six years of this project, that is since the habitat establishment began in the Northern Corridor, found that the indigenous biota that inhabits and that traverses the corridor is equal to or greater than that recorded in the East-West Link. The following results are relevant to the success of the Northern Corridor as measured against the criteria contained in the Landscape and Rehabilitation Plan approved by the Court.

The conditions of approval set out the criteria that must be considered in determining the success of the Northern Corridor. Surveys have shown that these criteria have been achieved and in some cases surpassed when comparing the data for the East-West Link and the Northern Corridor.

Results of the surveys indicate that the indigenous plant species now established and growing in the Northern Corridor meet or exceed the requirements set out in the consent conditions.

Self-colonising shrubs are common and the cover of indigenous understorey plants, most notably *Lomandra longifolia* now provides an extensive cover. Weeds are no longer prevalent in the northern corridor, with agricultural exotics such as Rhodes grass now isolated and actively suppressed, forming a minor constituent of the zone.

The results of previous surveys for vertebrate animals in the Northern Corridor demonstrate an increase in the cumulative number of species present each time the surveys are carried out. Photographs taken at permanent sites over the years show the progress in the development of the habitat in the Northern Corridor.

4.7.4. Planting/Rehabilitation Areas

The planting/rehabilitation zones as described in the Landscape and Rehabilitation Plan have been completed successfully. The eleventh annual report identified that with consistent monitoring and weed management across the zones, the success of plantings has been high. There are some issues with wild animals grazing on new growth (e.g. Swamp Wallabies and Rabbits) but overall the plants are establishing and will continue to grow and thrive.

Management activities to be undertaken in the 2019-20 period will be in accordance with the recommendations in the eleventh annual report. This will include weed control focusing on lantana and other minor weeds, maintenance of fencing, and some minor infill planting as described.

4.8. Acid Sulphate Monitoring

4.8.1. Standards and Performance Measures

There are no requirements for acid sulphate soils monitoring in the sites EPL.

The DC for the site requires an Acid Sulphate Management Plan to be prepared. This plan has been prepared and is included in the sites QEMP, which requires regular sampling and testing of the sand, stockpile leachate, and dredge pond water for analytes including pH, total oxidisable sulphur and other analytes to assess the site-specific risk of acid sulphate soils. Where an elevated risk is identified, further controls are required to be executed to minimise the risk of increased acidity developing in the dredge pond, and its effects on the local environment.

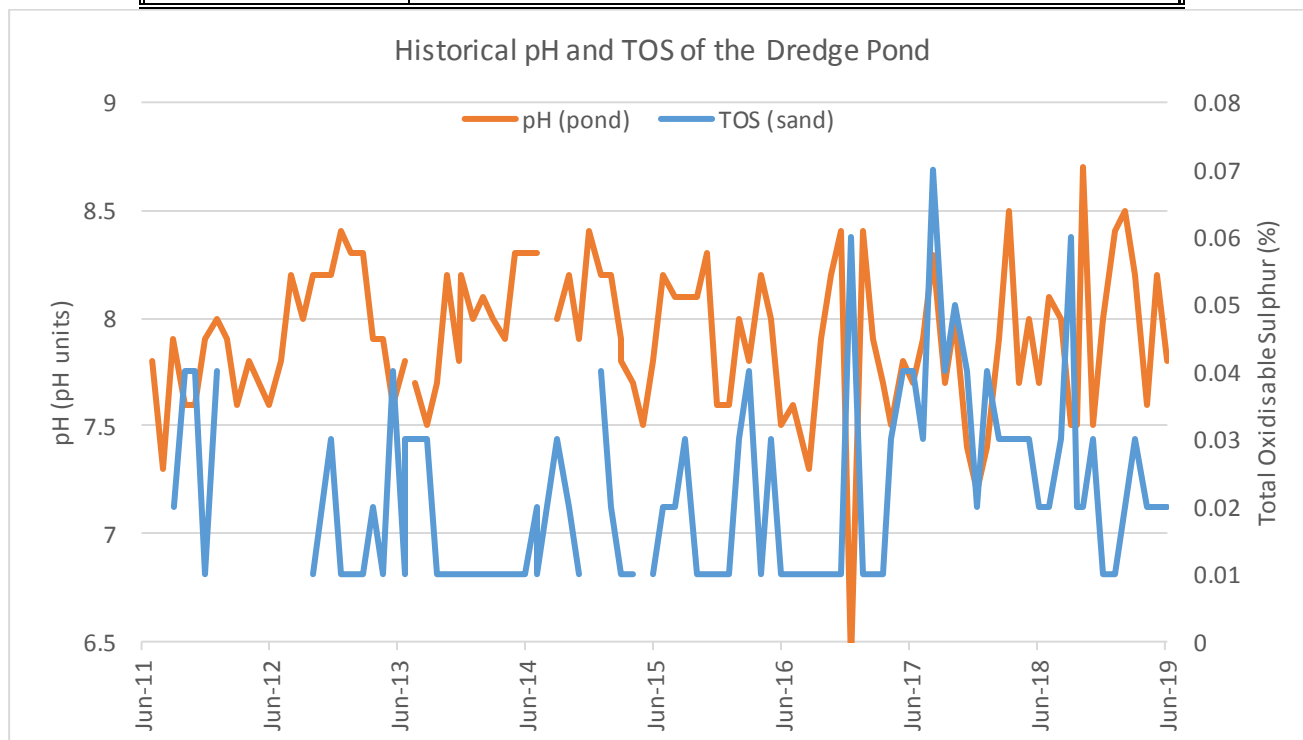
4.8.2. Environmental Performance

Stockpiles were examined regularly during the reporting period, and where leachate was present, pH was sampled. Water sampling of the dredge pond water was also undertaken on a monthly basis, as described in Section 4.3. Sampling of stockpiles was also undertaken for pH and the concentration of total oxidisable sulphur in the washed sand. The sand stockpiles are oriented to ensure runoff was towards the dredge pond and the sand also tested to ensure it could be used in concrete manufacture.

4.8.3. Acid Sulphate Monitoring

Progressive pH testing has not yet found any results outside the desired range of 6.5 – 9 pH units in the current reporting period. During the year, the constituency of the sand has had some minor variability, as dredging continues through areas previously dredged. This has led to a short-lived spike in total oxidisable sulphur (TOS), which has since returned to the very low historical range. A summary of the results of TOS of the extracted sand and pH of the dredge pond water is shown in the table below, with a graphical representation of historical trends also shown.

Parameter	2018/19 Reporting Period			Historical Results		
	Min	Average	Max	Min	Average	Max
pH (pH units)	7.5	8.0	8.7	6.4	7.9	8.5
TOS (%)	0.02	0.03	0.06	0.01	0.02	0.07
DC Criteria	N/A					
EA Predictions	N/A					



4.8.4. Acid Sulphate Monitoring Results Interpretation

As detailed above, testing indicates that the sand extracted for the period could not be considered an acid sulphate soil, with all results generally low and within the historical range with only a single anomalous sample in September 2018.

Current strategies described above to minimise the risk of adverse impacts from acid sulphate soils have been effective during the current reporting year, which is supported by the stable water and soil quality of the site.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to acid sulphate soils in the 2018-2019 reporting period.

4.9. General Environmental Management & Reporting

4.9.1. Licence Requirements

The EPL has various conditions regarding general environmental performance including reporting requirements for complaints, environmental harm and lodgement of an annual return.

The DC includes various environmental management and reporting procedural requirements that are implemented in the sites QEMP. The conditions that required attention beyond implementation into the QEMP are assessed below.

4.9.2. Performance Criteria and Compliance Assessment

Cleary Bros employs an authorised Environmental Officer to manage all compliance activities at the site, in association with the Quarry Manager.

4.10. Traffic Management

4.10.1. Licence Requirements

The DC requires Cleary Bros to ensure that no truck associated with the project uses Gerroa Road, except where the destination lies along or adjacent to that road.

4.10.2. Compliance Assessment

Cleary Bros Work Instructions for the site indicates which roads are to be used when entering and exiting the site and further prohibits incidental use of Gerroa road. Staff are trained in these Work Instructions regularly.

4.11. Independent Environmental Audit

4.11.1. Licence Requirements

The DC requires Cleary Bros to commission and carry out an Independent Environmental Audit within 12 months of the commencement of the Project and every three years thereafter..

4.11.2. Compliance Assessment

Cleary Bros commissioned ERM and Kevin Mills and Associates to carry out the third Independent Environmental Audit in November 2016. No “high” or “medium” non-compliances with the Site’s Environmental Protection Licence or Development Consent were identified in the audit. A copy of the audit was sent to the EPA, Kiama Council, Shoalhaven Council and the CCC members. A copy of the audit was also posted on Cleary Bros web site.

The below table summarises the progress of the corrective actions undertaken to address the non-conformances identified in the 2016 Independent Environmental Audit. The next audit is scheduled for November 2019.

Condition Number	Auditor Comment	Auditor Recommendation	Progress of Corrective Actions
Sch 2 Cond 1	A minor leak of diesel fuel was observed adjacent to the diesel above ground storage tank which fuelled the dredged material sorting plant. Staining from the leak extended over <1m ² and appeared to relate to disconnecting the hose from the tank to the plant (rather than an ongoing leak). It is noted that this represents a contractor management issue (i.e. CB did not cause the leak). ERM notes that the minor spill is not likely to be causing material environmental harm. However, best practice would dictate that the spills should be cleaned up.	Work with contractor to develop procedure to uncouple fuel lines from plant without causing spill. Refresh training regarding spill response with contractor. The diesel impacted sand should be excavated, classified in accordance with the NSW Waste Classification Guidelines, and disposed of using a suitably licenced contractor to an appropriately licenced facility.	Completed. Contaminated soil excavated and disposed of as per Waste Regulations. Diesel tank replaced with bunded tank to prevent future spills.
Sch 3 Cond 31	Drivers are inducted when they first visit the site by the Site Manager. The induction materials had recently been updated and did not include details of the correct and legal routes to take for drivers. Instructions are posted in the site office, where trucks are required to sign in, which outline the correct routes for trucks to take.	ERM recommends that the driver induction materials are amended to include details of the correct and legal routes to take for drivers under the conditions of consent.	Completed. Site induction updated to include approved truck routes.
Sch 3 Cond 32	Drivers are inducted when they first visit the site by the Site Manager. The induction materials had recently been updated and did not include details of the correct and legal routes to take for drivers. Instructions are posted in the gatehouse, where trucks are required to sign in, which outline the correct routes for trucks to take.	ERM recommends that the driver induction materials are amended to include details of the correct and legal routes to take for drivers under the conditions of consent.	Approved truck routes also displayed on site office and provided as a handout to all truck drivers.
Sch 5 Cond 1	ERM observed that the number in QEMP 24hr complaints line does not match number on website. CB informed ERM that the website	Ensure the complaints hotline number, the contact details on	Completed

Condition Number	Auditor Comment	Auditor Recommendation	Progress of Corrective Actions
	was currently being redesigned, which will include the realignment of relevant contact numbers.	the gate and on the CB website are consistent.	Website, signage, and QEMP updated for consistency.
Sch 5 Cond 7	CB provided the basis of the bond calculations. This appeared to be in compliance with the requirements of the development consent. However, it is noted that correspondence from the DP&E stated the following regarding the bond: "For Gerroa, although the calculation accounts for the entire disturbance area, inflation has not been accounted for since this time. We request that at the time of the Albion Pk bond recalculation in Oct 2017; that a review of the Gerroa bond is also undertaken to account for the effects of inflation."	Ensure Gerroa bond calculation considers inflation when Albion Park bond calculation is undertaken in October 2017	Completed. Gerroa bond recalculated in January 2017. Revised bond lodged with DPE in April 2017.
Sch 3 Cond 16	CB submitted a copy of the signed Planning Agreement to DoPI on 18 November 2013 Awaiting execution by the Minister before registering Agreement	Awaiting execution by the Minister before registering Agreement	CB are still awaiting execution by the DPE

5. Conclusion

The key issue identified in this AEMR is the continuing departure of surface and ground water quality from the objective levels listed in the DC. However monitoring undertaken in the current reporting period demonstrates that the water quality is generally consistent with historical levels, with no deterioration in groundwater or surface water quality related to dredging operations.

Site conditions during the current reporting period were largely impacted by the continuing below average rainfall experienced, causing an extensive rainfall deficit. This is supported by the NSW Department of Primary Industry characterising the area as drought affected as of July 2019. This has led to low water levels in all groundwater monitoring bores on site. However despite the dry conditions, surface and ground water quality has been relatively unaffected, with only a minor increase in ion concentrations measured across the monitoring network. At such dry times, any adverse impacts that may be associated with site activities would likely be heightened, however the monitoring conducted during the current reporting period has conversely shown that dredging activities are having minimal impact on the quality of the surface and ground water resources of the area. Furthermore, the health of the groundwater dependent ecosystems in the vicinity of the site have shown no obvious signs of stress during the current reporting period. Conversely, the vegetation growth across the planted areas of the site has been excellent in the current reporting period, despite the adverse climatic conditions.

Generally the site is performing well within the individual criteria and limits assigned to it in regard to environmental performance. The low number of non-compliances in conjunction with the absence of community complaints shows that Cleary Bros have maintained good environmental management performance during the reporting period.

Annexure A

Return to Department of Trade and Investment,
Resources and Energy Return 2017/2018



RETURN FOR EXTRACTIVE MATERIALS: YEAR ENDED 30 JUNE 2018

Quote RIMS ID in all correspondence

Quarry Id: 4507	Rims ID: 400491	Inquiries please telephone: (02) 4063 6713	2 0 1 7 - 2 0 1 8
Operators Name: Address:	CLEARY BROS (BOMBO) PTY LTD PO BOX 210 PORT KEMBLA NSW 2505	Completed or Nil Returns Email – mineral.royalty@planning.nsw.gov.au Postal Address (see below)	
Email:			
Quarry Name: Quarry Address:	GERROA SAND RESOURCE CNR BEACH RD & CROOKED RIVER RD	Please amend name, postal address and location of mine or quarry if incorrect or incomplete.	

The return should be completed and forwarded to the **MANAGER, ASSESSMENT COORDINATION, RESOURCE OPERATIONS, NSW DEPARTMENT OF PLANNING & ENVIRONMENT, PO BOX 344 HUNTER REGION MAIL CENTRE NSW 2310 on or before 30 November 2018**. If completion of the return is unavoidably delayed, an application for extension of time should be requested **before** the due date. If no work was done during the year, a **NIL** return must be forwarded.

The return should relate to the **above quarrying establishment**, and should cover the operations of quarrying and treatment (such as crushing, screening, washing etc.) carried out at or near the quarry. A return is required even if the operations are solely of a developmental nature, and whether the area being worked is held under a mining title or otherwise.

Director, Title Assessments

Please complete all of the following information to assist in identifying the location of the Quarry

Typical Geology _Sand_____

Nearest Town to Quarry _Gerroa_____

Local Council Name _Kiama Municipal Council; Shoalhaven Regional Council_____

Deposited Plan and Lot Number/s of Quarry _Lot A DP185785, Lot 2 DP1111012_____

Email Address of Operator _____

Name of Owner or Licensee _Cleary Bros (Bombo) Pty Ltd_____

Postal Address of Licensee _PO Box 210, Port Kembla NSW 2505_____

Licence/Lease Number/s (if any)
From Mineral Resources NSW (Industry & Investment NSW) _____

From Department of Lands or other Department _____

If any output was obtained from land NOT held under licence from the above Departments, state the Name/s and Address/es of the Owners of the land _Bridon Pty Ltd, PO Box 210, Port Kembla NSW 2505_____

- To the best of my knowledge, the particulars which have been entered in this return are correct and no blank spaces have been left where figures should have been inserted.

• **SIGNATURE of PROPRIETOR or MANAGER** _____ **DATE** 25/10/2018

• **CONTACT PERSON for this return** _____

• **NAME** (Block letters) _____ **Telephone** _____

SALES During 2017-2018

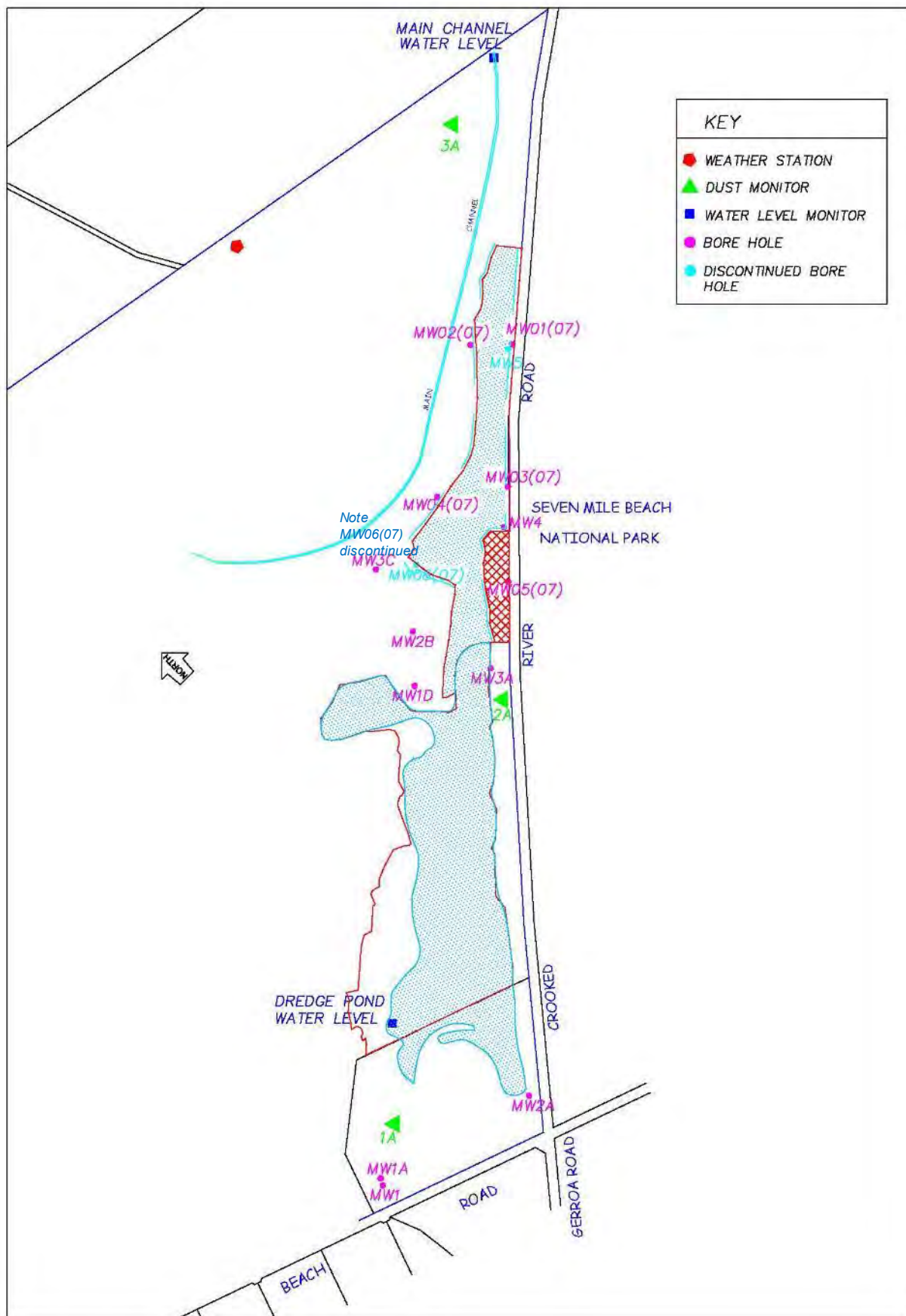
Production information may be published in aggregated form for statistical reporting. However, production data for individual operations is kept strictly confidential.

Product	Description	Quantity Tonnes
Virgin Materials		
• Crushed Coarse Aggregates		
Over 75mm		-
Over 30mm to 75mm		-
5mm to 30mm		-
Under 5mm		-
Natural Sand		-
Manufactured Sand		-
Prepared Road Base & Sub Base		-
Other Unprocessed Materials		-
Recycled Materials		
• Crushed Coarse Aggregates		
Over 75mm		-
Over 30mm to 75mm		-
5mm to 30mm		-
Under 5mm		-
Natural Sand		-
Manufactured Sand		-
Prepared Road Base & Sub Base		-
Other Unprocessed Materials		-
• River Gravel		
Over 30mm		-
5mm to 30mm		-
Under 5mm		-
• Construction Sand	Excluding Industrial	49,128
• Industrial Sand		
Foundry, Moulding		-
Glass		-
Other (Specify)		-
• Dimension Stone	Building, Ornamental, Monumental	
Quarried in Blocks		-
Quarried in Slabs		-
• Decorative Aggregate	Including Terrazzo	-
• Loam	Soil for Topdressing, Garden soil, Horticultural purposes)	-
• TOTAL SITE PRODUCTION		49,128
• Gross Value (\$) of all Sales		
• Type of Material	Sand	
• Number of Full-Time Equivalent (FTE) Employees	Employees: 3	Contractors: 3

Please Note: A return for clay based products can be obtained by contacting the inquiry number.

Annexure B

Environmental Monitoring Locations



Annexure B – Environmental Monitoring Locations

Annexure C

2018/19 Environmental Monitoring Results

Groundwater Monitoring Results

	pH (pH units)				EC (µS/cm)				Total Phosphorus (µg/L)				Total Nitrogen (µg/L)			
	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19
MW1	5.6	5.4	5.6	5.8	7760	7700	6490	8010	360	130	370	150	3200	2900	3600	2600
MW1A	dry	dry	dry	5.6	dry	dry	dry	244	dry	dry	dry	210	dry	dry	dry	7600
MW1D	6.7	6.9	6.3	7.3	626	723	706	813	90	70	110	120	700	70	1200	1100
MW2A	6.1	6.6	6.2	7.1	466	467	397	439	90	200	290	170	500	200	700	400
MW2B	6.9	7.1	6.3	7.6	615	808	656	645	100	80	40	100	500	80	1100	800
MW3A	6.8	7.4	6.8	7.6	552	509	467	553	80	110	130	200	200	400	1200	1100
MW3C	6.8	7.4	7	7.3	600	600	530	663	80	110	80	90	500	400	600	600
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	6	4.4	6.2	4.8	525	948	493	620	40	80	220	40	700	5000	2000	1300
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	6.8	7.4	6.9	7.6	728	775	483	772	620	700	570	890	1100	1000	1400	1700
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
	Sodium (mg/L)				Potassium (mg/L)				Magnesium (mg/L)				Chloride (mg/L)			
	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19
MW1	1320	1310	1320	1340	4	4	4	4	172	167	167	172	2510	1790	2390	1960
MW1A	dry	dry	dry	27	dry	dry	dry	5	dry	dry	dry	6	dry	dry	dry	44
MW1D	54	58	58	57	3	3	2	4	14	17	16	19	62	68	102	76
MW2A	24	16	21	19	2	2	2	2	5	6	6	7	21	23	46	26
MW2B	42	60	60	46	3	3	2	2	10	14	11	11	67	128	127	69
MW3A	40	39	30	28	2	2	2	2	7	7	6	8	57	43	42	45
MW3C	49	45	47	48	4	4	4	3	11	11	10	12	62	60	77	60
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	52	75	52	42	6	3	4	3	12	39	10	24	66	58	86	52
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	67	74	76	77	6	7	8	8	18	19	15	19	104	106	115	119
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
	Sulphate (mg/L)				Bicarbonate (mg/L)				Soluble Iron (mg/L)				Ammonium (mg/L)			
	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19
MW1	423	425	440	405	7	<1	34	29	35.5	40.1	50.3	43.9	1.97	1.84	1.13	2.17
MW1A	dry	dry	dry	6	dry	dry	dry	5	dry	dry	dry	0.4	dry	dry	dry	0.02
MW1D	24	33	60	45	167	205	183	199	0.53	0.26	0.23	0.41	0.22	0.28	0.23	0.14
MW2A	13	17	22	9	139	142	98	129	27.6	2.53	8.56	25.8	0.07	0.38	0.05	0.04
MW2B	24	44	21	8	148	172	158	171	0.79	0.79	1.64	1.76	0.3	0.52	0.59	0.41
MW3A	13	15	20	24	159	169	170	164	1.34	1.75	1.1	1.48	0.06	0.1	0.12	0.16
MW3C	21	23	19	66	159	172	160	141	1.41	1.42	1.18	1.73	0.27	0.34	0.25	0.18
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	65	347	50	191	56	<1	72	<1	1.81	10	3.53	3.06	0.26	0.11	0.38	0.04
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	59	70	72	47	135	157	132	134	<0.05	<0.05	<0.05	0.18	0.04	0.08	0.06	0.03
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
	Chlorophyll-a (µg/L)				Faecal Coliforms (CFU/100mL)				Enterococci (CFU/100mL)							
	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19	Sep-18	Dec-18	Mar-19	Jun-19				
MW1	<3	<2	<4	<2	<2	<2	<2	~4	<2	<2	<2	<2				
MW1A	dry	dry	dry	<1	dry	dry	dry	880	dry	dry	dry	100				
MW1D	<1	<2	<1	<1	<2	<2	~2	~6	<2	<2	~2	~8				
MW2A	<1	<3	<1	<1	<2	<2	<2	22	<2	<2	<2	~4				
MW2B	<1	<1	<1	<1	<2	~<2	~2	~8	<2	<2	~2	20				
MW3A	<1	<1	<1	<1	~2	~<2	~82	500	<2	<2	<2	42				
MW3C	<1	<1	<1	<1	<2	~<2	~<2	22	<2	<2	~2	44				
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry				
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry				
MW02(07)	<1	<1	0.35	<1	<2	<2	<2	40	<2	<2	44	~12				
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry				
MW04(07)	<2	<7	<2	<1	<2	~<2	~<2	36	~4	<2	~10	~10				
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry				

Groundwater and Surface Water Level Monitoring Results

(mAHD)	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
MW1	1.19	1.02	0.86	0.69	0.88	0.79	1.06	1.09	0.83	0.81	0.85	0.58
MW1A	2.93	dry	dry	3.12	dry	dry	3.11	dry	dry	3.05	dry	3.14
MW1D	0.79	0.62	0.63	0.7	0.64	0.61	0.69	0.58	0.44	0.67	0.57	0.71
MW2A	0.66	0.55	0.63	0.56	0.54	0.56	0.61	0.54	0.44	0.59	0.53	0.59
MW2B	0.8	0.63	0.63	0.73	0.65	0.62	0.73	0.59	0.51	0.7	0.58	0.78
MW3A	0.68	0.58	0.58	0.59	0.57	0.57	0.63	0.57	0.47	0.61	0.54	0.62
MW3C	0.77	0.56	0.6	0.72	0.64	0.59	0.71	0.55	0.39	0.69	0.53	0.8
MW4	dry	0.55	dry	0.45	dry	dry	0.45	dry	dry	0.45	0.45	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	0.6	0.47	0.51	0.56	0.53	0.49	0.53	0.48	0.39	0.52	0.48	0.62
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	0.52	0.41	0.43	0.47	0.43	0.41	0.47	0.4	0.28	0.45	0.42	0.52
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Dredge Pond	0.8	0.5	0.5	0.8	0.6	0.6	0.6	0.7	0.6	0.6	0.9	0.7
Channel (depth)	0.6	0.8	0.4	0.65	0.6	0.4	0.4	0.4	0.2	0.2	0.6	0.7

Dredge Pond Surface Water Monitoring Results

	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
EC (µS/cm)	721	828	774	749	779	762	729	752	744	835	793	822
pH (pH units)	8.1	8	7.5	8.7	7.5	8	8.4	8.5	8.2	7.6	8.2	7.8
Total Algae (cells/mL)			730			235000			2070000			236000
Cyanophyta (cells/mL)			<5			230000			2070000			233000
Total Phosphorus (µg/L)			<10			10			30			20
Total Nitrogen (µg/L)			300			400			1100			700
Chlorophyll-a (µg/L)			22			5			12			14
Faecal Coliforms (CFU/100mL)			22			72			~200			120
Enterococci (CFU/100mL)			~10			28			80			44
Sodium (mg/L)			74			73			81			74
Potassium (mg/L)			7			7			6			6
Magnesium (mg/L)			19			19			17			20
Chloride (mg/L)			113			106			115			103
Sulphate (mg/L)			66			70			78			109
Bicarbonate (mg/L)			146			157			121			128
Soluble Iron (mg/L)			<0.05			<0.05			<0.05			0.08
Ammonium (mg/L)			<0.01			0.36			0.04			<0.01
Turbidity (NTU)			3.4			3.5			12.5			17.7
Dissolved Oxygen (mg/L)			10.5			7.86			6.22			9.39
Dissolved Oxygen (%)			107			87.8			72.8			87.1

Air Quality Monitoring Results – Depositional Dust Gauges

TIS (g/m2/month)	1A	2A	3A
Jul-18	0.5	1.1	0.4
Aug-18	1.1	4.9	0.7
Sep-18	3.3	2.9	0.3
Oct-18	2.0	1.5	0.3
Nov-18	2.2	2.6	0.5
Dec-18	*	4.6	1.2
Jan-19	1.3	1.8	1.7
Feb-19	2.0	2.5	1.2
Mar-19	5.5	4.4	2.8
Apr-19	2.6	2.2	0.5
May-19	1.6	4.3	2.2
Jun-19	1.4	2.1	2.0
*Sample bottle damaged - no sample collected			

Acid Sulphate Monitoring

	TOS (%)
Jul-18	0.02
Aug-18	0.03
Sep-18	0.06
Sep-18	0.02
Oct-18	0.02
Nov-18	0.03
Dec-18	<0.02
Jan-19	<0.02
Feb-19	0.02
Mar-19	0.03
Apr-19	0.02
May-19	0.02
Jun-19	0.02

Annexure D

Eleventh Annual Review

Vegetation Management Plan

Niche Environment and Heritage

17 July 2019

Gerroa Sand Quarry

Annual Review

Vegetation Management Plan

Prepared for Cleary Bros (Bombo) Pty Limited | 17 July 2019



Document control

Project number	Client	Project manager	LGA
5123	Cleary Bros (Bombo) Pty Limited	Simon Tweed	Kiama

Version	Author	Review	Status	Date
D1	Sarah Hart	Sian Griffiths	Draft	9 July 2019
R0	Sarah Hart	Simon Tweed	Draft	15 July 2019
R0	Sarah Hart	Mark Hammond (Cleary Bros.)	Draft	16 July 2019
R1	Sarah Hart	Simon Tweed	Final	17 July 2019

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Table of Contents

Table of Contents	ii
1. Vegetation Management Annual Report	3
1.1 Introduction	3
1.2 Background	3
2. Assessment of Individual Zones.....	4
3. Conclusion and recommendations	10
4. References	11
5. Figures	12
Appendix 1 Selected Conditions of Approval	14
Appendix 2 Priority weeds for the South East region, <i>Biosecurity Act 2015</i>.	16

List of Figures

Figure 1: 2018/2019 Annual Update	13
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1. Vegetation Management Annual Report

1.1 Introduction

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by Cleary Bros (Bombo) Pty Limited (Cleary Bros) to complete the annual rehabilitation monitoring associated with the Gerroa Sand Quarry (the Project), located at the corner of Beach Road and Crooked River Road, Berry (the Site).

The primary objective of this report is to update any necessary control measures required with regards to priority weed management within the designated zones across the site and provide advice on any management actions that can be implemented to encourage the rehabilitation of the Site.

Primarily, this report aims to meet the Conditions of Approval granted by the NSW Land and Environment Court for the extension of the Gerroa Sand Quarry, operated by Cleary Bros (Bombo) Pty Limited (see Appendix 1 Selected Conditions of Approval). This report satisfies the condition requiring an annual report on the progress of the revegetation project.

This report is the 11th such annual report covering the site at Gerroa prepared since 2009. This report is based on inspections undertaken in first week of July 2019.

1.2 Background

Cleary Bros have undertaken annual monitoring of the Gerroa Sand Quarry since 2009. The sites mentioned in this report are those consistent with the document “Landscape and Rehabilitation Management Plan, Extension and Continuation of Gerroa Sand Quarry, Municipality of Kiama, City of Shoalhaven” Kevin Mills & Associates (KMA) (2008), which is the Court approved management plan for the Site.

This report is the annual inspection for the year 2018/2019; a similar report has been prepared annually since the beginning of the quarry expansion by Kevin Mills & Associates. The following has occurred at the Site in recent years (KMA 2018):

- The ‘Northern Corridor’ has been shown to be successful in terms of creating habitat and use by native animals, as compared to the ‘East-West Link’.
- The quarry has moved northwards and the forest in the East-West Link has been removed, the quarry subsequently reaching its most northern limit.
- Quarterly inspections and reports have continued to be undertaken during 2018-19, providing regular scrutiny of the progress of the revegetation/rehabilitation areas.
- All plantings within the designated revegetation areas have been completed and these areas are now in maintenance phase.
- Significant effort has been made to reduce the extent of Lantana on the Site through herbicide spraying.

Recent annual reports have detailed inspections of the revegetation areas with a view to analysing the progress towards native dominant forest and making relevant recommendations to improve management outcomes if required. There have been no wildlife surveys since 2016 as this was deemed no longer necessary by KMA (2018).

Note that the background information, detailed description of survey methods and the extensive survey information from the first nine years of reporting are contained in the earlier reports; this information is not repeated here.

In all planting areas, weeds have been controlled since the early stages of the project and are now considered to be well controlled within the planting areas. In this case, the zone descriptions below are provided as an indication of the weed situation in the current survey.

2. Assessment of Individual Zones

Planting was completed in all zones some time ago, these are now in the maintenance phase. A recent planting in Zone 2C.1 to expand the Northern Corridor area is also now in the maintenance phase and will require further works. Over the previous year, all zones were inspected by Cleary Bros staff and assessed during quarterly inspections.

Blue Angle Creek runs through the site and influences access during certain times of the year, during wetter months the paddocks become inundated with water and make it difficult to access particular zones (5, 5C.1, 2C.2, 2D, 2E, 1.4). Work and inspections are therefore only conducted in these zones when access is safe and achievable.

The following recommendations for the management zones (Figure 1) were made following the site inspection on 5 July 2019 conducted by ecologists Sarah Hart and David Wilkinson. See Appendix 2 Priority weeds for the South East region, *Biosecurity Act 2015*. for further detail on control of specific priority weed species.

The recommendations for the management zones are detailed below in Table 1.

Table 1: Recommendations for the management zones

Zone	Location/description	Recommendations for ongoing works 2019/2020
Zone 1 Forest Enhancement Zone Objectives (41.95ha) <ul style="list-style-type: none"> • Improve the quality of the forest by removal of weeds • Restrict access to grazing stock • Monitor the health of the forest • Strengthen tree cover south of previous dredge pond • 20 hours of weed control has been conducted over the last year in Zone 1 • Work in the past has included Lantana control and removal of some selected weeds such as Bitou Bush. Weed management is ongoing and is guided by the Weed Management Plan for the site (KMA 2008) 		
Subzone 1.1	Main area of existing forest, extending from the northern to near the southern extremities of the Site	<ul style="list-style-type: none"> • Lantana removal and spraying, generally along the edges and near tracks • Removal of various environmental weeds also along edges and tracks • Weed management within disturbed open area in middle of subzone 1.1 near track and subzone 2A.3; Cockspur Coral Tree (<i>Erythrina crista-galli</i>), Cape Ivy (<i>Delairea odorata</i>), Tobacco Bush (<i>Solanum mauritianum</i>), Maderia vine (<i>Anredera cordifolia</i>) and Lantana (<i>Lantana camara</i>).
Subzone 1.2	Covers the forest around the eastern and southern sides of the old dredge pond, which was planted many years ago. Lantana control is an ongoing management requirement.	<ul style="list-style-type: none"> • Lantana control (removal and chemical spraying), mainly along the edges and tracks • Adjacent to Crooked River Road, larger narrow patches of Lantana present with native species appearing. Continue with mosaic methods of weed removal (i.e. working in patches).
Subzone 1.3	Covers the old bund wall that was planted with trees long ago, behind the site office and towards the front gate.	<ul style="list-style-type: none"> • Monitor for Lantana and other environmental weeds. Control weeds upon establishment if required.
Subzone 1.4	A fenced patch of Swamp Oak within grazing land, which now has a planted link to the east (planting zone 2E). It is well established and requires very little ongoing work	<ul style="list-style-type: none"> • Monitor for any priority weeds and control as necessary.

Zone	Location/description	Recommendations for ongoing works 2019/2020
Zone 2 Broad scale planting zone Objectives (25.39 ha) <ul style="list-style-type: none"> Develop habitat by planting forest communities in accordance with the Landscape and Rehabilitation Management Plan (KMA 2008) Establish stronger habitat corridors to the north and south of the existing forest Monitor plantings and take action where necessary Strengthen east-west and north-south links between the preserved forest and Seven Mile Beach National Park. 96 hours of weed control has been conducted over the last year in Zone 2 1,230 tube stock plants have been planted across Zone 2, primarily in 2C1 to extend the Northern Corridor of adjoining vegetation (subzones 1.1, 2A.1, and 2C.1) 		
Subzone 2A.1	The prime area for developing the forested link in the northeast of the site; i.e. establishing the northern corridor including Zone 2A.1, 1.1 and 2C.1. Extensive work has been carried out over the past nine years to develop this area as habitat for native fauna.	<ul style="list-style-type: none"> Monitor for African Lovegrass (<i>Eragrostis curvula</i>) and Rhodes Grass (<i>Chloris gayana</i>) as previously targeted in the area. Maintain Lantana control along track edges and control any emerging Tobacco Bush.
Subzone 2A.2	Is important for the forest link to the south and into Seven Mile Beach National Park on the southern side of Beach Road. Good tree growth continues in most places. Re-spraying has recently occurred where necessary to control invasive grasses (2018/2019). Most of the planted Swamp Oak (<i>Casuarina glauca</i>) in the north died inexplicably; 24 replacement trees were subsequently planted in the previous year to fill the gap (KMA 2018). Monitor growth over the next year (2019/2020) and remove any tree guards of mature trees within the area.	<ul style="list-style-type: none"> Maintain control for Lantana and other environmental weeds as they occur.
Subzone 2A.3	Planted early in the re-planting program but experienced considerable obstacles with tree survival and growth. One obstacle has been Swamp Wallaby browsing on the new growth. However, there was obvious growth on trees during inspections in the previous 12 months.	<ul style="list-style-type: none"> Monitor growth of planting. Maintain weed control as subzone 2A3 adjoins a large area of subzone 1.1, which supports a variety of weeds species such as; Lantana and Cockspur Coral Trees.
Subzone 2B.2	Very low lying and is being colonised by Swamp Oak and a few other native trees without the need for further planting. Some planting was carried out on a higher part of the subzone in the south and west in previous years (KMA 2018).	<ul style="list-style-type: none"> Monitor for Lantana and control as required. Remove any unnecessary tree guards. Control any exotic grasses competing with plantings.

Zone	Location/description	Recommendations for ongoing works 2019/2020
Subzone 2B.3	A narrow area which required regeneration to link the creek-side forest to that within Zone 4. The subzone was spread with topsoil and some timber debris, and some plantings were undertaken. Considerable growth of the plantings has since been noted, which are well above the ground cover and are free from competition from Kikuyu Grass, etc.	<ul style="list-style-type: none"> Monitor for Lantana and control as required.
Subzone 2C.1	A long area which has been completely planted out. There is a potential for some more mature trees to be planted throughout the northern extent if any are made available at the local nursery. Mostly the growth of plantings is very good to satisfactory. Weed control (spraying) has been carried out across parts of the subzone, including far northern edge around small trees.	<ul style="list-style-type: none"> Remove any unnecessary tree guards, focus on the southern and middle section of the subzone. Spray Lantana that appears around plantings. Maintain control of Fireweed (<i>Senecio madagascariensis</i>) in the paddocks along edges of this zone.
Subzone 2C.2	A long narrow area supporting well advanced plantings, some being several metres tall.	<ul style="list-style-type: none"> Monitor growth of plants and manage weed species as they appear (Lantana and Blackberry (<i>Rubus fruticosus</i>)).
Subzone 2D	Modified some time ago to a triangular area between subzones 2E and 2D. This area was originally sprayed and partly spread with timber mulch prior to plantings. Growth since last year has been good. This area is prone to water inundation during wetter months, limiting some access to areas.	<ul style="list-style-type: none"> Monitor plantings and growth. Remove any unnecessary tree guards (some have moved due to weather and animals). Maintain weed control of Blackberry, Moth Vine (<i>Araujia sericifera</i>) and Lantana.
Subzone 2E	Planted out for some time and tree growth is progressing well, some trees are over six metres tall. This narrow strip of trees extends into subzone 1.4, an established area of trees.	<ul style="list-style-type: none"> Ensure stock do not enter this subzone. Monitor and control any weed species that occur.
Zone 3 Screen Planting Zone Objectives (0.42 ha) <ul style="list-style-type: none"> Establish a screen of native vegetation along the eastern edge of pond extension Maintain existing trees on south eastern boundary, remove Lantana and replace with native plantings 12 hours of weed control has been conducted over the last year in Zone 3 		
Zone 3	Includes the bund wall which reached its final height early in 2015. Most of the trees planted along the fence have survived and provide a useful addition to the bund wall. The sand bund is stabilised by growth of plants, mostly weeds.	<ul style="list-style-type: none"> Monitor bank stability and maintain weed control around planted natives as necessary.

Zone	Location/description	Recommendations for ongoing works 2019/2020
Zone 4 Bangalay Sand Forest (3.32 ha) <ul style="list-style-type: none"> Restrict access to grazing stock Establish a forest link to nearby larger area through plantings Monitor the health of the forest Remove weeds when required Seven hours of weed control has been conducted over the last year in Zone 4 		
Zone 4	A natural stand of Bangalay trees with a native understorey. Lantana has been removed from this zone in the past and is targeted during maintenance.	<ul style="list-style-type: none"> Monitor and control of Lantana as necessary.
Zone 5 Zone 5 Swamp Oak Forest Objectives (1.82 ha) <ul style="list-style-type: none"> Restrict access to grazing stock Establish a forest link to nearby larger area through plantings Monitor the health of the forest Remove weeds when required Two hours of weed control has been conducted over the last year in Zone 5 		
Zone 5	Supports a small fenced stand of natural Swamp Oak forest; the trees are quite dense with a native/weedy grassy understorey.	<ul style="list-style-type: none"> Remove unnecessary tree guards, some have moved into Zone 5 during wet weather. Control weeds such as Small-leaved Privet (<i>Ligustrum sinense</i>), Blackberry, Cockspur Coral Tree and Lantana.
Zone 5C.1	Occurs between the above forest and the creek that has been planted, although the area is dominated by Kikuyu Grass. The shrub <i>Melaleuca ericifolia</i> is expanding out from the creek-side.	<ul style="list-style-type: none"> Remove unnecessary tree guards Control weeds such as Blackberry, Cockspur Coral Tree and Lantana.
Zone 6: Dredge Pond Foreshore Objectives (not displayed on map) Dredge Pond Foreshore (includes 5m setback from pond and batter slopes on both the existing and extension pond) <ul style="list-style-type: none"> Stabilise the batters on the edges of the dredge pond Undertake plantings within the 5 m set back area along the edge of the retained littoral forest (Zone 7) ahead of the quarrying operation Continue rehabilitation of previous dredge pond areas Eight hours of weed control has been conducted over the last year in Zone 6 		

Zone	Location/description	Recommendations for ongoing works 2019/2020
Zone 6	Occurs within the foreshore areas of the Dredge Pond and it has been shaped, topsoil spread and planted as the dredge pond has progressed northwards. The pond banks are stable and erosion is not obvious. Considerable growth of colonising plants, mainly grasses, is occurring on the newest batter slopes. Trees are appearing on the older batter slopes.	<ul style="list-style-type: none"> Monitor and control of priority weeds such as Lantana as necessary and environmental weeds as they appear.
Zone 7 Littoral Rainforest Objectives (0.95 ha) <ul style="list-style-type: none"> Control weeds, particularly Lantana Monitor the health of the forest Protect the western edges of the site from quarrying Ensure that the felling of trees does not impact the vegetation in this area Ten hours of weed control has been conducted over the last year in Zone 7 		
Zone 7	Occurs along the eastern edge of the Site and has cultural significance, therefore minor works on Lantana have been conducted over time as necessary, between Zone 1.2 and Zone 3.	<ul style="list-style-type: none"> Monitor and control Lantana as necessary. Continue with mosaic methods of weed removal (i.e. working in patches).
Zone 8 the work area Objectives (not displayed on map) <ul style="list-style-type: none"> Control priority and environmental weeds 		
Zone 8	Occurs along the western side of the southern part of the dredge pond, supports largely bare ground and mainly abuts the forest within Zone 1.1.	<ul style="list-style-type: none"> Continue monitoring the zone and remove any priority or environmental weeds as they appear.

3. Conclusion and recommendations

Previous annual reports have reported on the success of plantings across the various zones (KMA 2018), this is also true for this 11th annual report. With consistent monitoring and weed management across the zones, the success of plantings has been high. There are some issues with wild animals grazing on new growth (e.g. Swamp Wallabies and Rabbits) but overall the plants are establishing and will continue to grow and thrive.

The Northern Corridor has been in development since the beginning of the Project and as of July 2019 has many mature trees with a growing understorey of native species. This area is being extended with recent planting in Zone 2 C.1.

The quarterly reports completed by Cleary Bros staff have allowed for improved management of priority weeds and the maintenance of fencing or unwanted grazing.

The management zones are in maintenance phase and weed management is on-going in all zones as per the recommendations of this report.

4. References

Cleary Bros (Bombo) (2018). Vegetation Management Plan, Albion Park Hard Rock Quarry. The Company, Port Kembla.

Kevin Mills & Associates Mills (2008). Landscape and Rehabilitation Management Plan, Extension and continuation of Gerroa Sand Quarry, Prepared for Municipality of Kiama, City of Shoalhaven, Cleary Bros (Bombo) Pty Limited. Cleary Bros (Bombo), Port Kembla, October.

Kevin Mills & Associates (2018). Tenth Annual Report, Flora and Fauna Monitoring Surveys, Gerroa Sand Quarry, Municipality of Kiama. Report prepared for Cleary Bros. (Bombo) Pty Ltd, June.

OEH (2017) Biodiversity Assessment Method. Office of Environment and Heritage. Dated August 2017.

Standards Reference Group SERA (2017) National Standards for the Practice of Ecological Restoration in Australia. Second Edition. Society for Ecological Restoration Australasia.

5. Figures



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Appendix 1 Selected Conditions of Approval

“Condition 17.

The Proponent shall:

- (b) ensure that within 4 years of the date of this approval, the additional plantings in the Northern Corridor and Southern Rehabilitation Area are comprised of at least 60% of the plant species recorded for the representative plant communities in the quarry extension area, such as Bangalay Sand Forest and Littoral Rainforest;

Condition 20.

The proponent shall

- (a) commence Compensatory Planting and the vegetation screen along the Crooked River Road frontage north of the east-west link (as shown conceptually in Appendix 3) within 12 months of the date of this approval or when sufficient propagation material has been collected; and
- (b) not sever the east-west link until it can be demonstrated to the satisfaction of the director-general that the established communities represented in the northern corridor comprise at least 60% of the native flora species as set out in Appendix 6 and the Northern Corridor is successful according to the criteria in Condition 25 to the satisfaction of the director-general.”

Condition 23.

Successful establishment of the Northern Corridor shall be measured by the following criteria:

- (a) presence of native flora species;
- (b) a majority of the flora species recorded from the removed forest occur in the area; (e.g. 60% of flora species recorded in removed forest are present);
- (c) species from all four layers have been planted and at least 50% of the projected cover has been achieved for each of the shrub and ground cover layers;
- (d) self-sustaining native plant populations (e.g. regeneration of a second generation);
- (e) no dominance by single flora species (e.g. Bracken);
- (f) weeds are not significantly impacting on the native vegetation;
- (g) weeds do not represent a majority of the flora species or a higher percentage cover than the native flora species; and
- (h) impacts such as grazing are excluded from the area.

Condition 24.

Successful establishment of fauna habitat in the Northern Corridor would be measured by:

- (a) presence of species;
- (b) a majority of the resident species recorded from the removed forest occur in the area;
- (c) fauna populations are resident in the area;
- (d) pest animals are controlled and not impacting upon the fauna or its habitat; and
- (e) impacts such as grazing are excluded from the area.

Condition 25.

Prior to the severance of the East-West Link the Proponent shall:

- (a) determine the presence of species in both the East-West Link and Northern Corridor by conducting standard animal survey techniques at least twice in the first year (e.g. Elliot trapping for small mammals, pitfall trapping for reptiles, observational surveys for frogs and birds, and spotlighting transects for arboreal animals);
- (b) determine whether a majority of animal species (particularly those determined to be likely to be impacted by fragmentation) utilising the corridor in the East-West Link are present in the conservation area and the Northern Corridor and the re-created link at the northern boundary.”

Appendix 2 Priority weeds for the South East region, *Biosecurity Act 2015*.

Note: this region includes the local council areas of Bega Valley, Eurobodalla, Goulburn, Mulwaree, Hilltops (eastern), Kiama, Queanbeyan-Palerang Regional, Shellharbour, Shoalhaven, Snowy Monaro Regional, Upper Lachlan, Wingecarribee, Wollongong and Yass Valley.

WARNING - ALWAYS READ THE LABEL

Users of agricultural or veterinary chemical products must always read the label and any permit, before using the product, and strictly comply with the directions on the label and the conditions of any permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this information. To view permits or product labels go to the Australian Pesticides and Veterinary Medicines Authority website www.apvma.gov.au

Common name	Scientific name	Duty under <i>Biosecurity Act 2015</i>	Action
African Lovegrass	<i>Eragrostis curvula</i>	Regional Recommended Measure Land managers reduce impacts from the plant on priority assets.	Spot spray new growth if any arise with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/Litre of water.
Bitou bush	<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i>	Biosecurity Zone The Bitou Bush Biosecurity Zone is established for all land within the State except land within 10 kilometres of the mean high water mark of the Pacific Ocean between Cape Byron in the north and Point Perpendicular in the south. Within the Biosecurity Zone this weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone.	If Bitou bush is found, attempt to remove and eradicate the plants where practicable. The weed has previously been recorded within Zone 1.1 and therefore should be monitored for on-going control.
Blackberry	<i>Rubus fruticosus</i> species aggregate	Prohibition on dealings Must not be imported into the State or sold <i>All species in the Rubus fruticosus species aggregate have this requirement, except for the varieties Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smooth Stem, and Thornfree.</i>	Not to be mulched with native species to reduce spread. Hand remove and/or remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/Litre of water.
Fireweed	<i>Senecio madagascariensis</i>	Regional Recommended Measure Exclusion zone: whole of region except the core infestation area of Wollongong, Kiama, Shellharbour,	Herbicides are most effective in combination with healthy, competitive pastures. The best time to treat fireweed with herbicide is late autumn. This controls the peak numbers of seedlings and young plants.

		<p>Eurobodalla, Shoalhaven, Bega Valley and Wingecaribee councils.</p> <p>Whole region: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.</p> <p>Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant.</p> <p>Core area: Land managers reduce impacts from the plant on priority assets.</p>	<p>Spot spray with a 600g/kg Metsulfuron-methyl (Brush off), a broad leaf selective herbicide to avoid harming native grasses, at a diluted rate of 1g/10L of water.</p>
Lantana	<i>Lantana camara</i>	<p>Regional Recommended Measure</p> <p>Exclusion zone: whole region excluding the core infestation area of Eurobodalla, Kiama, Shellharbour, Wollongong and the Shoalhaven local government area north of the Lantana Containment Line at 35°11'42" S</p> <p>Whole region: Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment.</p> <p>Exclusion zone: The plant should be eradicated from the land and the land kept free of the plant. Core area: Land managers reduce impacts from the plant on priority assets.</p>	<p>Gradually control sections of large infestations, starting at the edges. Dry or frosty periods are good times to work on mature lantana plants, treat regrowth or seedlings before they are 1 m high and control young plants before they are a year old to prevent new fruit and seeds.</p> <p>Chemical control:</p> <p>Cut stems off at about 15 cm from the ground. Apply herbicide to the cut surface of the stump within 15 seconds. Treat every cut stem because lantana regrows vigorously from untreated stems or a variety of spot spray especially on new growth if any arise with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/Litre of water.</p>
Maderia Vine	<i>Anredera cordifolia</i>	<p>Prohibition on dealings</p> <p>Must not be imported into the State or sold.</p>	<p>Successful control of Madeira vine requires all the tubers and bulbils to be removed or killed. Control activities are long-term, and require regular follow-up for many years. Single control activities generally cause disturbance that results in vigorous regrowth and can lead to worse infestation levels unless dedicated follow-up occurs.</p>