



# **Gerroa Sand Resource Annual Environmental Management Report**

**Period 01 July 2020 – 30 June 2021**

**Cleary Bros (Bombo) Pty Ltd**

39 Five Islands Road  
Port Kembla NSW 2505  
PO Box 210, Port Kembla

Telephone 02 4275 1000  
Facsimile 02 4274 1125  
[www.clearybros.com.au](http://www.clearybros.com.au)

## Title Block

<b>Name of operation</b>	Gerroa Sand Resource
<b>Name of operator</b>	Cleary Bros (Bombo) Pty Ltd
<b>Development consent #</b>	05/0099
<b>Name of holder of development consent</b>	Cleary Bros (Bombo) Pty Ltd
<b>AEMR start date</b>	1/7/2020
<b>AEMR end date</b>	30/6/2021
<p><b>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 2020 to 30 June 2021 and that I am authorised to make this statement on behalf of Cleary Bros (Bombo) Pty Ltd.</b></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>	
<b>Name of authorised reporting officer</b>	Helen Cleary
<b>Title of authorised reporting officer</b>	Executive General Manager
<b>Signature of authorised reporting officer</b>	
<b>Date</b>	20/7/21

## Table of Contents

<b>1. Introduction .....</b>	<b>4</b>
1.1. Statement of Compliance .....	4
1.2. Background .....	4
1.3. Objectives of the Annual Environmental Management Report.....	4
<b>2. Site Description and Activities .....</b>	<b>6</b>
2.1. Site Identification .....	6
<b>3. Key Licence Issues .....</b>	<b>7</b>
3.1. Environmental Protection Licence Annual Reports .....	7
3.2. Development Consent .....	7
3.3. Standards and Performance Measures that apply .....	7
3.4. Works Carried Out in Reporting Period .....	8
3.5. Works to be Carried Out in the Next Period .....	8
<b>4. Review of Environmental Performance .....</b>	<b>10</b>
4.1. Meteorological Monitoring .....	10
4.2. Groundwater Management .....	10
4.3. Surface Water Management.....	28
4.4. Air Quality .....	34
4.5. Noise Monitoring.....	35
4.6. Community .....	36
4.7. Rehabilitation & Vegetation Management .....	36
4.8. Acid Sulphate Monitoring.....	38
4.9. General Environmental Management & Reporting .....	39
4.10. Traffic Management.....	39
4.11. Independent Environmental Audit .....	39
<b>5. Conclusion .....</b>	<b>41</b>

### Annexures

Annexure A	Department of Regional NSW Return 2019/2020
Annexure B	Environmental Monitoring Locations
Annexure C	Environmental Monitoring Results
Annexure D	13 <sup>th</sup> 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
DPIE	Department of Planning, Industry 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	Reviewed By	Prepared Date
1	Initial Draft	M Hammond	H Cleary	12/7/21
2	Final	M Hammond	H Cleary	20/7/21

## 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, Industry and Environment (DPIE) 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 1<sup>st</sup> February to 31<sup>st</sup> January.

The EPA Annual Returns for 2005 to 2021 reporting periods were reviewed to provide a background to this report. These Annual Returns are summarised in the following table.

Reporting Period	Pollution complaints	Concentration monitoring summary	Volume or mass monitoring summary	Compliance with licence conditions
1 Feb 2005 – 31 Jan 2006	Nil	None required	None required	All conditions complied with
1 Feb 2006 – 31 Jan 2007	Nil	None required	None required	All conditions complied with
1 Feb 2007 – 31 Jan 2008	Nil	None required	None required	All conditions complied with
1 Feb 2008 – 31 Jan 2009	Nil	None required	None required	All conditions complied with
1 Feb 2009 – 31 Jan 2010	Nil <sup>1</sup>	None required	None required	All conditions complied with
1 Feb 2010 – 31 Jan 2011	Nil	None required	None required	All conditions complied with
1 Feb 2011 – 31 Jan 2012	Nil	None required	None required	All conditions complied with
1 Feb 2012 – 31 Jan 2013	Nil	None required	None required	All conditions complied with
1 Feb 2013 – 31 Jan 2014	Nil	None required	None required	All conditions complied with
1 Feb 2014 – 31 Jan 2015	Nil	None required	None required	All conditions complied with
1 Feb 2015 – 31 Jan 2016	Nil	None required	None required	All conditions complied with
1 Feb 2016 – 31 Jan 2017	Nil	None required	None required	All conditions complied with
1 Feb 2017 – 31 Jan 2018	Nil	None required	None required	All conditions complied with
1 Feb 2018 – 31 Jan 2019	Nil	None required	None required	All conditions complied with
1 Feb 2019 – 31 Jan 2020	Nil	None required	None required	All conditions complied with
1 Feb 2020 – 31 Jan 2021	Nil	None required	None required	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 an AEMR must be completed annually.

#### 3.3. Standards and Performance Measures that apply

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.

<sup>1</sup> 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).

**3.4. Works Carried Out in Reporting Period**

The total sand transported from site during the 2020/2021 reporting year was 43,155 tonnes. In the current reporting period, sand was extracted from previous laydown and stockpiling areas, as well as 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 (2019/2020) to the Department of Regional NSW is included as Annexure A for 54,178 tonnes. The return for the 2020/2021 is due in November 2021 to the Department of Regional NSW and will be included in next year's AEMR.

**3.5. Works to be Carried Out in the Next Period**

The dredge will continue into the area east 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 2021/2022 reporting period include any 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 DPIE.

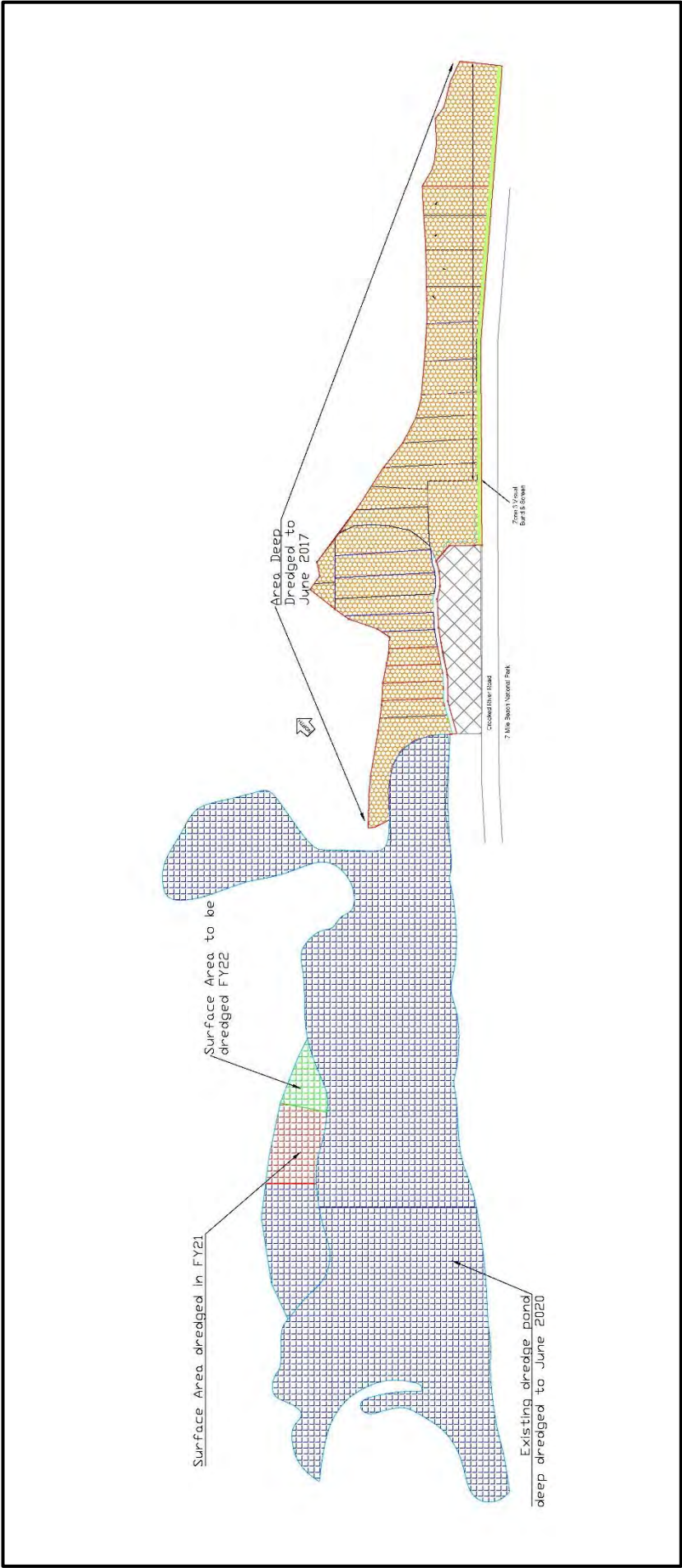


Figure 2 – Description of works

## 4. Review of Environmental Performance

### 4.1. Meteorological Monitoring

#### 4.1.1. Licence Requirements

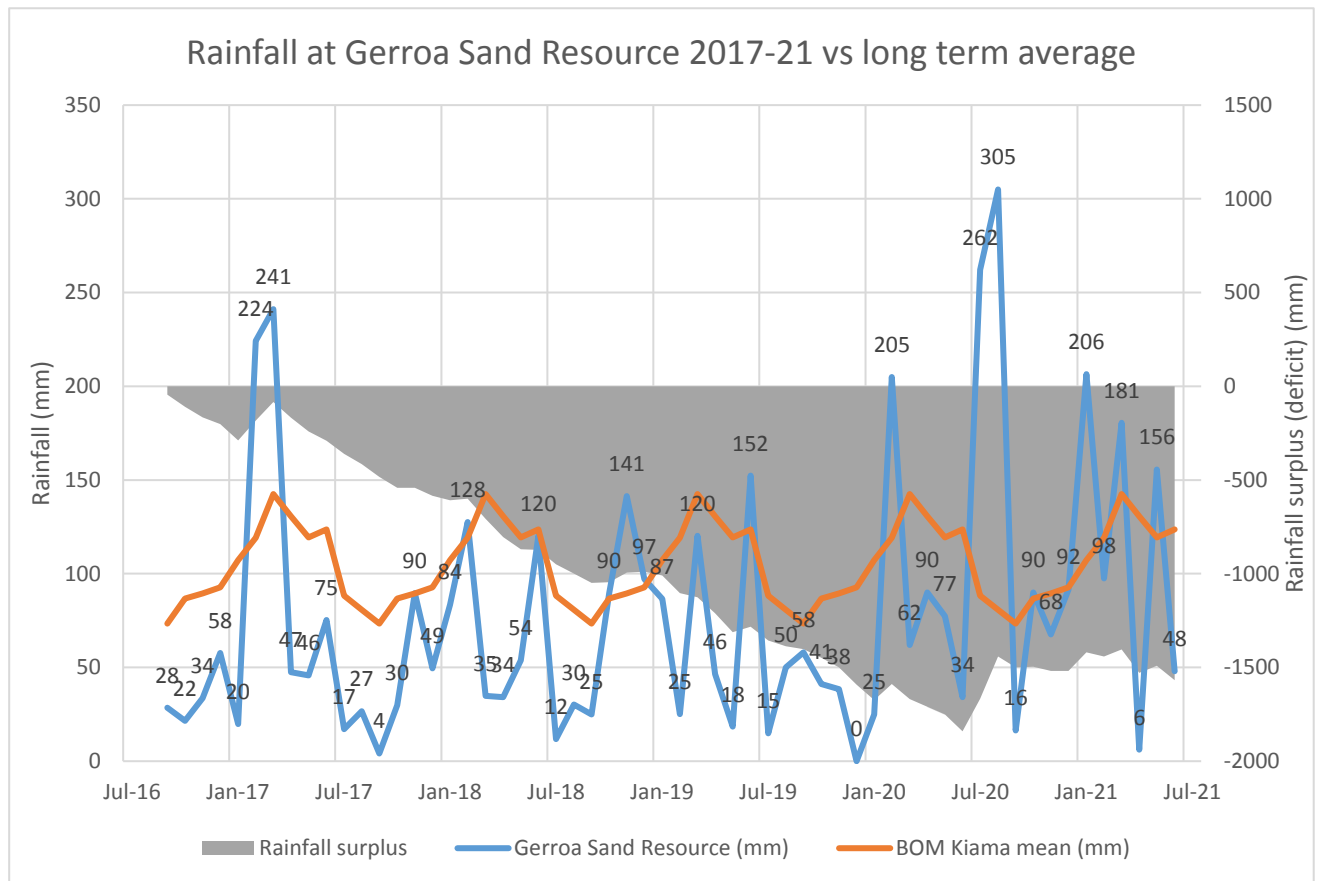
The DC requires Cleary Bros to maintain a meteorological station on site.

#### 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. The meteorological station has operated continuously during the reporting period.

#### 4.1.3. Meteorological Monitoring

Rainfall during the current year was above average, with 1,527mm of rain falling since July 2020. This has followed on from an extended period of below average rainfall, with a cumulative rainfall deficit of over 1800mm between July 2017 and June 2020. Significant rainfall was recorded in Winter 2020, with 567mm recording in July and August, which has replenished the regional groundwater environment, while follow up rainfall in the first half of 2021 have reset the hydrological environment, and provided excellent growing conditions for the establishing revegetation areas.



### 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

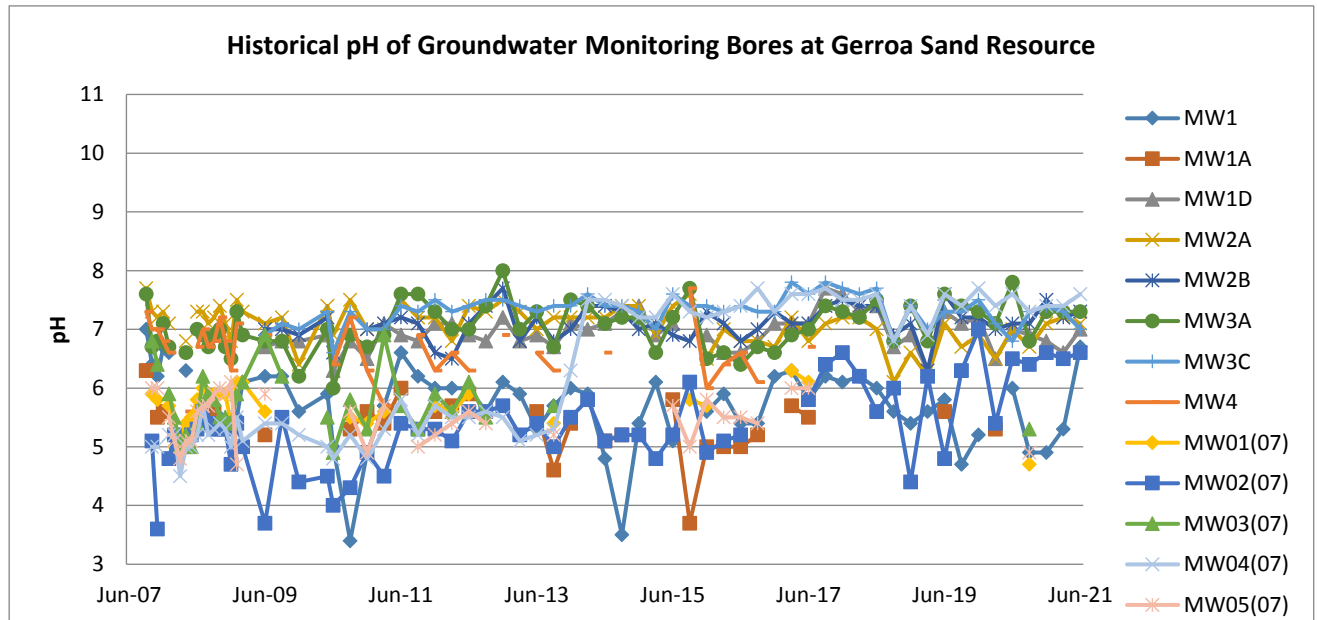
CB has implemented the Groundwater Monitoring Program and Acid Sulphate Soils Management Plan to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to conduct quarterly sampling and testing of the groundwater monitoring sites, as well as monthly testing of 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 DC, 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	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	4.9	5.5	6.7	3.4	5.7	7.0	6.0 - 8.5	N/A
MW1A	Dry/insufficient water for sample			3.7	5.4	6.3	6.0 - 8.5	N/A
MW1D	6.6	6.8	7.0	6.3	7.0	7.7	6.0 - 8.5	N/A
MW2A	6.7	7.0	7.2	6.1	7.1	7.7	6.0 - 8.5	N/A
MW2B	7.1	7.3	7.5	6.3	7.1	7.7	6.0 - 8.5	N/A
MW3A	6.8	7.2	7.3	6.0	7.0	8.0	6.0 - 8.5	N/A
MW3C	7.0	7.3	7.4	6.6	7.3	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)	4.7	4.7	4.7	5.0	5.7	6.3	6.0 - 8.5	N/A
MW02(07)	6.4	6.5	6.6	3.6	5.3	7.0	6.0 - 8.5	N/A
MW03(07)	5.3	5.3	5.3	4.9	5.7	6.9	6.0 - 8.5	N/A
MW04(07)	7.3	7.4	7.6	4.5	6.2	7.7	6.0 - 8.5	N/A
MW05(07)	4.9	4.9	4.9	4.7	5.5	6.1	6.0 - 8.5	N/A

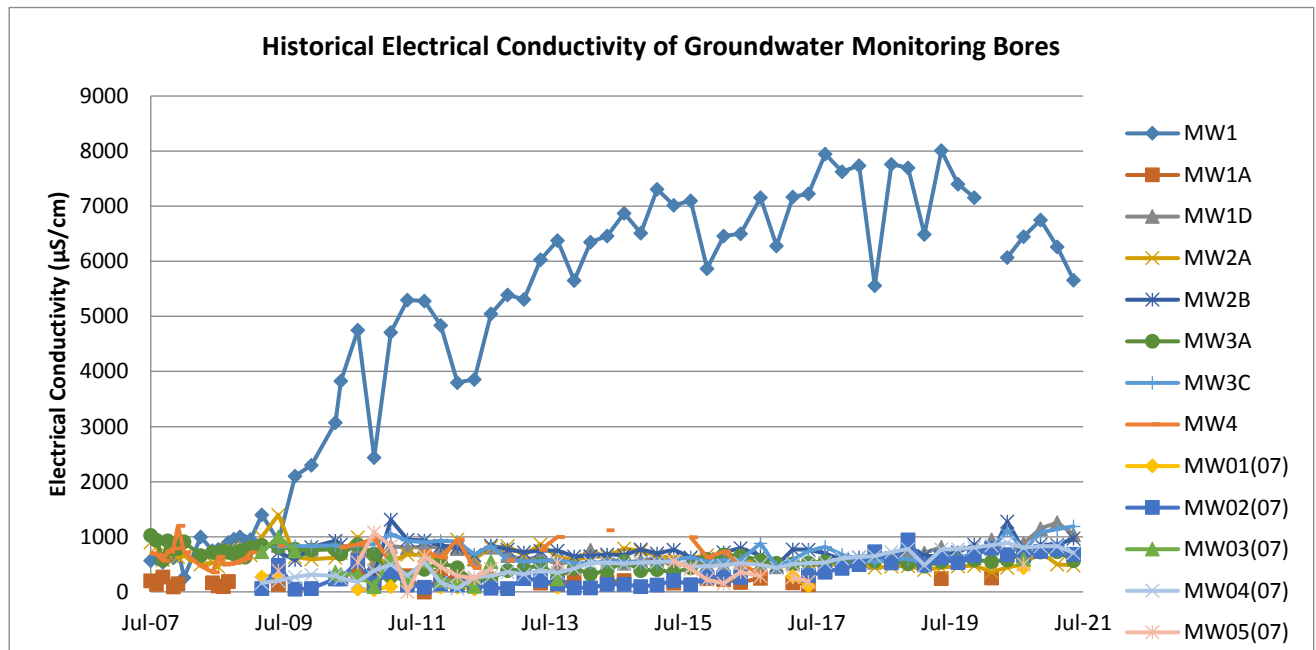


The pH values over the past 12 months have exhibited variability similar to that observed across the historical record. Most groundwater bores recorded pH levels in line with historical averages, with only the single result for MW01(07) recording a value slightly below the historical range for this bore, which is likely to reflect the natural liberation of acids in the vicinity of this bore as a result of the significant winter 2020 rainfall. The extended rainfall deficit leading into the reporting period has meant some bores were unable to be sampled during the reporting period.

Bores MW1, MW01(07), MW03(07), and 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	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	5660	6280	6750	260	4397	8010	< 1500	N/A
MW1A	Dry/insufficient water for sample			90	199	350	< 1500	N/A
MW1D	884	1084	1260	457	651	945	< 1500	N/A
MW2A	483	552	722	366	641	1400	< 1500	N/A
MW2B	750	858	968	300	742	1310	< 1500	N/A
MW3A	567	681	730	176	586	1030	< 1500	N/A
MW3C	755	1041	1190	453	697	1120	< 1500	N/A
MW4	Dry/insufficient water for sample			327	688	1200	< 1500	N/A
MW01(07)	441	441	441	40	142	310	< 1500	N/A
MW02(07)	655	714	780	50	300	948	< 1500	N/A
MW03(07)	595	595	595	100	419	1000	< 1500	N/A
MW04(07)	707	792	832	60	470	892	< 1500	N/A
MW05(07)	506	506	506	158	438	1080	< 1500	N/A

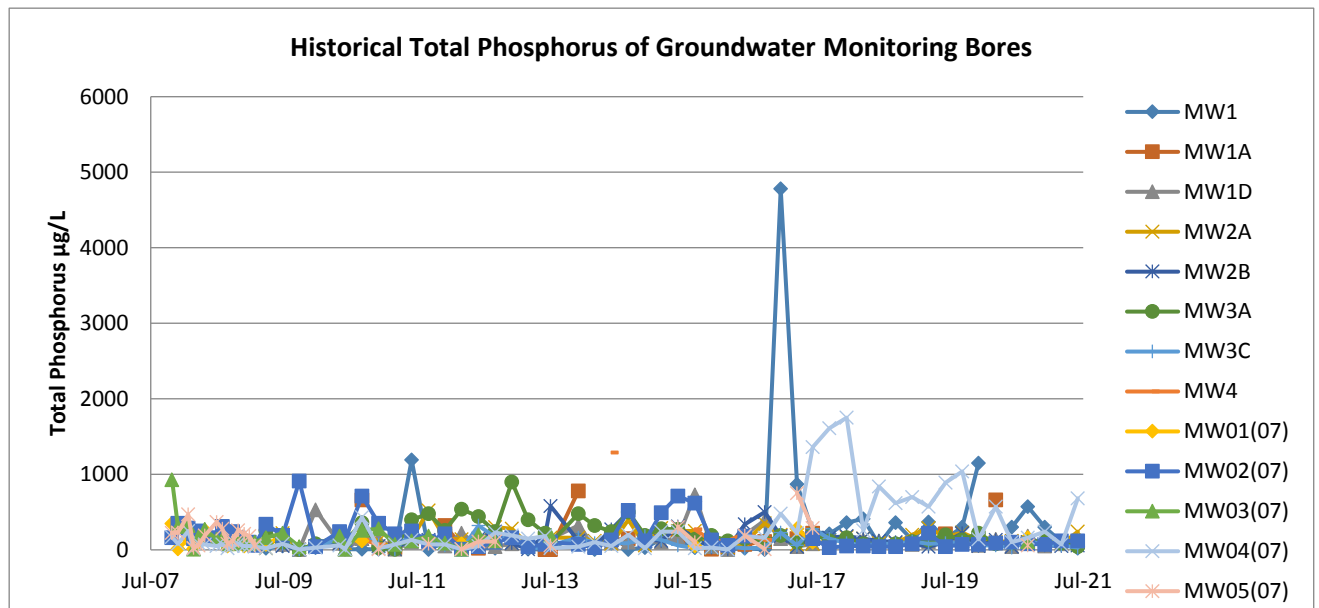


The results over the 12 month period show that the Electrical Conductivity (EC) of the groundwater in the boreholes is within the objective levels for all bores with the exception of MW1. The brackish groundwater in MW1 has not been observed at any other bore or within the dredge pond, and is consistent with other recorded groundwater records for bores screened within the Berry Siltstone unit to the southwest. The EC of this bore has reduced slightly in the current reporting period.

The monitoring bores have continued to show significant variability in EC concentrations across the monitoring network, and with the exception of MW1, the southernmost and eastern bores generally showing slightly lower EC than those bores to the northwest, albeit amongst a pattern of ongoing variability. This variability has likely been enhanced at various times throughout the current reporting period with the replenishment of rainfall infiltration to the aquifer.

**Total Phosphorus (µg/L)**

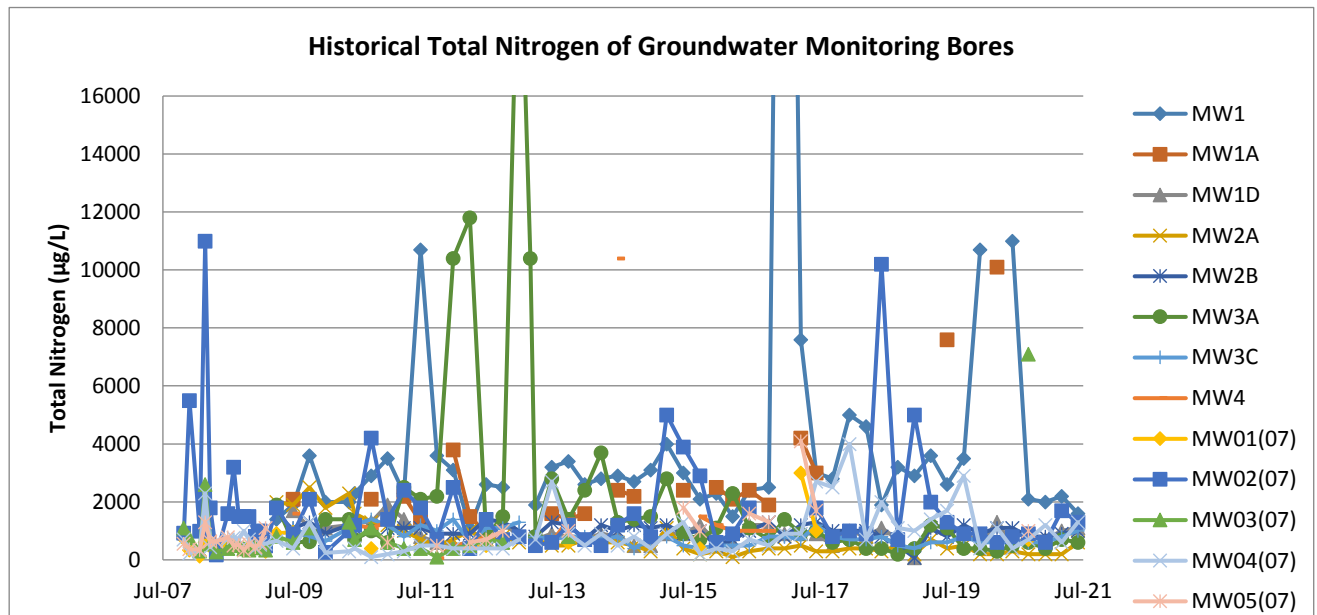
BORE HOLE	2020-21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	20	248	570	<10	278	4780	< 30	N/A
MW1A	Dry/insufficient water for sample			<10	192	780	< 30	N/A
MW1D	50	103	180	<10	130	730	< 30	N/A
MW2A	70	120	240	10	155	520	< 30	N/A
MW2B	50	68	100	<10	141	580	< 30	N/A
MW3A	40	90	120	<10	218	900	< 30	N/A
MW3C	30	70	120	<10	96	320	< 30	N/A
MW4	Dry/insufficient water for sample			70	215	1290	< 30	N/A
MW01(07)	160	160	160	12	117	346	< 30	N/A
MW02(07)	70	98	120	10	192	910	< 30	N/A
MW03(07)	110	110	110	8	172	929	< 30	N/A
MW04(07)	70	288	680	<10	256	1750	< 30	N/A
MW05(07)	60	60	60	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 agricultural land uses surrounding the Gerroa Sand Resource may have contributed to the measurements of total phosphorus in all bores.

## Total Nitrogen (µg/L)

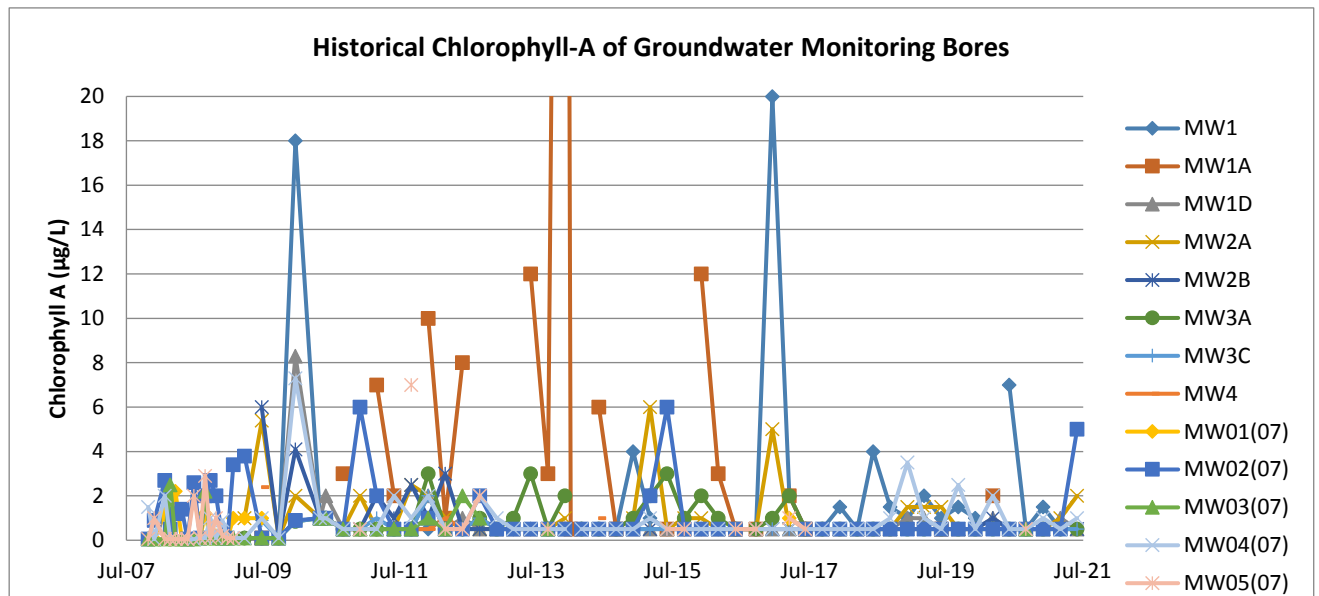
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1600	1975	2200	1100	4532	51100	< 350	N/A
MW1A	Dry/insufficient water for sample			900	2824	10100	< 350	N/A
MW1D	700	900	1100	400	913	1900	< 350	N/A
MW2A	200	300	600	300	726	2500	< 350	N/A
MW2B	800	875	1000	700	1007	1400	< 350	N/A
MW3A	400	575	700	600	2297	23200	< 350	N/A
MW3C	600	750	1000	400	802	1400	< 350	N/A
MW4	Dry/insufficient water for sample			60	1579	10400	< 350	N/A
MW01(07)	700	700	700	130	620	3000	< 350	N/A
MW02(07)	600	1125	1700	180	1852	11000	< 350	N/A
MW03(07)	7100	7100	7100	100	645	2600	< 350	N/A
MW04(07)	600	950	1300	100	880	4000	< 350	N/A
MW05(07)	1000	1000	1000	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 within the historical range in all bores with the exception of the single result for bore MW03(07), which was above the previous historical range. The presence of Total Nitrogen at those concentrations recorded in the bores are likely to be related to the presence of 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 consistently lower than that recorded across the broader groundwater monitoring network.

**Chlorophyll A ( $\mu\text{g/L}$ )**

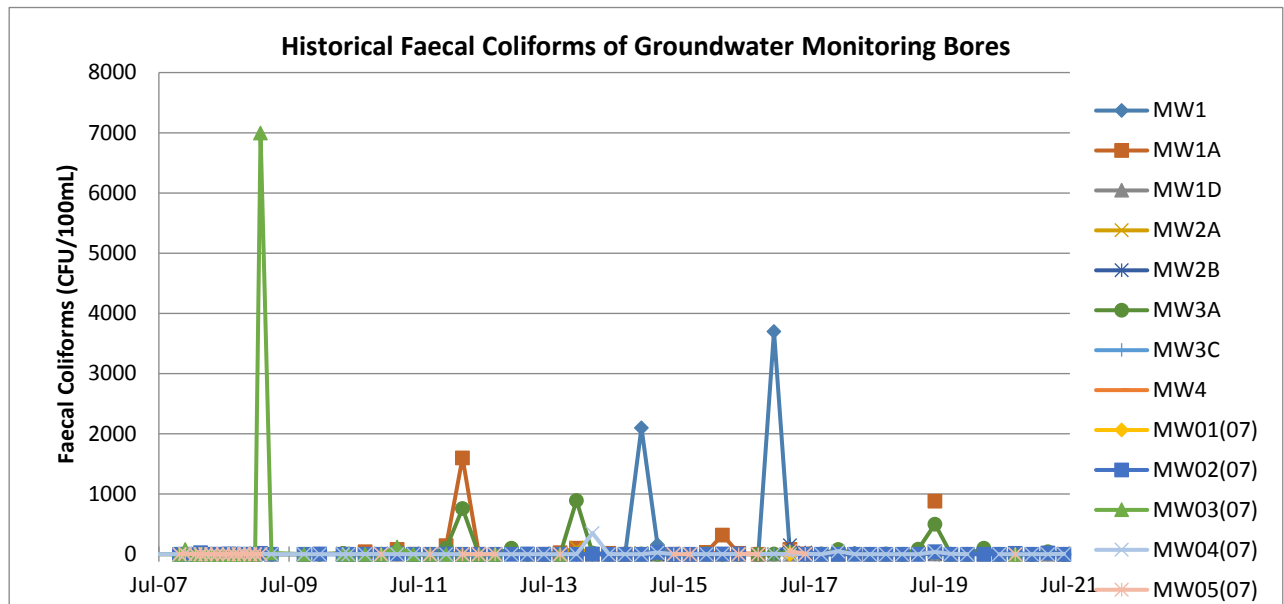
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1	<1	<3	<1	2	20	< 5	N/A
MW1A	Dry/insufficient water for sample			<1	7	90	< 5	N/A
MW1D	<1	<1	<2	<1	1	8	< 5	N/A
MW2A	<1	1	2	<1	1	6	< 5	N/A
MW2B	<1	<1	<1	<1	1	6	< 5	N/A
MW3A	<1	<1	<1	<1	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)	<1	<1	<1	<1	1	2	< 5	N/A
MW02(07)	<1	1	5	<1	1	6	< 5	N/A
MW03(07)	<1	<1	<1	<1	1	3	< 5	N/A
MW04(07)	<1	<1	<2	<1	1	7	< 5	N/A
MW05(07)	<1	<1	<1	<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 were within the objective level and historical ranges for the respective bores and were mostly below the limit of reporting.

**Faecal Coliforms (median number/100mL)**

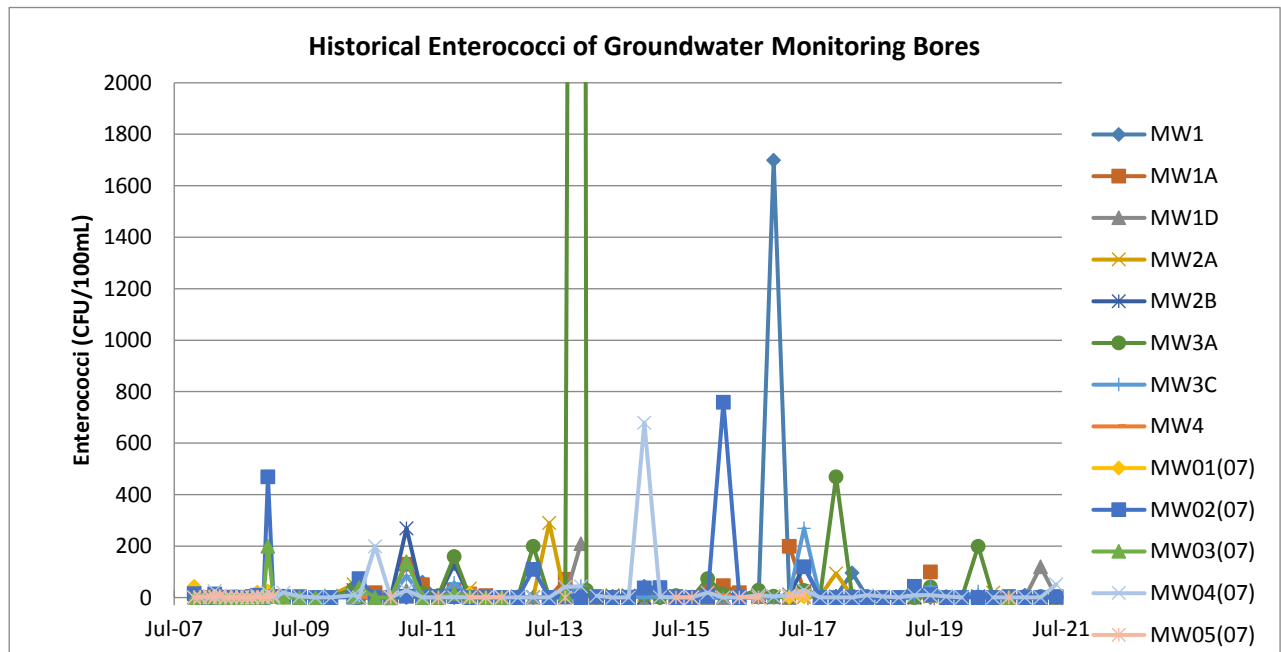
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<2	<2	<2	<1	137	3700	<1000	N/A
MW1A	Dry/insufficient water for sample			<1	167	1600	<1000	N/A
MW1D	<1	<2	<2	<1	2	18	<1000	N/A
MW2A	<1	3	10	<1	6	110	<1000	N/A
MW2B	<2	<2	4	<1	6	150	<1000	N/A
MW3A	<1	11	40	<1	61	890	<1000	N/A
MW3C	<2	<2	<2	<1	3	52	<1000	N/A
MW4	Dry/insufficient water for sample			<1	3	36	<1000	N/A
MW01(07)	<2	<2	<2	<1	2	10	<1000	N/A
MW02(07)	<2	10	20	<1	3	40	<1000	N/A
MW03(07)	<2	<2	<2	<1	250	7000	<1000	N/A
MW04(07)	<2	<2	<2	<1	9	350	<1000	N/A
MW05(07)	<2	<2	<2	<1	3	50	<1000	N/A



Faecal coliforms were within the objective levels and historical ranges during the reporting period.

**Enterococci (median number/100mL)**

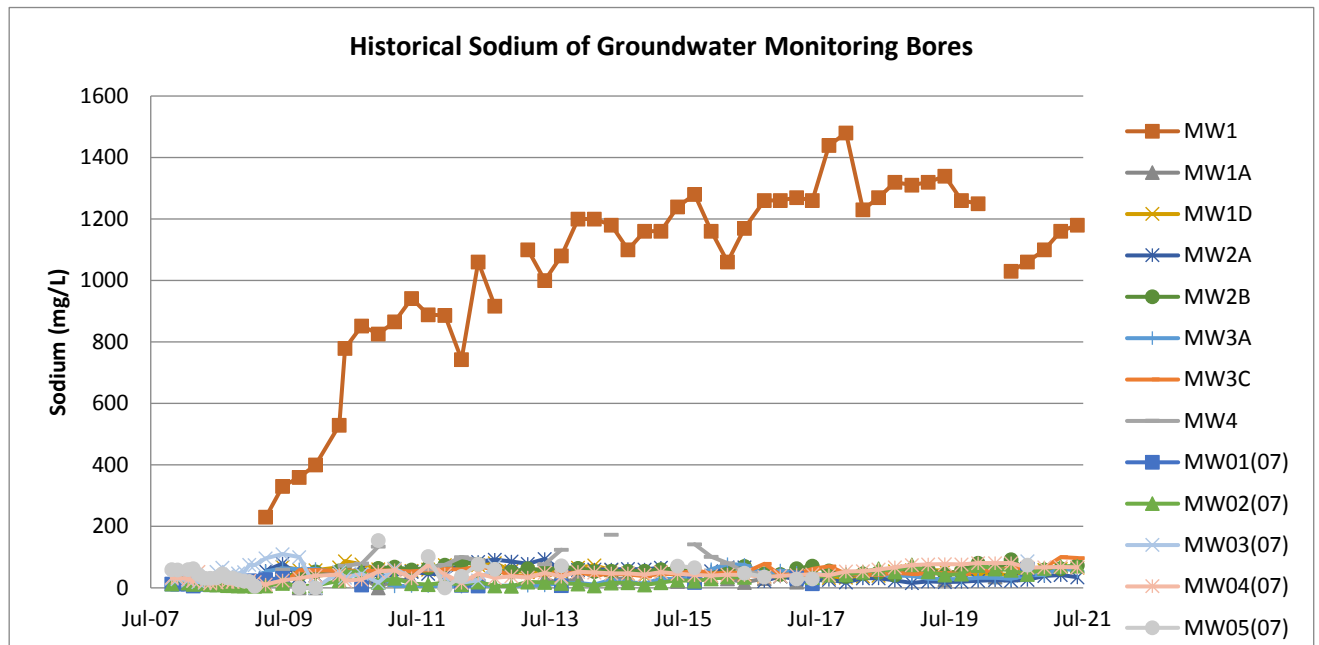
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<2	3	10	<1	45	1700	<230	N/A
MW1A	Dry/insufficient water for sample			<2	38	200	<230	N/A
MW1D	<2	31	120	<2	10	210	<230	N/A
MW2A	<2	<2	4	<1	14	290	<230	N/A
MW2B	<2	<2	<2	<1	16	270	<230	N/A
MW3A	<1	3	4	<1	349	15000	<230	N/A
MW3C	<2	<2	<2	<1	14	270	<230	N/A
MW4	Dry/insufficient water for sample			<1	7	32	<230	N/A
MW01(07)	2	2	2	<1	7	44	<230	N/A
MW02(07)	<2	3	4	<1	31	760	<230	N/A
MW03(07)	<2	<2	<2	<1	15	200	<230	N/A
MW04(07)	<2	14	52	<1	21	680	<230	N/A
MW05(07)	<2	<2	<2	<1	2	10	<230	N/A



Enterococci concentrations were within the objective levels and the historical ranges during the reporting period, and were mostly below the laboratory reporting limit.

## Sodium (mg/L)

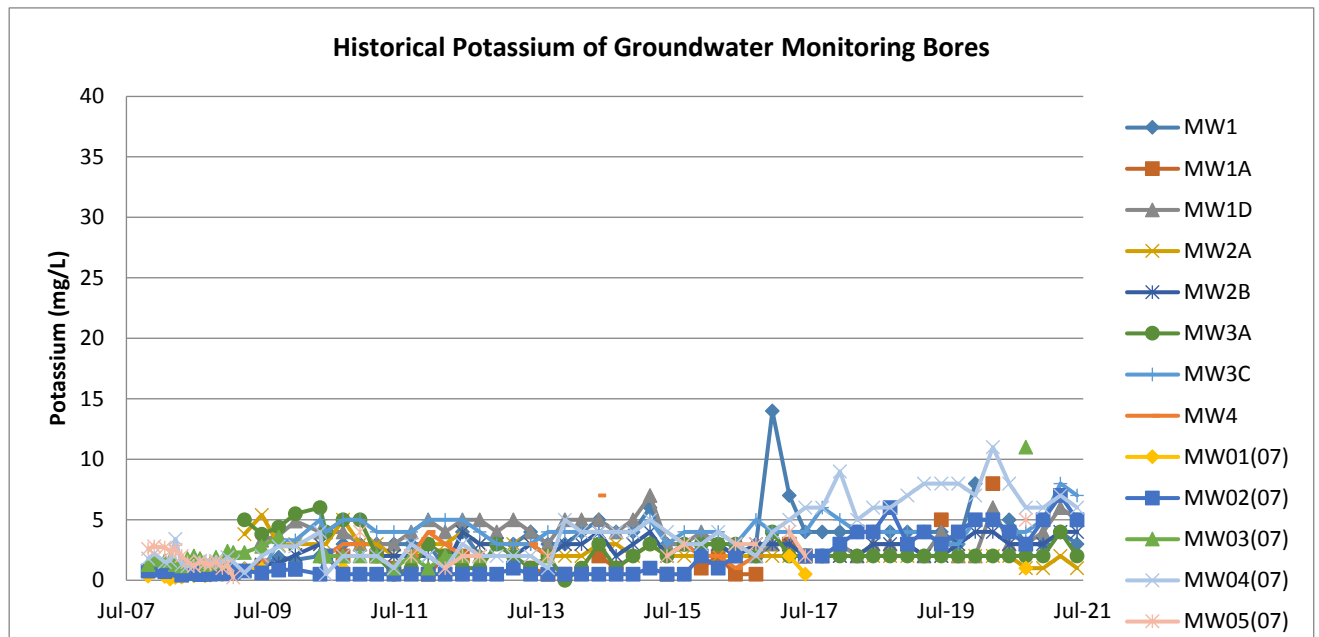
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1060	1125	1180	230	1045	1480	< 400	N/A
MW1A	Dry/insufficient water for sample			14	27	36	< 400	N/A
MW1D	54	60	66	33	54	87	< 400	N/A
MW2A	26	36	42	16	48	94	< 400	N/A
MW2B	55	63	73	38	58	92	< 400	N/A
MW3A	41	51	65	4	34	77	< 400	N/A
MW3C	59	81	100	11	51	78	< 400	N/A
MW4	Dry/insufficient water for sample			45	92	173	< 400	N/A
MW01(07)	61	61	61	6.2	16	33	< 400	N/A
MW02(07)	44	62	71	5.4	25	75	< 400	N/A
MW03(07)	87	87	87	17	48	110	< 400	N/A
MW04(07)	66	67	68	11	42	81	< 400	N/A
MW05(07)	74	74	74	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 (MW3C and MW01(07)) recorded sodium concentrations above the historical ranges for the respective bores. These are mirrored the EC recorded in the bores, and are likely reflective of greater tidal ingress into the bores closer to Blue Angle Creek in these drier periods of recent years, notwithstanding the improved rainfall recorded in the current reporting period.

**Potassium Ion (mg/L)**

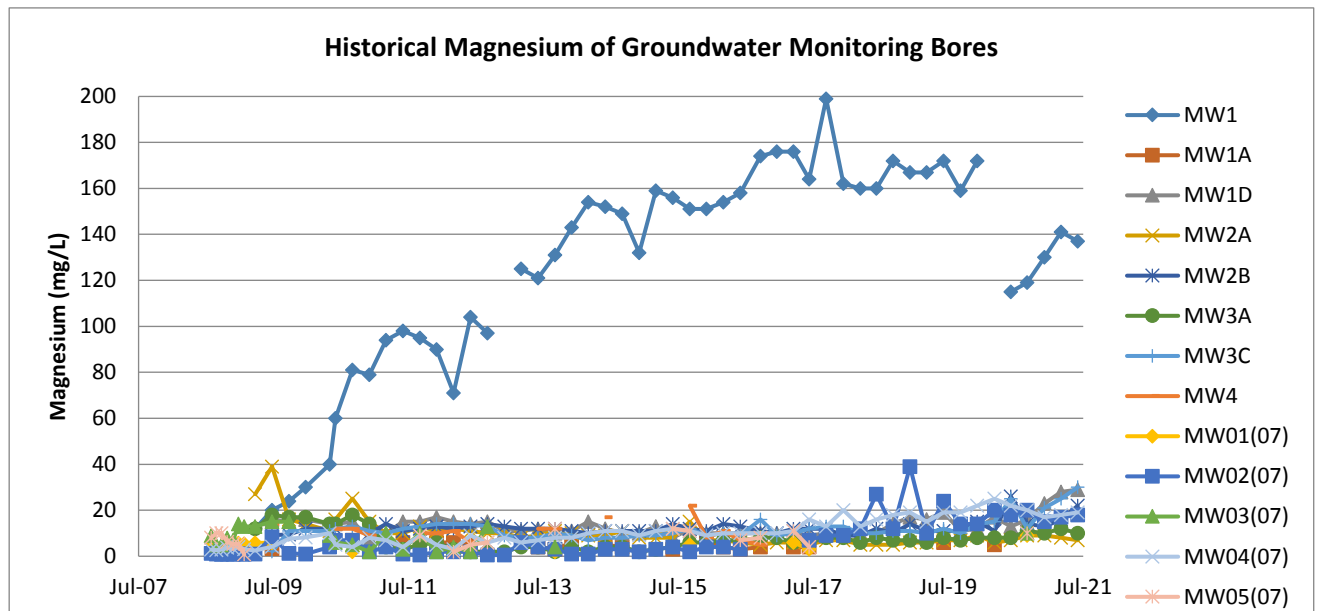
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	3	3	4	<1	4	14	< 50	N/A
MW1A	Dry/insufficient water for sample			<1	2	5	< 50	N/A
MW1D	3	5	6	2	4	7	< 50	N/A
MW2A	1	1	2	2	3	5.4	< 50	N/A
MW2B	3	4	4	1	2	4	< 50	N/A
MW3A	2	3	4	<1	3	6	< 50	N/A
MW3C	4	6	8	<1	4	6	< 50	N/A
MW4	Dry/insufficient water for sample			1	3	7	< 50	N/A
MW01(07)	1	1	1	<1	1	2	< 50	N/A
MW02(07)	3	5	7	<1	1	6	< 50	N/A
MW03(07)	11	11	11	1	2	3.6	< 50	N/A
MW04(07)	6	6	7	<1	3	9	< 50	N/A
MW05(07)	5	5	5	<1	2	4	< 50	N/A



Potassium ion concentrations have remained well below DC objective levels during the reporting period. Some samples across four bores were recorded above the historical range for the respective bores in the current reporting period, however all concentrations remaining very low and represent a minor component of the ionic balance in all bores. The monitoring results indicate no deterioration in groundwater quality related to potassium ion concentrations in the current reporting year.

**Magnesium Ion (mg/L)**

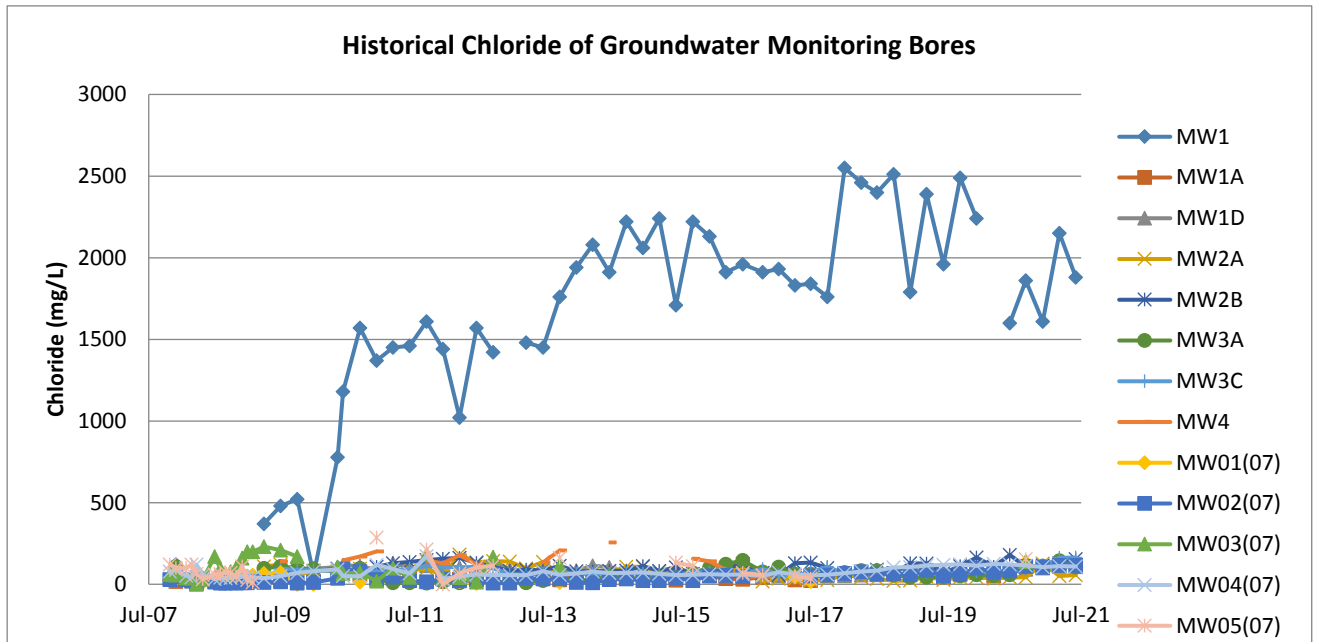
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	119	132	141	12	126	199	< 50	N/A
MW1A	Dry/insufficient water for sample			3	5	7	< 50	N/A
MW1D	16	24	29	8	12	19	< 50	N/A
MW2A	7	8	9	5	10	39	< 50	N/A
MW2B	13	16	22	9	12	26	< 50	N/A
MW3A	10	11	12	2	7	18	< 50	N/A
MW3C	12	22	30	2.1	11	25	< 50	N/A
MW4	Dry/insufficient water for sample			5	11	22	< 50	N/A
MW01(07)	9	9	9	2	4	6.1	< 50	N/A
MW02(07)	15	18	20	0.5	6	39	< 50	N/A
MW03(07)	10	10	10	2	8	15	< 50	N/A
MW04(07)	17	19	20	2.5	10	25	< 50	N/A
MW05(07)	10	10	10	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. All samples were within the historical range for their respective sites with the exception of bores MW1D, MW3C and MW01(07) which recorded concentrations above their respective historical ranges. Trends in magnesium concentration appear to be most closely linked with proximity to Blue Angle Creek, with those bores closest to Blue Angle Creek continuing to show increases in magnesium concentration while those furthest away showing reductions in response to the improved rainfall observed in the period.

## Chloride Ion (mg/L)

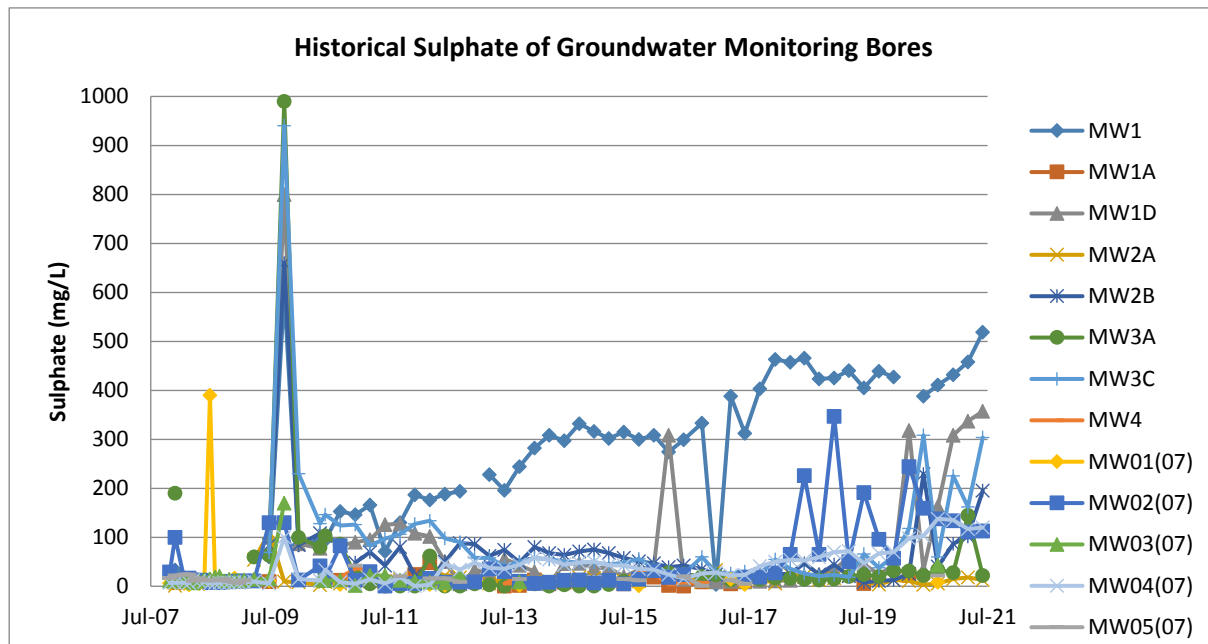
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1610	1875	2150	60	1670	2550	< 300	N/A
MW1A	Dry/insufficient water for sample			18	38	56	< 300	N/A
MW1D	91	102	110	48	82	142	< 300	N/A
MW2A	43	69	126	18	72	181	< 300	N/A
MW2B	107	126	154	57	103	180	< 300	N/A
MW3A	105	118	145	8	56	146	< 300	N/A
MW3C	92	132	164	55	76	112	< 300	N/A
MW4	Dry/insufficient water for sample			47	141	256	< 300	N/A
MW01(07)	134	134	134	0.5	30	72	< 300	N/A
MW02(07)	103	111	116	0.5	36	100	< 300	N/A
MW03(07)	139	139	139	0.5	98	230	< 300	N/A
MW04(07)	106	111	115	33	71	172	< 300	N/A
MW05(07)	154	154	154	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, with the exception of samples in bores MW3C, MW01(07) and MW02(07). These variations are in line with observations relating to electrical conductivity.

**Sulphate Ion (mg/L)**

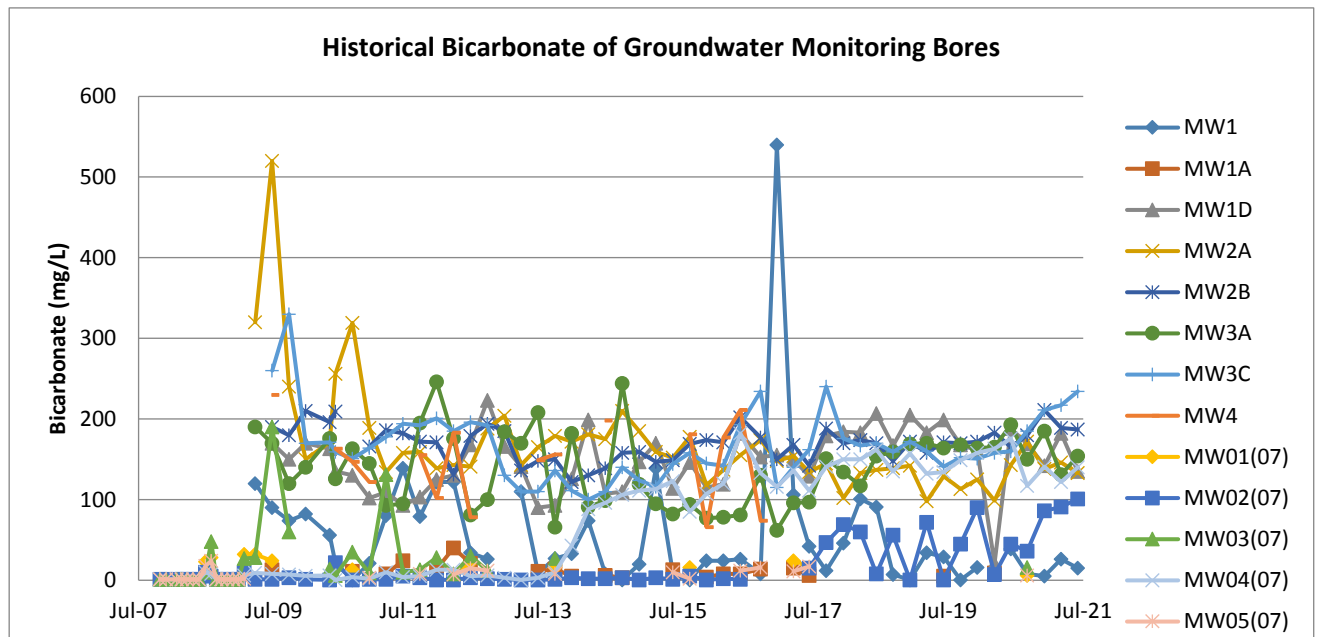
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	411	455	519	4	271	600	< 250	N/A
MW1A	Dry/insufficient water for sample			0.5	12	48	< 250	N/A
MW1D	163	291	357	5	76	800	< 250	N/A
MW2A	6	13	18	1	16	110	< 250	N/A
MW2B	40	106	195	8	68	660	< 250	N/A
MW3A	22	57	145	0.5	47	990	< 250	N/A
MW3C	60	188	304	19	92	940	< 250	N/A
MW4	Dry/insufficient water for sample			2	15	36	< 250	N/A
MW01(07)	8	8	8	1	24	390	< 250	N/A
MW02(07)	111	124	138	0.5	45	347	< 250	N/A
MW03(07)	43	43	43	2	18	170	< 250	N/A
MW04(07)	117	128	138	0.5	32	103	< 250	N/A
MW05(07)	22	22	22	1	15	42	< 250	N/A



The concentration of sulphate in all groundwater bores were within DC objectives with the exception of MW1, MW1D and MW3C. Sulphate concentrations in MW1 appear to have followed the trend of other major ions, with all samples within the historical range of measurements. Other bores have continued to show considerable variability in the current reporting period, which is likely related to rainfall infiltration to the groundwater table that has seen lower levels in recent years. All samples were within the historical ranges for the respective bores with the exception of MW04(07) which was above the historical range for this bore.

**Bicarbonate Ion (mg/L)**

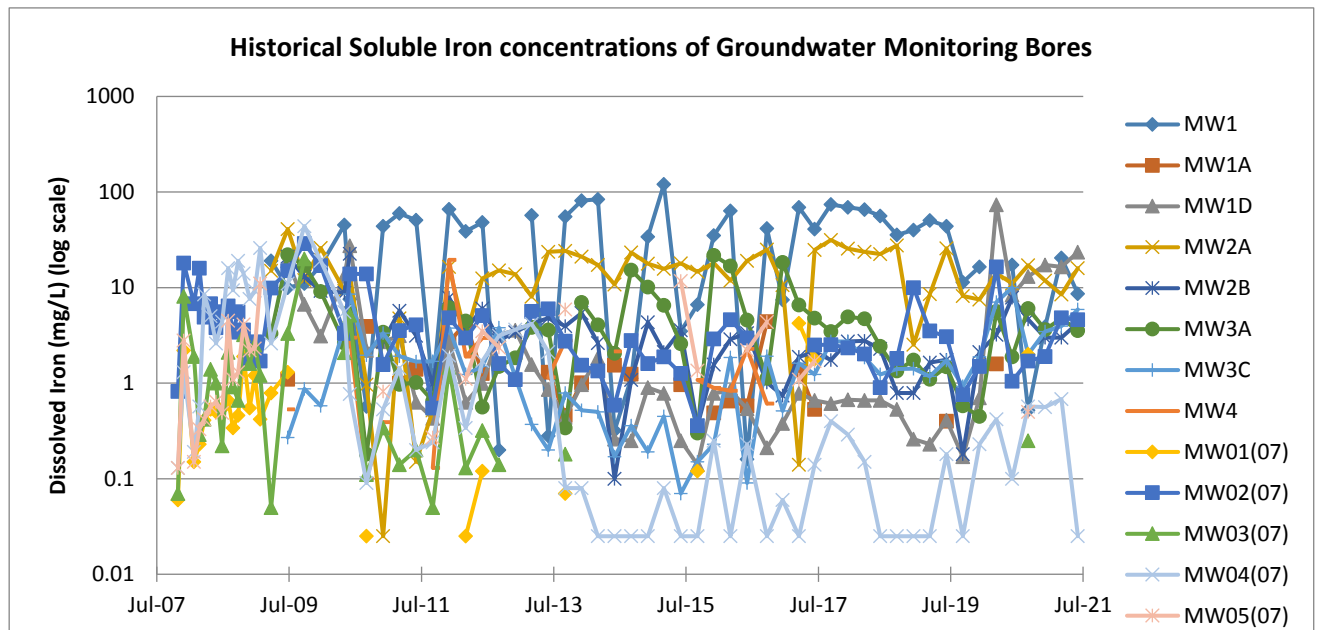
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	5	14	26	<1	60	540	< 750	N/A
MW1A	Dry/insufficient water for sample			3	12	40	< 750	N/A
MW1D	135	157	182	90	149	223	< 750	N/A
MW2A	133	147	172	98	176	520	< 750	N/A
MW2B	180	192	211	122	167	210	< 750	N/A
MW3A	131	155	185	62	135	246	< 750	N/A
MW3C	185	212	234	100	165	330	< 750	N/A
MW4	Dry/insufficient water for sample			66	150	230	< 750	N/A
MW01(07)	6	6	6	1	11	32	< 750	N/A
MW02(07)	36	79	101	<1	8	72	< 750	N/A
MW03(07)	16	16	16	1	24	190	< 750	N/A
MW04(07)	117	130	141	<1	53	182	< 750	N/A
MW05(07)	6	6	6	1	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 a single result from bore MW2B slightly above 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)**

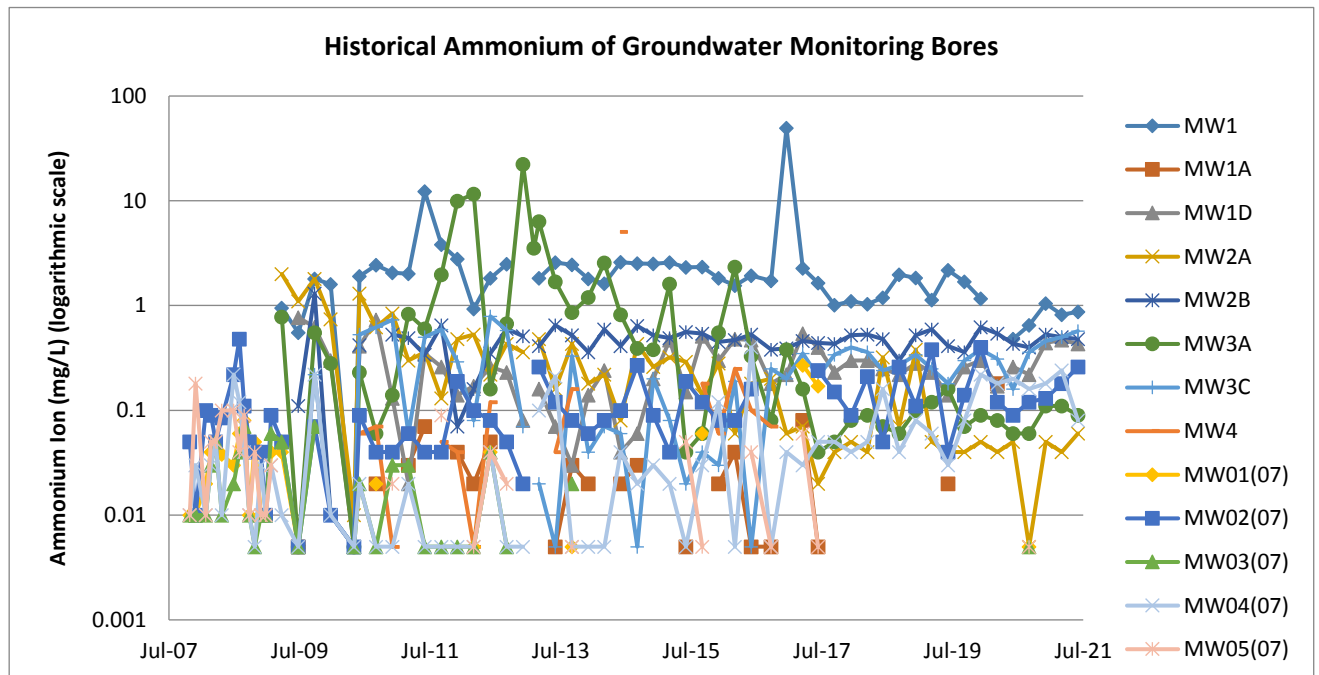
BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	0.52	8.4	20.5	0.16	36.3	120	< 6	N/A
MW1A	Dry/insufficient water for sample			0.4	1.5	4.4	< 6	N/A
MW1D	13.1	17.6	23.5	0.14	4.2	73.5	< 6	N/A
MW2A	8.48	13.3	17.1	0.025	15.1	41	< 6	N/A
MW2B	2.99	3.7	4.65	0.1	4.2	22.5	< 6	N/A
MW3A	3.56	4.5	6.04	0.18	5.2	22	< 6	N/A
MW3C	2.01	3.8	5.9	0.07	1.8	9.99	< 6	N/A
MW4	Dry/insufficient water for sample			0.1	2.5	19.5	< 6	N/A
MW01(07)	2.01	2.0	2.01	0.025	0.8	4.23	< 6	N/A
MW02(07)	1.7	3.3	4.84	0.36	5.2	29	< 6	N/A
MW03(07)	0.25	0.3	0.25	0.05	2.0	20	< 6	N/A
MW04(07)	<0.05	0.5	0.68	0.025	3.8	44	< 6	N/A
MW05(07)	0.5	0.5	0.5	0.13	2.6	11.7	< 6	N/A



The dissolved iron concentrations were above the objective levels for several bores at times during this reporting period. This is a common phenomenon, with the graph above showing significant fluctuations throughout the historical period of monitoring for all bores. This historical trend has continued in the current reporting period. The concentrations of dissolved iron in all bores for the reporting period are within the historical range for the respective bores, which indicates no deterioration in groundwater quality as evident by soluble iron concentration across the monitoring network.

## Ammonium Ion (mg/L)

BORE HOLE	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	0.65	0.85	1.05	<0.01	3.13	49.5	< 20	N/A
MW1A	Dry/insufficient water for sample			<0.01	0.03	0.18	< 20	N/A
MW1D	0.22	0.39	0.47	<0.01	0.27	0.77	< 20	N/A
MW2A	<0.01	0.04	0.06	<0.01	0.35	2	< 20	N/A
MW2B	0.40	0.48	0.53	<0.01	0.46	1.3	< 20	N/A
MW3A	0.06	0.09	0.11	<0.01	1.58	22.3	< 20	N/A
MW3C	0.36	0.47	0.57	<0.01	0.24	0.79	< 20	N/A
MW4	Dry/insufficient water for sample			<0.01	0.39	5.07	< 20	N/A
MW01(07)	<0.01	<0.01	<0.01	<0.01	0.05	0.27	< 20	N/A
MW02(07)	0.12	0.17	0.26	<0.01	0.11	0.48	< 20	N/A
MW03(07)	<0.01	<0.01	<0.01	<0.01	0.02	0.07	< 20	N/A
MW04(07)	0.08	0.17	0.24	<0.01	0.06	0.4	< 20	N/A
MW05(07)	<0.01	<0.01	<0.01	<0.01	0.04	0.18	< 20	N/A

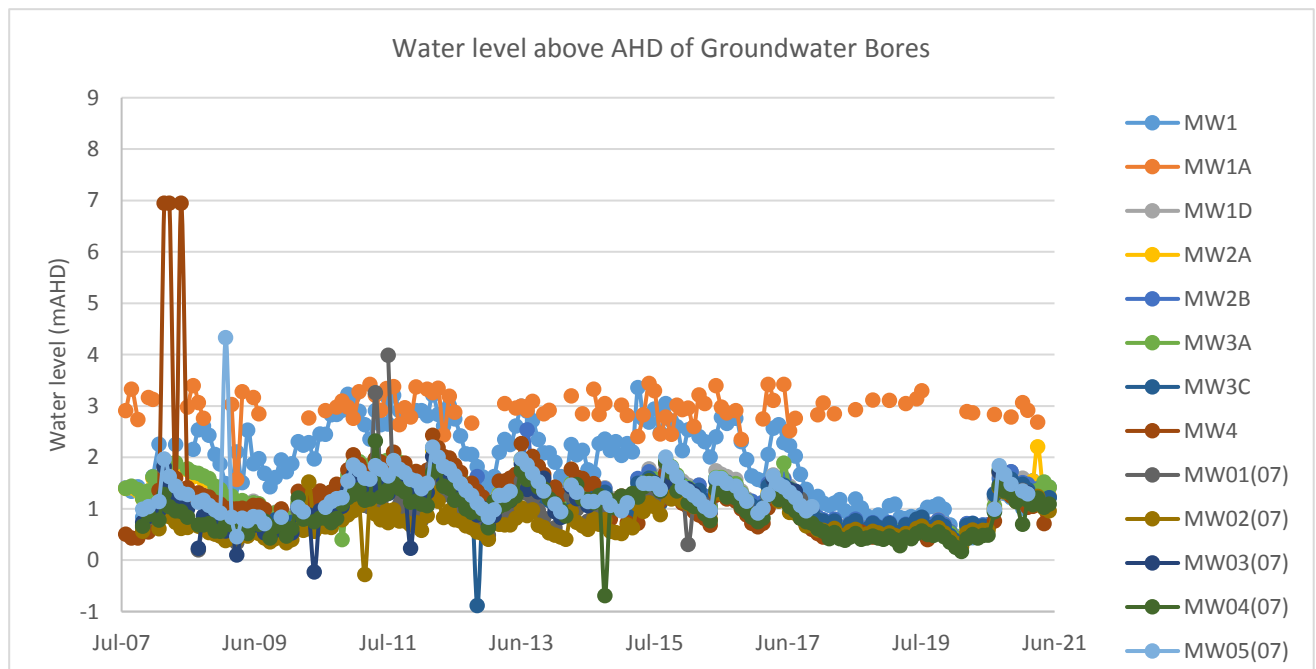


Ammonium ion concentrations were below the objective levels and within the historical ranges for all samples collected during the current reporting period. This indicates that there is no deterioration in groundwater quality as a result of dredging operations, and the low levels recorded give a strong 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	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	0.64	1.23	1.55	0.26	1.99	3.36	N/A	N/A
MW1A	2.69	2.86	3.07	1.57	2.98	3.44	N/A	N/A
MW1D	0.69	1.39	1.72	0.35	1.21	1.83	N/A	N/A
MW2A	0.63	1.40	2.21	0.34	1.21	2.14	N/A	N/A
MW2B	0.69	1.37	1.72	0.35	1.16	2.54	N/A	N/A
MW3A	0.65	1.37	1.76	0.34	1.24	2.19	N/A	N/A
MW3C	0.65	1.27	1.58	-0.88	1.04	1.6	N/A	N/A
MW4	0.71	1.06	1.36	0.4	1.38	6.95	N/A	N/A
MW01(07)	1.29	1.48	1.71	0.2	1.06	3.99	N/A	N/A
MW02(07)	0.58	1.12	1.41	-0.28	0.72	1.52	N/A	N/A
MW03(07)	1.31	1.53	1.73	-0.23	1.12	2.02	N/A	N/A
MW04(07)	0.49	1.08	1.44	-0.69	0.94	2.32	N/A	N/A
MW05(07)	0.99	1.44	1.84	0.46	1.35	4.33	N/A	N/A



Groundwater levels have varied consistent with significant rainfall events during the current reporting period, increasing from low base levels observed as a result of 3 years of significantly below average rainfall. A small rise was observed in March 2020, which coincided with the only month of above average rainfall (February) during the reporting period. All measurements were within the historical ranges for the respective bores. 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 program for the Gerroa Sand Resource, groundwater quality has for the most part remained relatively stable during the current reporting period. Some increases were observed in major ion concentrations in bores close to Blue Angle Creek, which is likely attributable to the effect of tidal influence from the Crooked River estuary combining with the overall depressed groundwater levels attributable to the significant drought preceding this reporting period. This reflects the

background variability of the environment, with no changes to groundwater quality as a result of dredging operations, as predicted by the Gerroa Sand Quarry Extension Environmental Assessment (2006).

Monitoring bore MW1 is connected to the Berry Siltstone aquifer, which forms the topographical high to the southwest of the project area. The Berry Siltstone aquifer is a slightly brackish water reservoir, with a relative deficiency of potassium, which is reflected in the monitoring results of MW1. Historical monitoring from this bore shows that higher salinity and major ion concentrations have been observed at various times since 1993. These records show that many of the water quality objectives in the Development Consent are not appropriate for this bore, given the inherent natural variability at the interface of the Berry Siltstone aquifer and alluvial aquifer. Nevertheless, the current monitoring program is well placed to both monitor any variations in groundwater quality over time, as well as monitoring the spatial distribution of any brackish 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 has 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 close to or below standard laboratory reporting limits, 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 comparison with historical results provides a far better method of detecting any adverse impacts on groundwater resources as a result of dredging and associated activities.

The current groundwater monitoring program 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 2020-2021 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:

#### *Water and land*

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 dredge 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 weekly 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.

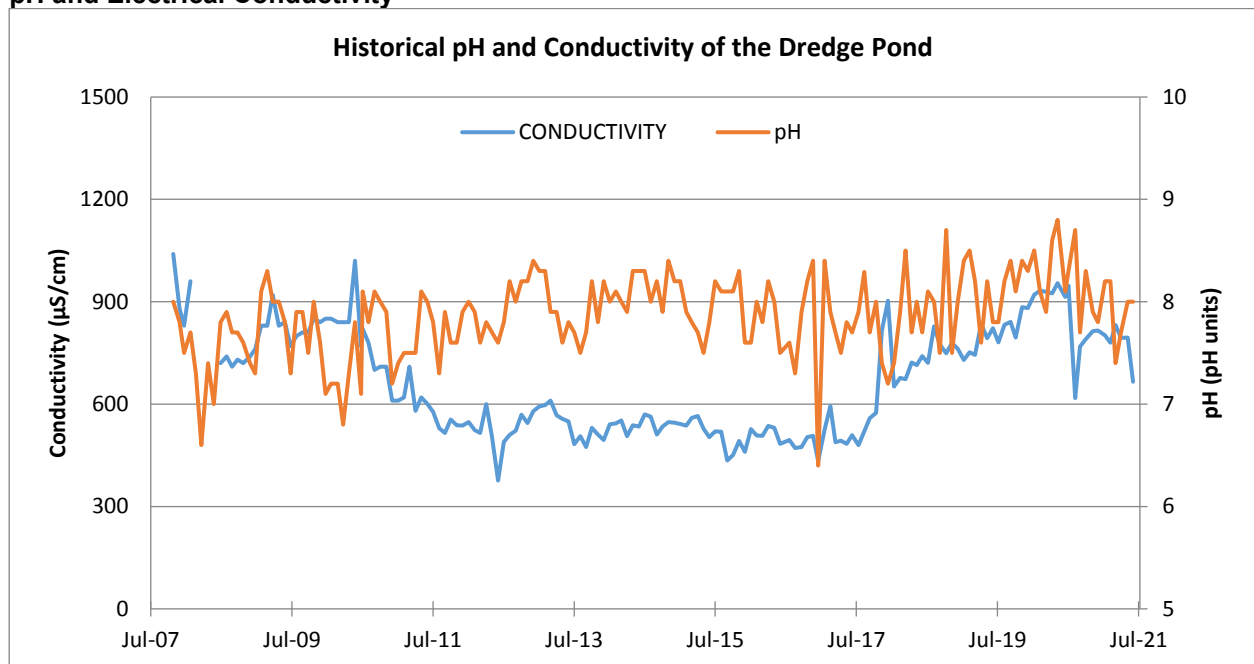
#### 4.3.3. Surface Water Monitoring

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.

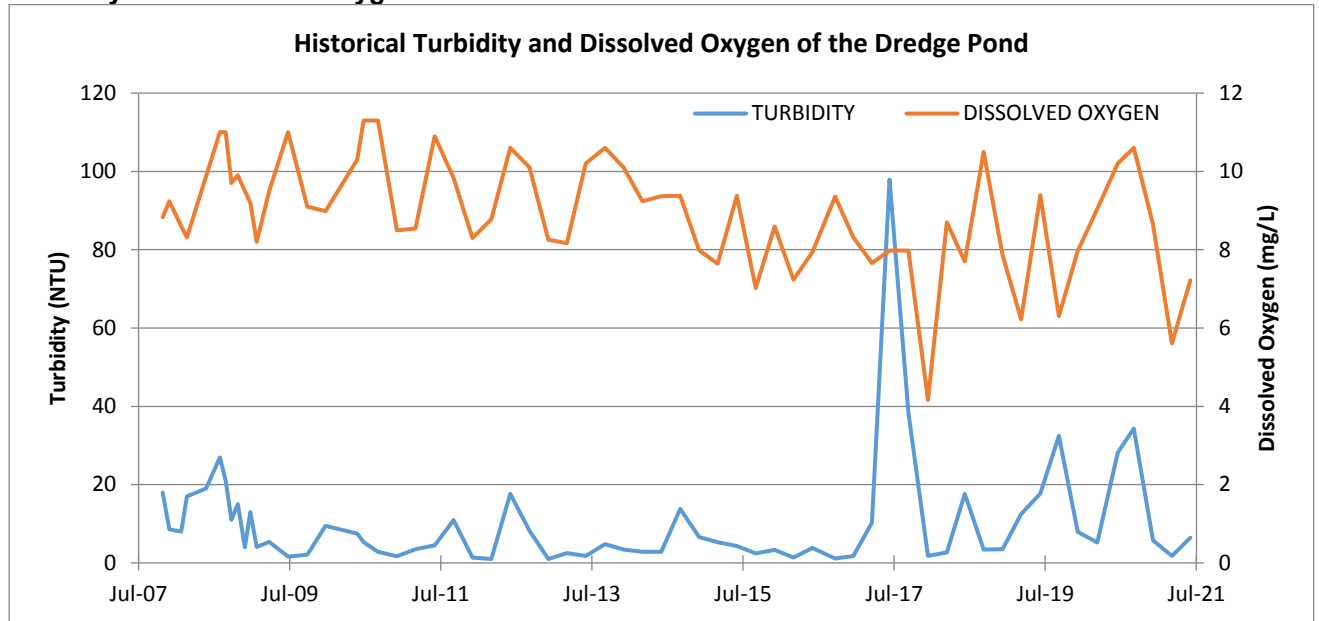
Analyte	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
Conductivity	618	785	947	376	660	1040	< 1,500	N/A
pH	7.4	8.0	8.7	6.4	7.8	8.8	6 - 8.5	N/A
Total Algae	45000	171350	473000	525	136767	2070000	< 15,000	N/A
Cyanophyta	38900	166650	472000	0	107189	2070000	< 15,000	N/A
Total phosphorus	<10	20	50	3	46	790	< 30	N/A
Total nitrogen	500	750	1200	40	618	6900	< 350	N/A
Chlorophyll-a	<1	11	37	<1	7	49	< 5	N/A
Faecal coliforms	4	15	22	1	120	2100	< 1000	N/A
Enterococci	2	13	20	<1	44	690	< 230	N/A
Sodium	66	67	69	33	55	91	< 400	N/A
Potassium ion	5	6	7	1	5	8	< 50	N/A

Analyte	2020/21 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
Magnesium ion	17	18	19	9	14	22	< 50	N/A
Chloride	107	114	119	16	83	140	< 300	N/A
Sulphate ion	110	129	142	25	110	1300	< 250	N/A
Bicarbonate ion	104	127	139	<2	96	313	< 750	N/A
Soluble iron ion	<0.05	<0.05	<0.05	<0.05	0.1	0.8	< 6	N/A
Ammonium ion	<0.01	0.02	0.05	<0.01	0.03	0.36	< 20	N/A
Turbidity	1.8	12.1	34.3	1	10.2	97.9	5 - 20	N/A
DO (mg/L)	5.6	8.0	10.6	4.2	9.0	11.3	> 6	N/A
DO (%)	68.1	85.8	102.0	51.9	98.9	125.0	> 80-90%	N/A

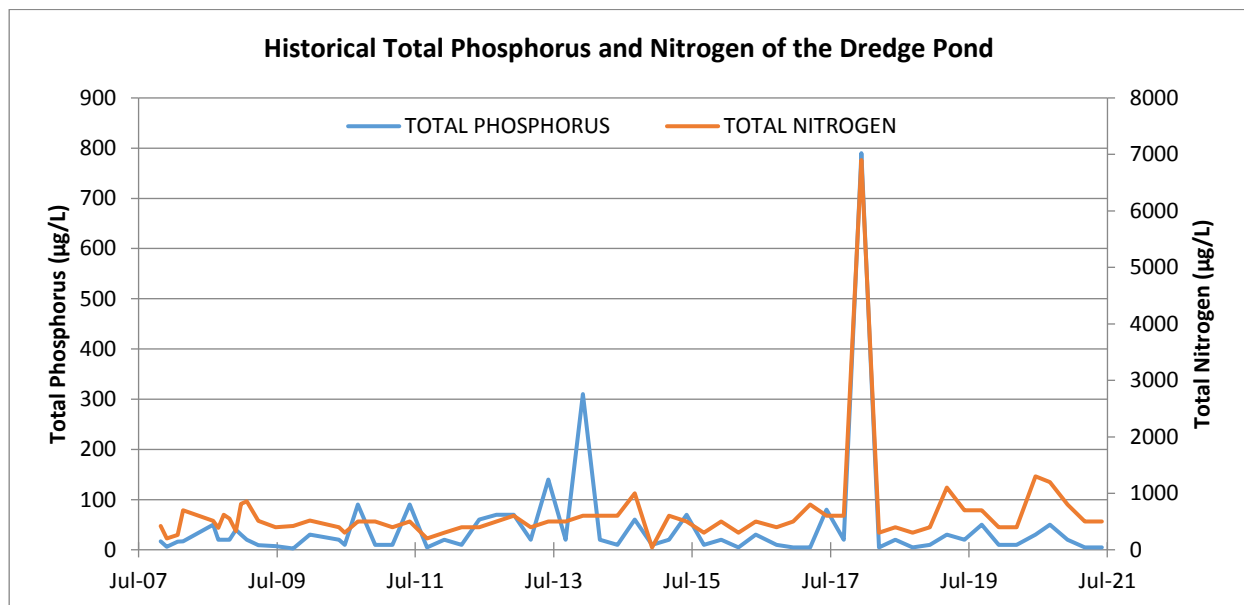
### pH and Electrical Conductivity



In the current reporting period, the dredge pond pH has reduced slightly as the water level has increased, to return to levels approximating the long term average pH of the dredge pond. All measurements were within the surface water quality objectives with the exception of a single measurement (8.7) in August 2020, which is likely related to the significant rainfall recorded in July 2020. Electrical Conductivity has reduced during the reporting period, consistent with rainfall patterns associated with the replenishment of the dredge pond with rainwater. The EC has remained within both the historical range and water quality objectives throughout the reporting period.

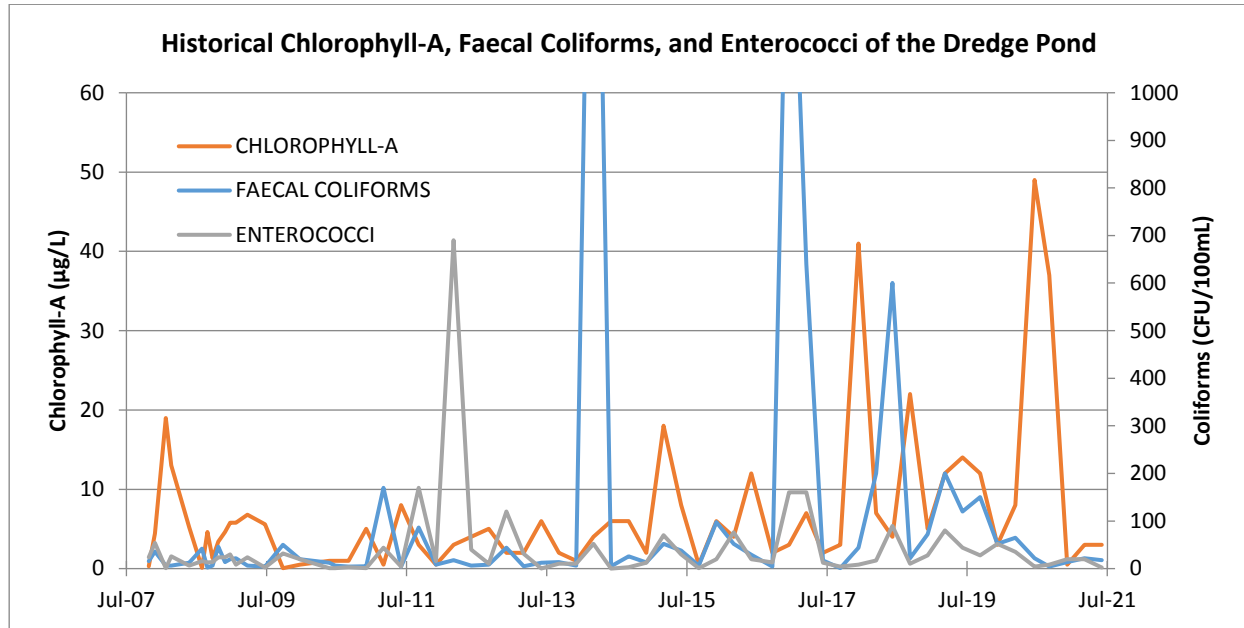
**Turbidity and Dissolved Oxygen**

Turbidity and dissolved oxygen have remained within their historical ranges in the current reporting period. Two samples recorded slightly below the percent saturation objective level for DO, with one of these samples also slightly below the mg/L objective level. One sample was above the upper limit of the turbidity objectives at the start of the reporting period, however recent turbidity results have been low.

**Total Phosphorus and Nitrogen**

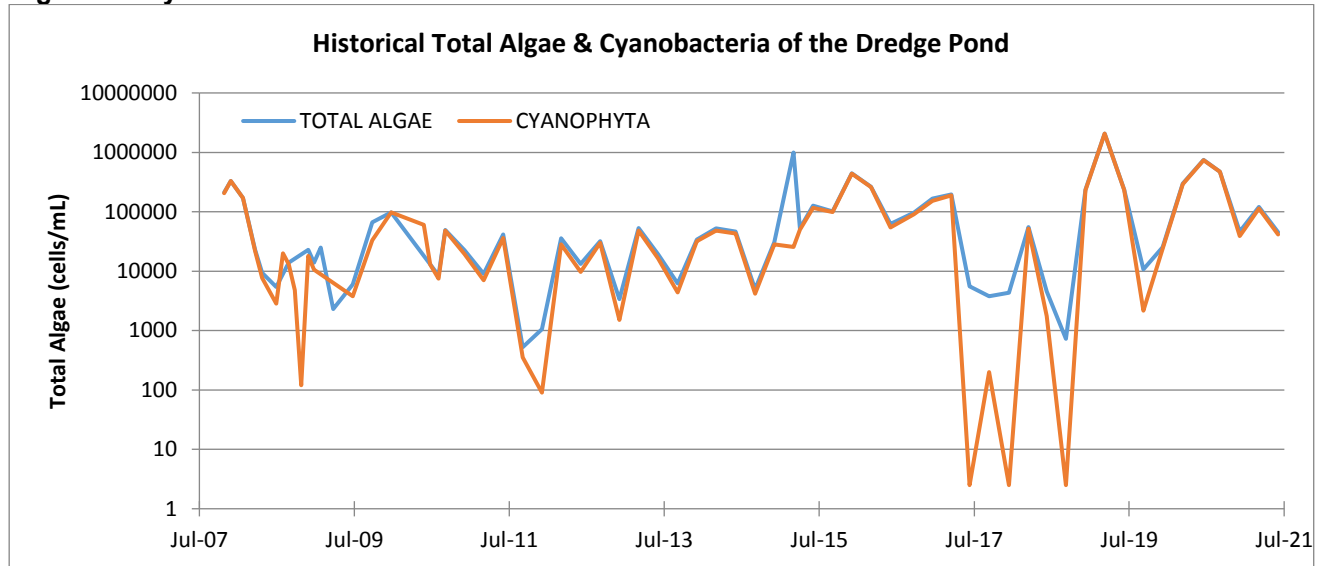
All nitrogen and phosphorus samples remained within the historical ranges for these analytes in the current reporting period, while phosphorus also met the objective levels in all but one sample at the start of the reporting period. Nitrogen was recorded above the objective level in the reporting period, however the graph above shows levels generally 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

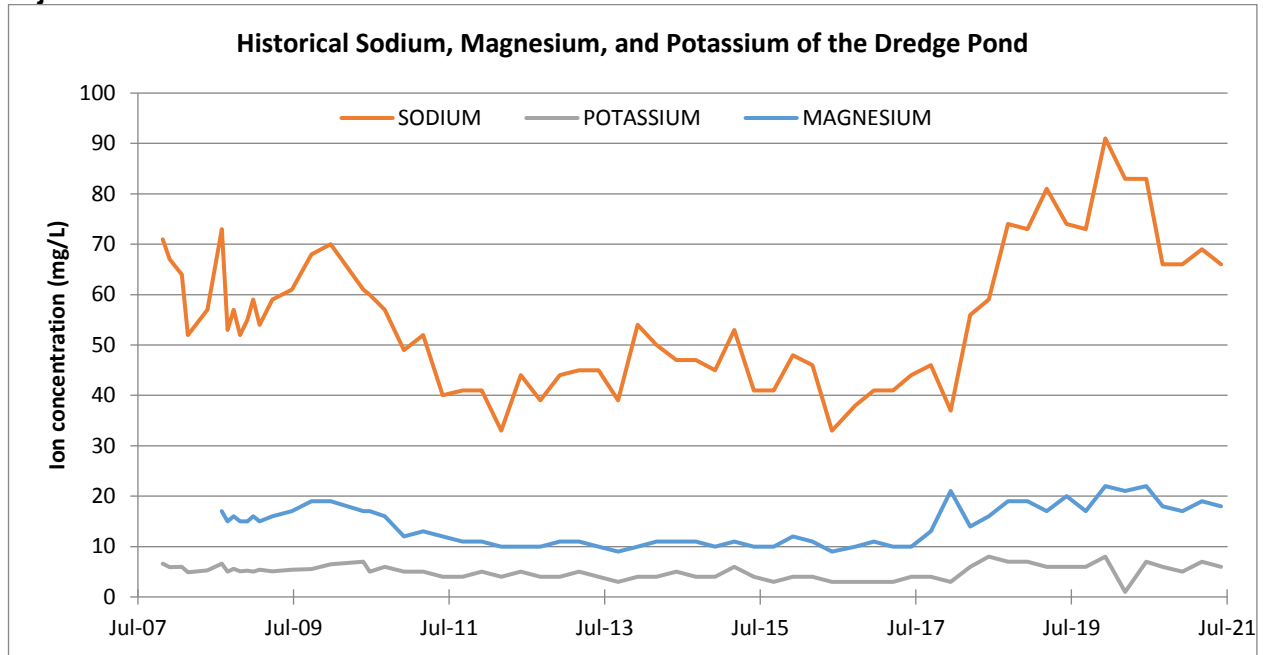


All chlorophyll-A, faecal coliform, and enterococci results were within the historical ranges for the respective analytes during the reporting period. All faecal coliform and enterococci results were also within the objective levels for the site, while a single sample for chlorophyll-A was above the objective level at the start of the reporting period before returning to low levels for subsequent sampling periods.

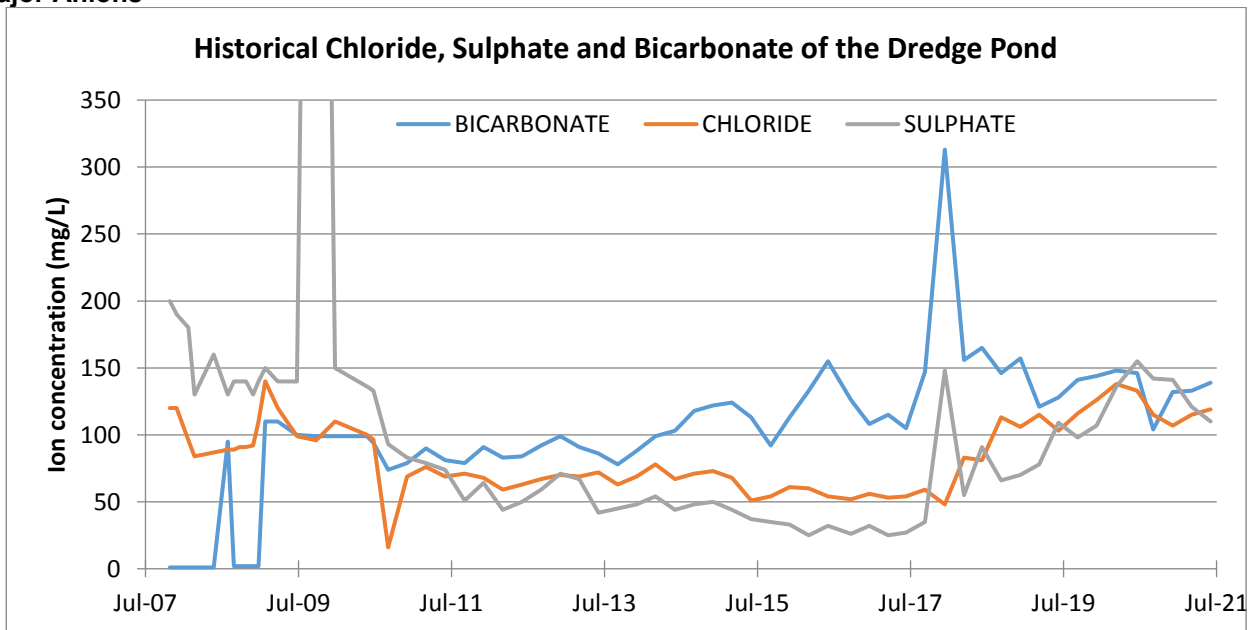
## Algae and Cyanobacteria



Total algae and cyanobacteria concentrations followed historical patterns, with seasonal fluctuations in concentrations of these organisms. Concentrations of both analytes were recorded above the objective levels during the year, which is consistent with historical results and does not reflect a decline in the water quality of the dredge pond.

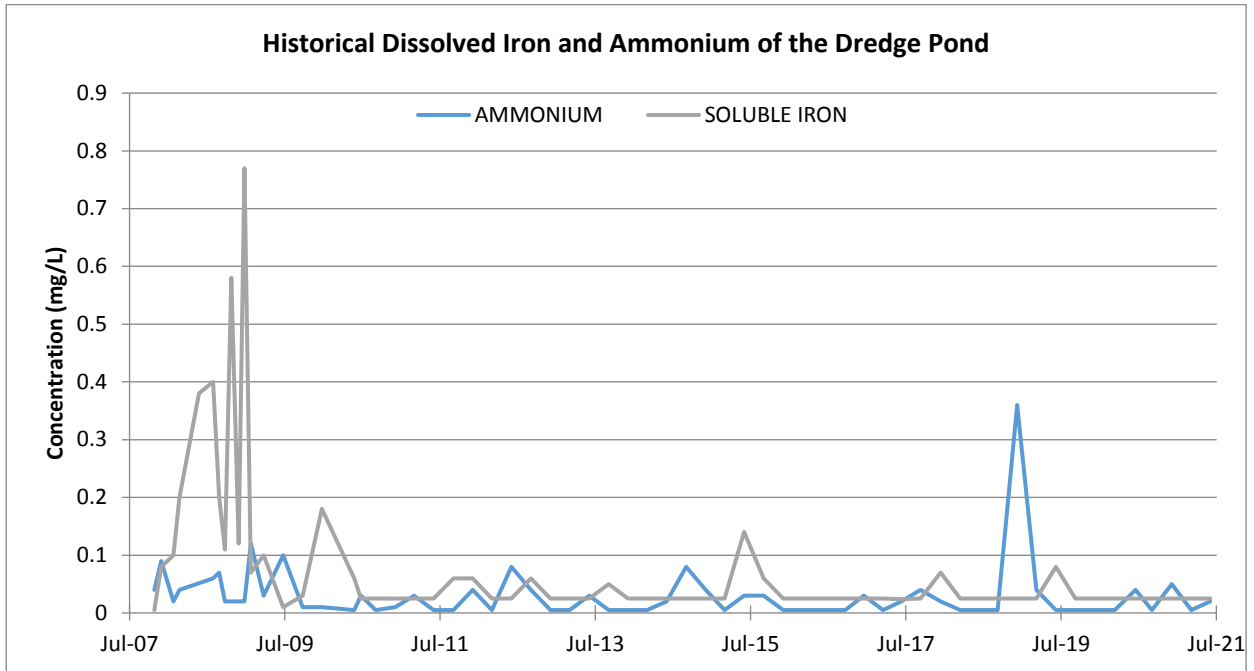
**Major Cations**

Sodium, magnesium, and potassium ion concentrations have followed the recent trends in electrical conductivity, with a steady rise over the previous dryer years, before reducing in the current reporting period in response to recent above average rainfall. All analytes remained within the objective levels and the historical ranges for the site during the reporting period.

**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.

## Soluble Iron and Ammonium



Soluble iron and ammonium ion concentrations have remained stable at very low levels and consistently below surface water quality objectives.

### 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 significant rainfall experienced in July 2020 has brought about a minor change in surface water characteristics, with those analytes that had shown variations in the preceding drier years returning to levels consistent with historical averages in the latter half of the reporting period.

The current surface water monitoring program 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 2020-2021 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/m<sup>2</sup>/month, maximum increase in deposited dust level; and
- 4g/m<sup>2</sup>/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 when required 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/m<sup>2</sup>/month) recorded in the three dust depositional gauges at the Gerroa Sand Resource.

Dust Gauge Units: g/m <sup>2</sup> /month	2020/21 Reporting Period			Historical Results		
	Min	Average	Max	Min	Average#	Max
1A	0.2	1.6	4.2	0.1	2.2	20.1
2A	0.1	0.9	2.4	0.1	2.2	49.7
3A	0.2	1.8	13.4	0.1	1.4	220.0
DC Criteria / EA Predictions		< 4			< 4	

#### 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 program 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 2020-2021 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 program 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 2020-2021 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 in July and December 2020, with the latter including a site visit. Minutes of these meetings have been sent to the DPIE 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 2020/2021, 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
2013/2014	0

Year	Environmental Complaints
2014/2015	0
2015/2016	0
2016/2017	0
2017/2018	0
2018/2019	0
2019/2020	0
2020/2021	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 thirteenth year of operation will be reviewed. The thirteenth 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. An ecologist from Niche Environment and Heritage carried out the thirteenth annual survey in June 2021 and it is attached as Annexure C.

#### **4.7.2. Summary of Quarterly Inspections and Key Works**

Quarterly inspections were carried out in September 2020, December 2020, March 2021 and June 2021.

Primary planting has been completed for all areas of revegetation, with infill planting and maintenance of these areas continuing. In the current reporting period, approximately 1,800 tubestock and advanced plantings were planted in Zones 2C.1, 2C.2, and 2D to make the most of the improved moisture conditions, with the key species planted including *Casuarina*, *Banksia*, *Acacia*, *Eucalyptus*, *Melaleuca* and *Pittosporum* species. This was despite considerable difficulties in sourcing local tubestock in 2020 due to demand from other projects including works associated with the 2020 bushfire recovery. Due to the difficulties in sourcing suitable plantings in the past year, Cleary Bros has established a small greenhouse on the site to boost tubestock growth, with the site-advanced plantings to be used to support continued infill planting for the following year.

The batters of the dredge pond foreshore are stable on both the east and west sides with minimal erosion evident. The sections of the batter that were planted in earlier years have established very well with significant growth and cover now evident. Redundant tree guards were removed from established trees in some of the planting areas in the year, with further tree guards to be removed in the coming year as they are no longer required on established trees.

In addition to supporting the growth of existing plantings on site, considerable weed control has been undertaken in the current reporting period in response to the improved growing conditions, with both native and non-native species showing considerable growth. The main weeds targeted included the ongoing suppression of lantana, and to a lesser extent the control of African Love Grass, Bitou Bush, Blackberry, Giant Arundo Grass, Morning Glory, and Tobacco Bush. Additional weed control was undertaken to support plantings using either herbicide or mechanical removal (mowing) or grasses. Approximately 216 hours of targeted weed control was undertaken across the management areas during the reporting period, with efforts concentrated in the second half the reporting period (H1 2021) due to the prolific growth of all vegetation on site.

#### **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 successful establishment of the Northern Corridor has been described extensively in previous reports.

#### **4.7.4. Findings and Recommendations from Annual Inspection**

The thirteenth annual report included an inspection of each zone where practicable, principally focusing on any areas for improvement where vegetation management efforts should be directed in the following year. The report stated the following general comment around the overall progress of the rehabilitation programme:

*The 13th annual monitoring report for the Gerroa Sand Quarry is consistent with previous reports, which detail the success of plantings across the various zones on the Site. The quarterly reports completed by Cleary Bros staff have allowed for continuous management of priority weeds and maintenance of fenced areas. As a result, the revegetation works across the Site have output a high success rate within a few years of establishment.*

The planting/rehabilitation zones as described in the Landscape and Rehabilitation Plan have been completed. The thirteenth annual report identified that continued targeting of priority weed species across the southern and eastern extent of the Site in conjunction with ongoing maintenance of planting areas will continue to improve canopy connectivity across the Site.

Management activities to be undertaken in the 2021-22 period will be in accordance with the recommendations in the thirteenth annual report. This will include maintenance of existing younger plantings, and weed control focusing on localised control of lantana, and other minor weeds such as Tobacco Bush, Giant Arundo Grass, Moth Vine, Crofton Weed, African Love Grass, Senna, Morning Glory, and Privet.

#### 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.

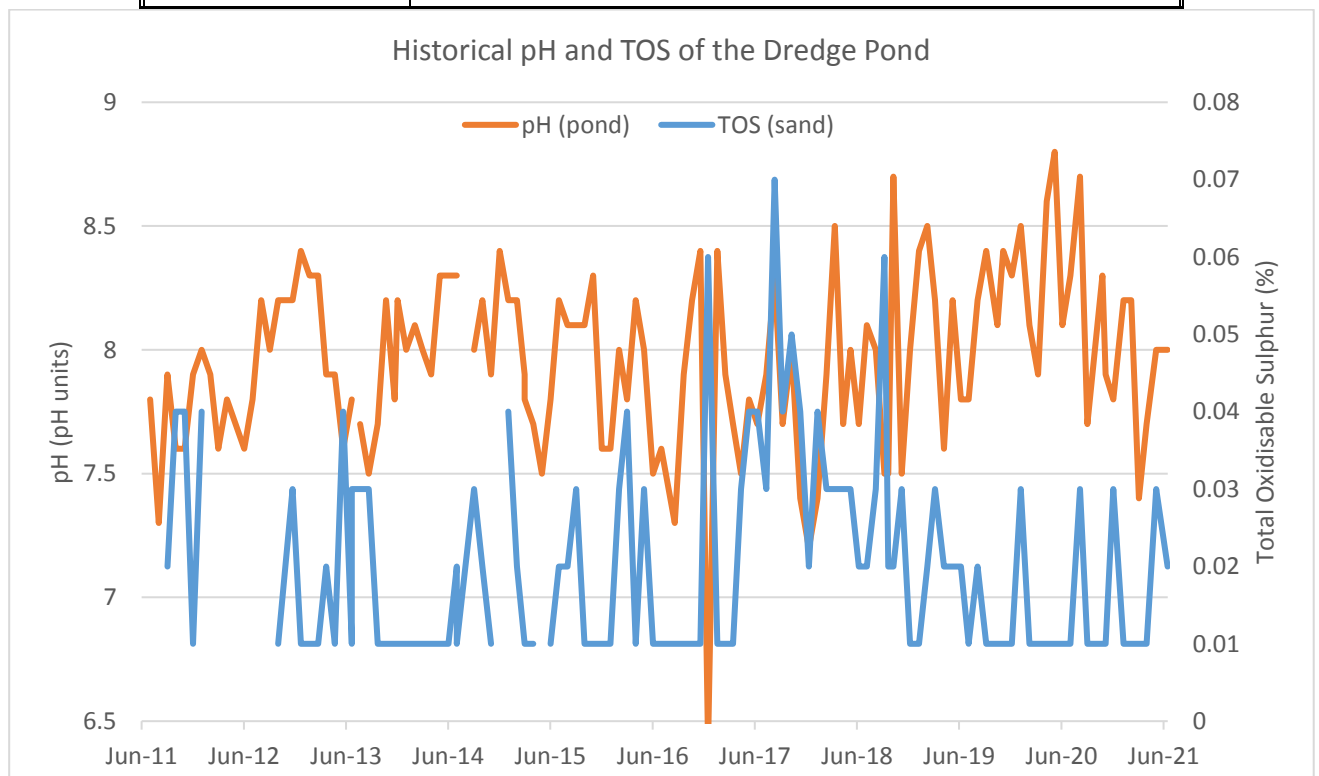
##### 4.8.2. Environmental Performance

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, however eight of the twelve results were below the standard laboratory limit of reporting (0.02%), with the remaining four at very low levels. 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	2020/21 Reporting Period			Historical Results		
	Min	Average	Max	Min	Average	Max
pH (pH units)	7.4	8.0	8.7	6.4	7.9	8.8
TOS (%)	<0.02	<0.02	0.03	<0.02	<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.

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 2020-2021 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 Site Induction and 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 to carry out the fourth Independent Environmental Audit in November 2019. 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 2019 Independent Environmental Audit. The next audit is scheduled for 2022.

<b>Condition Number</b>	<b>Auditor Comment</b>	<b>Auditor Recommendation</b>	<b>Progress of Corrective Actions</b>
Sch 2 Cond 1	Site management advised ERM that waste drums are being squashed with a front-end loader and recycled with scrap metal. Crushing used drums which have not been triple rinsed may resulting minor quantities of waste oil products being released to ground.	The practice of crushing drums on un-sealed ground should be ceased.	Completed - Oil drums will be removed from site once empty, and as such will no longer be crushed on site.

Condition Number	Auditor Comment	Auditor Recommendation	Progress of Corrective Actions
Sch 2 Cond 6	<p>The annual production volumes records presented by management are summarized below:</p> <ul style="list-style-type: none"> <li>• FY2017 - 80,020 t</li> <li>• FY2018 - 49,128 t</li> <li>• FY2019 - 55,790 t</li> </ul> <p>The exceedance for the FY2017 period was reported to the Department and a caution was Issued in relation to this matter.</p>	ERM reviewed the letter from CB to the Department in relation to the production exceedance which outlined plans for the Environmental Officer to undertake monthly cumulative production quantity monitoring.	Completed - Corrective action in relation to this notified event has been completed. No further action proposed.
Sch 2 Cond 8	During the site visit, ERM observed a drum suspended above a pump which appeared to be in use for oil storage. The drum appeared to be corroded, which suggests there is an increased likelihood of failure.	ERM recommends that this drum be replaced.	Completed - Drum replaced with appropriate storage vessel
Sch 3 Cond 11(d)	<p>ERM understands that CB are not currently undertaking any hydraulic conductivity testing required by Section 6.5 of the QEMP.</p> <p>Site management advised ERM that the original objective of this design feature was to prevent low hydraulic conductivity material from being imported and placed on site, altering the conditions which were present prior to dredging. The site is currently only emplacing processing returns from the wash-plant screening process which has a high hydraulic conductivity. Given that no imported material is being emplaced at the site and the hydraulic conductivity would be expected to be similar to the surrounding material, this non-conformance is considered minor in nature.</p>	ERM recommends CB review the QEMP and revise the plan in consultation with the Department to allow emplacement of processing returns without hydraulic conductivity testing.	Completed - QEMP updated with proposed procedure and submitted to DPIE for approval. Hydraulic conductivity of emplaced material has been tested and is consistent with reference site.
Sch 3 Cond 16	ERM has reviewed correspondence from CB to the Department and the proposed Planning Agreement document. Management advised that the Department have not yet responded and therefore no agreement has been formally entered into, therefore this requirement has not been formally met.	No action required while awaiting response from the Department.	In progress - CB has followed up with the Department and the VPA is currently in the process of being finalised.

## **5. Conclusion**

The primary 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 characterised by a significant increase in water availability associated with the above average rainfall recorded on the site, following on from four years of drought. This has seen improvements in surface water and groundwater quality and availability, as well as the prolific growth of both native and non-native species in the rehabilitation areas. Groundwater levels have generally returned to traditional levels across the monitoring network, while groundwater quality has generally improved. Despite the rise in groundwater levels following the extended drought, there has been no indication of mobilisation of oxidised iron sulphides in groundwater or surface water resources, with the pH of all groundwater monitoring bores, the dredge pond, and the floodgates on Blue Angle Creek consistent with historical results. With the improved soil moisture conditions, dust deposition has remained at very low levels.

Generally the site is performing well within the individual criteria and limits assigned to it in regard to environmental performance. There have been no non-compliances with the DC and no community complaints in the reporting period, with the site continuing to have no unexpected impacts on the local environment.

# **Annexure A**

Return to Department of Regional NSW 2019/2020

# Extractive Materials Return 2019-2020



## Regional NSW

Form S1 – Period Ending 30 June 2020

**Quote RIMS ID in all correspondence**

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

The return should be completed and forwarded to **Senior Advisory Officer, RESOURCE ECONOMICS, RESOURCE PLANNING & PROJECTS, DEPARTMENT OF REGIONAL NSW, PO BOX 344 HUNTER REGION MAIL CENTRE NSW 2310** on or before **31 October 2020**. 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, Resource Planning & Projects**

Please complete all 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 City 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 Mining, Exploration & Geoscience (NSW Mineral Resources) \_\_\_\_\_

From Crown Lands or other NSW 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, information entered in this return is correct and no blank spaces left where figures should have been inserted.

- **SIGNATURE of PROPRIETOR or MANAGER** \_\_\_\_\_ **DATE** 15/9/2020
- **CONTACT PERSON for this return:**
- **NAME** (Block letters) \_\_\_\_\_ **Telephone** \_\_\_\_\_

# Extractive Materials Return 2019-2020



Regional  
NSW

Form S1 – Period Ending 30 June 2020

**Sales During 2019-2020**

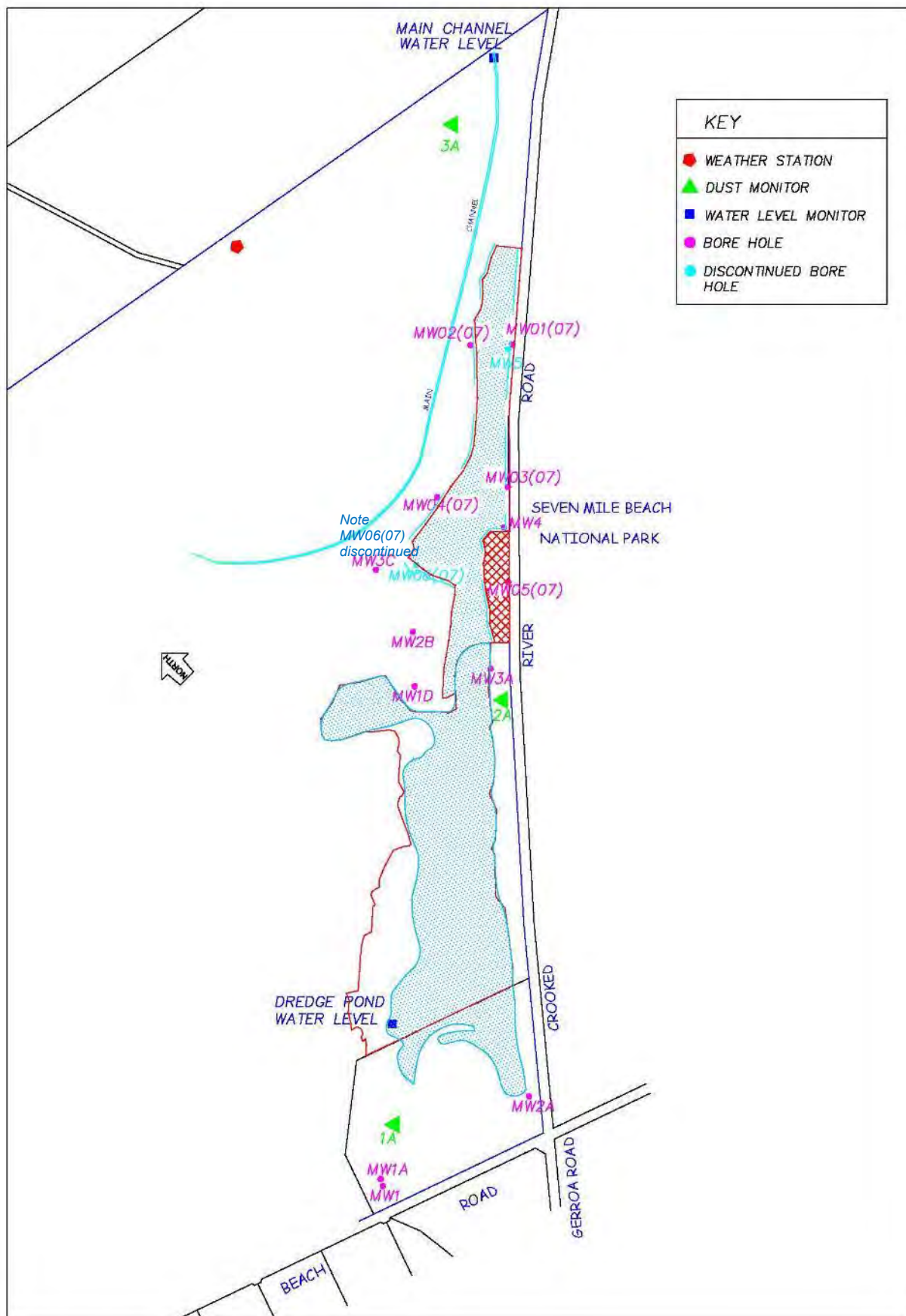
Production information may be published in aggregated form for statistical reporting. However, production data for individual operations is kept strictly confidential.

Product	Description	Quantity Tonnes
<b>Virgin Materials</b>		
<b>Crushed Coarse Aggregates</b>		
Over 75mm		-
Over 30mm to 75mm		-
5mm to 30mm		-
Under 5mm		-
Natural Sand		-
Manufactured Sand		-
Prepared Road Base & Sub Base		-
Other Unprocessed Materials		-
<b>Recycled Materials</b>		
<b>Crushed Coarse Aggregates</b>		
Over 75mm		-
Over 30mm to 75mm		-
5mm to 30mm		-
Under 5mm		-
Natural Sand		-
Manufactured Sand		-
Prepared Road Base & Sub Base		-
Other Unprocessed Materials		-
<b>River Gravel</b>		
Over 30mm		-
5mm to 30mm		-
Under 5mm		-
<b>Construction Sand</b>	Excluding Industrial	54,178
<b>Industrial Sand</b>		-
Foundry, Moulding		-
Glass		-
Other (Specify)		-
<b>Dimension Stone</b>	Building, Ornamental, Monumental	-
Quarried in Blocks		-
Quarried in Slabs		-
<b>Decorative Aggregate</b>	Including Terrazzo	-
<b>Loam</b>	Soil for Topdressing, Garden soil, Horticultural purposes)	-
<b>TOTAL SITE PRODUCTION</b>		54,178
<b>Gross Value (\$) of all Sales</b>		
<b>Type of Material</b>	Sand	
<b>Number of Full-Time Equivalent (FTE) Employees</b>	Employees: 4	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**

2020/21 Environmental Monitoring Results

## Groundwater Monitoring Results

	pH (pH units)				EC (µS/cm)				Total Phosphorus (µg/L)				Total Nitrogen (µg/L)			
	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21
MW1	4.9	4.9	5.3	6.7	6450	6750	6260	5660	570	300	100	20	2100	2000	2200	1600
MW1A	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW1D	6.9	6.8	6.6	7	884	1150	1260	1040	180	50	80	100	800	700	1000	1100
MW2A	6.7	7.1	7.2	7.1	503	722	501	483	100	70	70	240	200	200	200	600
MW2B	7.1	7.5	7.2	7.3	750	860	854	968	100	60	50	60	800	800	900	1000
MW3A	6.8	7.3	7.3	7.3	700	727	730	567	120	110	90	40	600	400	700	600
MW3C	7.3	7.4	7.3	7	755	1080	1140	1190	120	70	60	30	600	600	800	1000
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	4.7	dry	dry	dry	441	dry	dry	dry	160	dry	dry	dry	700	dry	dry	dry
MW02(07)	6.4	6.6	6.5	6.6	655	735	780	686	80	70	120	120	900	600	1700	1300
MW03(07)	5.3	dry	dry	dry	595	dry	dry	dry	110	dry	dry	dry	7100	dry	dry	dry
MW04(07)	7.3	7.4	7.4	7.6	798	830	832	707	160	240	70	680	700	1200	600	1300
MW05(07)	4.9	dry	dry	dry	506	dry	dry	dry	60	dry	dry	dry	1000	dry	dry	dry
	Sodium (mg/L)				Potassium (mg/L)				Magnesium (mg/L)				Chloride (mg/L)			
	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21
MW1	1060	1100	1160	1180	3	3	4	3	119	130	141	137	1860	1610	2150	1880
MW1A	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW1D	54	59	62	66	3	4	6	5	16	23	28	29	91	100	110	108
MW2A	26	39	42	35	1	1	2	1	9	9	8	7	43	126	50	57
MW2B	55	59	63	73	3	3	4	4	14	13	16	22	107	115	128	154
MW3A	41	42	65	54	2	2	4	2	11	10	12	10	111	112	145	105
MW3C	59	66	100	97	4	5	8	7	12	21	25	30	92	110	162	164
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	61	dry	dry	dry	1	dry	dry	dry	9	dry	dry	dry	134	dry	dry	dry
MW02(07)	44	64	70	71	3	5	7	5	20	15	17	18	110	103	116	115
MW03(07)	87	dry	dry	dry	11	dry	dry	dry	10	dry	dry	dry	139	dry	dry	dry
MW04(07)	66	67	68	67	6	6	7	6	20	17	18	19	115	106	112	109
MW05(07)	74	dry	dry	dry	5	dry	dry	dry	10	dry	dry	dry	154	dry	dry	dry
	Sulphate (mg/L)				Bicarbonate (mg/L)				Soluble Iron (mg/L)				Ammonium (mg/L)			
	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21
MW1	411	432	458	519	8	5	26	15	0.52	3.9	20.5	8.59	0.65	1.05	0.82	0.87
MW1A	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW1D	163	308	337	357	169	142	182	135	13.1	17.2	16.5	23.5	0.22	0.44	0.47	0.43
MW2A	6	15	18	13	172	138	146	133	17.1	11.8	8.48	15.9	<0.01	0.05	0.04	0.06
MW2B	40	87	102	195	180	211	189	187	4.65	2.99	3	4.28	0.4	0.53	0.5	0.48
MW3A	34	28	145	22	150	185	131	154	6.04	3.62	4.75	3.56	0.06	0.11	0.11	0.09
MW3C	60	225	162	304	185	211	217	234	2.01	3.46	3.95	5.9	0.36	0.46	0.5	0.57
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	8	dry	dry	dry	6	dry	dry	dry	2.01	dry	dry	dry	<0.01	dry	dry	dry
MW02(07)	138	134	111	113	36	86	91	101	1.7	1.9	4.84	4.62	0.12	0.13	0.18	0.26
MW03(07)	43	dry	dry	dry	16	dry	dry	dry	0.25	dry	dry	dry	<0.01	dry	dry	dry
MW04(07)	138	135	117	120	117	141	122	140	0.57	0.56	0.68	<0.05	0.16	0.18	0.24	0.08
MW05(07)	22	dry	dry	dry	6	dry	dry	dry	0.5	dry	dry	dry	<0.01	dry	dry	dry
	Chlorophyll-a (µg/L)				Faecal Coliforms (CFU/100mL)				Enterococci (CFU/100mL)							
	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21	Sep-20	Dec-20	Mar-21	Jun-21				
MW1	<1	<3	<1	<1	<2	<2	~2	<2	<2	~10	<2	<2				
MW1A	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry				
MW1D	<1	<1	<2	<1	<2	<2	<2	<2	<2	<2	~120	<2				
MW2A	<1	<1	1	2	<2	<2	<2	~10	<2	<2	<2	~4				
MW2B	<1	<1	<1	<1	<2	<2	<2	~4	~2	<2	<2	<2				
MW3A	<1	<1	<1	<1	<2	<2	~40	<2	<2	~4	~4	~2				
MW3C	<1	<1	<1	<1	<2	<2	<2	~<2	<2	<2	<2	~2				
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry				
MW01(07)	<1	dry	dry	dry	<2	dry	dry	dry	~2	dry	dry	dry				
MW02(07)	<1	<1	<1	5	~17	<2	~20	~<2	~4	<2	<2	~4				
MW03(07)	<1	dry	dry	dry	<2	dry	dry	dry	<2	dry	dry	dry				
MW04(07)	<1	<2	<1	1	<2	<2	<2	~2	<2	<2	<2	52				
MW05(07)	<1	dry	dry	dry	<2	dry	dry	dry	<2	dry	dry	dry				

## Groundwater and Surface Water Level Monitoring Results

(mAHD)	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21
MW1	3.27	2.97	2.6	2.61	2.69	2.46	2.9	2.6	2.36	2.64	2.63	2.49
MW1A	dry	1.07	dry	dry	1.12	dry	0.84	0.99	dry	1.22	dry	dry
MW1D	2.26	1.73	1.28	1.39	1.23	1.56	1.35	1.47	1.66	1.69	1.59	1.54
MW2A	3.31	2.93	2.2	2.34	2.43	2.58	2.54	2.62	2.4	1.73	2.75	2.69
MW2B	2.43	1.82	1.53	1.58	1.4	1.76	1.61	1.64	1.84	1.73	1.74	1.89
MW3A	2.56	2.15	1.45	1.59	1.66	1.82	1.8	1.84	1.94	1.85	1.69	1.79
MW3C	2.23	1.6	1.41	1.48	1.3	1.61	1.4	1.51	1.72	1.73	1.71	1.66
MW4	dry	6.19	dry	5.59	5.7	dry	5.82	5.92	5.9	5.79	6.24	dry
MW01(07)	dry	dry	4.19	4.34	4.44	dry	4.54	4.61	dry	dry	dry	dry
MW02(07)	1.98	1.56	1.15	1.23	1.24	1.42	1.31	1.39	1.48	1.32	1.55	1.6
MW03(07)	dry	dry	4.95	5.08	5.2	dry	dry	5.37	dry	dry	dry	dry
MW04(07)	3.91	3.46	2.96	3.05	3.1	3.26	3.7	3.23	3.32	3.19	3.37	3.31
MW05(07)	dry	5.45	4.6	4.77	4.96	dry	5.09	5.15	dry	dry	dry	dry
Dredge Pond	0.6	*	*	*	1.6	1.5	0.4	1.4	0.8	1.5	1.2	1.5
Channel (depth)	0.4	1.3	#	#	0.4	0.4	0.8	0.8	0.4	0.8	0.4	0.5
* access flooded												
# gauge not readable												

## Dredge Pond Surface Water Monitoring Results

	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21
EC (µS/cm)	947	618	769	790	814	816	802	780	832	794	795	666
pH (pH units)	8.3	8.7	7.7	8.3	7.9	7.8	8.2	8.2	7.4	7.7	8	8
Total Algae (cells/mL)			473000			46400			121000			45000
Cyanophyta (cells/mL)			472000			38900			114000			41700
Total Phosphorus (µg/L)			50			20			<10			<10
Total Nitrogen (µg/L)			1200			800			500			500
Chlorophyll-a (µg/L)			37			<1			3			3
Faecal Coliforms (CFU/100mL)			~4			~14			~22			~18
Enterococci (CFU/100mL)			~8			20			20			~2
Sodium (mg/L)			66			66			69			66
Potassium (mg/L)			6			5			7			6
Magnesium (mg/L)			18			17			19			18
Chloride (mg/L)			115			107			115			119
Sulphate (mg/L)			142			141			121			110
Bicarbonate (mg/L)			104			132			133			139
Soluble Iron (mg/L)			<0.05			<0.05			<0.05			<0.05
Ammonium (mg/L)			<0.01			0.05			<0.01			0.02
Turbidity (NTU)			34.3			5.8			1.8			6.4
Dissolved Oxygen (mg/L)			10.6			8.65			5.61			7.22
Dissolved Oxygen (%)			99.5			102			68.1			73.5

## Air Quality Monitoring Results – Depositional Dust Gauges

TIS (g/m2/month)	1A	2A	3A
Jul-20	1.1	1.6	1.1
Aug-20	2.3	1.0	0.8
Sep-20	1.9	1.3	13.4
Oct-20	4.2	2.4	2.4
Nov-20	1.8	0.8	0.6
Dec-20	1.9	0.6	0.6
Jan-21	1.5	0.1	0.5
Feb-21	1.2	1.0	0.7
Mar-21	0.8	1.3	0.2
Apr-21	1.8	0.6	0.4
May-21	0.8	0.2	0.3
Jun-21	0.2	0.4	0.2

## Acid Sulphate Monitoring

	TOS (%)
Jul-20	<0.02
Aug-20	0.03
Sep-20	<0.02
Oct-20	<0.02
Nov-20	<0.02
Dec-20	0.03
Jan-21	<0.02
Feb-21	<0.02
Mar-21	<0.02
Apr-21	<0.02
May-21	0.03
Jun-21	0.02

# **Annexure D**

Thirteenth Annual Review

Landscape and Rehabilitation Management Plan

Niche Environment and Heritage

19 July 2021

## **Gerroa Sand Quarry**

Annual Review

Vegetation Management Plan

Prepared for Cleary Bros (Bombo) Pty Limited | 19 July 2021



## Document control

Project number	Client	Project manager	LGA
6743	Cleary Bros (Bombo) Pty Limited	Nathan Browne	Kiama

Version	Author	Review	Status	Date
D1	Nathan Browne	Sian Griffiths	Draft	8 July 2021
Rev 0	Nathan Browne	Simon Tweed	Final	12 July 2021
Rev 1	Nathan Browne	Mark Hammond	Final	13 July 2021
Final	Nathan Browne	Simon Tweed	Final	15 July 2021

© Niche Environment and Heritage Pty Ltd (ACN 137 111 721) 2018

Copyright protects this publication. All rights reserved. Except for purposes permitted by the Australian Copyright Act 1968, reproduction, adaptation, electronic storage, transmission and communication to the public by any means is prohibited without our prior written permission. Any third party material, including images, contained in this publication remains the property of the specified copyright owner unless otherwise indicated, and is used subject to their licensing conditions.

### Disclaimer

While Niche Environment and Heritage Pty Ltd uses care and diligence in the preparation of this report, it is not responsible or liable for any mistakes, misprints, omissions or typographical errors. None of Niche Environment and Heritage Pty Ltd, nor its editors or authors are responsible for the results of any actions taken on the basis of information in this publication. Niche Environment and Heritage Pty Ltd and its editors and authors expressly disclaim all and any liability and responsibility to any person or organisation in respect of, or as a consequence of, anything done or omitted to be done by any person or organisation in reliance, whether wholly or partially, upon the whole or part of any of the contents of this publication, including any photographs, statements or descriptions. No representation is made as to the suitability of this publication for any particular purpose. The views expressed in this publication are not necessarily endorsed by this publication, its editors or authors, or the owners or management of Niche Environment and Heritage Pty Ltd.

### Enquiries should be addressed to:

Sydney Head Office  
Niche Environment and Heritage  
02 9630 5658  
info@niche-eh.com  
PO Box 2443 North Parramatta  
NSW 1750 Australia

## Table of Contents

---

<b>Table of Contents.....</b>	<b>ii</b>
List of Figures.....	ii
<b>1. Vegetation Management Plan: Annual Monitoring Report.....</b>	<b>3</b>
1.1 Introduction.....	3
1.2 Background.....	3
<b>2. Assessment of Individual Zones.....</b>	<b>5</b>
Table 1: Recommendations for the management zones.....	6
<b>3. Discussion and recommendations .....</b>	<b>24</b>
<b>References.....</b>	<b>25</b>
<b>Plates .....</b>	<b>26</b>
<b>Appendix 1: Selected Conditions of Approval.....</b>	<b>32</b>
<b>Appendix 2: Priority weeds for the South East region, <i>Biosecurity Act 2015</i> .....</b>	<b>34</b>

### List of Figures

Figure 1: Map of Gerroa Sand Quarry Planting and Conservation Areas.....	4
--	---

### List of Plates

Plate 1: Deer rubbing on <i>Banksia integrifolia</i> within subzone 2D planting areas. ....	26
Plate 2: Mature wild tobacco bush stand in Zone 2A.1.....	27
Plate 3: Crofton weed stands along the roadside in Zone 2A.1. ....	28
Plate 4: Native Common Silkpod ( <i>Parsonia straminea</i> ) not to be confused with Moth Vine ( <i>Araujia sericifera</i> ) when targeting Moth Vine in Zone 1.4.....	29
Plate 5: Example of kikuyu grass growing through tree guard and strangling planting, avoidance via more frequent mowing and hand removal to improve revegetation success in affected areas. ....	30
Plate 6: Small Senna stand near Site entry. Small stands like this should be removed prior to fruiting to avoid further seed dispersal. ....	31

## 1. Vegetation Management Plan: Annual Monitoring 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 assess the condition of the Conservation Area, 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 improved rehabilitation performance 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). This report satisfies the condition requiring an annual report on the progress of the revegetation project.

This report is the 13<sup>th</sup> such annual report covering the Site at Gerroa prepared since 2009. This report is based on an inspection that was undertaken in the last week of June 2021.

### 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 2020/2021; a similar report has been prepared annually since the beginning of the quarry expansion by Kevin Mills & Associates and others. 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 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 twelve years of reporting are contained in the earlier reports; this information is not repeated here.



# Planting & Conservation Areas

## Quarterly Inspection Report

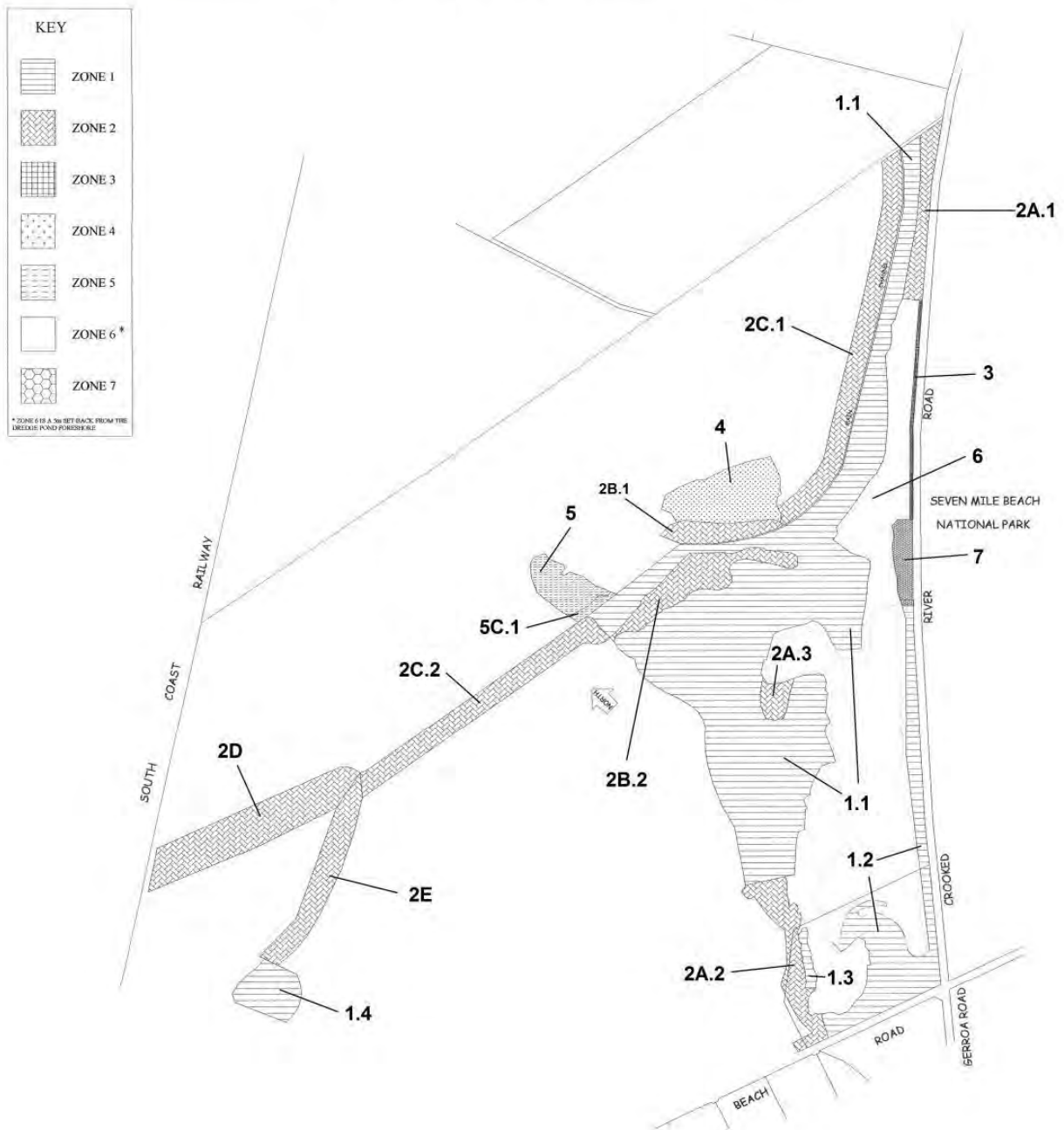


Figure 1: Map of Gerroa Sand Quarry Planting and Conservation Areas

## 2. Assessment of Individual Zones


---


Primary planting was completed in all zones some time ago, these are now in the maintenance phase. Additional plantings have occurred in the past year in Zones 2B.1, 2C.1, 2C.2, and 2D to improve the vegetation buffer along Blue Angle Creek, creating suitable habitat for local fauna. These areas are now similarly in the maintenance phase and will require ongoing management to ensure reduced competition from invasive species. Where plantings do not survive, infill planting should be used as required.


In all planting areas, weeds have been controlled since the early stages of the project and are now considered to be well controlled. In this case, the zone descriptions below in Figure 1 and Section 2 are provided as an indication of the weed situation in the current survey.


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 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 recommendations for the management zones (Figure 1) detailed in Table 1 were made following the site inspection conducted by ecologist Nathan Browne on 30 June 2021. See Appendix 2 for further detail on control of specific priority weed species.

**Table 1: Recommendations for the management zones**

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
<b>Zone 1: Forest Enhancement Zone Objectives (41.95 ha)</b> <ul style="list-style-type: none"> <li>• Improve the quality of the forest by removal of weeds</li> <li>• Restrict access to grazing stock</li> <li>• Monitor the health of the forest</li> <li>• Strengthen tree cover south of previous dredge pond</li> </ul> <p>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)</p>			
<b>Subzone 1.1</b>	Main area of existing forest, extending from the northern to near the southern extremities of the Site	<p>Removal of Giant Arundo Grass (<i>Arundo donax</i>) from the roadside and lower lying areas via cut and paint method.</p> <p>Ongoing Lantana (<i>Lantana camara</i>) treatment to reduce extent throughout the area using cut and paint method.</p> <p>Spraying for African Love Grass (<i>Eragrostis curvula</i>) along roadside.</p>	


Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Increase cut and paint control of Lantana to control spread. Small patch of Giant Arundo Grass, which requires cut and paint method. Moth Vine ( <i>Araujia sericifera</i> ) also requires maintenance particularly in eastern portions of the subzone.	


Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
Subzone 1.3	Covers the old bund wall that was planted with trees long ago, behind the site office and towards the front gate.	Morning Glory ( <i>Ipomoea indica</i> ) weed extent seemingly reduced. Lantana thickets should be the priority weed in this area using cut and paint methods, however, Senna ( <i>Senna pendula</i> var. <i>glabrata</i> ) and Crofton ( <i>Ageratina adenophora</i> ) weeds also require attention starting from roadside to reduce extent.	


Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
Subzone 1.4	A fenced patch of Swamp Oak within grazing land, which now has a planted link to the east (planting zone 2E). Vegetation is well established and requires very little ongoing work	Good condition <i>Allocasuarina</i> stand, some Moth Vine starting to creep into swamp extent. Remove Moth Vine via cut and paint, be sure not to confuse with nearby native Common Silkpod ( <i>Parsonisa straminea</i> ) – see Plate 4.	


#### Zone 2: Broad scale planting zone Objectives (25.39 ha)


- 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.

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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 eleven years to develop this area as habitat for native fauna.	Efforts of creek weed management evident, ongoing maintenance to roadside still required – tend to Crofton and Tobacco Bush ( <i>Solanum mauritianum</i> ) along road extent via spray and cut and paint methods. Multiple, small stands of Lantana popping up on eastern sides of the road in the oldest revegetation site. These small Lantana stands should be high priority given the current good condition of the area.	

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Ongoing Lantana management required via cut and paint method. Moreover, stands of Senna, Moth Vine and Wild Tobacco require ongoing management.	


Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Tree survival still an obstacle, however, those which did survive are standing strong. Lantana creeping into the subzone and should be removed. There is also a small Senna stand which should be removed simultaneous to the Lantana management.	

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
Subzone 2B.1	Small revegetation patch roadside adjacent to subzone 1.1. Plantings undertaken recently and generally in good condition	Continue to monitor noxious woody weed growth and take action when required. Continue to mow around tree guards and remove Kikuyu grass from within the guards when required.	


Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
Subzone 2B.2	<p>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).</p>	<p>Small stands of Tobacco Bush, Lantana and Thistle among grasses nearer the roadside that could be managed via cut and paint.</p>	

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
Subzone 2C.1	A linear area which has been completely planted out. 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.	Zone 2C.1 in good condition, old plantings standing tall and flowering indicating good health – generally free from high threat weeds. New stands within fenced area growing strong and free from predation. A good example site for what other newer plantings should look like. Continue to promote native tree and shrub cover via continued mowing to lessen risk of weed reinvasion.	

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
Subzone 2C.2	A long narrow area supporting well advanced plantings, some being over a metre tall.	Advanced plantings in good condition. More recent plantings require more frequent mowing to keep pasture grasses from competing with plantings. Continue to promote native tree and shrub cover via in-fill planting of native species to lessen risk of weed reinvasion.	

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Zone in good condition, however, recent plantings have become overrun with low threat weeds resultant from limited access. Mowing the area should be a priority to keep competition with plantings to a minimum. Deer grazing and antler rubbing evident (Plate 1) – Deer control may be necessary if plantings fail to take despite increased weed control.	
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.	Largely inaccessible given recent rainfall, narrow strip of trees looks in good health from afar. Given proximity to subzone 1.4 there may be some Moth Vine growth that needs tending to.	N/A

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
<b>Zone 3: Screen Planting Zone Objectives (0.42 ha)</b> <ul style="list-style-type: none"> <li>Establish a screen of native vegetation along the eastern edge of pond extension</li> </ul> Maintain existing trees on south eastern boundary, remove Lantana and replace with native plantings.			
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.	Mature plants have outgrown their slips, remove slips where necessary. Fence maintenance controlling Senna and Lantana regrowth via cut and paint methods would assist with weed spread into the quarry. However, these stands are not an immediate priority.	
<b>Zone 4: Bangalay Sand Forest (3.32 ha)</b> <ul style="list-style-type: none"> <li>Restrict access to grazing stock</li> <li>Establish a forest link to nearby larger area through plantings</li> <li>Monitor the health of the forest</li> </ul> Remove weeds when required.			

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Some Lantana stands that still require attention (pictured), Single Coral Tree ( <i>Erythrina crista-galli</i> ) in distance that requires cut and paint method.	

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
<b>Zone 5: Swamp Oak Forest Objectives (1.82 ha)</b> <ul style="list-style-type: none"> <li>• Restrict access to grazing stock</li> <li>• Establish a forest link to nearby larger area through plantings</li> <li>• Monitor the health of the forest</li> </ul> Remove weeds when required.			
<b>Zone 5</b>	Supports a small, fenced stand of natural Swamp Oak Forest; the trees are quite dense with a native/weedy grassy understorey.	Good condition <i>Allocasuarina</i> stands. Control weeds such as Small-leaved Privet ( <i>Ligustrum sinense</i> ) where present.	


Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Some Lantana stands still present	N/A


#### Zone 6: Dredge Pond Foreshore Objectives (not displayed on Figure 1)

Dredge Pond Foreshore (includes 5 m setback from pond and batter slopes on both the existing and extension pond)

- 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 Rainforest (Zone 7) ahead of the quarrying operation

Continue rehabilitation of previous dredge pond areas.

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
<b>Zone 6</b>	Occurs within the foreshore areas of the Dredge Pond, being 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.	Monitor and control of priority weeds such as Lantana and Tobacco Bush using cut and paint method as necessary. Avoid spraying in this area to ensure native species retain dredge pond bank stability.	
<b>Zone 7: Littoral Rainforest Objectives (0.95 ha)</b> <ul style="list-style-type: none"> <li>• Control weeds, particularly Lantana</li> <li>• Monitor the health of the forest</li> <li>• Protect the western edges of the site from quarrying</li> </ul> <p>Ensure that the felling of trees does not impact the vegetation in this area.</p>			

Zone	Location/description	Recommendations for ongoing works 2021/22	Reference Images
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.	Monitor and control Lantana as necessary. Continue with mosaic methods of weed removal (i.e. working in patches). Starting office end and working eastwards.	

### 3. Discussion and recommendations

---

The 13<sup>th</sup> annual monitoring report for the Gerroa Sand Quarry is consistent with previous reports, which detail the success of plantings across the various zones on the Site. The quarterly reports completed by Cleary Bros staff have allowed for continuous management of priority weeds and maintenance of fenced areas. As a result, the revegetation works across the Site have output a high success rate within a few years of establishment.

Given wetter weather conditions experienced this year, some zones have been largely inaccessible, however, rapid growth of native and non-native species is evident. As the access paddocks dry out, zones previously inaccessible should be subject immediate attention, particularly if they contain recent plantings, for example: Zone 2D and Zone 2B.1.

Deer grazing and rubbing upon newly planted tube stock was observed in Zone 2D and Zone 4 which may hinder the success of present and future revegetation works in the area. If predation intensifies and rates of tube stock success dwindle, these zones may require on-site deer control methods and to achieve successes exhibited from older parts of Zone 2C.1.

Similarly, to uniformly achieve revegetation successes, such as those exhibited in the northern portions of the Gerroa Sand Quarry, mature weeds such as Wild Tobacco Bush found in Zone 2B.2, Lantana stands in Zone 3, and the Coral Tree in Zone 4 should be targeted to limit further seed dispersal given their higher fecundity. Future weed removal should be undertaken using cut and paint methods for these woody weeds since it offers a higher kill rate and avoids indirect poisoning of adjacent native species. Where cut and paint methods are less suitable i.e., managing grassy weed species, spraying should be undertaken with more caution. Given that native flora species such as Bracken fern were found to have been impacted by spraying methods on site.

Additionally, the control of small Lantana stands popping up in Zone 2A.1 should be high priority before they begin to fruit. Ongoing Lantana control in other areas should be undertaken in a mosaic pattern in areas up to 1000m<sup>2</sup> at a time to allow for fauna to disperse through adjacent habitat whilst native revegetation occurs in the targeted extent.

Continued targeting of priority weed species across the southern and eastern extent of the Site in conjunction with ongoing maintenance of planting areas will continue to improve canopy connectivity across the Site. Whilst mature native species continue to flower and fruit, ongoing revegetation will continue to increase the proportion of native flora species until recent plantings become self-sustaining in years to come.

## References

---

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.

Department of Primary Industries (2021). NSW WeedWise, July.

## Plates

---



**Plate 1: Deer rubbing on *Banksia integrifolia* within subzone 2D planting areas.**



**Plate 2: Mature wild tobacco bush stand in Zone 2A.1.**



**Plate 3: Crofton weed stands along the roadside in Zone 2A.1.**



**Plate 4: Native Common Silkpod (*Parsonia straminea*) not to be confused with Moth Vine (*Araujia sericifera*) when targeting Moth Vine in Zone 1.4.**



**Plate 5: Example of kikuyu grass growing through tree guard and strangling planting, avoidance via more frequent mowing and hand removal to improve revegetation success in affected areas.**



**Plate 6: Small Senna stand near Site entry. Small stands like this should be removed prior to fruiting to avoid further seed dispersal.**

## 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](http://www.apvma.gov.au)

Common name	Scientific name	Duty under Biosecurity Act 2015	Action
African Lovegrass	<i>Eragrostis curvula</i>	<b>Regional Recommended Measure</b> 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>	<b>Biosecurity Zone</b> 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	<b>Prohibition on dealings</b> 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>	<b>Regional Recommended Measure</b> <b>Exclusion zone:</b> 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><b>Whole region:</b> 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><b>Exclusion zone:</b> The plant should be eradicated from the land and the land kept free of the plant.</p> <p><b>Core area:</b> 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><b>Regional Recommended Measure</b></p> <p><b>Exclusion zone:</b> 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><b>Whole region:</b> 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><b>Exclusion zone:</b> 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><b>Chemical control:</b></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><b>Prohibition on dealings</b></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>