

GALES-KINGSCLIFF

PTY LTD  
ABN: 75 093 540 080

# Annual Review

for the

# Cudgen Lakes Sand Quarry

1 July 2018 to 30 June 2019

*Compiled by:*



**R.W. CORKERY & CO. PTY. LIMITED**

September 2019

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ABN: 75 093 540 080

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## 1 July 2018 to 30 June 2019

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**Compiled for:**

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
Ref No. 617/38

September 2019



R. W. CORKERY & CO. PTY. LIMITED

## TITLE BLOCK

<b>Name of Operation</b>	Cudgen Lakes Sand Quarry
<b>Name of Operator</b>	Neumann Contractors
<b>Development consent / project approval #</b>	Project Approval 05_0103
<b>Name of holder of development consent / project approval</b>	Gales-Kingscliff Pty Ltd
<b>Mining Lease #</b>	Not Applicable
<b>Name of holder of mining lease</b>	Not Applicable
<b>Water licence #</b>	WAL 40902
<b>Name of holder of water licence</b>	Gales-Kingscliff Pty Ltd
<b>MOP/RMP start date</b>	Not Applicable
<b>MOP/RMP end date</b>	Not Applicable
<b>Annual Review start date</b>	01/07/18
<b>Annual Review end date</b>	30/06/19
<p>I, <b>Stephen Segal</b>, certify that, to the best of my knowledge, this audit report is a true and accurate record of the compliance status of the Cudgen Lakes Sand Quarry for the period 1 July 2018 to 30 June 2019 and that I am authorised to make this statement of behalf of Gales-Kingscliff Pty Ltd.</p> <p><i>Note.</i></p> <p>a) <i>The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000.</i></p> <p>b) <i>The Crimes Act 1900 contains other offences relating to false and misleading information: Section 192G (Intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); Section 307A, 307B and 307C (false or misleading application/information/documents – maximum penalty 2 years imprisonment or \$22,000, or both).</i></p>	
<b>Name of authorised reporting officer</b>	Stephen Segal
<b>Title of authorised reporting officer</b>	Managing Director
<b>Signature of authorised reporting officer</b>	
<b>Date</b>	30/09/2019

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## 1. STATEMENT OF COMPLIANCE

The compliance status of relevant approvals was reviewed for the reporting period and is summarised in **Table 1.1**. It was determined that there was a total of four non-compliances during the reporting period relating to the implementation of the Air Quality and Soil and Water Management Plans. The non-compliances recorded during the reporting period have been ranked according to the risk matrix included in **Table 1.2**.

**Table 1.1**  
**Statement of Compliance**

Were all conditions of the relevant approval(s) complied with?	Yes / No
Project Approval 05_0103B	No
Environment Protection Licence 12385	Yes

**Table 1.2**  
**Non-compliances**

Relevant Approval	Condition	Condition Description (summary)	Compliance Status	Comment	Where Addressed in Annual Review
PA 05_0103	2(2)	The Proponent, in acting on this approval, must carry out the project in accordance with the conditions of this approval.	Non-compliant	Non-compliance with the conditions of PA05_0103 were recorded during the reporting period (see below).	Section 1.
PA 05_0103	5(3)	Continue to apply existing approved management plans until the approval of a similar plan following a modification to this approval.	Non-compliant	Water monitoring was not undertaken at all sites at the frequency required by the existing SWMP. This was reported as an incident on 4 and 11 March 2019. Deposited dust monitoring has not been undertaken in accordance with the existing AQMP which did not explicitly confirm that monitoring was not required during non-operational periods. Updated AQMP awaiting approval.	Sections 4.3, 5 and 11.1.
PA 05_0103	SoC 9.3	Under water quality monitoring in accordance with the approved Blue-Green Algae Management Plan	Non-compliant	As above.	Section 4.3, 5 and 11.1.
PA 05_0103	SoC 12.5	Undertake monitoring in accordance with the Air Quality Monitoring Program.	Non-Compliant	As above.	Section 4.5, 5 and 11.1.

**Compliance Status Key**

Risk level	Colour code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.
Medium	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> <li>potential for serious environmental consequences, but is unlikely to occur; or</li> <li>potential for moderate environmental consequences, but is likely to occur.</li> </ul>
Low	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> <li>potential for moderate environmental consequences, but is unlikely to occur; or</li> <li>potential for low environmental consequences, but is likely to occur.</li> </ul>
Administrative non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions).

## 2. INTRODUCTION

### 2.1 OVERVIEW OF OPERATIONS

The Cudgen Lakes Sand Quarry (the Quarry) is located at Cudgen approximately 1km south of the Tweed River and 8km south of the New South Wales/Queensland Border (see **Figure 2.1**). Project Approval 05\_0103 was granted 16 June 2009 and has since been modified as follows.

- a. Modification 1 (MOD 1) – 19 February 2016, including the addition of an initial processing area with operations planned to remain south of the existing alignment of Altona Road for a period of at least 5 years from commencement.
- b. Modification 2 (MOD 2) – 22 January 2019, including utilisation of the ‘Initial’ Processing Area as the long-term Processing Area, consolidation of the Northern and Southern Extraction Areas into a single lake and increase of the final lake batters to 1:3 (V:H).

The approved layout of the operations is shown in **Figure 2.2** whilst surrounding land ownership, residences and registered groundwater bores are shown in **Figure 2.3**.

Operations at the Quarry were physically commenced on 13 September 2016, site establishment activities commenced on 26 June 2017 and the first extraction campaign commenced 30 October 2017 and ceased on 8 February 2018. The approval for the realignment of Altona Road (DA05/1450) was physically commenced in 2011 through the placement of sub-base material in the eastern section of the road realignment. Further details on the activities undertaken during the reporting period are provided in Section 4.

### 2.2 SCOPE AND FORMAT

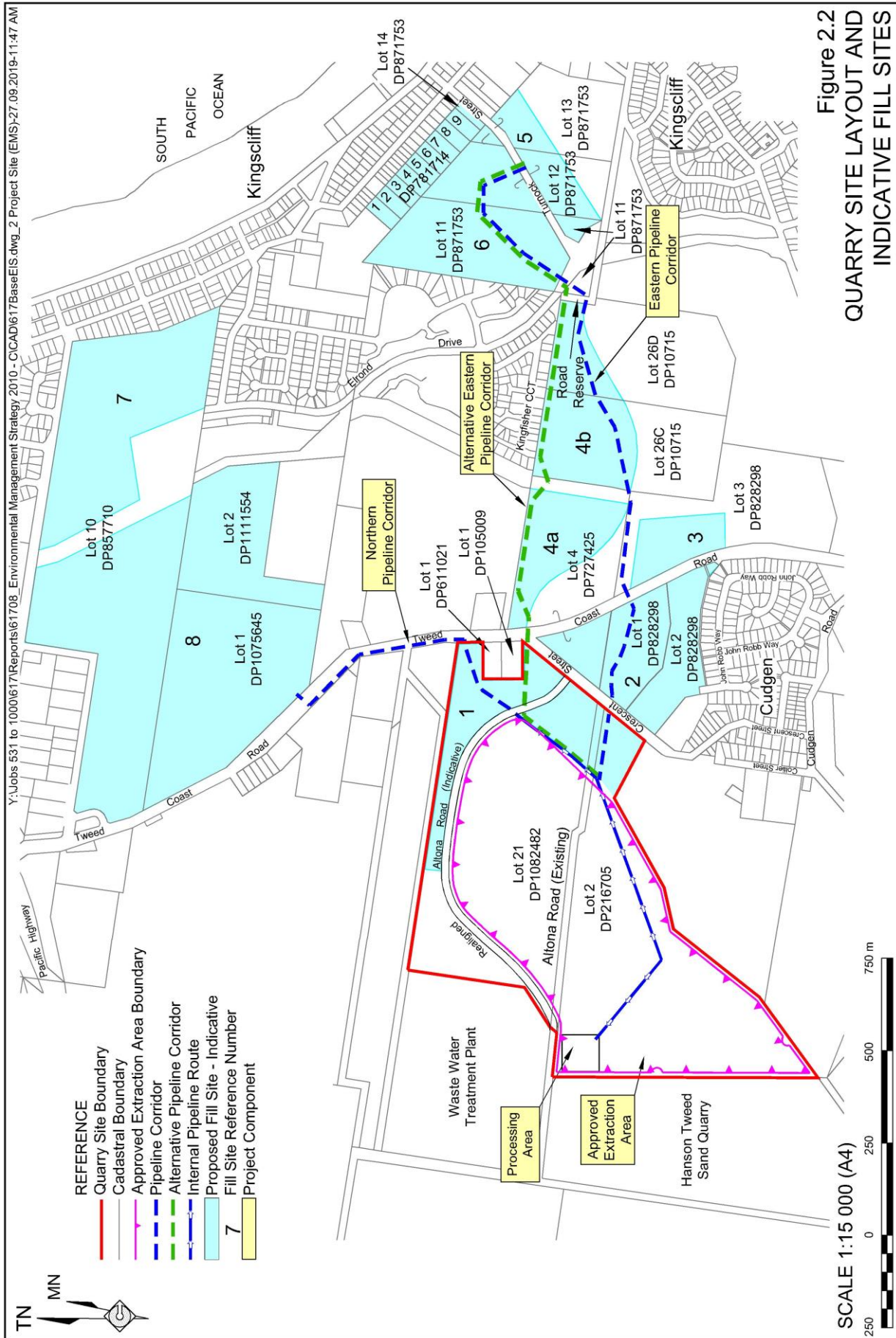
This Annual Review for the Quarry has been compiled by R.W. Corkery & Co. Pty. Limited on behalf of Gales-Kingscliff Pty Ltd (“the Company”).

This is the ninth (9<sup>th</sup>) Annual Review submitted for the Quarry, following one Annual Environmental Management Report, and is applicable for the period 01 July 2018 to 30 June 2019 (“the reporting period”). The information presented within this Annual Review is based on information compiled by R.W. Corkery & Co. Pty. Limited and provided by Gales-Kingscliff Pty Limited, Neumann Contractors and HMC Environmental Consulting.

The report generally follows the format and content requirements identified in the *Annual Review Guideline* dated October 2015 and the approval and licencing requirements, as applicable for the reporting period.









## **2.3 KEY PERSONNEL CONTACT DETAILS**

The key personnel contact names, position and phone numbers during the reporting period are as follows.

<b>Name</b>	<b>Company</b>	<b>Position</b>	<b>24 Hour Contact</b>
Gareth Brown	Neumann Contractors*	Contracts Manager	0409 346 555
Stephen Segal	Gales-Kingscliff	Managing Director	0414 322 455
Jeff Holloway	-	Site Caretaker	0402 427 938

\* During this reporting period Neumann Contractors fulfilled the role of “Quarry Manager” as defined in the approved management plans. The “Quarry Manager” role will vary during future reporting periods and will be specified in the respective Annual Review.

### 3. APPROVALS

The Quarry operates in accordance with the approvals listed in **Table 3.1**.

**Table 3.1**  
**Cudgen Lakes Sand Quarry – Consents, Leases and Licences**

Consent/Lease/Licence	Issue Date	Expiry Date	Details / Comments
Project Approval 05_0103*	16/06/2009 MOD1 - 19/02/2016 MOD2 – 22/01/2019	31/12/2047	Issued by the (then) Department of Planning.
Environment Protection Licence 12385*	18/11/2005 (licence version dated 18 January 2019)	Not Applicable	Issued by NSW Environment Protection Authority (EPA). Renewed annually.
Water Access Licence 40902	09/11/2016	Not Applicable	Issued by Water NSW. Includes 700ML water allocation. Nominated works 30CA321269.
Water Supply Works and Use Approval 30CA321269	01/07/2016	28/02/2021	Issued by Water NSW at commencement of <i>Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016</i> .
DA 05/1450	18/08/2006	Not Applicable	Issued by Tweed Shire Council for the realignment of Altona Road.

\* A compliance review is included in **Appendix 1** reflecting the conditions relevant as at the end of this reporting period.

During the reporting period, modification application (MOD 2) for Project Approval 05\_0103 was approved on 22 January 2019. As discussed in Section 2.1, the modification includes utilisation of the ‘Initial’ Processing Area as the long-term Processing Area, consolidation of the Northern and Southern Extraction Areas into a single lake and increase of the final lake batters to 1:3 (V:H).

Additionally, a variation application lodged for Environment Protection Licence (EPL) 12385 was approved 18 January 2019. The variation approved the removal of Cudgen Heights from the licence (given filling operations were completed during the previous reporting period) and the removal of Monitoring Point 7, a private groundwater bore (GW300847) which no longer exists. Future fill sites will be added to EPL 12385 as appropriate and prior to commencement of filling at those sites.

It is also noted that initial discussions with the Natural Resources Access Regulator (NRAR) indicate that the Water Supply Works and Use Approval may have been issued in error. This is supported by the fact that, as the Quarry is a State Significant Development, Section 4.41 of the *Environmental Planning and Assessment Act 1979* states that a water use approval or water management work approval under the *Water Management Act 2000* is not required. Notwithstanding, the Water Access Licence and associated water allocation remain valid and are required for the ongoing operations. Confirmation from NRAR on this matter has been sought and is awaited.

## 4. OPERATIONS SUMMARY

### 4.1 EXTRACTION OPERATIONS

No extraction was undertaken, no sand was processed or transported by road and no Virgin Excavated Natural Material (VENM) was imported onto the Quarry Site during the reporting period. **Table 4.1** provides the production summary.

**Table 4.1**  
**Production Summary**

Material	Approved limit (specify source)	Previous reporting period (actual)	This reporting period (actual)	Next reporting period (forecast)
Waste Rock / Overburden <sup>1</sup>	NA	0	0	0
ROM <sup>1</sup>	NA	0	0	0
Coarse Reject <sup>2</sup>	NA	0	0	0
Fine Reject <sup>2</sup>	NA	0	0	0
Saleable Product <sup>3</sup> (transported by road)	300,000t [PA 05_0103 Condition 2(9)]	0	0	0
Total Extraction	650,000m <sup>3</sup> [PA 05_0103 Condition 2(8)]	352,195m <sup>3</sup> #	0	50,000m <sup>3</sup>
Imported VENM	45,000t [PA 05_0103 Condition 2(10)]	0	0	0

Notes: 1. The Quarry does not generate waste rock / overburden or 'Run of Mine' material.  
2. Whilst some coarse materials and fines will be generated through sand washing and returned to the extraction ponds, there are no approval limits applicable to these materials.  
3. 300 000t is equivalent to approximately 200 000m<sup>3</sup>.  
# This is a maximum volume. A more precise volume will be reported following further hydrographic survey to confirm the final volume of returned silts. This will be completed prior to recommencement of extraction.

### 4.2 OTHER OPERATIONS DURING THE REPORTING PERIOD

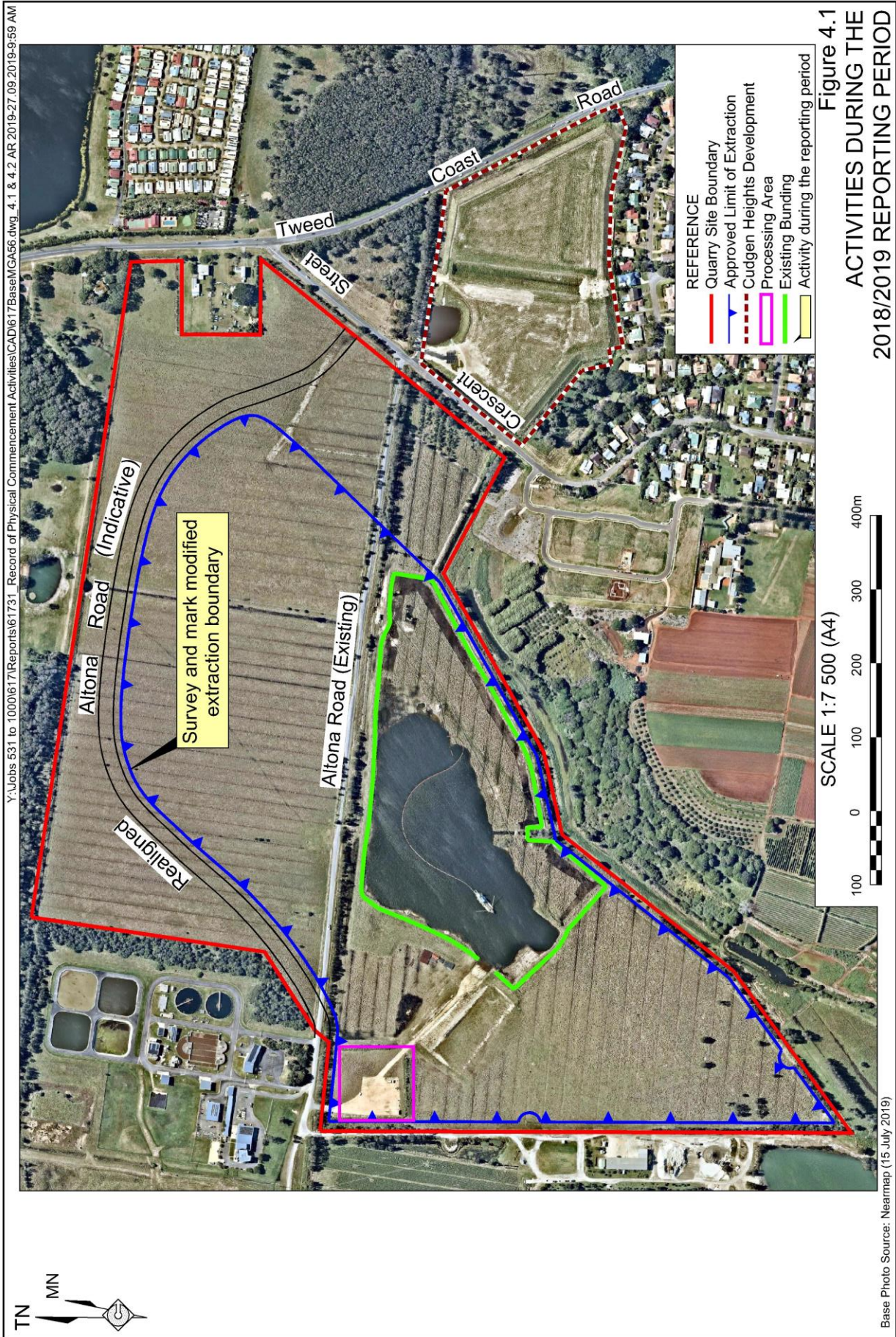
The status of the Quarry at the end of the reporting period is presented in **Figure 4.1** and a summary of activities during the reporting period provided as follows.

#### Site Establishment and Construction Activities

No site establishment or construction activities were undertaken at the Quarry during the reporting period. Discussions commenced with the operator of the adjacent Tweed Sand Quarry regarding maintenance of Altona Road and planned upgrades to Altona Road and the Tweed Coast Road / Crescent Street intersection, however, no physical works commenced during the reporting period.

#### Monitoring

Environmental monitoring, including surface and groundwater monitoring, continued throughout the reporting period. Results of this monitoring is summarised in Sections 6 and 7.



## Other Activities

Following the approval of MOD 2 during the reporting period, the following management plans and strategies for the Quarry were updated.

- a. Environmental Management Strategy (EMS).
- b. Noise Management Plan (NMP).
- c. Air Quality Management Plan (AQMP).
- d. Soil and Water Management Plan (SWMP).
- e. Rehabilitation Management Plan (RMP).

The updated EMS, NMP and AQMP were submitted to the Department on 22 April 2019. The NMP and AQMP were prepared in consultation with NSW EPA who had no comments. The Department provided feedback on 29 April 2019 with the final plans to be approved with the remaining management plans. Approval was provided by the Department for the submission of the updated SWMP and RMP by 8 July 2019 (slightly after this Annual Review period). A summary of the consultation and status for each plan is provided as follows.

- SWMP
  - Council comments received 28 June 2019 and response provided 1 July 2019.
  - Water NSW Algal Committee Comments received 3 July 2019 and discussed in teleconference 5 July 2019. SWMP updated accordingly.
  - Water NSW (general) confirmed no comments.
  - EPA confirmed no comments.
  - DoI – Water comments not yet received.
- RMP
  - Water NSW (general) confirmed no comments.
  - OEH comments received 22 July 2019
  - Council comments received 24 September 2019.
  - DoI – Water comments not yet received.

The Aboriginal Cultural Heritage Management Plan (ACHMP) only required an administrative update to reflect the adjusted site layout as approved by MOD2 and therefore did not require consultation.

In addition to the update of the management plans, the modified extraction boundary as approved by MOD2 was surveyed by B&P Surveys and marker pickets placed with ~2m high orange conduit to enhance the visibility of the markers. A total of 12 new markers were placed and 5 existing markers were retained.

## 4.3 NEXT REPORTING PERIOD

Activities planned to be undertaken during the next reporting period are summarised as follows and displayed on Figure 4.2.



## Site Establishment and Construction

Site establishment and construction activities during the next reporting period may include the establishment of processing equipment within the processing area and commencement of road transportation at a rate of up to 10 trucks per day. Road upgrade works may also be undertaken by the operators of the adjacent Tweed Sand Quarry which would also enable road transportation from the Cudgen Lakes Sand Quarry at a rate greater than 10 trucks per day.

## Extraction, Processing and Transportation

Extraction may recommence during the next reporting period, either by dredge or excavator and haul truck for the production of saleable products within the processing area. These products would be transported via road. The volume of products will be dependent upon customer demand but has nominally been estimated at 75 000t (approximately 50 000m<sup>3</sup>)<sup>1</sup>. Based on the predicted volumes, extraction would remain within the existing bunded area.

Further dredging and hydraulic transfer of sand to fill sites is currently not considered likely during the next reporting period and is dependent upon finalisation of approvals and development plans for those fill sites.

No importation of VENM is expected during the next reporting period given that terminal extraction faces will not yet be available for VENM placement.

## Monitoring

Surface water and groundwater monitoring will be undertaken as applicable and in accordance with the conditional requirements of Project Approval 05\_0103 and the approved Soil and Water Management Plan. Monitoring requirements and frequency will be adjusted in accordance with the updated Soil and Water Management Plan following its approval.

As outlined within the updated Air Quality and Noise Management Plans, deposited dust and noise monitoring is only proposed during operational periods. Therefore, monitoring of air and noise will also be undertaken during the next reporting period should operational activities recommence.

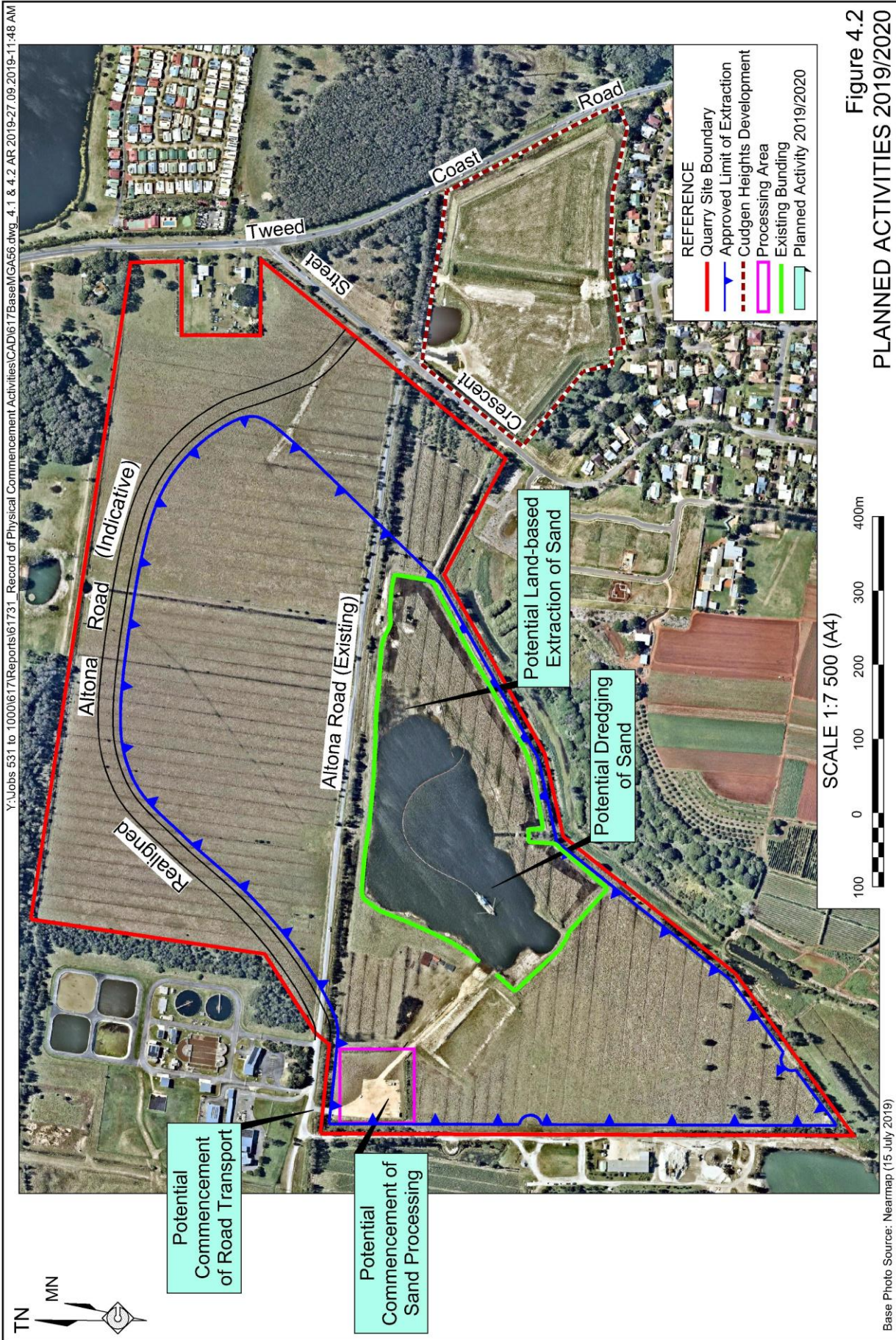
## Other Activities

Any final amendments to the updated management plans will be made in accordance with comments received from government agencies. Following approval of the Rehabilitation Management Plan, within 6 months a review of the rehabilitation bond will be completed and submitted. Commissioning and completion of an Independent Environmental Audit will also be undertaken during the reporting period with the audit required to be commenced prior to 30 October 2019 and completed within 12 weeks.

The finalising of agreements concerning surrounding planned upgrades and maintenance of Altona Road and upgrade of the Tweed Coast Road / Crescent Street intersection will also continue with the operator of the adjacent Tweed Sand Quarry. Pending outcomes of these agreements being finalised, upgrades and maintenance works may be undertaken during the next reporting period.

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<sup>1</sup> It is estimated that 1m<sup>3</sup> of in situ sand will yield 1.5t of product, however, this conversion factor will be confirmed utilising production records once road transportation commences.



## 5. ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The 2017/2018 Annual Review was submitted to the (then) DPE, Tweed Shire Council, Water NSW and EPA on 31 August 2018. The 2017/2018 Annual Review was accepted by DPE on 21 September 2018, however, three action items were outlined. A summary of these and their status is provided as follows. No feedback or comments were received from Tweed Shire Council, Water NSW or EPA.

### Action Item A

***“Schedule 3, Condition 9 – Ensure that the requirements of all currently approved Management Plans are followed to remain compliant with all obligations. The Department notes that Air Quality was not monitored following the cessation of extraction, which is not approved under the currently approved Air Quality Management Plan.”***

It is noted that, due to the continued non-operational state of the Quarry (i.e. no extraction, processing, site establishment or construction activities), air quality monitoring was not undertaken during the reporting period. As outlined in the 2017/2018 Annual Review, an update to the Air Quality Management Plan (AQMP) was proposed to be sought. Given the processing of the MOD2 application, in discussion with the Department on 14 September 2019 it was agreed that the management plans would be updated in a single update following the determination of MOD2. MOD2 was determined on 22 January 2019 and provided 3 months for the update of the AQMP. The updated AQMP, including provision for cessation of deposited dust monitoring during non-operational periods, was submitted 22 April 2019. Feedback was received from the Department 29 April 2019 requesting some minor adjustments, but otherwise not disagreeing with the cessation of air quality monitoring during non-operational periods. The Department’s final approval of the AQMP (and other updated management plans) is awaiting finalisation of the updated SWMP (which is currently awaiting feedback from NRAR and the Department– see Section 4.2).

### Action Item B

***“Schedule 5, Condition 3 and 4 – Exceedances of environmental monitoring criteria is classified as an incident under the terms of the approval. Throughout the reporting period exceedances of criteria regarding Noise, Air Quality, Surface Water Quality and Groundwater Quality went unreported to the Department. Ensure that all exceedances of monitoring criteria are reported to the Department in line with the Conditions.”***

During the reporting period the trigger action level for blue green algae, incorporating trigger values for both algal abundance as well as several environmental factors, was exceeded. This exceedance of trigger action levels was reported as an incident to the Department on 11 March 2019. Further details regarding this incident are presented in Section 11.1.

### Action Item C

***“Schedule 5, Condition 5f – Section 7.3 of the report does not include a summary of Groundwater Quality data analysed against current limits in tabular format. Ensure that all subsequent AEMRs include a table that analyses trigger levels against monitoring data. Please also ensure that future AEMRs analyse environmental data against the Environmental Assessment predictions as required by the Condition.”***

A tabulated summary of groundwater quality results obtained during the reporting period are presented in Section 7.3 and complete groundwater monitoring results are presented as **Appendix 3**. A comprehensive assessment of groundwater quality monitoring results is also presented in the updated Soil and Water Management Plan for the Quarry.

Specific predictions of water quality impacts were not provided in the Environmental Assessment for the Quarry, however, groundwater drawdown impacts were predicted. As the Quarry was non-operational during the reporting period and therefore no groundwater extraction occurred, groundwater drawdown did not exceed the predicted impacts.

## 6. ENVIRONMENTAL PERFORMANCE

### 6.1 SUMMARY OF ENVIRONMENTAL PERFORMANCE

A summary of environmental performance for the principal environmental aspects is provided in **Table 6.1**. Further detail regarding specific environmental aspects is also provided in the following subsections. Environmental performance relating to water is discussed in Section 7.

**Table 6.1**  
**Environmental performance**

Aspect	Approval criteria / EIS prediction	Performance during the reporting period	Trend/key management implications	Implemented/proposed management actions
Noise	47dB(A) day & evening. 44dB(A) shoulder.	No complaints were received. The Quarry was non-operational during the reporting period.	No trends identifiable. Currently no management implications.	No other specific management measures were required during the reporting period. Updated Noise Management Plan prepared and submitted for approval.
Blasting	Blasting is not an approved activity.	No blasting undertaken.	Nil.	Nil.
Air Quality	PM <sub>10</sub> 24hr = 50ug/m <sup>3</sup> PM <sub>10</sub> Annual = 30ug/m <sup>3</sup> TSP Annual = 90ug/m <sup>3</sup> Dep Dust Annual = 4g/m <sup>2</sup> /month	No complaints were received. The Quarry was non-operational during the reporting period.	No trends identifiable. Currently no management implications.	No other specific management measures currently proposed. Updated Air Quality Management Plan prepared and submitted for approval.
Biodiversity	Establish rehabilitation bond. No significant impacts predicted.	No native vegetation was disturbed.	No trends applicable. Currently no management implications.	The rehabilitation bond for \$163,375 was lodged and accepted by DPE 12/04/17. A review of the rehabilitation bond will be undertaken with 6 months of approval of the updated Rehabilitation Management Plan in accordance with <i>Condition 3(35)</i> .
Heritage	Prepare Aboriginal Cultural Heritage Management Plan. No items of heritage have been located.	No heritage items were identified or disturbed.	No trends applicable. Currently no management implications.	Induction by Tweed LALC previously completed. No further specific management measures currently proposed.
Acid Sulfate Soils	Manage acid sulfate soils in accordance with an Acid Sulfate Soil Management Plan.	No further soil stripping during the reporting period.	No acid generation potential has been identified in topsoil (upper 250mm of soil). Topsoil is not considered an acid sulfate soil risk. Revised management measures outlined in updated management plan.	Continue implementation of Acid Sulfate Soil Management Plan. Updated Acid Sulfate Soil and Sediment Management Plan (included within updated Soil and Water management Plan) prepared and submitted for approval.

## 6.2 METEOROLOGICAL MONITORING

Meteorological monitoring is undertaken utilising an on-site automatic rain gauge (installed 1 October 2017) and the Bureau of Meteorology's Coolangatta Station No. 040717. A summary of the rainfall data during the reporting period is presented in **Table 6.2** whilst monthly wind roses are presented in **Figures 6.1a** and **6.1b**.

**Table 6.2**  
**Monthly Rainfall Records**

Period	Average Monthly Rainfall (mm)												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
2017	142.8	55.6	444	28.6	100.2	211.8	15.6	6.2	1.0	212.4	142	77.2	1437.4
2018	60.8	239	147	51.6	42.6	40.2	<b>19.2</b>	<b>0.0</b>	<b>12.2</b>	<b>86.8</b>	<b>49.2</b>	<b>97.8</b>	846.2
2019	<b>10.4</b>	<b>71.2</b>	<b>227.8</b>	<b>66.0</b>	<b>55.4</b>	<b>145.4</b>							

*Bold italics* values relevant to this reporting period.

Total rainfall during the 2018/2019 reporting year was 841.4mm, 672mm less than the long-term average rainfall of 1 513.4mm recorded at Coolangatta Station.

## 6.3 NOISE

### Environmental Management

The Quarry was non-operational during the reporting period. No noise management measures were implemented during the reporting period.

### Environmental Performance

No noise monitoring was undertaken during the reporting period as the Quarry was non-operational.

No Quarry-related noise complaints or enquiries were received during the reporting period.

### Reportable Incidents and Further Improvements

No reportable noise incidents occurred during the reporting period and no further improvements relating to noise management are currently planned.

## 6.4 AIR QUALITY

### Environmental Management

As the Quarry was non-operational during the reporting period, no site establishment activities, extraction, processing, or transportation was undertaken. As groundcover has been well established over the previously formed bunding and soil stockpiles, no specific dust control measures were required during the reporting period.

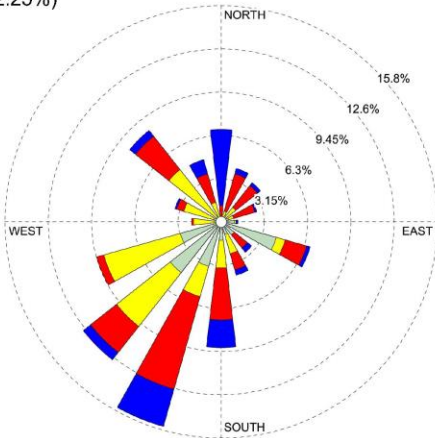
### Environmental Performance

Deposited dust monitoring was not undertaken during the reporting period as the Quarry was non-operational. No air quality complaints were received during the reporting period.

Y:\Jobs 531 to 1000\617\Reports\61738\_AR\_2019\ICAD\617 Wind Roses.dwg\_Layout1-13.08.2019-1:48 PM

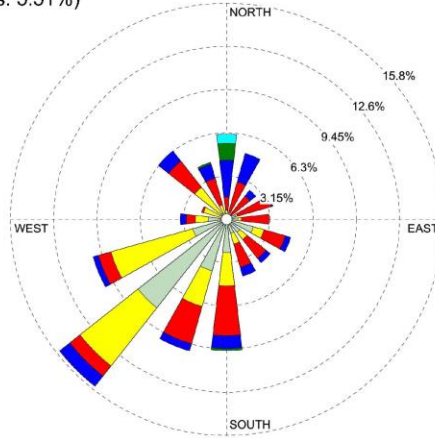
July 2018

(Calms: 2.25%)



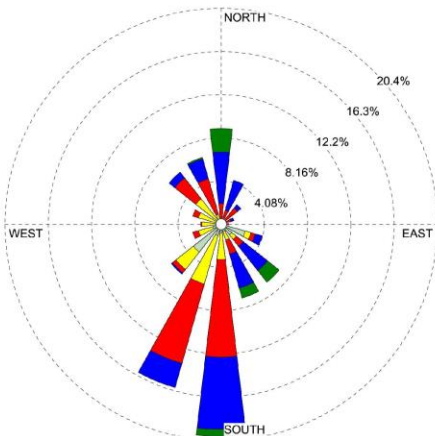
August 2018

(Calms: 5.51%)



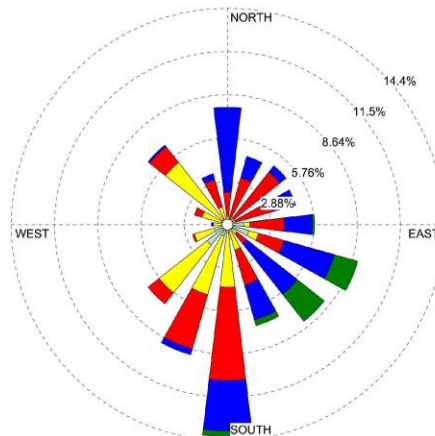
September 2018

(Calms: 1.94%)



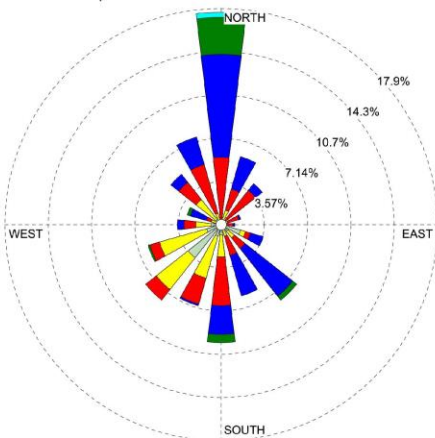
October 2018

(Calms: 2.02%)



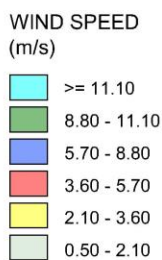
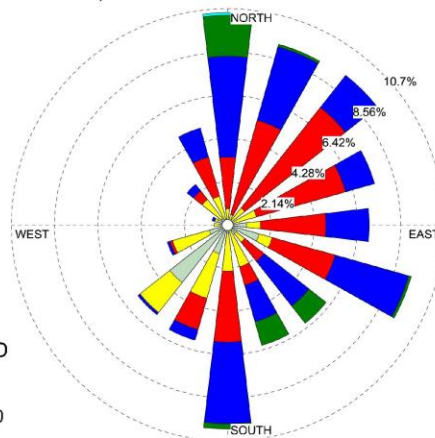
November 2018

(Calms: 1.81%)



December 2018

(Calms: 0.81%)



Source: Bureau of Meteorology, Coolangatta Weather Station 040717

Figure 6.1A  
WIND ROSES - COOLANGATTA







## Reportable Incidents and Further Improvements

No reportable air quality incidents occurred during the reporting period and no further improvements relating to air quality management are currently planned. However, in accordance with the updated AQMP, air quality monitoring will recommence during the next reporting period if operational activities recommence.

## 6.5 BIODIVERSITY

The rehabilitation bond for \$163,375 was previously lodged and accepted by the (then) DPE on 12 April 2017. No disturbance of native vegetation was required during the reporting period and no specific biodiversity management measures or monitoring was deemed necessary. No incidents occurred during the reporting period and no further improvements are currently planned. However, it is noted that, in accordance with *Condition 3(35)* of PA 05\_0103 the rehabilitation bond will be reviewed during the next reporting period, within 6 months of the approval of the Rehabilitation Management Plan (see Section 4.3).

## 6.6 HERITAGE

### Environmental Management

The Contracts Manager for Neumann Contractors, the approved Quarry Operator for the Cudgen Lakes Sand Quarry, was previously inducted by the Tweed Local Aboriginal Land Council on 2 September 2016 in accordance with the approved Aboriginal Cultural Heritage Management Plan. No further management measures were required during the reporting period.

### Environmental Performance, Reportable Incidents, and Further Improvements

No clearing/stripping/extractive activities were undertaken and no Aboriginal heritage sites were identified during the reporting period. No reportable incidents occurred during the reporting period and no further improvements are currently planned or deemed necessary.

## 6.7 ACID SULFATE SOILS

### Environmental Management

The Quarry was non-operational during the reporting period and all previous sampling indicated no ongoing management requirement. Therefore, no specific acid sulfate soil control measures were required.

### Environmental Performance, Reportable Incidents, and Further Improvements

No samples were required to be collected during the reporting period as the Quarry was non-operational. No reportable acid sulfate soil incidents occurred during the reporting period.

As discussed in Section 4.3, the Acid Sulfate Soil and Sediment Management Plan, included within the Soil and Water Management Plan, was reviewed and revised during the reporting period to reflect the results of previous soil testing. The updated plan is expected to be approved during the next reporting period.

## **6.8 OTHER ENVIRONMENTAL MANAGEMENT ASPECTS**

In accordance with PA 05\_0103 Condition 3(40), a summary of waste management is also provided. As no operations occurred during the reporting period there was no generation of production waste such as returned fines or oversize from washing. There was also no generation of non-production wastes / general wastes. Any waste generated during monitoring activities (such as lunch waste) was removed by the monitoring consultant and disposed of off-site.

## 7. WATER MANAGEMENT

### 7.1 WATER TAKE

Applicable water licencing held for the Quarry operations include Water Supply Works and Use Approval 30CA321269 and Water Access Licence (WAL) 40902, which has a water share component of 700ML. The Quarry Site is located within the *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016*, which commenced on 1 July 2016.

As there was no extraction or pumping of water from the dredge pond or spears, the water take for the reporting period is nil.

### 7.2 SURFACE WATER

#### Environmental Management

The principal surface water management measure is bunding which has been installed around the extraction pond to prevent both 'clean' water from running into the extraction area and to prevent water from discharging from within the extraction area (excluding during flood events). Stripped topsoil and disturbed areas not required for ongoing operations have previously been temporarily rehabilitated through the re-establishment of pasture grass.

No further surface water controls were required during the reporting period.

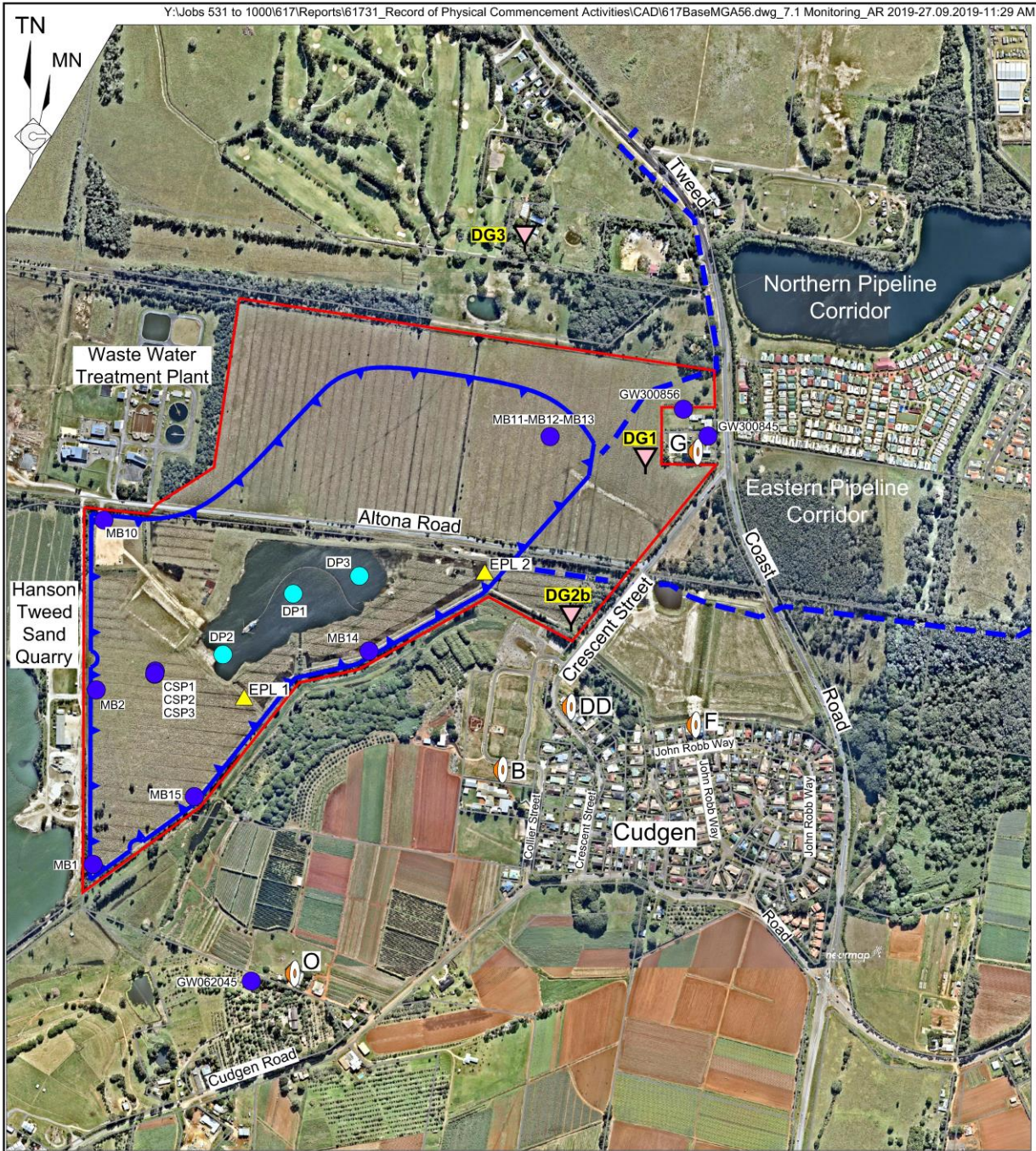
#### Environmental Performance

Whilst no operational activities occurred during the reporting period, water monitoring continued within the dredge pond and surrounding groundwater bores. In reviewing and interpreting the monitoring results it should be noted that the dredge pond effectively represents a 'window' into the groundwater table and is therefore interconnected with the surrounding groundwater aquifer. Results of monitoring within the surrounding groundwater monitoring bores is provided in Section 7.3.

Monitoring was undertaken at three locations within the dredge pond including two edge locations (DP2 and DP3) as well as one in the approximate centre of the pond (DP1) (see **Figure 7.1**). Monitoring at 1m or 2m depth intervals also occurs at monitoring location DP1.

A summary of the monitoring results is provided in **Table 7.1** and key analytes and historical trends are displayed graphically in **Figure 7.2**. A full copy of the non-summarised results is presented in **Appendix 2**.

As no discharges occurred during the reporting period, no monitoring was undertaken at the EPL monitoring locations positioned at the dredge pond spillways (see **Figure 7.1**).



REFERENCE

- Quarry Site Boundary
- Cadastral Boundary
- - - Pipeline Corridor
- Extraction Site Boundary
- Noise Monitoring Location
- DG1** Deposited Dust Gauge Location
- Groundwater Monitoring Location
- Surface Water Monitoring Location (Locations Approximate)
- EPL 1** Environment Protection Licence Monitoring Location

SCALE 1:12 000 (A4)



Base Photo Source: Nearmap (15 July 2019)

Figure 7.1  
MONITORING LOCATIONS



Table 7.1  
Surface Water Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae														
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a			
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10			
DP1																																	
Pre-Extraction	Average	26.6	8.27	717	6.78	108.0	16	44.4	4	85	30	14	8	148	27	85	0.093	0.001	0.03	0.042	0.017	0.82	0.01	0.03	0.82	0.02	0.02	1070	567	5	6		
	Maximum	28.3	9.07	901	9.24	192.0	68	156.0	5	132	46	21	8	236	57	130	0.190	0.002	0.07	0.090	0.020	1.10	0.01	0.03	1.10	0.02	0.03	4800	1180	5	10		
	Minimum	24.5	7.71	591	5.87	48.7	2	0.9	2	64	24	11	7	110	14	57	0.030	0.001	0.01	0.010	0.010	0.50	0.01	0.02	0.50	0.01	0.02	40	10	5	2		
Reporting Period (2018/2019)	Average	26.0	8.47	5054	7.41	17.5	8	7.8	5	725	114	109	24	1309	313	183	0.030	0.002	0.05	0.028	0.006	1.17	0.01	0.01	1.16	0.06	0.02	203	190	74099	13		
	Maximum	29.4	8.80	5995	9.92	109.0	18	23.8	5	813	127	123	27	1390	364	226	0.060	0.005	0.06	0.050	0.010	1.40	0.02	0.04	1.40	0.37	0.06	270	410	284000	31		
	Minimum	17.9	7.80	4140	4.93	-110.0	5	-9.7	5	642	94	98	22	1170	292	148	0.010	0.001	0.05	0.010	0.001	0.60	0.01	0.01	0.60	0.01	0.01	110	40	1200	5		
All Results (2015-2019)	Average	23.9	7.97	2829	5.29	106.5	13	27.1	4	559	100	83	20	989	234	181	0.040	0.002	0.05	0.040	0.009	1.11	0.01	0.02	1.10	0.07	0.03	551	580	40848	15		
	Maximum	30.9	9.07	6549	9.92	224.0	68	156.0	5	813	137	123	27	1390	364	270	0.190	0.005	0.07	0.150	0.020	1.60	0.02	0.12	1.60	0.37	0.13	4800	2160	284000	51		
	80th Percentile	27.3	8.47	4869	6.89	201.6	13	36.4	5	736	128	112	24	1332	314	237	0.056	0.002	0.05	0.056	0.010	1.40	0.01	0.03	1.40	0.12	0.03	430	1180	51320	23		
	Median	23.2	7.84	2448	5.05	113.5	7	8.2	5	663	114	99	23	1245	296	189	0.030	0.002	0.05	0.030	0.010	1.10	0.01	0.01	1.10	0.03	0.02	179	267	12700	12		
	20th Percentile	21.2	7.60	1033	3.93	37.1	5	1.7	4	196	38	19	8	204	47	111	0.010	0.001	0.05	0.010	0.003	0.83	0.01	0.01	0.83	0.02	0.01	40	40	145	9		
All Results (2015-2019)	Minimum	17.9	7.20	591	0.20	-110.0	2	-9.7	2	64	24	11	7	110	14	57	0.010	0.001	0.01	0.010	0.001	0.50	0.01	0.01	0.50	0.01	0.01	20	10	5	2		
	DP2																																
	Pre-Extraction	Average	26.3	8.12	695	4.87	114.7	6	39.1	3	65	26	12	8	117	15	95	0.073	0.002	0.03	0.04	0.020	0.89	-	-	0.9	0.02	0.02	139	188	5	9	
		Maximum	27.5	8.61	890	6.41	194.0	9	143.0	4	67	27	12	8	120	16	96	0.100	0.002	0.07	0.05	0.020	0.94	-	-	0.9	0.02	0.02	150	340	5	9	
		Minimum	23.7	7.79	613	3.43	58.8	4	3.5	2	64	25	12	7	110	14	94	0.050	0.001	0.01	0.04	0.020	0.82	-	-	0.8	0.02	0.02	128	50	5	9	
Reporting Period (2018/2019)	Average	26.3	8.41	5057	7.66	33.5	7	8.7	5	727	115	110	24	1308	308	178	0.030	0.002	0.05	0.02	0.006	1.12	0.01	0.01	1.1	0.06	0.02	167	237	87131	12		
	Maximum	30.5	8.83	5954	9.65	107.0	12	39.3	5	782	126	119	27	1380	335	224	0.050	0.005	0.05	0.05	0.010	1.40	0.02	0.05	1.4	0.36	0.07	240	460	409000	32		
	Minimum	18.4	7.76	4135	5.00	-109.0	5	-9.9	5	674	97	99	22	1210	293	139	0.010	0.002	0.05	0.01	0.001	0.60	0.01	0.01	0.6	0.01	0.01	80	110	835	6		
All Results (2015-2019)	Average	23.8	7.93	2906	5.31	150.6	9	24.0	5	594	107	91	21	1092	256	189	0.03	0.002	0.05	0.04	0.009	1.12	0.01	0.02	1.1	0.07	0.03	134	281.4	50937	15		
	Maximum	32	8.83	6564	9.65	1322.0	38	143	5	782	137	119	27	1380	335	270	0.10	0.005	0.07	0.1	0.020	1.40	0.02	0.11	1.4	0.36	0.13	240	1180	409000	40		
	80th Percentile	27.3	8.45	4989	7.47	207.2	11	35.38	5	741	126	113.4	25	1328	313	237	0.05	0.002	0.05	0.054	0.010	1.34	0.01	0.04	1.34	0.12	0.04	174	436	58500	25		
	Median	22.6	7.80	2473	4.93	138.5	5	9.2	5	684	119	100.5	24	1270	296	190	0.03	0.002	0.05	0.03	0.010	1.20	0.01	0.01	1.15	0.03	0.015	135	140	12120	12		
	20th Percentile	21.2	7.60	1016	3.89	45.7	5	3.444	4	520	103	82.4	20	950.4	236	150	0.01	0.002	0.05	0.01	0.002	0.93	0.01	0.01	0.928	0.02	0.01	80	102	918	7		
All Results (2015-2019)	Minimum	19.2	7.10	613	0.19	-0.8	4.3	3.5	2	64	25	12	7	110	14	94	0.01	0.001	0.01	0.01	0.010	0.80	0.01	0.01	0.8	0.01	0.01	60	50	5	7		
	DP3																																
	Pre-Extraction	Average	27.3	7.87	898	7.17	63.4	-	139.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	7
		Maximum	27.3	7.87	898	7.17	63.4	-	139.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	7
		Minimum	27.3	7.87	898	7.17	63.4	-	139.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5	7
Reporting Period (2018/2019)	Average	25.9	8.42	5042	7.38	33.7	8	8.0	5	720	115	108	24	1289	307	177	0.028	0.002	0.06	0.027	0.005	1.11	0.01	0.01	1.10	0.07	0.02	180	157	94264	13		
	Maximum	28.9	8.81	5954	9.71	197.0	14	31.6	5	800	128	119	26	1390	331	224	0.050	0.005	0.10	0.050	0.010	1.40	0.02	0.04	1.40	0.36	0.06	330	270	418000	32		
	Minimum	18.4	7.70	4147	4.91	-94.8	5	-9.7	5	656	96	99	22	1180	293	137	0.010	0.001	0.05	0.010	0.001	0.70	0.01	0.01	0.70	0.01	0.01	90	50	1040	5		
All Results (2017-2019)	Average	23.8	7.92	3088	5.20	115.0	12	17.2	5	668	120	102	23	1229	291	208	0.022	0.002	0.05	0.037	0.007	1.16	0.01	0.02	1.13	0.08	0.03	147	353	54919	14		
	Maximum	30.8	8.81	6587	9.71	225.0	54	139.0	5	800	136	119	26	1390	331	273	0.050	0.005	0.10	0.120	0.010	1.50	0.02	0.14	1.50	0.36	0.16	330	1620	418000	48		
	80th Percentile	27.4	8.36	4938	7.17	201.0	14	26.1	5	745	128	112	25	1320	320	241	0.030	0.002	0.05	0.058	0.010	1.38	0.01	0.04	1.30	0.14	0.05	288	810	62000	22		
	Median	22.6	7.84	3282	4.83	134.0	8	9.4	5	681	125	101	23	1270	300	224	0.020	0.002	0.05	0.030	0.010	1.20	0.01	0.01	1.15	0.05	0.01	120	150	12000	10		
	20th Percentile	21.1	7.60	1119	3.67	28.6	5	2.1	5	609	110	94	22	1160	249	170	0.010	0.001	0.05	0.010	0.001	1.00	0.01	0.01	1.00	0.01	0.01	50	46	1112	7		
All Results (2017-2019)	Minimum	18.4	7.28	857	0.19	-94.8	5	-9.7	5	456	96	73	18	845	192	137	0.010	0.001	0.05	0.010	0.001	0.70	0.01	0.01	0.70	0.01	0.01	50	40	5	3		

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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Table 7.1 (Cont'd)  
Surface Water Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae												
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a	
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10	
DP1-1																															
Pre-Extraction	Average	22.8	7.98	822	5.76	87.7	34	76.5	ND	114	40	19	8	208	48	113	0.060	0.001	0.06	0.080	0.010	0.65	0.01	0.02	0.65	0.09	0.02	245	425	5	1
	Maximum	24.0	8.44	824	7.01	121.0	62	149.0	ND	129	46	20	8	236	56	128	0.070	0.001	0.06	0.150	0.010	0.90	0.01	0.03	0.90	0.16	0.03	480	840	5	1
	Minimum	21.5	7.51	819	4.51	54.4	5	3.9	ND	98	33	17	7	179	39	98	0.050	0.001	0.06	0.010	0.010	0.40	0.01	0.01	0.40	0.02	0.01	10	10	5	1
Reporting Period (2018/2019)	Average	26.1	8.54	4919	5.21	63.5	7	9.8	5	703	115	106	23	1260	307	168	0.037	0.003	0.05	0.030	0.007	1.13	0.01	0.01	1.13	0.05	0.01	207	193	0	0
	Maximum	28.9	8.62	5300	5.93	96.9	8	13.8	5	735	125	112	24	1320	334	193	0.050	0.005	0.05	0.040	0.010	1.20	0.01	0.01	1.20	0.05	0.01	340	370	0	0
	Minimum	24.6	8.44	4559	4.84	13.5	5	7.5	5	680	98	102	22	1220	288	139	0.030	0.002	0.05	0.020	0.002	1.00	0.01	0.01	1.00	0.04	0.01	90	50	0	0
All Results (2017-2019)	Average	25.4	8.10	3960	4.62	53.3	19	36.5	5	546	105	83	20	977	231	188	0.030	0.002	0.05	0.053	0.008	1.08	0.01	0.02	1.07	0.10	0.03	171	208	5	1
	Maximum	30.6	8.62	6553	7.01	121.0	62	149.0	5	766	153	114	27	1350	334	263	0.070	0.005	0.06	0.150	0.010	1.40	0.01	0.12	1.40	0.29	0.13	480	840	5	1
	80th Percentile	28.6	8.55	5220	5.89	94.5	55	78.7	5	735	135	112	24	1320	308	239	0.050	0.002	0.06	0.080	0.010	1.30	0.01	0.03	1.30	0.16	0.03	340	370	ID	ID
	Median	25.7	8.23	4626	4.85	45.9	8	15.8	5	680	121	102	24	1220	281	193	0.030	0.002	0.05	0.040	0.010	1.20	0.01	0.01	1.20	0.05	0.01	100	120	5	1
	20th Percentile	22.0	7.54	1272	2.93	14.7	5	5.0	5	129	46	20	8	236	56	128	0.010	0.001	0.05	0.020	0.002	0.90	0.01	0.01	0.90	0.02	0.01	60	50	ID	ID
Minimum	18.7	7.51	819	2.16	-2.0	5	3.9	5	98	33	17	7	179	39	98	0.010	0.001	0.05	0.010	0.001	0.40	0.01	0.01	0.40	0.02	0.01	10	10	5	1	
DP1-2																															
Pre-Extraction	Average	21.6	7.78	793	5.09	94.9	26	84.0	ND	115	39.5	19	8	207	51	114	0.075	0.001	0.08	0.060	0.010	0.75	0.01	0.02	0.75	0.10	0.02	245	510	5	2
	Maximum	23.0	8.23	798	6.86	126.0	46	166.0	ND	134	46	21	8	237	57	131	0.110	0.001	0.10	0.110	0.010	1.10	0.01	0.02	1.10	0.17	0.02	450	1010	5	2
	Minimum	20.1	7.32	787	3.32	63.8	5	1.9	ND	96	33	17	7	176	44	97	0.040	0.001	0.05	0.010	0.010	0.40	0.01	0.02	0.40	0.02	0.02	40	10	5	2
Reporting Period (2018/2019)	Average	25.4	8.44	5016	7.34	10.1	8	7.2	5	716	114	108	24	1292	307	177	0.027	0.002	0.05	0.023	0.005	1.10	0.01	0.01	1.09	0.07	0.01	140	110	67980	13
	Maximum	29.0	8.78	5968	8.95	92.0	13	22.5	5	776	133	118	27	1380	345	225	0.050	0.005	0.05	0.050	0.010	1.30	0.02	0.04	1.30	0.36	0.06	180	170	299000	32
	Minimum	17.9	7.80	4096	4.23	-106.0	5	-9.8	5	643	97	99	22	1170	282	135	0.010	0.001	0.05	0.010	0.001	0.80	0.01	0.01	0.80	0.01	0.01	120	50	955	6
All Results (2017-2019)	Average	24.7	8.15	4444	6.05	33.0	13	23.6	5	626	112	95	22	1147	267	194	0.028	0.002	0.05	0.035	0.007	1.10	0.011	0.02	1.09	0.10	0.02	117	174	44679	13
	Maximum	29.0	8.78	6558	8.95	126.0	53	166.0	5	776	146	118	27	1380	345	270	0.110	0.005	0.10	0.110	0.010	1.40	0.02	0.11	1.40	0.36	0.13	450	1010	299000	32
	80th Percentile	27.6	8.59	5293	8.08	82.6	13	23.4	5	731	132	111	26	1344	313	240	0.038	0.002	0.05	0.066	0.010	1.30	0.01	0.02	1.30	0.16	0.02	168	162	51440	19
	Median	24.9	8.25	4679	6.70	33.0	8	9.5	5	690	118	103	24	1265	295	189	0.030	0.002	0.05	0.020	0.010	1.10	0.01	0.01	1.10	0.06	0.01	75	75	13700	12
	20th Percentile	21.3	7.56	4005	3.30	-6.4	5	2.7	5	607	106	93	22	1138	234	155	0.010	0.001	0.05	0.010	0.001	1.00	0.01	0.01	1.00	0.02	0.01	40	50	2079	7
Minimum	17.9	7.32	787	2.17	-106.0	5	-9.8	5	96	33	17	7	176	44	97	0.010	0.001	0.05	0.010	0.001	0.40	0.01	0.01	0.40	0.01	0.01	30	10	5	2	
DP1-3																															
Pre-Extraction	Average	21.0	7.54	756	4.57	100.8	27	83.2	-	113	41	19	8	205	50	115	0.025	0.001	0.05	0.050	0.010	0.75	0.02	0.02	0.75	0.11	0.03	210	395	5	2
	Maximum	22.8	8.05	769	6.02	125.0	48	163.0	-	130	48	21	8	236	57	134	0.040	0.001	0.05	0.090	0.010	1.00	0.02	0.02	1.00	0.19	0.03	400	770	5	2
	Minimum	19.1	7.03	743	3.12	76.6	6	3.4	-	96	33	17	7	174	43	96	0.010	0.001	0.05	0.010	0.010	0.50	0.01	0.01	0.50	0.02	0.02	20	20	5	2
Reporting Period (2018/2019)	Average	25.3	8.51	4904	5.40	63.7	9	9.2	5	710	116	107	24	1250	306	173	0.037	0.003	0.05	0.023	0.007	1.13	0.01	0.01	1.13	0.04	0.01	150	113	0	0
	Maximum	28.8	8.58	5308	7.17	84.0	11	11.7	5	745	127	115	25	1310	330	200	0.050	0.005	0.05	0.030	0.010	1.40	0.01	0.01	1.40	0.05	0.01	220	190	0	0
	Minimum	22.3	8.42	4510	4.50	24.1	8	6.2	5	687	98	102	22	1200	288	138	0.030	0.002	0.05	0.020	0.001	1.00	0.01	0.01	1.00	0.02	0.01	40	10	0	0
All Results (2017-2019)	Average	24.2	7.93	3946	4.59	54.5	23	41.8	5	549	106	84	20	1007	236	201	0.021	0.002	0.05	0.044	0.008	1.08	0.012	0.03	1.06	0.14	0.04	113	147	12753	5
	Maximum	28.8	8.58	6577	8.59	125.0	88	163.0	5	745	133	115	25	1370	330	270	0.050	0.005	0.05	0.140	0.010	1.60	0.02	0.11	1.50	0.30	0.13	400	770	25500	8
	80th Percentile	27.8	8.49	5151	6.71	84.6	56	113.0	5	716	132	109	24	1302	307	260	0.038	0.002	0.05	0.086	0.010	1.38	0.018	0.08	1.38	0.28	0.08	214	180	ID	ID
	Median	24.9	8.05	4510	4.53	60.7	10	11.7	5	661	123	100	23	1220	281	214	0.010	0.002	0.05	0.025	0.010	1.05	0.01	0.02	1.00	0.11	0.02	40	90	12753	5
	20th Percentile	19.2	7.48	1683	2.73	20.5	6	5.4	5	195	58	31	10	365	90	135	0.010	0.001	0.05	0.010	0.003	0.76	0.01	0.01	0.76	0.02	0.01	12	12	ID	ID
Minimum	18.2	7.03	743	1.07	-14.0	5	3.4	5	96	33	17	7	174	43	96	0.010	0.001	0.05	0.010	0.001	0.50	0.01	0.01	0.50	0.02	0.01	10	10	5	2	

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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Table 7.1 (Cont'd)  
Surface Water Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae												
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a	
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10	
DP1-4																															
Pre-Extraction	Average	20.3	7.51	762	3.68	103.1	34	85.4	-	111	40	19	7	204	50	116	0.030	0.001	0.06	0.055	0.010	0.70	0.02	0.02	0.70	0.12	0.03	290	850	5	2
	Maximum	22.7	7.95	777	5.57	125.0	61	166.0	-	131	46	20	8	234	57	134	0.050	0.001	0.06	0.100	0.010	1.00	0.02	0.02	1.00	0.20	0.04	290	850	5	2
	Minimum	17.9	7.06	746	1.79	81.1	7	4.8	-	90	33	17	6	173	43	97	0.010	0.001	0.05	0.010	0.010	0.40	0.01	0.02	0.40	0.04	0.02	290	850	5	2
Reporting Period (2018/2019)	Average	24.0	8.11	4867	4.09	-50.6	6	9.7	5	716	117	108	24	1281	301	201	0.024	0.002	0.06	0.023	0.006	1.01	0.01	0.01	1.00	0.07	0.01	47	50	63728	20
	Maximum	27.1	8.52	5956	7.64	88.0	14	39.5	5	783	131	121	26	1360	333	264	0.050	0.005	0.19	0.050	0.010	1.30	0.02	0.04	1.20	0.37	0.06	110	120	387000	89
	Minimum	17.8	7.33	4086	0.33	-219.7	5	-9.8	5	624	103	97	22	1180	286	176	0.010	0.001	0.05	0.010	0.001	0.60	0.01	0.01	0.60	0.01	0.01	10	10	155	6
All Results (2017-2019)	Average	23.8	7.94	4369	3.94	1.1	176	28.3	5	627	114	95	22	1144	267	206	0.021	0.002	0.06	0.121	0.007	1.33	0.01	0.02	1.32	0.11	0.02	83	201	42280	17
	Maximum	28.1	8.52	6627	7.64	131.0	2660	166.0	5	783	146	121	26	1380	333	264	0.050	0.005	0.19	1.810	0.010	7.30	0.02	0.12	7.30	0.37	0.14	290	850	387000	89
	80th Percentile	26.8	8.37	5082	5.96	83.4	12	51.0	5	745	131	113	25	1308	306	240	0.030	0.002	0.05	0.066	0.010	1.28	0.01	0.02	1.20	0.23	0.03	110	430	63360	24
	Median	24.6	7.98	4651	4.46	24.0	6	7.7	5	687	124	103	24	1260	289	208	0.020	0.002	0.05	0.020	0.010	1.10	0.01	0.01	1.05	0.06	0.01	70	80	12535	11
	20th Percentile	20.0	7.53	3979	1.26	-83.4	5	3.5	5	606	108	93	22	1140	262	179	0.010	0.001	0.05	0.010	0.002	0.80	0.01	0.01	0.80	0.03	0.01	10	10	245	6
Reporting Period (2018/2019)	Average	21.5	7.71	2130	3.82	51.8	25	60.2	5	312	65	48	13	563	134	144	0.028	0.001	0.06	0.044	0.009	0.80	0.01	0.02	0.80	0.10	0.02	209	583	21246	8
	Maximum	24.0	8.11	4867	5.57	125.0	61	166.0	5	716	117	108	24	1281	301	201	0.050	0.002	0.06	0.100	0.010	1.01	0.02	0.02	1.00	0.20	0.04	290	850	63728	20
	Minimum	17.9	7.06	746	1.79	-50.6	6	4.8	5	90	33	17	6	173	43	97	0.010	0.001	0.05	0.010	0.006	0.40	0.01	0.01	0.40	0.04	0.01	47	50	5	2
All Results (2018-2019)	Average	23.0	7.87	3489	4.28	38.0	235	51.9	5	483	93	74	18	871	207	185	0.026	0.002	0.07	0.183	0.008	1.43	0.01	0.03	1.41	0.15	0.04	138	346	86936	23
	Maximum	28.1	8.52	6627	7.64	131.0	2660	166.0	5	783	146	121	26	1380	333	264	0.050	0.005	0.19	1.810	0.010	7.30	0.02	0.12	7.30	0.37	0.14	290	850	387000	89
	80th Percentile	27.2	8.49	5312	6.90	107.4	84	123.6	5	753	131	114	25	1318	313	261	0.050	0.003	0.09	0.104	0.010	1.34	0.02	0.05	1.33	0.30	0.06	290	850	ID	ID
	Median	23.8	7.95	4369	4.09	81.1	12	28.3	5	627	114	97	22	1180	281	201	0.024	0.002	0.05	0.050	0.010	1.01	0.01	0.02	1.00	0.11	0.02	110	180	12753	6
	20th Percentile	18.1	7.28	758	1.65	-21.3	6	4.5	5	108	38	18	7	198	49	112	0.010	0.001	0.05	0.010	0.002	0.58	0.01	0.01	0.58	0.02	0.01	12	12	ID	ID
Reporting Period (2018/2019)	Average	21.6	7.66	4748	2.14	-117.4	7	3.9	5	708	129	108	24	1277	282	254	0.018	0.002	0.09	0.024	0.005	1.25	0.01	0.01	1.25	0.33	0.01	53	63	31200	11
	Maximum	24.4	8.31	6192	7.40	82.0	19	16.0	5	786	148	118	26	1340	344	342	0.050	0.005	0.18	0.050	0.010	2.60	0.02	0.04	2.60	1.43	0.06	70	90	276000	46
	Minimum	17.7	7.07	4071	0.11	-313.0	5	-9.7	5	637	120	95	22	1140	196	187	0.010	0.001	0.05	0.010	0.001	0.70	0.01	0.01	0.70	0.03	0.01	30	20	5	2
	Average	22.1	7.73	4804	2.60	-52.8	7	10.3	5	692	129	106	24	1274	279	251	0.017	0.002	0.08	0.025	0.006	1.21	0.01	0.02	1.20	0.28	0.02	94	94	24783	12
	Maximum	27.4	8.31	6676	7.40	138.0	19	95.0	5	786	148	118	26	1340	344	342	0.050	0.005	0.18	0.080	0.010	2.60	0.02	0.10	2.60	1.43	0.12	260	210	276000	46
	80th Percentile	24.6	8.11	5215	5.76	70.9	9	13.0	5	733	133	114	25	1310	300	297	0.020	0.002	0.13	0.040	0.010	1.48	0.01	0.03	1.48	0.52	0.03	222	186	21420	18
All Results (2018-2019)	Median	21.8	7.79	4655	2.09	-7.4	5	3.4	5	710	130	107	23	1280	283	239	0.010	0.002	0.05	0.020	0.005	1.20	0.01	0.01	1.10	0.11	0.01	60	80	3570	8
	20th Percentile	19.5	7.36	4238	0.39	-239.1	5	2.2	5	631	122	96	22	1242	258	218	0.010	0.002	0.05	0.010	0.001	0.82	0.01	0.01	0.82	0.03	0.01	34	30	5	4
	Minimum	17.7	7.07	3942	0.11	-313.0	5	-9.7	5	605	120	95	22	1140	196	187	0.010	0.001	0.05	0.010	0.001	0.70	0.01	0.01	0.70	0.01	0.01	30	20	5	2

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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Table 7.1 (Cont'd)  
Surface Water Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae												
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a	
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10	
DP1-7																															
Reporting Period (2018/2019)	Average	21.4	7.71	4733	1.40	-129.9	5	2.6	5	695	134	105	23	1257	283	276	0.023	0.003	0.1	0.02	0.011	1.47	0.01	0.01	1.5	0.64	0.01	40	120	NS	NS
	Maximum	22.2	8.40	5385	3.44	78.0	5	2.9	5	727	145	110	24	1270	342	326	0.050	0.005	0.16	0.02	0.012	2.70	0.01	0.01	2.7	1.67	0.01	60	270	NS	NS
	Minimum	20.2	7.32	4190	0.31	-273.6	5	2.2	5	665	127	101	22	1250	240	221	0.010	0.002	0.05	0.02	0.010	0.80	0.01	0.01	0.8	0.03	0.01	20	40	NS	NS
All Results (2018-2019)	Average	20.3	7.89	4976	2.61	-49.5	5	3.88	5	689	132	105	23	1272	284	267	0.018	0.0024	0.08	0.016	0.009	1.26	0.01	0.03	1.24	0.454	0.04	72	134	16400	8
	Maximum	22.2	8.40	6713	5.82	87.0	5	7.8	5	727	145	111	24	1320	342	326	0.050	0.005	0.16	0.02	0.012	2.70	0.02	0.11	2.7	1.67	0.13	190	270	16400	8
	80th Percentile	22.1	8.36	6447	5.34	85.2	5	7	5	727	142	111	24	1310	335	317	0.042	0.0044	0.146	0.02	0.012	2.40	0.02	0.09	2.38	1.392	0.11	164	254	ID	ID
	Median	20.2	8.13	4623	3.04	55.0	5	2.9	5	694	130	105	22	1270	268	271	0.010	0.002	0.05	0.02	0.010	0.90	0.01	0.01	0.9	0.22	0.01	50	120	16400	8
	20th Percentile	18.22	7.34	4015	0.34	-257.7	5	2.3	5	637	127	97	22	1250	245	224	0.010	0.0012	0.05	0.01	0.003	0.72	0.01	0.01	0.72	0.038	0.01	24	42	ID	ID
	Minimum	17.9	7.32	3971	0.31	-273.6	5	2.2	5	630	127	96	22	1250	240	221	0.010	0.001	0.05	0.01	0.001	0.70	0.01	0.01	0.7	0.03	0.01	20	40	16400	8
DP1-8																															
Reporting Period (2018/2019)	Average	20.9	7.87	5293	2.91	-78.7	5	4.6	5	694	135	106	23	1281	289	271	0.026	0.003	0.10	0.02	0.010	1.59	0.01	0.05	1.58	0.72	0.06	94	148	16400	8
	Maximum	22.2	8.40	6713	5.82	87.0	5	7.8	5	727	145	111	24	1320	342	326	0.050	0.005	0.16	0.02	0.012	2.70	0.02	0.11	2.70	1.67	0.13	190	270	16400	8
	Minimum	20.2	7.32	4190	0.31	-273.6	5	2.2	5	665	127	101	22	1250	240	221	0.010	0.002	0.05	0.02	0.009	0.80	0.01	0.01	0.80	0.03	0.01	20	40	16400	8
All Results (2018-2019)	Average	20.5	7.87	5006	2.51	-75.5	5	3.8	5	688	134	105	23	1272	287	272	0.025	0.003	0.09	0.02	0.009	1.52	0.01	0.03	1.51	0.68	0.04	71	143	NS	NS
	Maximum	22.2	8.40	6713	5.82	87.0	5	7.8	5	727	145	111	24	1320	342	326	0.050	0.005	0.16	0.02	0.012	2.70	0.02	0.11	2.70	1.67	0.13	190	270	NS	NS
	80th Percentile	22.2	8.40	6447	5.34	85.2	ID	7.0	ID	727	145	111	24	1310	342	326	0.050	0.005	0.16	0.02	0.012	2.70	0.02	0.09	2.70	1.67	0.11	ID	ID	NS	NS
	Median	20.3	7.89	4733	2.61	-49.5	5	2.9	5	694	132	105	23	1270	283	271	0.018	0.002	0.08	0.02	0.010	1.26	0.01	0.01	1.24	0.45	0.01	50	120	NS	NS
	20th Percentile	18.2	7.32	4015	0.31	-273.6	ID	2.2	ID	637	127	97	22	1250	240	221	0.010	0.001	0.05	0.01	0.003	0.72	0.01	0.01	0.72	0.03	0.01	ID	ID	NS	NS
	Minimum	17.9	7.32	3971	0.31	-273.6	5	2.2	5	630	127	96	22	1250	240	221	0.010	0.001	0.05	0.01	0.001	0.70	0.01	0.01	0.70	0.03	0.01	20	40	NS	NS

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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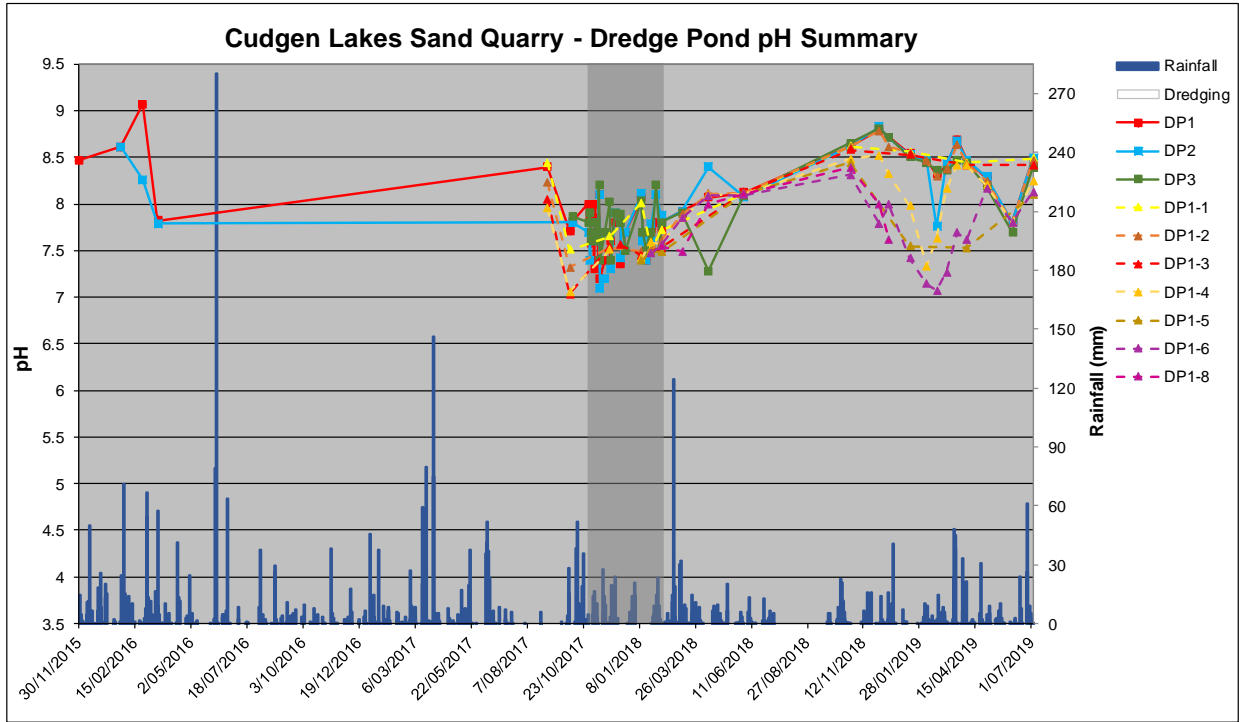


Figure 7.2a Surface Water Quality Parameters – pH

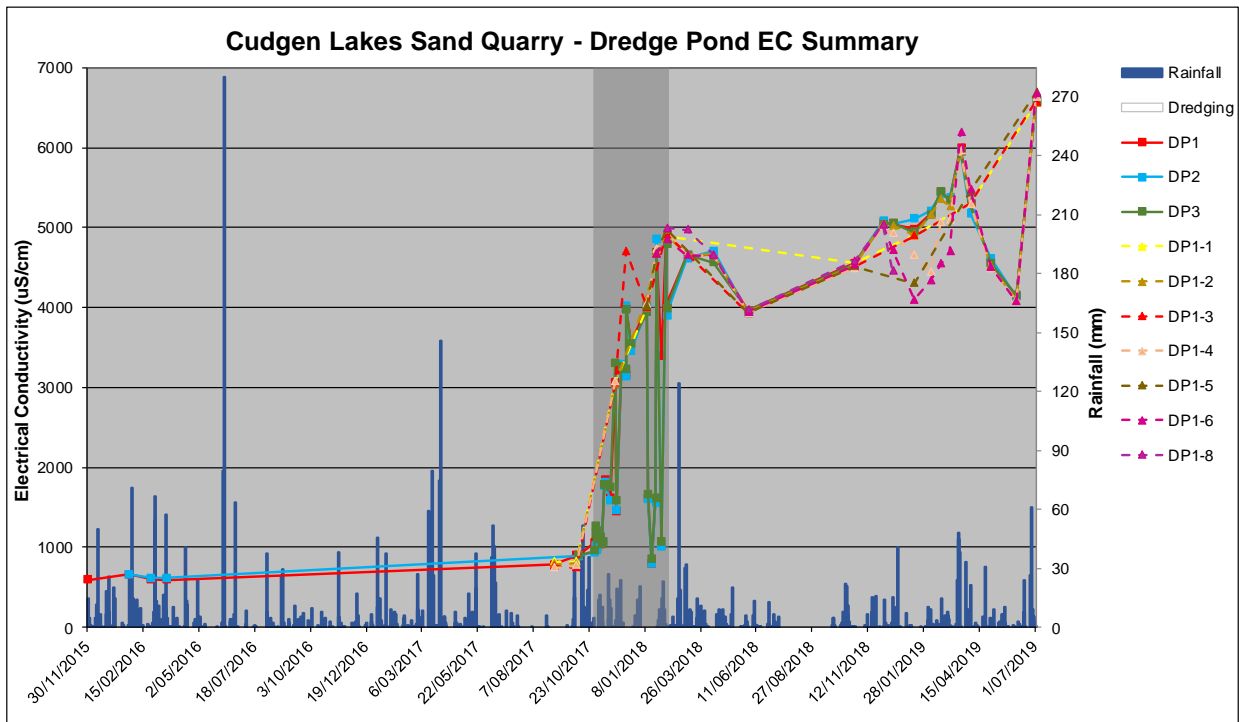


Figure 7.2b Surface Water Quality Parameters – Electric Conductivity

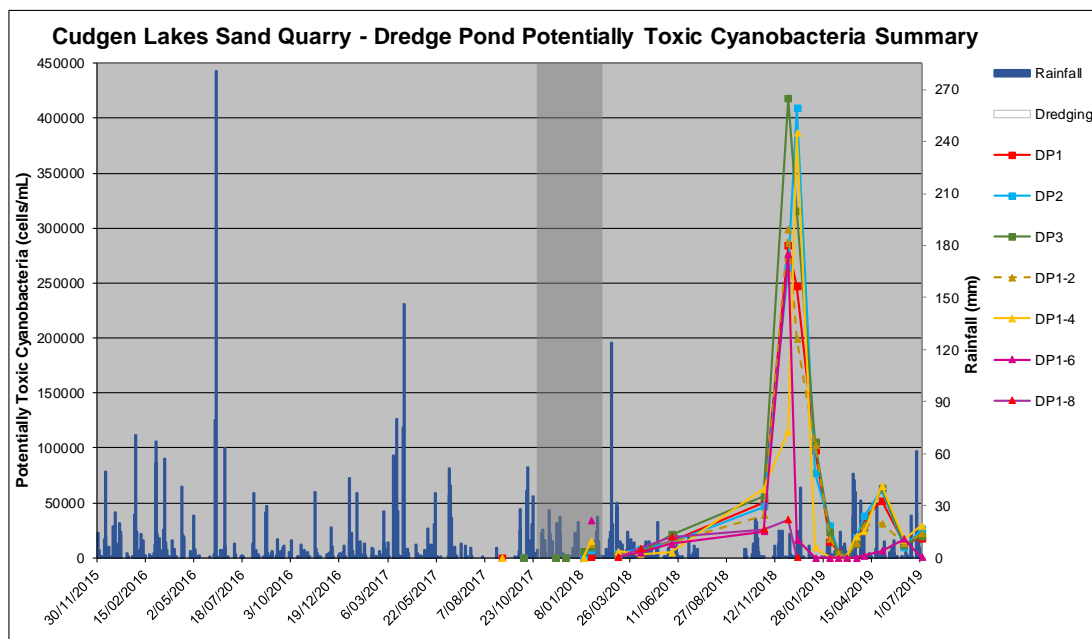


Figure 7.2c Surface Water Quality Parameters – Potentially Toxic Cyanobacteria

### Physical Parameters and Major Cations and Anions

To date, extraction has reached a depth of approximately -12m AHD and, as expected, the EC levels within the dredge pond rapidly increased as the deeper water was encountered. Since cessation of dredging the EC within the dredge pond has fluctuated with a further overall increase recorded to date.

These fluctuations correspond with fluctuations within both the shallow and deeper groundwater bores surrounding the dredge pond (see Section 7.3) and appear to be natural fluctuations in the groundwater system. During the reporting period, measured EC values ranged from 4 071 $\mu$ S/cm to 6 192 $\mu$ S/cm. Elevated cations and anions were similarly recorded consistent with the EC values. As extraction continues, the EC (and major cations and anions) within the dredge pond is expected to further increase for a period of time as deeper groundwater is encountered and prior to further lateral expansion mixing this with the additional fresh upper layers.

In contrast to the surrounding groundwater monitoring bores, the pH within the dredge pond has remained consistently neutral to slightly alkaline both prior to, during and following dredging. During the reporting period pH ranged from 7.07 to 8.83. On the occasions when the pond has recorded pH values >8.5 these have generally been the surface samples during summer and are likely the result of algal activity.

Total suspended solids during the reporting period ranged from 5mg/L to 19mg/L whilst turbidity ranged from 0.6NTU to 39.5NTU. These levels are well below those recorded during the dredging campaign and are consistent with the non-operational status during the reporting period.

The average dissolved oxygen level at the surface sites DP1, DP2 and DP3 during the reporting period were 7.41mg/L, 7.66mg/L and 7.38mg/L. Consistent with expectations for the non-operational pond which is not experiencing mixing as a result of the action of dredging, the average dissolved oxygen level decreased with depth down to an average of 1.40mg/L at 7m depth.

Oil and grease was consistently below the objective limit at all sites.

### **Metals**

The monitored metals filterable iron, aluminium and arsenic all consistently remained well below the quality objectives with no discernible trends.

### **Nutrients and Bacteria**

Nutrient levels (both phosphorus and particularly nitrogen / nitrogen containing species) remained consistently elevated throughout the reporting period. Elevated nutrient levels have been recorded in pre-extraction baseline monitoring and in surrounding groundwater bores. This is reflective of past and current agricultural activities within and surrounding the Quarry both on the floodplain and the Cudgen Plateau.

Faecal coliforms remained within the quality objectives at all monitoring locations throughout the reporting period. However, elevated levels of Enterococci were recorded during three out of the four quarterly monitoring events. The highest level recorded was 1 800cells/mL at DP1, which remains below the previously recorded maximum of 2 160cells/mL. Similar to nutrients, elevated levels of Enterococci have regularly been recorded in both surface water and groundwater within the area and is again reflective of previous and ongoing agricultural practices within the area, particularly cattle grazing and possibly off-site poultry and on-site water birds.

### **Blue-Green Algae**

Within the dredge pond moderately elevated levels of potentially toxic cyanobacteria (Blue-Green Algae) were recorded during the initial extraction campaign (30 October 2017 and 8 February 2018) but other parameters, including temperature, dissolved oxygen, nutrient levels and/or stratification remained within levels that did not result in a trigger action response. However, during the 2018/2019 summer months (this reporting period), whilst the Quarry was non-operational, highly elevated levels of potentially toxic cyanobacteria were recorded. The maximum cell count recorded for potentially toxic cyanobacteria was 418 000cells/mL. As outlined in Section 11.1, on two occasions in December 2018 the elevated cyanobacteria were concurrently recorded with elevated nutrients, low dissolved oxygen, high water temperature and stratification, resulting in exceedance of the trigger action response.

Given the results recorded within the Cudgen Lakes Sand Quarry to date and the ongoing presence of blue-green algae in the adjacent Hanson Tweed Sand Quarry, algal blooms are expected to regularly occur within the dredge pond, particularly during non-operational periods. However, as the dredge pond is isolated from surface flows (except during flooding) and no evidence of migration through groundwater has been recorded, these blooms are considered to have been fully contained within the Quarry Site.

### **Reportable Incidents**

The exceedance of the trigger action response levels was reported as an incident in accordance with PA 05\_0103 *Condition 5(9)*. Further details of the incident reporting are provided in Section 11.1.

## Further Improvements

As a result of the Blue-Green Algae exceedance, a significant review and update to the SWMP has been completed. As part of this update, the approach to Blue-Green Algae management has been revised. Further details on the outcomes of the review and approach to Blue-Green Algae management is provided in Section 11.1.

All other parameters remained within expected levels or within ranges recorded prior to commencement of extraction and no further improvements are currently deemed necessary.

## 7.3 GROUNDWATER

### Environmental Management

As outlined in Section 7.2, the dredge pond is effectively a ‘window’ into the groundwater table and is the principal location for potential interactions with the local groundwater environment. The key management measures for groundwater are therefore:

- ensuring that extraction rates do not cause drawdown beyond those predicted;
- monitoring of water quality to ensure that drawdown is not resulting in a reduction in pH (which would indicate oxidation of acid sulfate soils); and
- storage of all hydrocarbons in accordance with the relevant Australian Standards.

As no extraction or pumping occurred during the reporting period no specific measures were required to manage drawdown. Monitoring also did not indicate the need for any management measures relating to water quality. No hydrocarbons were stored within the Quarry Site during the reporting period and therefore no specific hydrocarbon management measures were required.

### Environmental Performance

The groundwater resources within the local area are located within two aquifers, namely the Quaternary sands beneath the Tweed River floodplain and the Tertiary basalts of the Cudgen Plateau. It is expected that freshwater from the Tertiary basalts flows northwards into the Quaternary sands resulting in a wedge of freshwater that thins northwards towards the Tweed River. Beneath this, water quality is largely influenced by the degree of mixing between the freshwater from the Cudgen Plateau, as well as rainfall recharge directly to the Quaternary sands, and the deep saline waters originally derived from estuarine and marine infiltration.

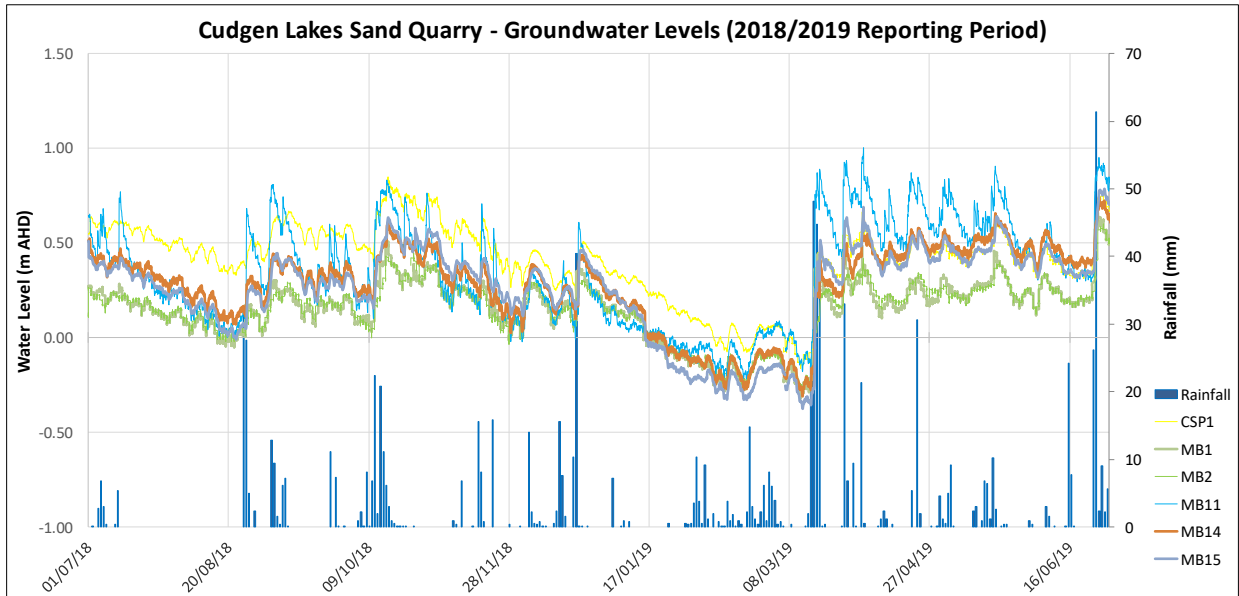
Groundwater levels and water quality were monitored in nine dedicated monitoring bores, and at two regional private bores throughout the reporting period (see **Figure 7.1**). In addition to manual sampling, the monitoring network includes seven continuous groundwater level loggers (although data has been excluded from MB10 due to potential calibration issues – this logger is currently being serviced).

### Groundwater Levels

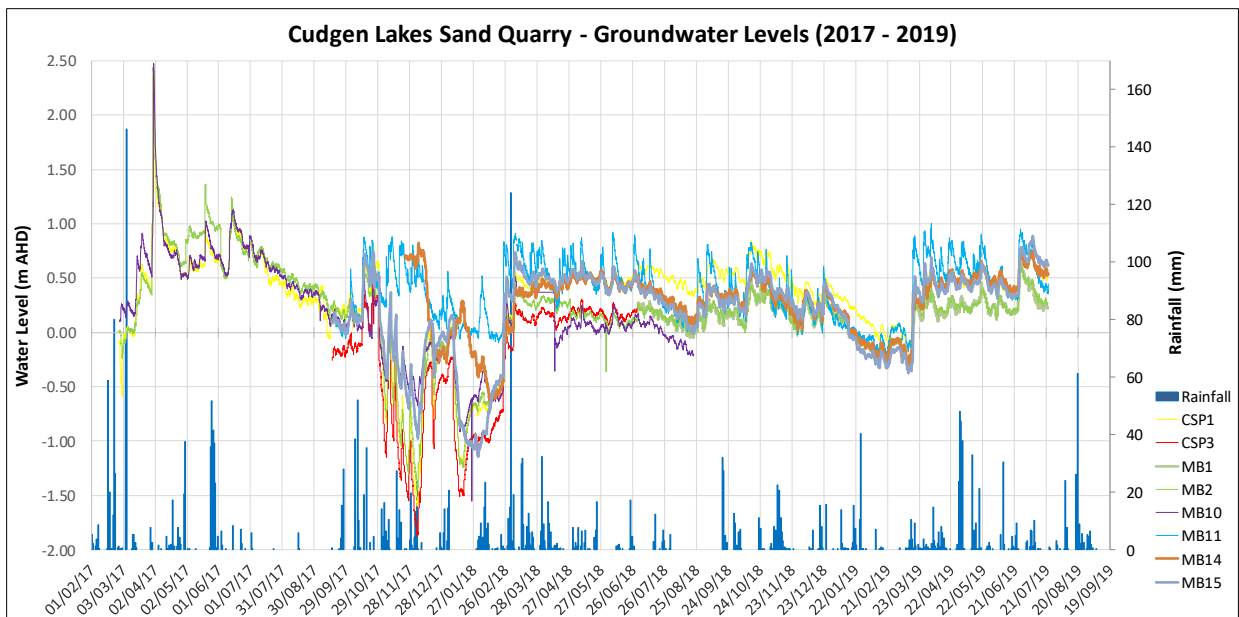
As dredging from the first extraction campaign ceased 5 months prior to the commencement of the reporting period and no operations occurred during the reporting period, groundwater levels recorded are a reflection of natural fluctuations and, to a lesser extent, surrounding activities.



**Figure 7.3** presents the groundwater levels recorded during the reporting period whilst **Figure 7.4** provides the long-term logger data.



**Figure 7.3 Groundwater Levels – 2018/2019 Reporting Period**



**Figure 7.4 Groundwater Levels – 2017 to 2019**

As evident from the meteorological data (see Section 6.2), there was a period of substantially below average rainfall from January 2018 to the beginning of March 2019. Whilst rapid rises in water levels occurred following rainfall events, the overall groundwater levels declined throughout the reporting period with the lowest level of -0.37m AHD recorded in bore MB15 on 12 March 2019. Water levels then recovered following a series of substantial rainfall events during March 2019 with the highest water level of 0.98m AHD recorded in bore MB11 on 3 April 2019 (see **Figure 7.4**).

### Groundwater Quality

A summary of groundwater monitoring results is provided in **Table 7.2** and key analytes are displayed graphically in **Figure 7.5** whilst the full range of historical data is presented in **Figure 7.6** to assist with interpreting long-term trends. A full copy of the non-summarised results is presented in **Appendix 3**.

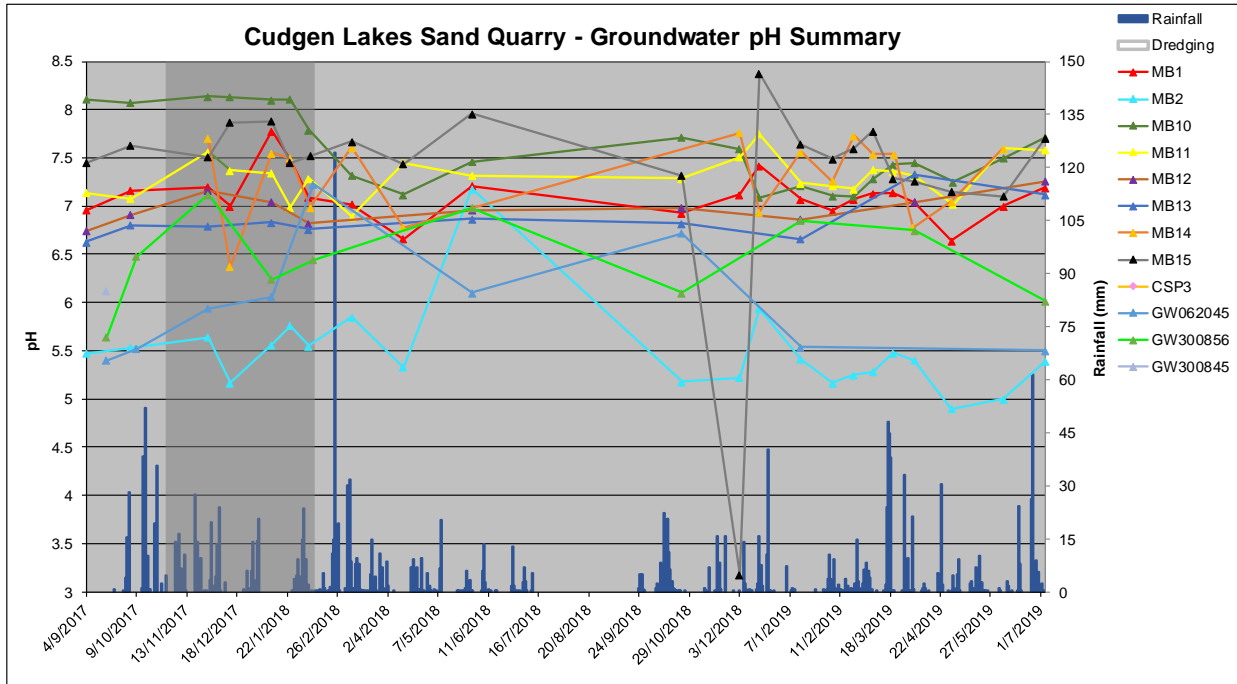


Figure 7.5a Groundwater Quality Parameters – pH

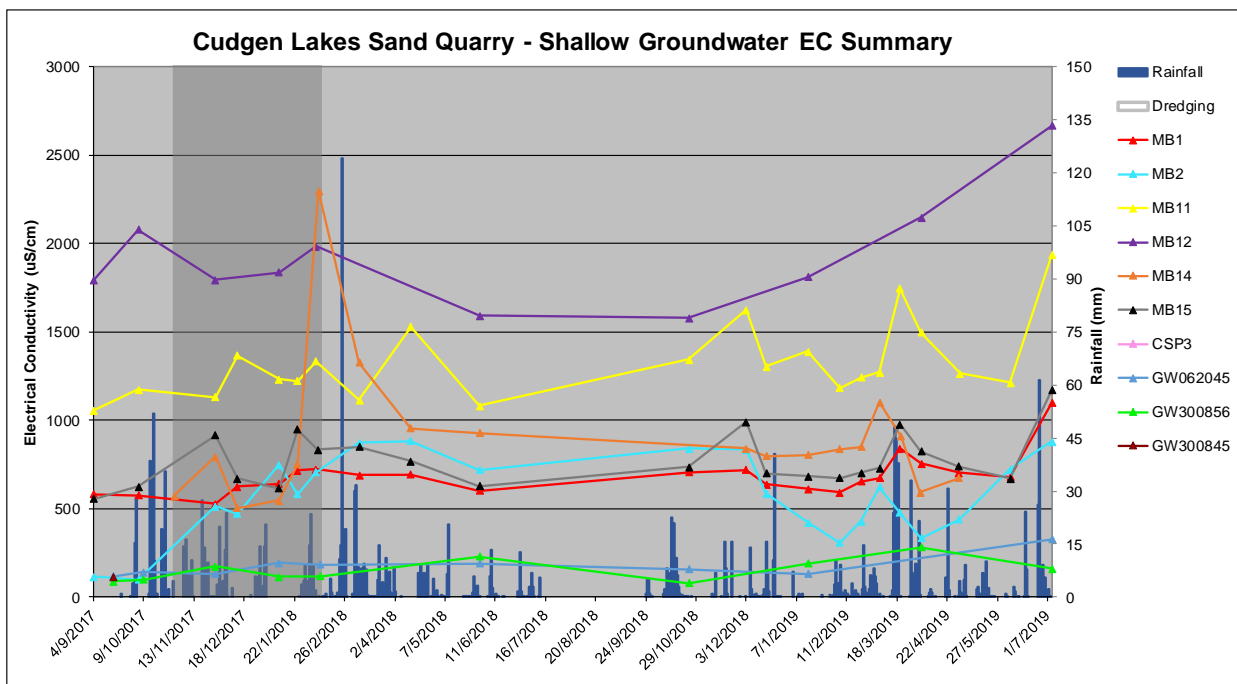


Figure 7.5b Groundwater Quality Parameters – Electric Conductivity (Shallow Bores)

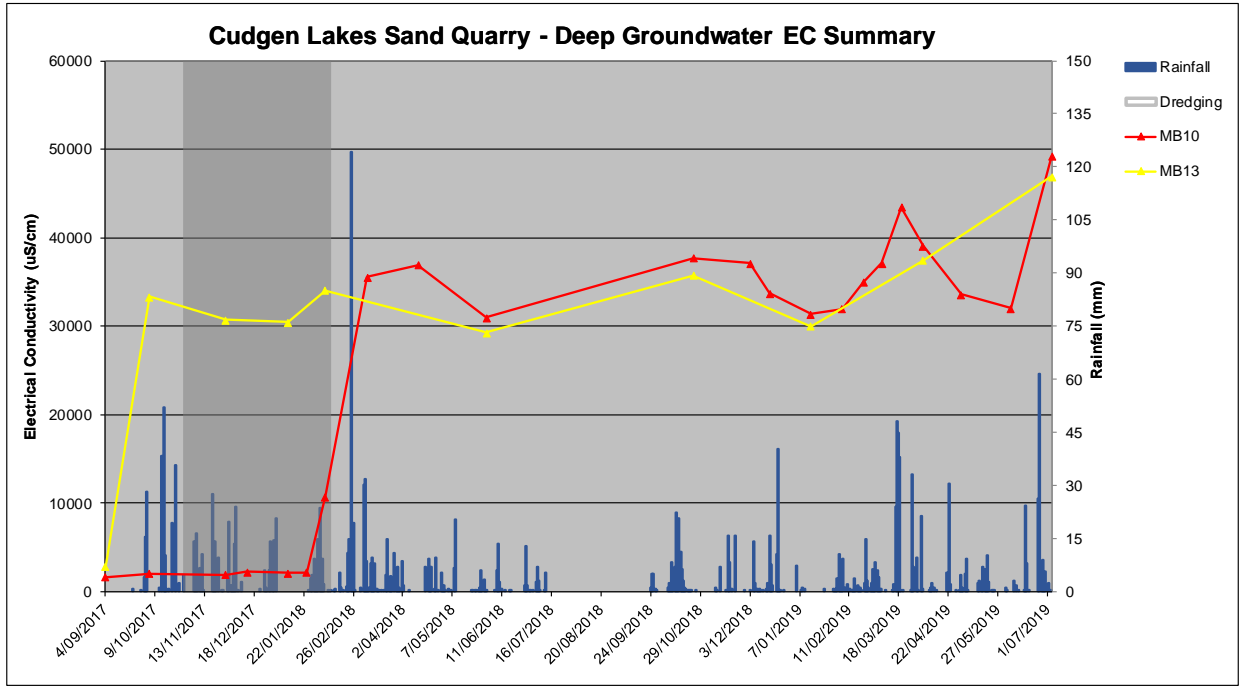


Figure 7.5c Groundwater Quality Parameters – Electric Conductivity (Deep Bores)

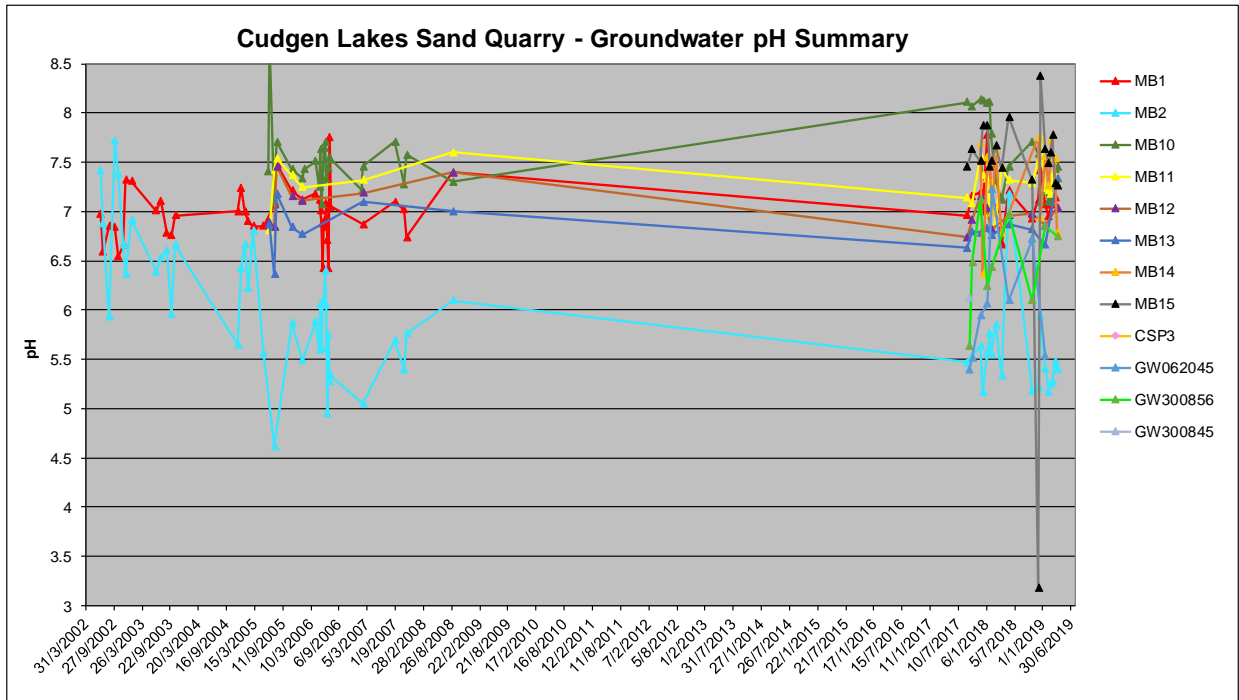


Figure 7.6a Long Term Groundwater Quality Parameters – pH

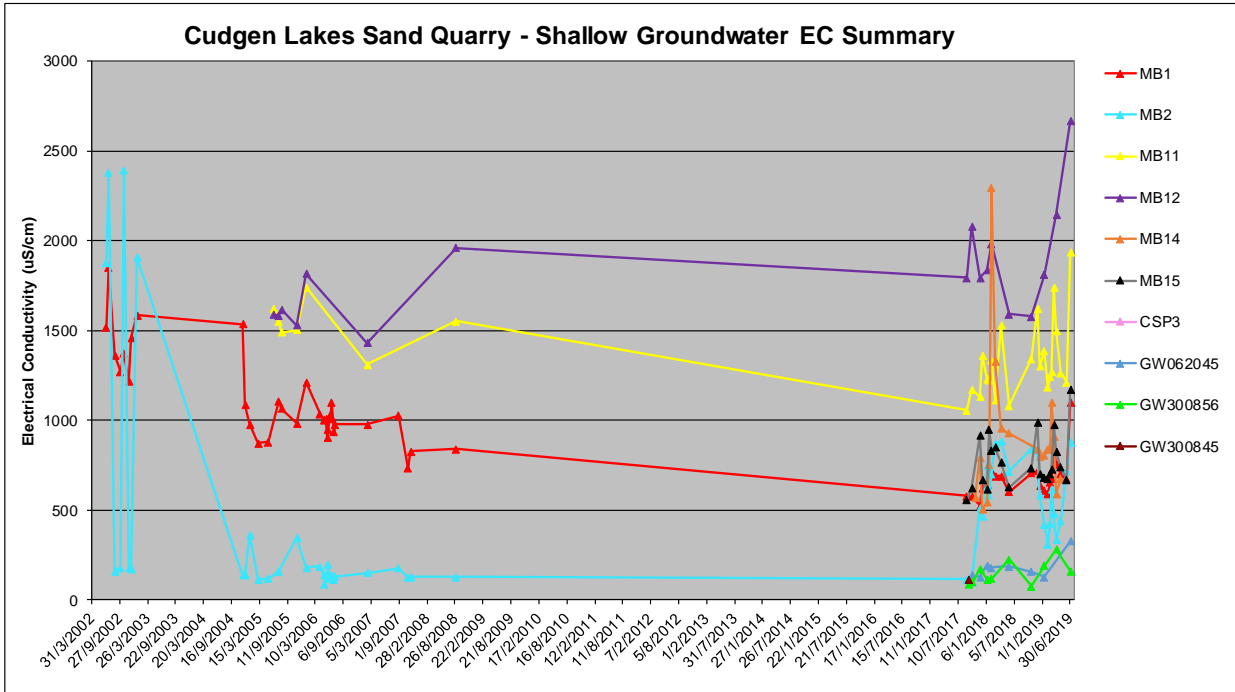


Figure 7.6b Long Term Groundwater Quality Parameters – Electric Conductivity (Shallow Bores)

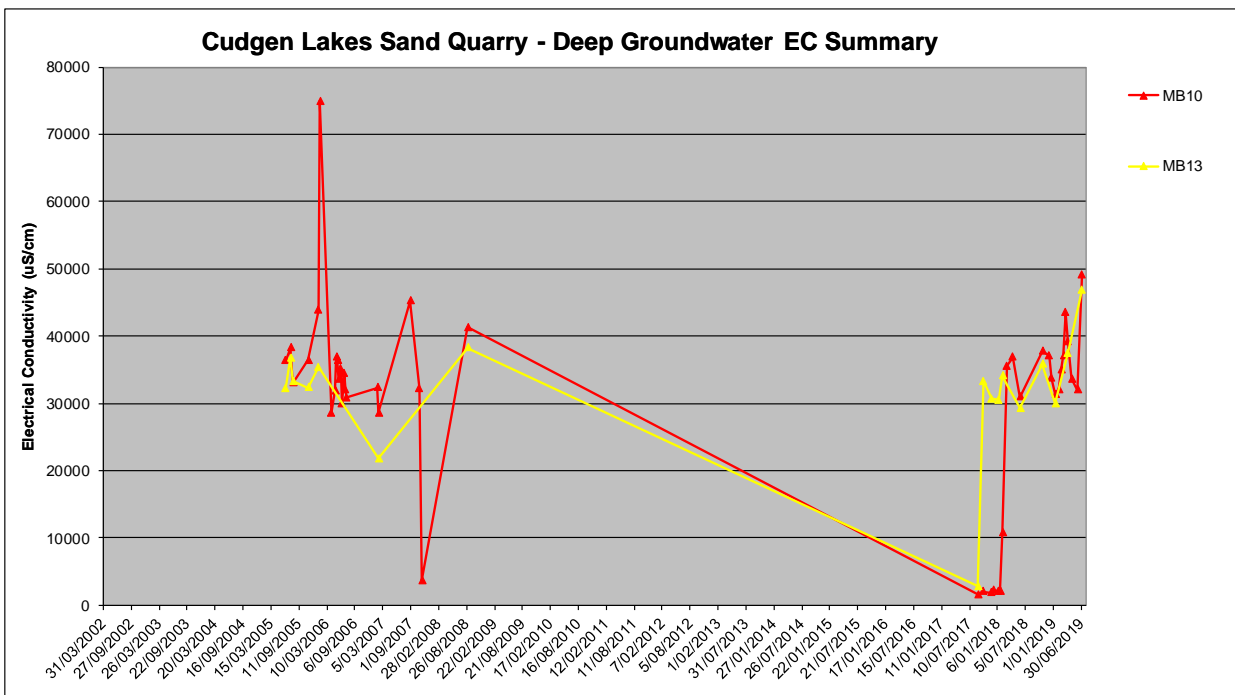


Figure 7.6c Long Term Groundwater Quality Parameters – Electric Conductivity (Deep Bores)

Table 7.2  
Groundwater Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae												
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a	
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10	
MB1																															
Pre-Extraction	Average	20.8	6.98	1081	0.96	-233.0	32	18.2	5	39	131	21	5	64	220	186	0.047	0.001	9.18	0.285	0.010	0.65	0.01	0.01	0.65	0.34	0.01	10	10	NS	NS
	Maximum	21.8	7.76	1854	7.66	23.0	32	35.0	5	58	193	36	5	124	492	292	0.140	0.001	22.00	0.460	0.010	0.70	0.01	0.01	0.70	0.39	0.01	10	10	NS	NS
	Minimum	19.8	6.43	576	0.05	-1398.0	32	1.4	5	31	77	13	4	35	10	110	0.010	0.001	0.24	0.110	0.010	0.60	0.01	0.01	0.60	0.28	0.01	10	10	NS	NS
Reporting Period (2018/2019)	Average	22.8	7.05	689	0.61	-113.5	28	5.5	5	30	99	10	3	32	8	335	0.014	0.001	9.34	0.178	0.015	0.75	0.01	0.01	0.68	0.40	0.01	10	10	5	1
	Maximum	26.0	7.42	841	1.21	-17.2	34	44.6	5	37	119	12	4	41	14	596	0.050	0.005	13.60	0.280	0.080	1.20	0.01	0.02	1.20	0.55	0.02	10	10	5	1
	Minimum	19.3	6.64	593	0.31	-186.9	23	-8.6	5	21	83	8	3	23	3	277	0.010	0.001	0.05	0.110	0.003	0.40	0.01	0.01	0.09	0.31	0.01	10	10	5	1
All Results (2002-2019)	Average	23.0	7.02	943	0.87	-138.3	29	6.8	5	34	112	14	4	49	112	269	0.029	0.001	8.20	0.176	0.012	0.83	0.01	0.02	0.79	0.43	0.02	9	10	5	1
	Maximum	26.0	7.78	1854	7.66	23.0	51	44.6	5	58	193	36	5	124	492	596	0.140	0.005	22.00	0.460	0.080	1.90	0.01	0.21	1.90	0.91	0.22	10	10	5	1
	80th Percentile	24.9	7.19	1105	1.08	-32.7	33	9.6	5	38	135.2	20	5	63	227	326	0.040	0.001	13.00	0.218	0.010	1.14	0.01	0.02	1.14	0.55	0.02	10	10	5	1
	Median (50th Percentile)	23.7	7.02	942	0.47	-97.1	29	3.5	5	32	102	11	4	40	14	290	0.010	0.001	8.29	0.160	0.010	0.70	0.01	0.01	0.70	0.41	0.01	10	10	5	1
	20th Percentile	20.9	6.84	676	0.21	-147.9	24	0.3	5	29	88.6	10	3	28	6	170	0.010	0.001	0.69	0.110	0.008	0.60	0.01	0.01	0.56	0.31	0.01	10	10	5	1
Minimum	19.3	6.43	526	0.05	-1398.0	12	-8.6	5	21	77	8	3	23	3	110	0.010	0.001	0.05	0.080	0.001	0.40	0.01	0.01	0.09	0.14	0.01	2	8	5	1	
MB2																															
Pre-Extraction	Average	21.3	6.07	383	0.74	5.1	9	10.9	5	16	1	1	15	26	15	16	2.033	0.010	6.60	0.075	0.050	0.70	0.01	0.01	0.70	0.24	0.01	10	10	NS	NS
	Maximum	21.7	7.72	2394	5.09	216.0	9	14.4	5	23	1.8	2	20	45	27	60	6.370	0.011	9.50	0.080	0.070	0.80	0.01	0.01	0.80	0.29	0.01	10	10	NS	NS
	Minimum	20.8	4.62	88	0.16	-130.0	9	7.3	5	12	0.2	0	4	10	1	7	0.430	0.009	3.12	0.070	0.030	0.60	0.01	0.01	0.60	0.19	0.01	10	10	NS	NS
Reporting Period (2018/2019)	Average	23.1	5.29	546	0.93	13.2	14	9.8	5	74	8	5	11	124	89	11	0.147	0.034	23.21	0.054	0.010	0.81	0.01	0.01	0.74	0.35	0.01	53	10	5	1
	Maximum	24.9	7.18	882	2.85	76.0	41	70.6	5	116	25	8	14	189	134	28	0.180	0.079	33.20	0.060	0.030	1.30	0.01	0.01	1.30	0.58	0.10	140	10	5	4
	Minimum	20.3	4.90	309	0.31	-90.1	5	-8.4	5	37	5	3	10	51	36	4	0.110	0.022	12.00	0.040	0.002	0.60	0.01	0.01	0.08	0.14	0.01	10	10	5	1
All Results (2002-2019)	Average	23.4	5.88	469	0.78	-2.7	12	8.4	5	55	7	4	12	82	53	13	1.084	0.027	14.80	0.055	0.015	0.85	0.01	0.01	0.83	0.35	0.01	125	115	5	1
	Maximum	26.1	7.72	2394	5.09	216.0	41	70.6	5	119	25	9	26	189	159	60	6.370	0.116	37.40	0.140	0.070	1.50	0.01	0.01	1.50	0.77	0.10	930	560	5	4
	80th Percentile	24.7	6.49	721	0.81	51.6	27	12.9	5	95	11	7	17	151	98	17	1.500	0.031	22.84	0.064	0.020	1.12	0.01	0.01	1.12	0.46	0.01	140	410	5	2
	Median (50th Percentile)	23.6	5.41	583	0.62	1.2	8	6.5	5	79	9	6	10	135	86	12	0.145	0.024	20.45	0.050	0.010	0.80	0.01	0.01	0.80	0.31	0.01	10	10	5	1
	20th Percentile	21.9	5.18	387	0.33	-59.1	5	0.3	5	49	5	3	6	81	55	4	0.110	0.008	16.40	0.040	0.005	0.60	0.01	0.01	0.60	0.20	0.01	1	10	5	1
Minimum	20.3	4.90	100	0.17	-115.0	5	-8.4	5	12	0.9	1	4	16	1	1	0.040	0.002	3.54	0.020	0.001	0.04	0.01	0.01	0.08	0.14	0.01	1	1	5	1	
MB10																															
Pre-Extraction	Average	21.8	7.53	32513	2.15	-72.8	5	9.5	5	4553	151	617	202	8230	1282	610	0.093	0.002	0.62	3.015	2.890	157.00	3.80	0.69	153.00	147.00	4.49	10	20	NS	NS
	Maximum	23.7	8.75	74900	4.11	107.0	5	13.0	5	7500	233	1150	292	14750	2490	852	0.340	0.002	1.96	3.320	3.220	162.00	4.39	1.20	157.00	158.00	5.59	10	20	NS	NS
	Minimum	19.9	7.07	1605	0.38	-187.0	5	6.0	5	94	30	17	24	194	77	247	0.010	0.002	0.01	2.710	2.560	152.00	3.20	0.18	149.00	136.00	3.38	10	20	NS	NS
Reporting Period (2018/2019)	Average	23.1	7.34	35635	1.77	-144.2	10	5.5	5	6737	228	1062	224	11764	1781	1114	0.051	0.005	0.12	1.053	1.011	25.22	0.11	0.02	30.36	27.05	0.11	10	190	5	1
	Maximum	26.3	7.71	43460	5.40	-10.0	38	28.0	5	7610	272	1170	254	12300	1910	1160	0.100	0.005	0.27	1.210	1.100	31.50	0.53	0.05	34.70	30.10	0.56	10	520	5	1
	Minimum	20.6	7.09	31347	0.00	-273.0	5	-11.1	5	6040	204	952	198	10500	1630	1060	0.010	0.001	0.05	0.960	0.930	2.94	0.01	0.01	28.80	25.10	0.01	10	10	5	1
All Results (2005-2019)	Average	23.1	7.53	30586	1.71	-126.3	8	7.1	5	5044	173	758	187	8923	1348	891	0.059	0.004	0.28	1.661	1.675	64.92	0.59	0.11	60.37	57.30	0.69	10	4644	5	1
	Maximum	26.3	8.75	74900	5.40	107.0	38	30.0	5	7610	272	1170	292	14750	2490	1170	0.340	0.005	1.96	3.350	3.860	186.00	4.39	1.20	184.00	174.00	5.59	30	39000	5	1
	80th Percentile	24.6	7.71	37568	2.73	-40.4	8	15.7	5	7316	232.8	1124	249	12700	1856	1134	0.082	0.005	0.26	3.134	3.082	153.20	1.10	0.17	151.00	141.60	1.31	10	1800	5	1
	Median (50th Percentile)	23.6	7.46	33600	1.54	-124.0	5	3.7	5	6565	206	1005	217	11800	1695	1060	0.050	0.005	0.10	1.105	1.055	31.10	0.02	0.02	30.80	27.80	0.04	10	90	5	1
	20th Percentile	21.0	7.25	28600	0.42	-210.8	5	0.9	5	244	55.2	37	29	254	98	638	0.010	0.002	0.05	0.992	0.989	29.04	0.01	0.01	29.10	26.00	0.01	1	10	5	1
Minimum	19.9	7.07	1605	0.00	-273.0	5	-11.1	5	94	30	17	24	194	71	247	0.010	0.001	0.01	0.960	0.930	2.94	0.01	0.01	0.50	0.23	0.01	1	3	5	1	

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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Table 7.2 (Cont'd)  
Groundwater Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae												
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a	
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10	
MB11																															
Pre-Extraction	Average	20.0	7.28	1446	1.02	-107.3	5	27.2	5	103	209	58	13	146	416	333	0.745	0.001	4.18	0.530	0.140	3.70	0.01	0.01	3.70	1.64	0.01	10	10	NS	NS
	Maximum	20.8	7.60	1743	2.11	-74.0	5	43.1	5	220	289	72	19	311	520	432	3.130	0.001	11.00	0.640	0.270	4.60	0.01	0.01	4.60	1.80	0.01	10	10	NS	NS
	Minimum	19.1	6.81	1056	0.37	-144.0	5	11.3	5	34	168	45	9	47	328	235	0.010	0.001	0.87	0.420	0.010	2.80	0.01	0.01	2.80	1.48	0.01	10	10	NS	NS
Reporting Period (2018/2019)	Average	23.5	7.35	1371	1.38	-192.5	22	7.2	5	41	167	47	11	64	263	397	0.020	0.001	0.34	0.581	0.427	4.09	0.02	0.04	4.06	3.18	0.04	10	2070	5	1
	Maximum	26.2	7.75	1744	7.07	297.1	93	25.5	5	50	201	54	12	115	387	500	0.050	0.005	0.73	1.370	1.000	11.80	0.10	0.20	11.70	9.71	0.25	10	4200	5	1
	Minimum	20.7	7.02	1183	0.10	-354.0	5	-5.5	5	33	43	42	9	43	172	331	0.010	0.001	0.08	0.220	0.050	1.40	0.01	0.01	1.40	0.60	0.01	10	710	5	1
All Results (2005-2019)	Average	23.3	7.32	1381	1.16	-135.0	18	9.1	5	56	175	49	11	76	311	352	0.184	0.001	1.35	0.431	0.359	3.00	0.04	0.10	2.88	2.05	0.13	8	4508	5	1
	Maximum	27.1	7.75	1935	7.07	297.1	93	43.1	5	220	289	72	19	311	520	500	0.310	0.005	11.00	1.370	1.750	11.80	0.33	0.56	11.70	9.71	0.72	10	34000	5	1
	80th Percentile	25.5	7.54	1553	2.00	-34.5	32	16.5	5	51	196.8	54	11	86	355	419	0.110	0.001	2.38	0.668	0.530	4.84	0.04	0.24	4.84	3.42	0.28	10	4200	5	1
	Median (50th Percentile)	24.0	7.32	1334	0.65	-134.0	9	6.7	5	41	178.5	50	11	51	325	345	0.010	0.001	0.39	0.315	0.264	2.15	0.01	0.03	1.95	1.17	0.03	10	320	5	1
	20th Percentile	21.0	7.14	1183	0.27	-289.4	5	0.7	5	35	164.4	42	10	46	244	321	0.010	0.001	0.10	0.226	0.079	1.40	0.01	0.01	1.26	0.58	0.01	1	10	5	1
Minimum	19.1	6.81	1056	0.10	-354.0	5	-5.5	5	20	33	8	2	17	21	98	0.010	0.001	0.06	0.100	0.010	0.20	0.01	0.01	0.20	0.04	0.01	1	1	5	1	
MB12																															
Pre-Extraction	Average	21.3	7.08	1713	0.72	-75.0	15	13.6	5	49	329	54	12	101	609	267	0.202	0.001	6.99	0.110	0.015	0.60	0.01	0.01	0.60	0.34	0.01	10	10	NS	NS
	Maximum	21.9	7.46	2080	1.65	-54.0	15	20.1	5	66	433	59	13	147	720	329	0.740	0.001	20.40	0.110	0.020	0.60	0.01	0.01	0.60	0.34	0.01	10	10	NS	NS
	Minimum	20.7	6.74	1433	0.09	-98.0	15	7.1	5	39	219	46	10	54	410	223	0.009	0.001	1.31	0.110	0.010	0.60	0.01	0.01	0.60	0.33	0.01	10	10	NS	NS
Reporting Period (2018/2019)	Average	23.1	6.96	1845	1.54	-70.2	27	14.5	5	44	346	43	10	109	696	306	0.023	0.002	4.57	0.020	0.009	0.63	0.01	0.16	0.47	0.29	0.17	10	260	NS	NS
	Maximum	25.0	7.04	2146	2.17	-17.5	43	32.4	5	55	371	43	11	122	771	314	0.050	0.005	13.60	0.030	0.010	0.80	0.02	0.44	0.60	0.38	0.46	10	480	NS	NS
	Minimum	19.9	6.86	1580	0.63	-124.1	5	1.1	5	29	324	42	10	91	653	290	0.010	0.001	0.05	0.010	0.007	0.50	0.01	0.02	0.30	0.10	0.02	10	10	NS	NS
All Results (2005-2019)	Average	22.9	7.05	1813	1.32	-41.7	23	21.4	5	47	340	48	11	107	652	297	0.095	0.001	5.41	0.042	0.010	0.62	0.01	0.11	0.52	0.30	0.11	8	3647	NS	NS
	Maximum	26.5	7.46	2667	3.75	73.5	43	47.9	5	66	433	59	13	147	771	340	0.740	0.005	20.40	0.110	0.020	0.80	0.02	0.44	0.80	0.38	0.46	10	32000	NS	NS
	80th Percentile	25.5	7.22	2022	2.10	30.2	39	33.4	5	55	373	54	12	131	720	325	0.150	0.001	13.60	0.098	0.010	0.78	0.01	0.28	0.60	0.38	0.28	10	480	NS	NS
	Median (50th Percentile)	23.0	7.04	1795	1.23	-69.0	22	21.0	5	46	348	48	11	114	661	314	0.010	0.001	1.53	0.030	0.010	0.60	0.01	0.02	0.50	0.34	0.02	10	10	NS	NS
	20th Percentile	20.3	6.85	1584	0.28	-91.2	9	7.1	5	39	322	42	10	84	596	236	0.010	0.001	0.05	0.012	0.008	0.50	0.01	0.01	0.40	0.15	0.01	5	10	NS	NS
Minimum	19.9	6.74	1433	0.09	-124.1	5	1.1	5	29	219	40	10	54	410	223	0.009	0.001	0.05	0.010	0.001	0.40	0.01	0.01	0.30	0.10	0.01	1	5	NS	NS	
MB13																															
Pre-Extraction	Average	22.4	6.84	29572	0.86	-112.1	26	3.8	5	6500	960	1227	193	10702	2490	386	0.230	0.003	8.44	0.415	0.015	1.85	0.01	0.16	1.70	1.37	0.16	10	750	NS	NS
	Maximum	24.0	7.18	38200	2.97	-34.0	26	5.9	5	6940	2350	2040	240	15198	4000	534	0.750	0.005	19.00	0.560	0.020	2.90	0.01	0.30	2.90	2.59	0.30	10	750	NS	NS
	Minimum	20.7	6.36	2826	0.05	-250.0	26	1.6	5	5700	533	888	127	247	2110	194	0.009	0.001	0.05	0.270	0.010	0.80	0.01	0.02	0.50	0.14	0.02	10	750	NS	NS
Reporting Period (2018/2019)	Average	23.0	6.94	34387	0.82	-91.7	15	8.4	5	5960	543	919	163	11100	2040	532	0.050	0.005	1.06	0.550	0.289	3.60	0.01	0.01	3.60	3.05	0.01	10	310	NS	NS
	Maximum	25.4	7.33	37420	1.33	-24.0	22	23.7	5	6820	595	1020	186	11400	2270	582	0.050	0.005	2.79	1.000	0.848	4.80	0.01	0.01	4.80	4.49	0.01	10	780	NS	NS
	Minimum	20.1	6.66	29980	0.38	-217.2	5	0.7	5	5200	503	845	147	10500	1860	468	0.050	0.005	0.05	0.060	0.010	1.40	0.01	0.01	1.40	1.03	0.01	10	60	NS	NS
All Results (2005-2019)	Average	23.0	6.87	31799	1.13	-72.1	20	14.3	5	6282	725	1060	178	11044	2218	470	0.121	0.004	5.48	0.356	0.126	3.31	0.10	0.10	3.12	2.61	0.19	8	4231	NS	NS
	Maximum	25.4	7.33	46890	2.97	72.0	33	39.6	5	7080	2350	2040	240	15198	4000	582	0.750	0.005	19.00	1.000	0.848	5.70	0.35	0.33	5.70	4.82	0.68	10	36000	NS	NS
	80th Percentile	24.5	7.11	37048	2.32	-28.0	30	28.9	5	6870	629	1090	215	12600	2270	552	0.170	0.005	11.70	0.584	0.264	4.76	0.30	0.27	4.76	4.32	0.43	10	780	NS	NS
	Median (50th Percentile)	23.7	6.83	33300	0.83	-52.3	21	9.1	5	6300	555	968	175	11400	2165	496	0.050	0.005	2.30	0.285	0.010	3.15	0.01	0.04	2.90	2.39	0.05	10	120	NS	NS
	20th Percentile	20.7	6.72	29682	0.24	-162.7	8	1.0	5	5700	530	888	150	10900	1980	382	0.010	0.001	0.05	0.096	0.010	1.58	0.01	0.01	1.56	1.28	0.01	5	40	NS	NS
Minimum	20.1	6.36	2826	0.05	-250.0	5	0.7	5	5200	430	821	127	247	1540	194	0.009	0.001	0.05	0.060	0.010	0.80	0.01	0.01	0.50	0.14	0.01	1	10	NS	NS	

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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Table 7.2 (Cont'd)  
Groundwater Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae												
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a	
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10	
<b>MB14</b>																															
Reporting Period (2018/2019)	Average	22.6	7.38	834	<b>2.00</b>	-98.6	24	<b>34.4</b>	5	91	66	19	6	134	44	190	0.010	0.001	1.88	<b>0.128</b>	<b>0.018</b>	<b>0.39</b>	0.02	0.02	0.37	0.08	<b>0.03</b>	10	10	5	1
	Maximum	24.2	7.76	1102	10.30	210.7	45	<b>217.4</b>	5	112	143	23	7	156	54	205	0.010	0.001	6.06	<b>0.270</b>	<b>0.054</b>	<b>1.10</b>	0.10	0.15	0.90	0.12	<b>0.16</b>	10	10	5	1
	Minimum	21.5	6.78	593	<b>-0.30</b>	-244.0	6	<b>0.6</b>	5	68	44	14	5	90	28	172	0.010	0.001	0.63	<b>0.090</b>	0.004	0.20	0.01	0.01	0.20	0.03	0.01	10	10	5	1
All Results (2017-2019)	Average	23.0	7.29	893	<b>1.92</b>	-87.0	39	<b>30.1</b>	5	85	71	21	5	142	62	192	0.013	0.001	3.10	<b>0.162</b>	<b>0.019</b>	<b>0.38</b>	0.02	0.02	0.37	0.08	<b>0.02</b>	8	75	5	1
	Maximum	28.3	7.76	2296	10.30	210.7	195	<b>217.4</b>	5	182	154	39	8	491	181	284	0.050	0.005	<b>22.90</b>	<b>0.430</b>	<b>0.100</b>	<b>1.10</b>	0.10	0.15	0.90	0.15	<b>0.16</b>	10	<b>260</b>	5	1
	80th Percentile	23.9	7.63	984	<b>3.34</b>	-8.8	44	<b>34.2</b>	5	114	87.6	24	7	180	86	208	0.010	0.001	5.07	<b>0.272</b>	<b>0.024</b>	<b>0.42</b>	0.01	0.01	0.42	0.10	<b>0.01</b>	10	212	5	1
	Median (50th Percentile)	22.6	7.52	822	<b>0.83</b>	-107.1	26	14.8	5	85	60.5	20	6	140	48	192	0.010	0.001	1.15	<b>0.125</b>	<b>0.010</b>	0.35	0.01	0.01	0.35	0.07	0.01	10	15	5	1
	20th Percentile	21.7	6.91	589	<b>0.38</b>	-165.6	8	<b>3.2</b>	5	45	50.4	14	3	36	38	170	0.010	0.001	0.51	<b>0.098</b>	<b>0.010</b>	0.20	0.01	0.01	0.20	0.06	0.01	3	10	5	1
Minimum	21.1	<b>6.37</b>	505	<b>-0.30</b>	-244.0	6	<b>0.6</b>	5	20	33	8	2	17	21	98	0.010	0.001	0.05	<b>0.080</b>	0.004	0.20	0.01	0.01	0.20	0.03	0.01	1	10	5	1	
<b>MB15</b>																															
Pre-Extraction	Average	21.1	7.54	590	<b>0.33</b>	-119.8	14	<b>36.5</b>	5	101	33	12	7	79	43	213	0.275	0.002	0.74	<b>0.275</b>	<b>0.215</b>	<b>0.45</b>	0.01	0.01	0.45	0.19	0.01	10	<b>1900</b>	NS	NS
	Maximum	21.6	7.63	625	<b>0.65</b>	-87.0	14	<b>62.0</b>	5	116	40	14	8	83	48	217	<b>0.520</b>	0.002	1.35	<b>0.330</b>	<b>0.220</b>	<b>0.60</b>	0.01	0.01	0.60	0.26	0.01	10	<b>1900</b>	NS	NS
	Minimum	20.6	7.45	555	<b>0.01</b>	-152.6	14	10.9	5	86	25	10	6	74	37	208	0.030	0.001	0.13	<b>0.220</b>	<b>0.210</b>	0.30	0.01	0.01	0.30	0.12	0.01	10	<b>1900</b>	NS	NS
Reporting Period (2018/2019)	Average	22.9	7.11	766	<b>0.72</b>	-77.0	12	<b>2.5</b>	5	80	52	17	10	88	57	199	0.014	0.001	0.29	<b>0.187</b>	<b>0.124</b>	<b>0.44</b>	0.02	0.04	0.41	0.28	<b>0.04</b>	170	110	5	1
	Maximum	25.0	8.38	990	<b>2.40</b>	203.7	24	13.4	5	124	83	17	13	98	91	206	0.050	0.005	0.58	<b>0.230</b>	<b>0.165</b>	<b>0.70</b>	0.10	0.34	0.50	0.46	<b>0.34</b>	490	<b>310</b>	5	1
	Minimum	19.9	<b>3.18</b>	670	<b>0.03</b>	-200.0	5	<b>-7.1</b>	5	60	42	15	8	83	41	190	0.010	0.001	0.10	<b>0.130</b>	<b>0.080</b>	0.30	0.01	0.01	0.30	0.20	0.01	10	10	5	1
All Results (2017-2019)	Average	23.0	7.38	773	<b>0.97</b>	-71.3	12	12.0	5	90	45	16	10	87	63	199	0.036	0.001	0.31	<b>0.206</b>	<b>0.143</b>	<b>0.52</b>	0.02	0.04	0.50	0.32	<b>0.04</b>	61	<b>5054</b>	5	1
	Maximum	25.1	8.38	1170	6.45	203.7	24	<b>62.0</b>	5	144	83	18	14	119	138	217	<b>0.520</b>	0.005	1.35	<b>0.330</b>	<b>0.220</b>	<b>1.40</b>	0.10	0.34	1.40	0.66	<b>0.34</b>	490	<b>43000</b>	5	2
	80th Percentile	24.8	7.82	929	<b>1.20</b>	-2.4	19	<b>21.6</b>	5	111	52	17	11	95	81	207	0.010	0.001	0.38	<b>0.264</b>	<b>0.173</b>	<b>0.80</b>	0.01	0.02	0.74	0.48	<b>0.03</b>	10	<b>1900</b>	5	1
	Median (50th Percentile)	22.9	7.52	733	<b>0.54</b>	-86.0	12	5.5	5	84	43.5	16	10	87	55	199	0.010	0.001	0.26	<b>0.200</b>	<b>0.140</b>	<b>0.40</b>	0.01	0.01	0.40	0.29	0.01	10	50	5	1
	20th Percentile	21.4	7.28	653	<b>0.36</b>	-164.2	6	<b>0.9</b>	5	70	36.8	14	8	81	43	190	0.010	0.001	0.06	<b>0.170</b>	<b>0.110</b>	0.30	0.01	0.01	0.30	0.20	0.01	1	10	5	1
Minimum	19.9	<b>3.18</b>	555	<b>0.01</b>	-200.0	5	<b>-7.1</b>	5	60	25	10	6	60	37	176	0.010	0.001	0.05	<b>0.120</b>	<b>0.080</b>	0.20	0.01	0.01	0.20	0.04	0.01	1	10	5	1	
<b>CSP3</b>																															
Pre-Extraction	Average	20.9	7.13	608	<b>0.40</b>	-118.5	5	<b>4.6</b>	5	25	89	8	9	53	32	196	0.081	0.001	4.12	<b>0.260</b>	<b>0.080</b>	<b>1.30</b>	0.01	1.56	1.30	0.44	0.01	10	30	NS	NS
	Maximum	21.3	8.09	1007	<b>2.61</b>	27.7	5	7.4	5	83	148	19	28	123	182	271	0.260	0.001	9.82	<b>0.280</b>	<b>0.100</b>	<b>2.00</b>	0.01	3.10	2.00	0.60	0.01	10	30	NS	NS
	Minimum	20.5	<b>6.34</b>	300	<b>0.04</b>	-160.1	5	<b>1.7</b>	5	9	50	5	5	8	5	135	0.010	0.001	0.59	<b>0.240</b>	<b>0.060</b>	<b>0.60</b>	0.01	0.01	0.60	0.28	0.01	10	30	NS	NS
Reporting Period (2018/2019)	Average	23.0	7.28	1174	<b>0.27</b>	-152.0	5	<b>0.6</b>	5	18	187	26	15	32	226	360	0.023	0.002	0.35	<b>0.417</b>	<b>0.293</b>	<b>2.60</b>	0.01	0.01	2.60	2.14	<b>0.01</b>	130	60	NS	NS
	Maximum	24.2	7.31	1347	<b>0.58</b>	-32.9	5	<b>0.9</b>	5	24	211	27	15	33	235	378	0.050	0.005	0.74	<b>0.440</b>	<b>0.390</b>	<b>3.10</b>	0.01	0.02	3.10	2.68	<b>0.02</b>	370	160	NS	NS
	Minimum	21.3	7.24	1028	<b>0.08</b>	-290.0	5	<b>0.3</b>	5	5	163	25	14	31	220	342	0.010	0.001	0.09	<b>0.380</b>	<b>0.100</b>	<b>1.60</b>	0.01	0.01	1.60	1.24	0.01	10	10	NS	NS
All Results (1991-2019)	Average	22.5	7.19	728	<b>0.61</b>	-157.3	5	<b>4.4</b>	5	30	112	12	11	56	79	252	0.057	0.001	2.80	<b>0.490</b>	<b>0.378</b>	<b>2.69</b>	0.01	0.45	2.69	2.12	<b>0.01</b>	50	<b>4809</b>	NS	NS
	Maximum	24.3	8.09	1643	7.17	27.7	6	15.4	5	83	211	27	28	123	235	<b>458</b>	0.260	0.005	9.82	<b>0.960</b>	<b>0.810</b>	<b>4.70</b>	0.01	3.10	4.70	4.42	<b>0.02</b>	370	<b>41000</b>	NS	NS
	80th Percentile	24.0	7.50	1015	<b>0.51</b>	-125.0	6	9.2	5	61	157.6	22	16	108	182	356	0.110	0.001	6.29	<b>0.784</b>	<b>0.742</b>	<b>4.12</b>	0.01	1.25	4.12	3.24	0.01	30	<b>1800</b>	NS	NS
	Median (50th Percentile)	22.7	7.20	608	<b>0.24</b>	-154.0	5	<b>2.3</b>	5	22	100	9	14	44	17	232	0.010	0.001	1.93	<b>0.435</b>	<b>0.390</b>	<b>3.05</b>	0.01	0.01	3.05	2.60	0.01	10	30	NS	NS
	20th Percentile	21.3	6.90	552	<b>0.15</b>	-250.0	5	<b>0.7</b>	5	13	68.4	6	5	26	8	177	0.010	0.001	0.05	<b>0.256</b>	<b>0.100</b>	<b>0.96</b>	0.01	0.01	0.96	0.46	0.01	2	10	NS	NS
Minimum	20.5	<b>6.34</b>	300	<b>0.04</b>	-290.0	5	<b>0.3</b>	5	5	50	5	5	8	5	135	0.010	0.001	0.05	<b>0.240</b>	<b>0.060</b>	<b>0.60</b>	0.01	0.01	0.60	0.28	0.01	1	1	NS	NS	

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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Table 7.2 (Cont'd)  
Groundwater Monitoring Data Summary

Parameters	Physical Parameters								Major Cations & Anions							Metals			Nutrients / Bacteria / Algae											
	Temp °C	pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Redox mV	Total Suspended Solids mg/L	Turbidity NTU	Oil & Grease mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Reactive Phosphorous mg/L	Total Nitrogen mg/L	Nitrite mg/L	Nitrate mg/L	TKN mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml	Potentially Toxic Cyanobacteria	Chlorophyll a
Objectives	-	6.5-8.5	<3000	>6	-	-	5-20	10	<500	-	<100	<40	<1000	<800	<400	<0.5	<0.42	<20	0.01	<0.005	0.35	-	-	-	<20	0.01	<1000/100	<230/100	<50000	<10
GW062045																														
Pre-Extraction	Average	22.6	5.46	129	1.31	146.0	2.1	5	16	3	5	1	23	5	8	0.110	0.001	0.05	0.025	0.010	5.65	0.01	5.22	0.45	0.04	5.22	10	10	NS	NS
	Maximum	23.5	5.52	140	1.34	150.0	2.4	5	16	3	5	1	23	5	10	0.210	0.001	0.05	0.030	0.010	5.90	0.01	5.41	0.50	0.06	5.41	10	10	NS	NS
	Minimum	21.6	5.40	117	1.27	142.0	1.8	5	15	2	4	1	22	4	6	0.010	0.001	0.05	0.020	0.010	5.40	0.01	5.02	0.40	0.01	5.02	10	10	NS	NS
Reporting Period (2018/2019)	Average	22.6	6.13	145	6.34	138.4	7.2	5	6	4	3	2	23	4	22	0.305	0.010	2.23	0.145	0.110	2.60	0.01	2.31	0.75	0.12	1.85	20	1855	NS	NS
	Maximum	22.7	6.72	159	8.43	178.0	11.5	5	10	5	4	2	24	5	34	0.560	0.015	4.40	0.270	0.210	4.50	0.01	3.67	0.80	0.19	3.67	30	3700	NS	NS
	Minimum	22.5	5.54	130	4.24	98.7	2.8	5	1	2	2	1	22	3	9	0.050	0.005	0.05	0.020	0.010	0.70	0.01	0.95	0.70	0.05	0.02	10	10	NS	NS
All Results (2017-2019)	Average	22.7	6.00	174	4.35	113.1	2.8	5	13	2	4	1	21	4	11	0.099	0.003	0.54	0.051	0.032	4.44	0.01	4.18	0.59	0.06	4.07	30	558	NS	NS
	Maximum	23.5	7.23	328	8.43	178.0	11.5	5	17	5	5	2	24	5	34	0.560	0.015	4.40	0.270	0.210	6.00	0.01	5.60	1.00	0.19	5.60	75	3700	NS	NS
	80th Percentile	23.1	6.72	194	5.66	150.0	2.8	5	16	3	5	1	23	5	11	0.210	0.005	0.08	0.050	0.010	5.90	0.01	5.48	0.80	0.18	5.48	72	1576	NS	NS
	Median (50th Percentile)	22.9	5.94	159	4.31	115.0	2.1	5	15	2	4	1	22	4	9	0.010	0.001	0.05	0.020	0.010	5.40	0.01	5.20	0.50	0.02	5.20	10	10	NS	NS
	20th Percentile	22.5	5.50	130	1.34	98.7	0.5	5	10	2	4	1	19	4	6	0.010	0.001	0.05	0.010	0.010	0.90	0.01	0.95	0.40	0.01	0.87	7	5	NS	NS
Minimum	21.6	5.40	117	1.27	-21.3	0.0	5	1	2	2	1	18	3	6	0.010	0.001	0.05	0.010	0.008	0.70	0.01	0.87	0.40	0.01	0.02	2	1	NS	NS	
GW300856																														
Pre-Extraction	Average	21.8	6.06	95	3.34	36.0	16.7	5	8	4	2	2	17	5	9	1.995	0.018	5.78	0.360	0.285	0.95	0.01	0.01	0.95	0.18	0.01	10	10	NS	NS
	Maximum	22.9	6.48	100	4.36	41.0	17.3	5	8	4	2	2	17	6	10	3.270	0.019	6.19	0.410	0.320	1.10	0.01	0.01	1.10	0.20	0.01	10	10	NS	NS
	Minimum	20.7	5.64	89	2.31	31.0	16.0	5	8	4	2	2	17	4	7	0.720	0.016	5.36	0.310	0.250	0.80	0.01	0.01	0.80	0.16	0.01	10	10	NS	NS
Reporting Period (2018/2019)	Average	24.3	6.57	183	4.21	-10.3	5	9	3	3	1	19	5	10	0.413	0.009	2.91	0.220	0.089	1.07	0.01	0.01	0.73	0.14	0.32	10	27	NS	NS	
	Maximum	25.9	6.85	281	4.76	9.7	5	9.6	5	16	4	2	21	6	11	0.650	0.017	4.64	0.350	0.220	1.40	0.01	0.02	1.00	0.21	0.95	10	60	NS	NS
	Minimum	21.8	6.10	78	3.80	-44.0	0.1	5	1	2	2	1	18	4	7	0.010	0.001	0.05	0.010	0.010	0.80	0.01	0.01	0.40	0.06	0.01	10	10	NS	NS
All Results (2017-2019)	Average	23.5	6.46	154	4.06	-8.1	6	15.3	5	9	4	2	19	5	8	0.740	0.013	4.09	0.284	0.168	0.83	0.01	0.01	0.73	0.16	0.11	11	15	NS	NS
	Maximum	25.9	7.12	281	5.26	41.0	25.5	5	16	5	4	2	23	7	11	3.270	0.019	6.19	0.410	0.320	1.40	0.01	0.02	1.10	0.28	0.95	30	60	NS	NS
	80th Percentile	25.2	6.95	220	4.78	26.7	22.6	5	10	4.8	2	2	21	6	11	0.706	0.019	5.46	0.358	0.248	1.08	0.01	0.02	0.96	0.21	0.02	14	20	NS	NS
	Median (50th Percentile)	23.4	6.46	140	4.16	-12.1	5	16.7	5	10	4	2	20	5	8	0.530	0.012	4.34	0.305	0.210	0.80	0.01	0.01	0.75	0.15	0.01	10	10	NS	NS
	20th Percentile	22.0	6.04	91	3.18	-39.1	5	8.4	5	8	3.2	2	17	4	7	0.312	0.010	3.11	0.242	0.015	0.62	0.01	0.01	0.44	0.09	0.01	4	7	NS	NS
Minimum	20.7	5.64	78	2.31	-44.0	0.1	5	1	2	2	1	17	4	4	0.010	0.001	0.05	0.010	0.009	0.40	0.01	0.01	0.40	0.06	0.01	2	5	NS	NS	

Red and bold values exceed the objective value for that analyte. IS - Insufficient data for statistical analysis. NS = No Sample Required. ND = No Data

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### **Physical Parameters and Major Cations and Anions**

Groundwater monitoring data to date supports the expected hydrogeological environment with water within the Quaternary sand aquifer essentially fresh in the upper 5m to 10m and becoming saline at depth with increasing salinity within the water profile towards the Tweed River.

During the reporting period the EC for all shallow groundwater bore sites remained within the water quality objective of 3,000uS/cm. However, a slight increase in EC was recorded across all shallow bores whilst the deep groundwater bores (MB10 and MB13) recorded a substantial increase in EC. The EC levels at MB10 remain within the historical maximum (74,900uS/cm), however, levels at MB13 (46,890uS/cm recorded 04 July 2019 – just after the end of this reporting period) exceed the previously recorded maximum of 32,800uS/cm at that location. Elevated EC levels are consistent with their screening at the saline interface, however, the cause of the current increase in both the deep and shallow bores is not known and may be attributable to natural fluctuations within the groundwater system. Given the ‘global’ nature of the change and the fact that no extraction operations have occurred since February 2018 these changes are not considered to be related to the Quarry. Review will be made against the results recorded at the adjoining Hanson Tweed Sand Quarry for the 2018/2019 reporting period once those monitoring results become available.

As expected, and previously recorded, most major cations and anions also exceed the current objective values at the deep groundwater bores consistent with and the cause of the higher electrical conductivity.

During the reporting period the pH generally remained near neutral to slightly alkaline with the exception of monitoring bore MB2 on the western Quarry boundary and the off-site private groundwater bores GW62045 and GW00856 respectively located on the Cudgen Plateau and adjacent Tweed Coast Road (see **Figure 7.1**). These locations regularly recorded a pH less than 6.5 but remained within pre-extraction ranges.

One anomalous result was recorded at MB15 with a pH of 3.18 recorded on 3 December 2018. There was no corresponding increase in aluminium, iron or sulphate, as may be expected during an acidification event, and alkalinity remained at 206mg/L of CaCO<sub>3</sub>. Furthermore, the pH on 24 October 2018 was 7.32 and on 17 December 2018 was 8.38. It is therefore considered that this result was equipment error.

Oil and grease was consistently below the objective limit at all sites.

### **Metals**

During the reporting period slightly elevated iron levels continued to be regularly recorded at MB2 and slightly elevated aluminium was recorded at GW062045 on 15 January 2019 (0.56mg/L) and GW300856 on 24 October 2018 (0.65mg/L) and 4 April 2019 (0.58mg/L). These slightly elevated iron and aluminium levels are indicative of the low pH which has been regularly recorded and is likely due to acid sulfate soils in the vicinity of these bores. These effects have been evident in pre-extraction monitoring.

At all other monitoring locations, the monitored metals (filterable iron, aluminium and arsenic) remained well below the quality objectives with no discernible trends. This is consistent with the near neutral to slightly alkaline pH recorded at these locations.

### ***Nutrients and Bacteria***

As for the dredge pond, nutrient levels (both phosphorus and particularly nitrogen / nitrogen containing species) remained consistently elevated throughout the reporting period. Elevated nutrient levels have been recorded in pre-extraction baseline monitoring and in surrounding groundwater bores. This is reflective of past and current agricultural activities within and surrounding the Quarry both on the floodplain and the Cudgen Plateau. Significantly elevated ammonia levels also continued to be recorded at bore MB10. Given that MB10 is located immediately adjacent the Kingscliff Wastewater Treatment Plant, the elevated ammonia could be originating from the treatment plant.

As would be expected with the high nutrient levels, Enterococci were observed to be elevated in MB10, MB11, MB12, MB13, MB15 and GW062045 on a number of occasions during the reporting period. The presence of Enterococci is likely attributed to previous stocking of the property with cattle and possibly off-site poultry and has been recorded within surrounding groundwater bores, prior to, during and post dredging and are not related to the previous dredging activities.

### ***Blue-Green Algae***

All measurements of cyanobacteria and Chlorophyll a were below the lower limit of reaction at all sites throughout the reporting period. This strongly indicates that the cyanobacteria in the dredge pond (and adjoining Hanson Tweed Sand Quarry pond) are not migrating through the groundwater. Ongoing for cyanobacteria in surrounding groundwater bores is therefore no longer considered necessary and would not provide any further meaningful data.

In summary, analysis of the groundwater quality parameters shows that the previous dredging campaign has had little direct impact on groundwater quality.

### **Reportable Incidents**

There were no reportable groundwater incidents during the reporting period with all levels remaining within objective limits, historic or expected levels.

### **Further Improvements**

As discussed in Section 4.2, the Groundwater Monitoring Program (forming part of the Soil and Water Management Plan) was revised during the reporting period to reflect proposed changes to the range of analytes monitored and the frequency of sampling based on monitoring results recorded to date. Water levels loggers will also be serviced as required to ensure accurate ongoing measurements.

## 8. REHABILITATION

### 8.1 REHABILITATION PERFORMANCE DURING THE REPORTING PERIOD

**Figure 8.1** shows the status of disturbance and rehabilitation at the end of the reporting period whilst **Table 8.1** provides a summary of the disturbance and rehabilitation areas.

**Table 8.1**  
**Rehabilitation Summary**

Quarry Area Type	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
	Year 9 (ha)	Year 10 (ha)	Year 11 (ha)
Total Quarry footprint	11.8 <sup>1</sup>	11.8 <sup>1</sup>	11.8 <sup>2</sup>
Total active disturbance	11.8 <sup>1</sup>	11.8 <sup>1</sup>	11.8 <sup>2</sup>
Land being prepared for rehabilitation	0	0	0
Land under active rehabilitation	0	0	0
Completed rehabilitation	0	0	0

Notes: 1. Includes approximately 3.6ha of temporary rehabilitation.  
2. Estimate pending commencement and extent of operation dredging during next reporting period.

The total active disturbance area did not change during the reporting period as no extraction, site establishment, or construction activities were undertaken. The current active disturbance area of 11.8ha includes an area of approximately 3.6ha which is considered to have been temporarily rehabilitated at the end of the last reporting period.

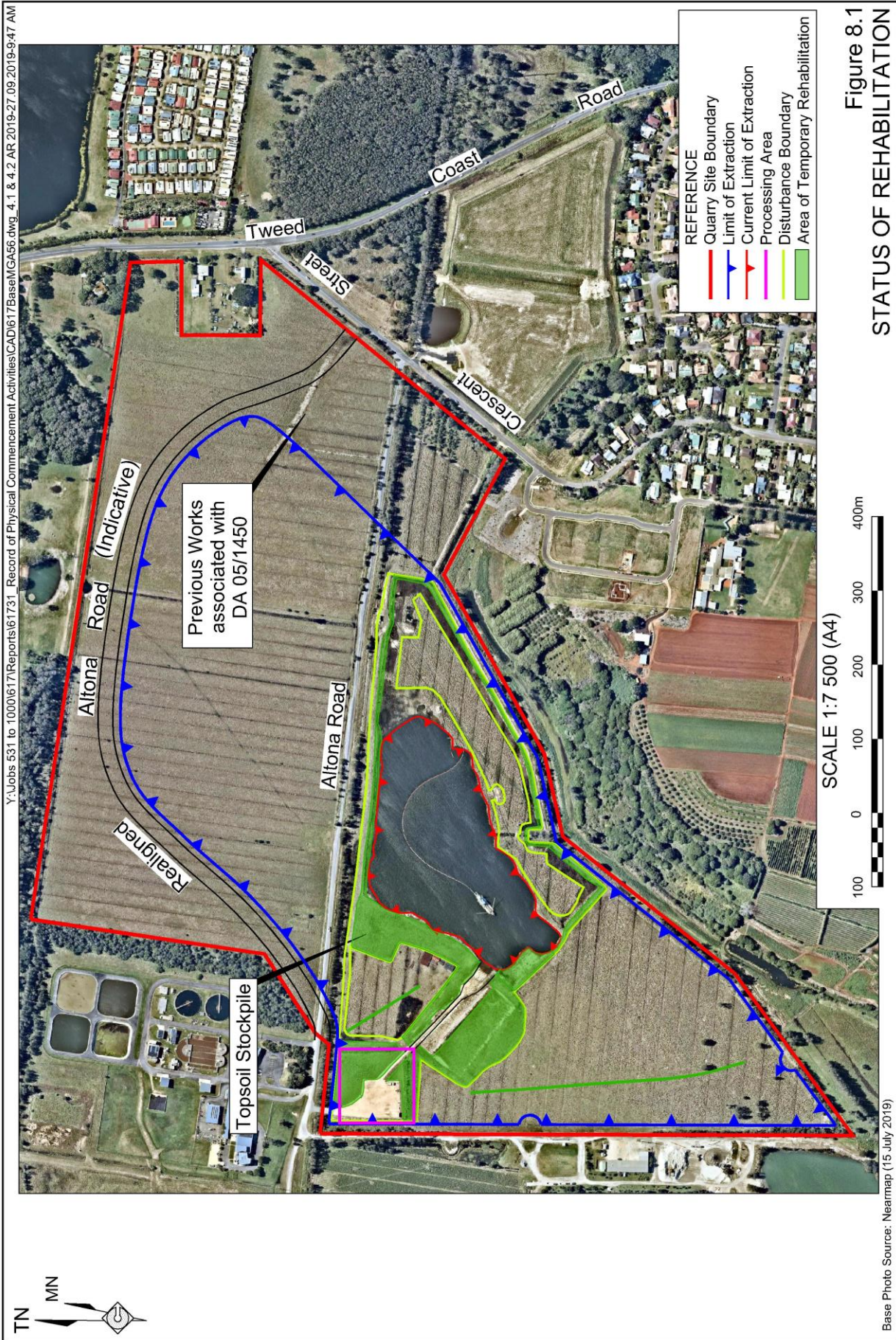
A small area (approximately 0.5ha) of disturbance is also present in relation to the physical commencement of DA 05/1450 for the realignment of Altona Road. No rehabilitation works for this area are planned until following the realignment of Altona Road. As these works are managed under separate approval, these areas are not included in **Table 8.1**.

Maintenance activities mainly consisted of spraying of grass around the plants within the vegetative screens and for landscaping on the processing area bunds. Fence repairs were also undertaken as required to exclude cattle from the vegetative screen.

### 8.2 ACTIONS FOR THE NEXT REPORTING PERIOD

No specific rehabilitation actions or trials are planned during the next reporting period and no areas will become available for final rehabilitation. Further, given that extraction activities during the next reporting period are expected to be confined to the existing extraction area, no additional areas are expected to require temporary rehabilitation.

It is anticipated that rehabilitation activities during the next reporting period would be limited to ongoing maintenance activities.





## 9. COMMUNITY

### 9.1 COMMUNITY COMPLAINTS

No complaints were received during the reporting period and no complaints have been received in previous reporting periods.

### 9.2 COMMUNITY LIAISON

The principal form of formal community consultation relating to the Quarry during the reporting period was via the Community Consultative Committee (CCC). During the reporting period, the CCC consisted of following representatives.

- The CCC Chairperson - Mr John Griffin who was approved as the chairperson by DPE on 8 July 2016.
- Community members – Ms Felicia Cecil and Mr Barrie Green who were approved by DPE on 14 November 2016. Ms Marion Gardner has also previously attended by invitation as a community member from the Cudgen area.
- Company representatives – Dr Stephen Segal of Gales-Kingscliff and Mr Gareth Brown of Neumann Contractors.
- Tweed Shire Council representatives – Ms Denise Galle, Team Leader Development Assessment, Mr Ray Clark, Traffic Engineer, and Mr Mark Longbottom, Environmental Health Officer.

During the reporting period the CCC held one meeting on 28 September 2018. Apologies were received from Ms Galle, Mr Longbottom, and Ms Marion Gardner.

Company representatives provided an overview of activities during the reporting period, principally monitoring and the modification application for PA 05\_0103. An update was also provided on the flood studies being undertaken as part of the broader Gales development activities. No specific issues were raised by CCC members in relation to the Quarry.

Continued CCC meetings will be undertaken at times set by the CCC. Minutes from these meetings will also continue to be placed on the Company website and reported through the respective Annual Review. As no operational activities were undertaken during the reporting period, the CCC Chairperson John Griffin recommended that a status report be distributed to CCC members in lieu of a CCC meeting before the end of 2019. This report will be placed on the Company website.

## **10. INDEPENDENT AUDIT**

No independent audit was undertaken during the reporting period. The first independent audit is required within 2 years of the commencement of quarrying operations. With confirmation from DPIE, it is proposed that the first independent audit be commenced during October 2019 and address the period to 30 June 2019 to coincide with the Annual Review reporting periods.

## 11. INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

### 11.1 REPORTABLE INCIDENTS AND NON-COMPLIANCES

In accordance with *Condition 5(9)* of PA 05\_0103, on 4 March 2019 the Department was notified by email that non-compliance had occurred with the implementation of the SWMP – PA 05\_0103 *Condition 3(18)*. Specifically:

- the frequency of water quality monitoring was not been undertaken in accordance with the SWMP; and
- water quality trigger actions levels were exceeded for Blue-Green Algae.

A follow up incident report was also provided to the Department and copies sent to Council, EPA, and Water NSW. A fully copy of the report is provided in **Appendix 4** and a summary provided as follows.

#### Sampling Frequency

Whilst extensive water quality monitoring was completed during the reporting period in accordance with the approved Soil and Water Management Plan, the following non-compliances were identified with regards to the frequency of water quality monitoring.

- Blue-Green Algae monitoring was not undertaken between 31 May 2018 and 25 October 2018, with four required monthly monitoring events therefore not completed.
- Blue-Green Algae monitoring was undertaken 3 and 17 December 2018, 15 January 2019, 6/7 and 21 February 2019 and 6 March 2019, a total of 6 sample events compared to the 9 monitoring events required between 25 October 2018 and 7 March 2019.
- Groundwater monitoring was not undertaken quarterly at all required monitoring sites with MB12 not monitored in October 2018, and MB13, MB14, CSP3 GW300845, GW300856, GW062045 not monitored in December 2018.

On behalf of the Company, RWC completed an extensive review of the available data, prepared draft summary reports for each round of monitoring and, on 7 February 2019, returned these together with a request for the provision of a range of information and matters to be confirmed by HMC, the consultant undertaking the monitoring. Further information was received from HMC on Monday 25 February 2019 and reviewed by RWC over Friday 1 March 2019 and Monday 4 March 2019 at which point it was definitively confirmed what monitoring had in fact not been completed.

As part of RWC's review of the monitoring data and as an immediate response to the identified non-compliances, the following was undertaken.

1. A single page monitoring summary report was prepared for each round of surface water and groundwater monitoring. The monitoring summary reports provide a clear summary of whether any criteria/objectives have been exceeded and if a trigger action response is required to be activated.

2. These monitoring reports (or updated versions) are now being completed by the monitoring consultant and provided to Gales and RWC within 2 weeks of receipt of the monitoring results from the laboratory.
3. HMC have confirmed that the required monitoring as well as the data review and reporting will be completed within the required timeframes.
4. A monitoring calendar has been prepared by RWC and provided to HMC.

Additionally, RWC, on behalf of the Company, completed a monthly review of monitoring and reporting completed by HMC for a period of 3 months to confirm that monitoring and reporting was undertaken in accordance with the approved Soil and Water Management Plan.

### **Exceedance of Blue-Green Algae Trigger Action Response**

Following the review by RWC (see above), it was identified that monitoring undertaken across two sampling rounds in December 2018 met all factors required to activate the Blue-Green Algae trigger action response were exceeded at monitoring location DP1-4 (location DP1 at a depth of 4 metres).

As a result of the trigger action response the following actions were undertaken.

- Continued monitoring and assessment of the water quality within the dredge pond and correlation of results with data for groundwater quality, climate, and adjacent agricultural activity to determine any causal links.
- Trends were reviewed and groundwater and surface water quality was compared with background monitoring sites and the adjacent Hanson Tweed Sand Quarry dredge pond.
- Consultation was undertaken with the North Coast Regional Algal Coordinating Committee.

The outcomes of the monitoring, review and consultation was as follows.

- It was concluded that elevated nutrients are a key contributing factor and are a feature of the area, likely from historical and ongoing surrounding agricultural activities.
- Blue-Green Algae from the dredge pond was not detected in surrounding groundwater bores indicating that Blue-Green Algae is contained to the dredge pond.
- Short-term removal and control of nutrients is not feasible and ongoing algal blooms will continue during the warmer months.
- Long-term control is most likely to be achieved through establishment of a self-sustaining ecosystem. This will be undertaken progressively as final lake edges are created over the life of the Quarry.
- Ongoing management during operations is principally a workplace health and safety issue with appropriate notification and safety measures to be implemented.

The SWMP was subsequently updated to reflect the revised approach to Blue-Green Algae management and is generally consistent with existing management practices for other operations in the region.

Correspondence from the (then) DPE dated 15 April 2019 confirmed that no further action was planned to be undertaken by the Department at that time. Notwithstanding, as a result of the above the compliance review for this reporting period has recorded non-compliances against PA 05\_0103 *Condition 5(3)* and Statement of Commitment 9.3 (see **Table 1.2**).

In addition to the above reported non-compliance, a non-compliance has also been recorded against PA 05\_0103 Statement of Commitment 12.5, relating to air quality monitoring. As outlined in Section 5, whilst the AQMP has been updated, approval remains pending finalisation of the other management plans. Whilst approval remains pending the finalisation of the other management plans, the comments received from the Department regarding the AQMP do not disagree with the cessation of monitoring during non-operational periods. Therefore, the previously recorded administrative non-compliance technically remains until approval of the updated AQMP which is expected during the next reporting period. No further action is currently required by Gales on this matter.

## 11.2 COMPLIANCE REVIEWS / INSPECTIONS

No additional compliance reviews or inspections were undertaken during the reporting period.

## 12. ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Activities planned to be completed during the next reporting period are outlined in Section 4.3 and planned improvements in environmental management practices in Sections 6 and 7. In summary, the key activities planned for the next reporting period are as follows.

- Potential establishment of processing equipment in the processing area and commencement of road transportation.
- Potential extraction, either by dredge or excavator and haul truck for the production saleable products within the processing area. These products would be transported via road.
- Continued environmental monitoring.
- Continued community consultation, principally through the CCC, to inform the community about Quarry activities.

Key environmental improvements planned during the next reporting period include the implementation of the various updated management plans following their formal approval. It is anticipated that updated monitoring programs outlined in the management plans will rationalise environmental monitoring requirements and the trigger action response plans for the Quarry.