Soil & Water Management Plan

GALES-KINGSCLIFF

PTY LTD
ABN: 75 093 540 080

Soil and Water Management Plan

for the

Cudgen Lakes Sand Quarry

Project Approval No. 05_0103 (MOD2)

Prepared by:

R.W. CORKERY & CO. PTY. LIMITED

In conjunction with:

Australasian Groundwater & Environmental Consultants Pty Ltd

HMC Environmental Consulting Pty Ltd

May 2021

Notes: 1. References to the conditional requirements referred to throughout this report relate to the Project Approval issued on 16 June 2009 and subsequently modified 19 February 2016 (MOD 1) and 22 January 2019 (MOD 2).

2. This document makes reference to a range of government agencies which were in existence at the time of the document's approval. In recognition of the fact that the names of government agencies may change throughout the life of the Cudgen Lakes Sand Quarry, a reference should be made to the prevailing name of the respective agency at the relevant time.

Approved by
The Secretary's nominee, Matthew Sprott,
On 20 July 2021

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Prepared for:

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1. INTRODUCTION

This Soil and Water Management Plan (SWMP) has been prepared by R.W. Corkery & Co. Pty Limited (RWC), in conjunction with Australasian Groundwater and Environmental Consultants Pty Ltd (AGEC) and HMC Environmental Consulting Pty Ltd (HMC), on behalf of Gales-Kingscliff Pty Ltd (Gales) for the Cudgen Lakes Sand Quarry ("the Quarry"). The appointment of RWC, AGEC and HMC to prepare this SWMP was endorsed by the (then) NSW Department of Planning and Environment (DPE) on 31 May 2019.

The SWMP has been prepared in consultation with the Environment Protection Authority (EPA), Water NSW, the Department of Industry (now Natural Resources Access Regulator [NRAR]), and Tweed Shire Council. Additionally, the Water NSW's Coastal Regional Algal Coordinating Committee was consulted and reviewed aspects of the SWMP relating to Blue-Green Algae.

The SWMP is applicable to the operations at the Cudgen Lakes Sand Quarry. The SWMP does not specifically cover potential operations at fill sites which would be managed under separate approvals.

2. STATUTORY REQUIREMENTS

2.1 PROJECT APPROVAL 05_0103

Gales operates the Quarry in accordance with Project Approval (PA) 05_0103 originally granted by the (then) Minister for Planning on 16 June 2009 and last modified (MOD 2) 22 January 2019. Relevant soil and water management-related conditions and commitments in PA 05_0103 are reproduced in **Table 2.1** and **Table 2.2** respectively, with a reference provided to the section(s) of this SWMP where each condition is addressed.

Table 2.1
Project Approval Requirements Relating to Soil and Water Management

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Cond No.	Requirement	Plan Section
3(18)	Within three months of the determination of Modification 2, unless otherwise agreed by the Secretary, the Proponent must prepare a Soil and Water Management Plan for the project in consultation with EPA, Water NSW, NSW, DoI and Council, to the satisfaction of the Secretary. This plan must be prepared by a suitably qualified expert whose appointment has been approved by the Secretary, and include:	1
	(a) a Site Water Balance;	3
	(b) an Erosion and Sediment Control Plan;	4
	(c) a Surface Water Monitoring Program;	7
	(d) a Groundwater Monitoring Program; and	6
	(e) a Blue-green Algae Management Plan.	8
	The Proponent must implement the approved plan as approved from time to time by the Secretary.	Document Control
3(19)	The Site Water Balance must include details of: (a) sources and security of water supply;	3.2
	(b) water use and management on site;	3.3
	(c) any off-site water transfers;	3.3
	(d) reporting procedures; and	9.1, 9.4
	(e) measures to be implemented to minimise clean water use on site.	3.5

Table 2.1 (Cont'd)
Project Approval Requirements Relating to Soil and Water Management

Cond No.	Requirement	Plan Section
3(20)	The Erosion and Sediment Control Plan must:	
	(a) be consistent with the relevant requirements of the Department of Housing's *Managing Urban Stormwater: Soil and Construction Manual*, the NSW Acid Sulfate Soil Advisory Committee's *Acid Sulfate Soil Manual*, and relevant Council codes, or most recent versions of these documents;	4.1, 5.1
	(b) describe construction and operational activities that could cause soil erosion, sedimentation or generation of acid sulfate soils;	4.2, 5.2
	(c) describe the location, function, and capacity of soil and water management and control structures during construction, stabilisation and operational stages;	4.3
	(d) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;	4.3
	(e) define procedures for managing the potential acid sulfate soils on the site;	5.3, 5.4
	(f) define procedures for managing water releases from the site; and	7.8
	(g) define procedures for the maintenance of soil and water management structures on the site during the life of the project.	4.4
3(21)	The Surface Water Monitoring Program must include:	
	(a) a detailed description of the surface water management system;	7.2
	(b) surface water impact assessment criteria;	7.4
	(c) a program to monitor bank and bed stability;	4.4
	(d) a program to monitor and manage pH in the dredge pond;	7.5
	(e) a program to monitor and report on adverse impacts of the project on surface water flows and quality, including any surface water discharges; and	7.7, 7.8
	(f) a protocol for the investigation, notification and mitigation of identified exceedances of the surface water impact assessment criteria.	7.7
3(22)	The Groundwater Monitoring Program must include:	
	(a) detailed baseline data on groundwater levels and quality, based on statistical analysis;	6.2
	(b) groundwater impact assessment criteria;	6.3
	(c) a program to monitor and report on adverse impacts of the project on groundwater flows and quality;	6.4, 6.5
	(d) a program to monitor groundwater level effects on vegetation, and on groundwater supply to adjoining properties; and	6.4
	(e) a protocol for the investigation, notification and mitigation of identified exceedances of the groundwater impact assessment criteria.	6.5
3(23)	The Blue-Green Algae Management Plan must:	
	(a) be consistent with extant guidelines for blue-green algae management including the National Health and Medical Research Council's *Guidelines for Managing Risks in Recreational Water*;	8.2
	(b) describe the measures that would be implemented to prevent and control the sources of algal blooms over the short, medium and long term;	8.5
	(c) include a detailed recovery plan that aims to reduce algae levels to meet the water quality completion criteria in the Rehabilitation Management Plan;	8.5
	(d) include reasonable and feasible measures to reduce nutrient levels in the pond/s over the short, medium and long term, and include interim water quality targets for nutrients based on continual improvement and established water quality objectives for the Tweed River catchment; and	8.5, 8.6
	(e) define procedures for the management and notification of identified algal blooms.	8.8

Table 2.1 (Cont'd)
Project Approval Requirements Relating to Soil and Water Management

Cond No.	Requirement	Plan Section
5(2)	The Proponent must ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:	
	(a) a summary of relevant background or baseline data;	6.2, 7.3, 8.3
	(b) a description of:	
	- the relevant statutory requirements (including any relevant approval, licence or lease conditions);	2
	- any relevant limits or performance measures/criteria; and	6.3, 7.4, 8.4
	- the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	6.3, 7.4, 8.4
	(c) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	6.5, 7.7, 8.8
	(d) a program to monitor and report on the:	
	- impacts and environmental performance of the project; and	9
	- effectiveness of any management measures (see (c) above);	9, 10
	(e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	5.4.4, 6.5, 7.7, 8.8
	(f) a program to investigate and implement ways to improve the environmental performance of the project over time;	9, 10
	(g) a protocol for managing and reporting any:	6.5, 7.7, 8.8, 9.1, 10
	- incidents;	EMS
	- complaints;	11.2, 11.3
	- non-compliances with statutory requirements;	
	(h) a protocol for periodic review of the plan;	10
	(i) a document control table that includes version numbers, dates when the management plan was prepared and reviewed, names and positions of the person/s who prepared and reviewed the management plan, a description of any revisions made and the date of the Secretary's approval.	Document Control
Note:	The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.	

Table 2.2
Statement of Commitments Relating to Soil and Water Management

Desired Outcome	Action	Plan Section
4. Flooding and Drainage		
Minimisation of potential flooding impacts upon the Quarry operations and surrounding land users and property.	4.1 Construct and maintain shallow spillways (approximate elevation 1.3m AHD) within the bunds surrounding the extraction pond at the eastern and western extents of the bunding.	4.3, 7.2
	4.2 Remove sections of bunding once floodwaters have peaked to allow floodwaters trapped behind the bunds to drain freely to the western drainage channel as the flood recedes.	7.8
	4.3 Maintain drainage paths outside of the bunded and filled areas to allow floodwaters to drain freely.	4.3
	4.4 Prepare a flood evacuation plan to ensure that personnel respond appropriately to a warning of an imminent Tweed River overbank flood.	Separate plan prepared
	4.5 Realign the western drainage channel within the Altona Road reserve to provide an equivalent or more efficient drain.	4.3

Table 2.2 (Cont'd)
Statement of Commitments Relating to Soil and Water Management

Desired Outcome	Action	Plan Section
5. Groundwater		
Minimisation of potential groundwater quality or quantity impacts upon surrounding groundwater users (including groundwater-dependent ecosystems).	5.1 Adjust sand extraction rates to ensure that groundwater drawdown levels remain within the predicted limits.	6.5
	5.2 Install a height gauge within the extraction pond so that water levels can be monitored daily to m AHD.	7.5.2
	5.3 Continue groundwater monitoring following the cessation of extraction and placement of VENM.	5.4.3
	5.4 Compile an annual summary of all monitoring results and forward to Water NSW as part of the Annual Review for the Quarry.	9
	5.5 Consult with each likely affected landowner and investigate complaints of poor water quality in neighbouring dams/bores.	6.5
	5.6 Negotiate an agreement with each affected landholder to either: - deepen the existing bore or install a replacement bore; - pay a cash compensation equal to the assessed cost of deepening the bore; - provide an alternative water supply, such as from the extraction ponds or groundwater bore registered to the Proponent; or - provide an appropriately sized rainwater storage tank to enhance property water storage.	6.5
	5.7 Implement the provision of an alternative water supply or other agreed compensation.	6.5
	5.8 Provide copies of any negotiated agreements to the Department of Planning and Environment and Water NSW for their records.	6.5
6. Surface Water		
Prevention of discharge of dirty, acidic or otherwise contaminated water from the Quarry Site.	6.1 Reduce sand extraction and temporarily cease VENM placement if a significant deterioration in extraction pond water quality occurs, until the source is identified and appropriate amelioration measures are implemented.	5.4.2, 7.8
	6.2 Regularly monitor surface water to provide an accurate assessment of the adequacy of practices implemented as part of the operation.	7.5
7. Acid Sulfate Soils and Sediments, Soil Contamination and Agricultural Suitability		
Minimisation of PASS and VENM(b) acidification and adequate treatment and storage of these materials.	7.1 Convey return water (from both the wash plant and fill sites) in a manner which ensures fines / silts remain in suspension and do not settle in the return pipelines or are otherwise flushed from the pipeline. If a pipeline is not used, undertake sluicing in a manner that ensures turbulent flow and sufficient velocity to prevent the deposition of fines material within the drainage line.	5.3
	7.2 Do not extract residual clay material from the base of the sand resource.	5.3.1
	7.3 Ensure a suitably qualified or trained person assesses imported material (VENM) in accordance with the Acid Sulfate Soil Management Plan and confirms its classification as VENM prior to acceptance at the Quarry Site.	5.4.1
	7.4 Place VENM(b) received at the premises which is intended to be dredged or interned at the base of the extraction pond within the nominated period.	5.4.2

Table 2.2 (Cont'd)
Statement of Commitments Relating to Soil and Water Management

Desired Outcome	Action	Plan Section
7. Acid Sulfate Soils and Sediments, Soil Contamination and Agricultural Suitability (Cont'd)		
The level of documentation for managing and reporting matters relating to Potentially Acid Sulfate Soils and Sediments is comprehensive and appropriately maintained.	7.5 Retain records of monitoring together with the application rates of the alkaline amendment used as neutralising agents. Provide these records to statutory authorities upon request.	9.2
	7.6 Obtain documentation for each truck load of VENM(b) received at the Quarry Site that demonstrates that the excavation of VENM(b) and its transport and handling has been conducted in accordance with the Acid Sulfate Soil Management Plan to prevent the generation of acid.	5.4.1
	7.7 Retain documentation for each truck load of VENM(b) received at the site which indicates: - the details of the originating site (name, address, owner and developer, contact details); - the details of the transportee (name, address, contact details, vehicle registration); - date and time of the extraction of the VENM(b); - pH of the VENM(b) at the time of its extraction, and at the time immediately prior to its placement underwater; and - the name of the person (certified practicing soil scientist) who assessed the material and classified it as VENM(b).	5.4.1
	7.8 Ensure verification of neutralising agent application volumes and verification results are available.	9.2
Prevention of any off-site impacts as a result of acidification of acid sulfate material or water.	7.9 Treat any acid sulfate material excavated on site at determined rates prior to use in earthen bunds or for rehabilitation.	5.3
	7.10 Collect and analyse samples of acid sulfate soil material that is to be recovered through excavation (i.e. not dredged) and is not to be washed using a hydrocyclone (or similar).	5.3.2
	7.11 Incorporate an alkaline amendment into the excavated acid sulfate material at the calculated rate (based on the results of sampling).	5.3
	7.12 Complete the validation sampling of treated material in accordance with the approved Acid Sulfate Soil Management Plan.	5.2, 5.3, 5.4
	7.13 Construct bunding around the extraction and processing areas to control drainage.	4.3, 7.2
	7.14 Ensure all surface water and runoff from the extraction and processing area drains or is pumped into the extraction pond.	7.2
Demonstration that adverse impacts arising from Potentially Acid Sulfate Soils and Sediments are not evident on site.	7.15 Audit the effectiveness of the operational safeguards and monitoring by an external environmental consultant.	10
	7.16 Test the pH of the water into which the VENM(b) is placed to ensure it is not less than 6.5 at any time.	5.4.2
	7.17 Undertake monitoring in accordance with the approved Acid Sulfate Soil Management Plan in relation to VENM(b) receipt and processing / internment.	5.4.3
	7.18 Undertake monitoring in accordance with the approved Acid Sulfate Soil Management Plan in relation to VENM(b) receipt and processing / internment.	5.4.3
	7.19 Test the pH of the VENM(b) immediately prior to under-water disposal / backfilling to ensure the pH is not less than 5.5.	5.4.2
	7.20 Undertake internal environmental audits of VENM(b) receipt and treatment during the initial stages of the operation to ensure appropriate treatment is being conducted and records are up to date.	5.4

Table 2.2 (Cont'd)
Statement of Commitments Relating to Soil and Water Management

Desired Outcome	Action	Plan Section
7. Acid Sulfate Soils and Sediments, Soil Contamination and Agricultural Suitability (Cont'd)		
Appropriate procedures are in place to manage any departures from nominated procedures or criteria.	7.21 Complete the following in the event that validation or monitoring criteria are exceeded for any extracted materials. - Test the acid neutralising capacity of the material. - Incorporate alkaline amendments at the appropriate rate if the measured acid neutralising capacity is insufficient to neutralise the existing and potential acidity. - Undertake validation testing following treatment and apply additional alkaline amendments as required. Repeat process until compliance with action criteria is met.	5.3.2, 5.3.3
Appropriate procedures are in place to manage any departures from nominated procedures or criteria.	7.22 Terminate VENM(b) receipt at the premises if the pH of the water falls below accepted levels until approval to continue is received in writing from the EPA.	5.4.2
	7.23 Complete the following in the event monitoring criteria are exceeded for imported VENM(b). - Test the acid neutralising capacity of the material. - Incorporate alkaline amendments at the appropriate rate if the measured acid neutralising capacity is insufficient to neutralise the existing and potential acidity. - Undertake validation testing following treatment and apply additional alkaline amendments as required. Repeat process until compliance with action criteria is met.	5.4.4
	7.24 Undertake the following as soon as possible after becoming aware that any waste/material accepted at the premises is not VENM. - Notify the EPA in writing. - Remove the material/waste from the premises and dispose of it at a facility licensed to take such waste, or otherwise as directed by the EPA.	5.4.4
	7.25 Implement a procedure to audit all further incoming loads from that waste origin site prior to accepting any further waste, until such time as the results of such audits demonstrate that the waste origin site's screening and assessment procedures have been corrected to prevent further miss-classification of waste.	5.4.4
	7.26 Introduce hydrated lime at the appropriate rate if the extraction pond water quality fails accepted levels and ensure target pH level of 6.5 is not "overshot" leading to severely alkaline conditions (pH>9.0).	5.4.4
9. Aquatic Ecology		
Minimisation of short and long term impacts on aquatic ecology within and surrounding the Quarry Site.	9.1 During the realignment of the western drainage channel as part of the realignment of Altona Road, unless otherwise specified in approval conditions, - maintain the original connection to other upstream and downstream drainage channels; - avoid stranding native fish and, where possible, relocate them to similar habitat; - ensure fish free passage through the channel is made available where permanent crossings are to be constructed (e.g. access road crossings); and - consult with DPI - Fisheries officers during the realignment process.	4.3
	9.2 Create wetlands along finalised sections of the extraction pond in accordance with the approved Landscape Management Plan.	8.5
	9.3 Undertake frequent and regular monitoring of temperature, dissolved oxygen, nutrients, colour and concentrations of blue-green algae.	8.6
	9.4 Obtain samples and readings from the dredge pond in accordance with the approved Blue Green Algae Management Plan.	8.6

2.2 OTHER APPROVALS, LEASES AND LICENCES

Other approvals, leases, and licences for the Quarry which contain conditions or criteria relevant to soil and water management are listed in **Table 2.3**. Conditions associated with EPL 12385 relevant to soil and water management are listed in **Table 2.4**, and conditions associated with the water licencing are listed in **Table 2.5**.

Table 2.3
Other Approvals and Licences Relevant to Soil and Water Management

Licence	Issue Date	Expiry Date	Details / Comments
Environment Protection Licence 12385	18/11/2005 (licence version date 18/01/19)	Not Applicable	Issued by NSW Environment Protection Authority (EPA). Renewed annually.
Water Supply Works Approval 30CA321269	01/07/16	28/02/31	Issued by Water NSW at commencement of *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016* and renewed by NRAR.
Water Access Licence WAL40902	09/11/16	Continuing Tenure	Issued by Water NSW. Includes 700ML water allocation. Nominated works 30CA321269.
Monitoring Bore Licences 30BL2017143 & 30BL2017146	06/08/14	Issued in Perpetuity	Issued by (then) DPI and cover a total of 19 bores within Lot 2 DP216705 and Lot 21 DP1082482.

Table 2.4
EPL 12385 Requirements Relating to Soil and Water Management

Page 1 of 3

Cond No.	Requirement				Plan Section
P1	**Discharges to Air and Water and Applications to Land**				
P1.2	The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.				
	EPA ID No.	Type of Monitoring Point	Type of Discharge Point	Location Description	
	1	Water Quality Monitoring Point	Water Quality Monitoring Point	Dredge Pond South Spillway West	7.8
	2	Water Quality Monitoring Point	Water Quality Monitoring Point	Dredge Pond South Spillway East	
	4	Groundwater Monitoring – MB15	-	Groundwater monitoring bore. Defined as MB15 in Gales-Kingscliff Pty Ltd, Soil and Water management Plan for the Cudgen Lakes Sand Quarry, May 2017 (GKSWMP). Location described in Section 5.2.2 **Figure 5.1**.	
	5	Groundwater Monitoring – MB10	-	Groundwater monitoring bore. Defined as MB10 in Gales-Kingscliff Pty Ltd, Soil and Water Management Plan for the Cudgen lakes Sand Quarry, May 2017 (GKSWMP). Location described in Section 5.2.2 **Figure 5.1**.	6.4.2
	6	Groundwater Monitoring – MB11	-	Groundwater monitoring bore. Defined as MB11 in Gales-Kingscliff Pty Ltd, Soil and Water management plan for the Cudgen Lakes Sand Quarry, May 2017 (GKSWMP). Location described in Section 5.2.2 **Figure 5.1**.	

Table 2.4 (Cont'd)
EPL 12385 Requirements Relating to Soil and Water Management

Cond No.	Requirement	Plan Section
L1	**Pollution of Waters**	
L1.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the *Protection of the Environment Operations Act 1997*.	4, 7.2
L1.2	Exceedance of the quality limits specified in this licence for the discharge of TSS, pH and Oil and Grease from Points 1 or 2 or exceedance of a volume limit for discharges from Points 1 or 2 are permitted if the discharge occurs solely as a result of rainfall at the premises exceeding a total of 82.5 millimetres over any consecutive five day period.	7.8
L1.3	The licensee must take all practical measures to avoid or minimise TSS, pH etc. contained in wet weather discharges.	7.2
L2	**Concentration Limits**	
L2.1	For each monitoring/discharge point or utilisation area specified in the table\s below (by a point number), the concentration of a pollutant discharged at that point, or applied to that area, must not exceed the concentration limits specified for that pollutant in the table.	6.4, 7.5, 8.6
L2.2	Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.	6.4, 7.5, 8.6
L2.3	To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.	6.4, 7.5, 8.6
L2.4	Water and/or Land Concentration Limits. Point 1, 2 **Pollutant** / **Unit of Measure** / **50 Percentile Concentration Limit** / **90 Percentile Concentration Limit** / **3DGM Concentration Limit** / **100 Percentile Concentration Limit** Oil & Grease / Visible / - / - / - / Nil pH / pH / - / - / - / 6.5 – 8.5 TSS / mg/L / - / - / - / 50	6.4, 7.5
L3	**Waste**	
L3.1	The licensee must not cause, permit or allow any waste generated outside the premises to be received at the premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the premises to be disposed of at the premises, except as expressly permitted by the licence.	5.2
L3.2	Virgin Excavated Natural Material (VENM) may be received at the premises for the purpose of land application.	5.2, 5.4
O4	**Processes and Management**	
O4.1	Any pond subject to dredging, or containing turbid water due to recent dredging must be maintained and operated to prevent discharges of any water from these ponds. A vegetated barrier must be used at all times to ensure that the active dredge and fines placement area / pond are isolated from stormwater drainage channels.	4.3, 7.2
O4.2	The licensee must maximise the diversion of run-on waters from lands upslope and around the site whilst land disturbance activities are being undertaken.	4.3, 7.2
O4.3	The licensee must ensure that sampling point(s) for water discharged from the Dredge Pond(s) and Sediment Dam are provided and maintained in an appropriate condition to permit: a) the clear identification of each Dredge Pond and Sediment Dam and discharge point(s); b) the collection of representative samples of the water discharged from the Dredge Pond(s) and Sediment Dam; and c) access to the sampling point(s) at all times by an authorised officer of the EPA.	7.8
O5	**Other Operating Conditions**	
O5.1	The licensee must assess and manage any acid sulfate soil (ASS) and potential acid sulfate soil (PASS) in accordance with the 1998 *Acid Sulfate Soils Manual* published by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC).	5

Table 2.4 (Cont'd)
EPL 12385 Requirements Relating to Soil and Water Management

Cond No.	Requirement	Plan Section
M1	**Monitoring Records**	
M1.1	The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.	9
M1.2	All records required to be kept by this licence must be: a) in a legible form, or in a form that can readily be reduced to a legible form; b) kept for at least 4 years after the monitoring or event to which they relate took place; and c) produced in a legible form to any authorised officer of the EPA who asks to see them.	9
M1.3	The following records must be kept in respect of any samples required to be collected for the purposes of this licence: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) the name of the person who collected the sample.	9
M2	**Requirement to Monitor Concentration of Pollutants Discharged**	
M2.1	For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:	6.4, 7.5
M2.1	Water and/ or Land Monitoring Requirements Point 1, 2 **Pollutant** / **Unit of Measure** / **Frequency** / **Sampling Method** Oil and Grease / Visible / Special Frequency 1 / Visual Inspection pH / pH / Special Frequency 1 / Probe Total Suspended Solids / Milligrams per Litre / Special Frequency 1 / Grab Sample Point 4, 5, 6 **Pollutant** / **Unit of Measure** / **Frequency** / **Sampling Method** Ammonia / Milligrams per Litre / Yearly / Grab Sample Chloride / Milligrams per Litre / Yearly / Grab Sample Electrical Conductivity / Microsiemens per Centimetre / Yearly / Grab Sample Oil and Grease / Milligrams per Litre / Yearly / Grab Sample pH / pH / Yearly / Grab Sample Standing Water Level / Metres (AHD) / Yearly / No Method Specified Sulfate / Milligrams per Litre / Yearly / Grab Sample Total Suspended Solids / Milligrams per Litre / Yearly / Grab Sample	6.4, 7.5
M2.3	Special Frequency 1 means: sampling once <24 hours prior to; and, sampling the discharge daily during, each discharge event arising from rainfall of less than 82.5mm falling in total over a period of up to five days duration.	7.8
M3	**Testing Methods – Concentration Limits**	
M3.1	Subject to any express provision to the contrary in this licence, monitoring for the concentration of a pollutant discharged to waters or applied to a utilisation area must be done in accordance with the Approved Methods Publication unless another method has been approved by the EPA in writing before any tests are conducted.	6.4, 7.5

Table 2.5
Monitoring Bore Licence and Water Supply Works Approval Conditions Relating to Soil and Water Management

Cond No.	Requirement	Plan Section
Monitoring Bore Licences 30BL207143 & 30BL207146		
1	The licensee shall allow NSW Office of Water or any person authorised by it, full and free access to the works, either during or after construction, for the purpose of carrying out inspection or test of the works and its fittings and shall carry out any work or alterations deemed necessary by the Department for the protection and proper maintenance of the works, or the control of the water extracted and for the protection of the quality and the prevention from pollution or contamination of sub-surface water.	11.3
3	The Licensee shall not allow any tailwater/ drainage to discharge into or onto: – any adjoining public or crown road; – any other persons land; – any crown land; – any river, creek or watercourse; – any native vegetation as described under the *Native Vegetation Conservation Act 1997*; – any wetlands of environmental significance.	7.8
5	Water shall not be pumped from the bore authorised by this licence for any purpose other than groundwater monitoring purposes.	3
Water Supply Works Approval 30CA321269		
Water Management Works		
DK0888-00001	Any water supply work authorised by this approval used for the purpose of conveying, diverting or storing water must be constructed or installed to allow free passage of floodwaters flowing into or from a river or lake.	4.3
DS2349-00001	The approval holder must make all reasonable efforts not to allow any used water to discharge, by any means including surface or subsurface drains or pipes, into or onto: – any adjoining public or crown road; – any other person's land; – any Crown land; – any river, creek or watercourse or aquifer.	7.8
DS4771-00001	The works, authorised by this approval, must be operated in such a way that:	
	the drawdown of the natural water levels from operation of the quarry does not result in acidification of the acid sulfate soils surrounding the Cudgen Lakes Sand Quarry,	6.3.1
	by-products from any acid sulfate soils placed in the work do not escape into the groundwater systems surrounding the works, and	5.3
	the quality of the groundwater near the site is not diminished.	6
DS4772-00001	The Northern excavation must not be filled with silts and fines from the sand mining operation.	No Longer Applicable
	The Southern dredge pond excavation must not be filled with silts and fines from the sand mining operation to a final depth that is higher than 8.0m below 0.0 AHD.	5.3.1
DS4773-00001	The silts and fines in the Southern dredge pond excavation must be:	
	covered by at least 4.0m of water at all times during the life of the quarry, and	5.3.1
	enter the excavation at least 3m below the water surface.	
DS4780-00001	The works, authorised by this approval, must be managed in accordance with the Acid Sulfate Soil Management Plan for the Cudgen Lakes Sand Quarry, as approved by Water NSW. A copy of the project plan is held at the Water NSW, Grafton Office.	5

Table 2.5 (Cont'd)
Monitoring Bore Licence and Water Supply Works Approval Conditions Relating to Soil and Water Management

Cond No.	Requirement	Plan Section
Water Supply Works Approval 30CA321269 (Cont'd)		
Monitoring and Recording		
DS4774 -00001	Measurements of surface water and groundwater must be carried out in accordance with sections 6 and 7 of the report: 'Soil and Water Management Plan for the Cudgen Lakes Sand Quarry' dated April 2014. A copy of the report is held in Water NSW, Grafton Office.	6, 7
DS4775 -00001	Groundwater from the work authorised by this approval must be measured once every week for: pH, EC (electrical conductivity), DO (dissolved oxygen), Eh (redox potential) at 0.5m below the surface level.	6.4.5
	If the pH falls below 5.0 then lime should be immediately added to the water in the excavation until the pH increases to approximately pH 7.	5.4.4
	Groundwater must be measured once every three months for pH, EC, DO and Eh at 1m vertical intervals from the surface level down to the base of the authorised works.	6.4.5
	Calibration of the instrument must be carried out before measurements are taken on each date.	7.5.2, 9.1
	All measurements must be recorded, including dates, and copies of the instrument calibrations carried out must be provided to Water NSW once a year together with the Annual Groundwater Management Report.	9
DS4776 -00001	Groundwater levels must be measured and recorded every month in the sand excavation and the monitoring bores.	6.4.5, 7.5.2
	Groundwater flow contours (relative to AHD) must be determined monthly, based on the measurements taken, to show the groundwater flow directions on the site.	6.4.7
	All measurements and flow contours must be included in the Annual Groundwater Management Report.	6.4.7
DS4778 -00001	Monitoring of the works authorised by this approval must be carried out in accordance with the Soil and Water Management Plan for the Cudgen Lakes Sand Quarry (April 2014).	4.4
	If monitoring of the works identifies that:	6.5
	a groundwater mound is found to be forming beneath the work or	
	groundwater around the work has been contaminated, the approval holder must inform Water NSW, Grafton Office, within 14 days of the event being ascertained.	
Reporting		
DS4777 -00001	A qualified consultant must prepare a yearly Groundwater Management Report.	9.4
	A hard copy and electronic copy of the report must be forwarded to Water NSW, Grafton Office, by 1st September each year.	9.4

3. SITE WATER BALANCE

3.1 INTRODUCTION

Schedule 3 Condition 19 of Project Approval 05_0103 requires a water balance which includes details regarding:

a) sources and security of water supply;

b) water use and management on site;

c) any off-site water transfers;

d) reporting procedures (see Section 9); and

e) measures to minimise clean water use on site.

A site water balance was developed by AGE Consultants (2008) as part of the Groundwater Assessment for the Quarry. A summary of the water balance calculations is provided in the following subsection together with details of the water sources, uses, transfers and measures to minimise water use and loss.

3.2 WATER SOURCES AND SUPPLY (INPUTS)

The key water source / supply for the Quarry is the extraction pond, which forms a window into the Quaternary sand aquifer. This aquifer forms part of the Tweed-Brunswick Coastal Sands Groundwater Source as defined by the *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016*, which commenced on 1 July 2016.

The principal inputs to the system are rainfall inputs which can be assessed on weighted monthly averages (see **Table 3.1**) and groundwater inflows from the surrounding sand aquifer. As the extraction pond will be surrounded by bunding to separate 'clean' stormwater runoff from the extraction pond, the catchment for rainfall recharge will effectively only be the area of the extraction pond. Rainfall recharge to the surrounding sand aquifer is expected to be relatively high at between 20% and 35% of annual rainfall.

Table 3.1
Rainfall and Evaporation Averages

	Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Rainfall Condong Stn 058013	1887-1972	220	250	264	148	139	123	94	73	66	88	106	151	1 720
Rainfall Murwillumbah Stn 058158	1972-2004	190	235	224	170	150	88	71	50	39	85	124	159	1 585
Weighted average rainfall	1887-2004	212	246	253	154	142	113	87	67	59	87	111	153	1 683
Evaporation Alstonville Stn 058131	1963-2004	180	141	133	105	84	75	84	109	138	158	165	189	1 560
Pan Factor	-	0.97	0.92	0.96	0.81	0.73	0.66	0.66	0.86	0.73	0.82	0.94	0.96	-
Open Water Body Evaporation	-	174	130	128	85	61	50	55	93	101	130	155	182	1 344
Rainfall minus Evaporation	-	37	116	125	69	81	64	32	-26	-42	-43	-44	-29	339

During dredging it is expected that the sand to water ratio would be approximately 1:3, however, approximately 90% of the water will be returned to the extraction pond via a 'tailwater' pipeline. Rather than being considered an input, the 10% water loss has been accounted as an output from the system.

3.3 WATER USE AND OFF-SITE TRANSFERS (OUTPUTS)

The principal water outputs / losses include the following.

- Evaporation from the extraction pond.
- Water lost through incorporation into products (estimated up to 20ML per year).
- Water pumped from the extraction pond for dust suppression (estimated up to 35ML per year).
- Water pumped from the extraction pond for use in watering rehabilitated/ revegetated areas (approximate estimate of 55ML per year).
- Approximately 10% loss of 'tailwater' from sand hydraulically transferred to fill sites primarily through infiltration into the soil profile prior to pumping of the 'tailwater' back to extraction pond. At maximum production (i.e. 450 000m^3 of sand hydraulically transferred to fill sites), this would equate to 135ML (assuming 1:3 sand to water ratio).

Although not strictly a loss of water, as sand is removed from below the water table, groundwater inflow is required to replace the lost volume of sand. The volume of water required to replace the extracted sand is assumed conservatively to be approximately 0.7m^3 for every 1m^3 of sand replaced (as approximately 0.3m^3 of the volume would be water which drains from the sand as it is removed – i.e. providing for a porosity of 30%). At the maximum production of 650 000m^3 per year this would equate to a total of 455ML/year.

Outputs of water required to aid in on-site rehabilitation / revegetation would principally occur in the later years of operation as terminal sections of 'shoreline' are created within the extraction area. Watering may be required for areas planted back to wetland to maintain their 'muddy' condition when dredging activities lower the water level.

In accordance with the Rehabilitation Management Plan, it is estimated that watering would be required for approximately a 15 week period. Assuming all proposed wetland areas and all fringing revegetated areas require watering within the same year (~10ha), it is approximated that 55ML would be required.

For water licencing purposes, a total annual groundwater allocation of 700ML has been attached to Water Access Licence 40902 which was issued by Water NSW for the Quarry operations (see Section 2.2). It is noted that this volume would not be required during the initial years of operation and may only be required during years of maximum extraction. This volume includes groundwater inflow into the extraction areas to replace the lost volume of sand.

All water required for use in the offices and amenities would be sourced either from rainwater tanks and drinking water supply services or mains water.

3.4 WATER BALANCE

Based on the inputs and outputs, AGE Consultants (2008) completed a numerical model for the extraction pond. The water balance is shown in **Figure 3.1**. The water balance is based upon a maximum production of 450 000m^3 per year for the first 2 years of operations and then 650 000m^3 per year for a further 6 years.

The larger variations in rainfall and evaporation with time reflect the increasing area of the extraction pond and hence increasing volumes of rainfall input and evaporation loss.

Based upon this water balance, the simulated water level of the extraction pond is shown in **Figure 3.2**. The water balance indicates that, under the continuous maximum extraction rate, the water level in the extraction pond would fall to about -1.5m AHD during the early stages of extraction and would gradually recover as extraction progresses and the size of the extraction pond increases. An annual fluctuation in pond levels is also evident over this period due to the wet summer and dry winter seasons. At cessation of sand extraction, the water level in the final lake recovers rapidly and within a 1 year period cycles between 0m AHD and 0.25m AHD, i.e. within background levels.

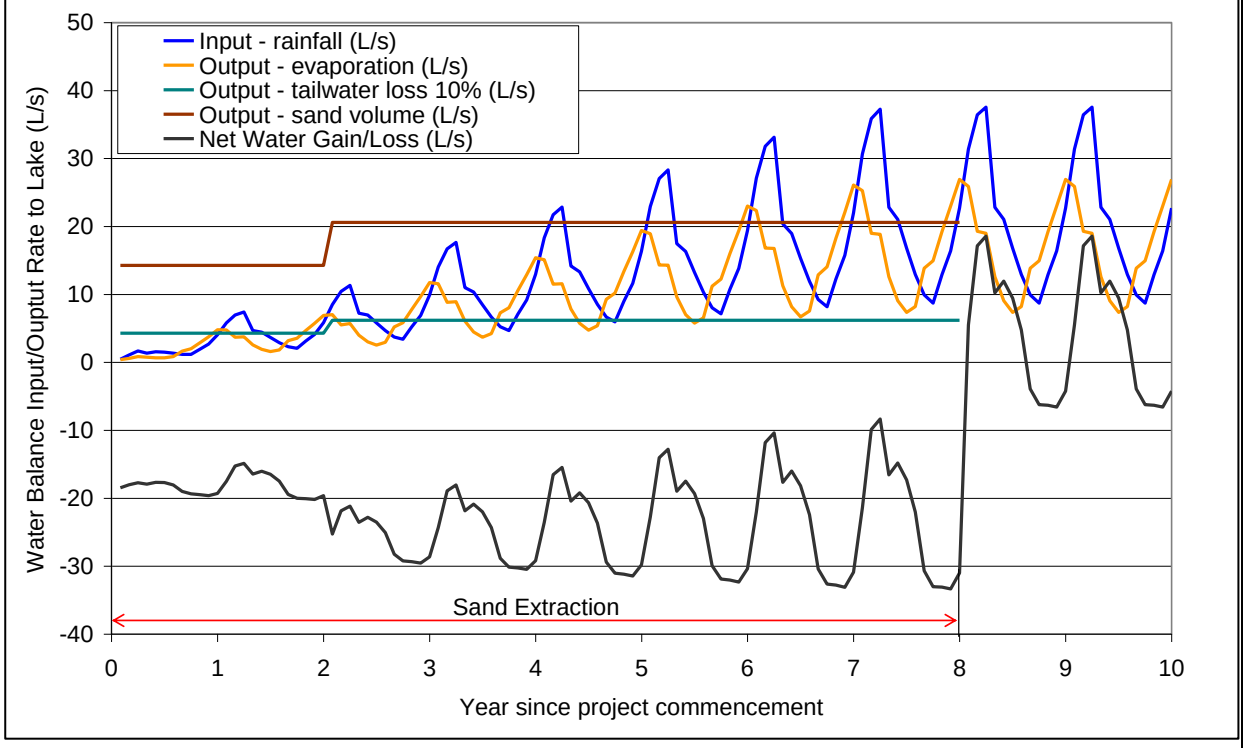

FIGURE 3.1
WATER BALANCE FOR EXTRACTION POND

(Source: AGEC (2008) – Figure 16)

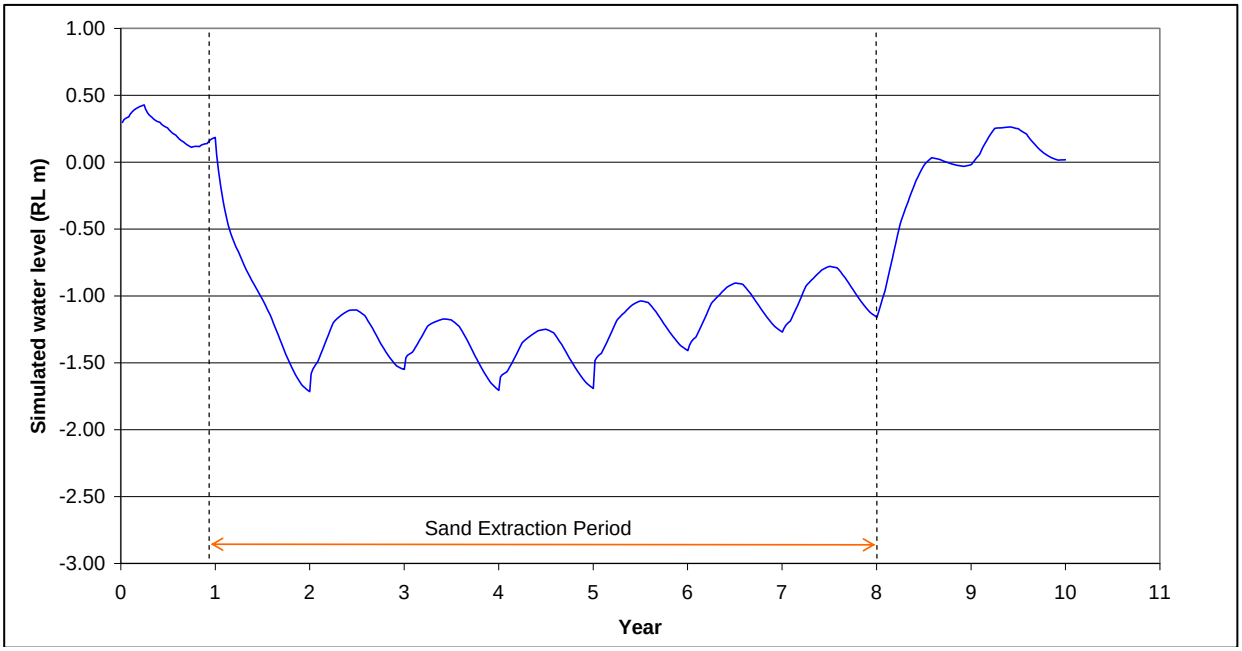

FIGURE 3.2
SIMULATED EXTRACTION POND WATER LEVEL

(Source: AGEC (2008) – Figure 20)

3.5 MEASURES TO REDUCE WATER USE / LOSS

The principal measures to reduce water use or loss will include the following.

- The return of tailwater to the extraction pond as soon as practicable to reduce loss from infiltration at the fill sites.
- Daily inspections of the sand delivery and tailwater return pipelines to ensure no water is leaking from the pipelines.
- Avoidance of unnecessary or excessive use of the water cart.

4. EROSION AND SEDIMENT CONTROL PLAN

4.1 INTRODUCTION

The Erosion and Sediment Control Plan (ESCP) has been prepared to address *Schedule 3 Condition 20* of Project Approval 05_0103B. In accordance with this condition, the ESCP:

a) is consistent with the relevant requirements of *Managing Urban Stormwater: Soils and Construction*, Volume 1, 4th Edition, 2004 (Landcom), and Council's codes including its *Code of Practice for Soil and Water Management on Construction Sites*, Development Design Specification D7 – Stormwater Quality and Tweed Urban Stormwater Quality Management Plan;

b) identifies activities that could cause soil erosion and generate sediment;

c) describes the location, function, and capacity of erosion and sediment control structures;

d) describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters; and

e) describes measures that would be implemented to maintain these structures over time.

The management of acid sulfate soils is described in the Acid Sulfate Soil and Sediment Management Plan (see Section 5) and the management of any water discharges required is outlined within the Surface Water Monitoring Program (see Section 7.8).

4.2 POTENTIAL SOURCES OF EROSION AND SEDIMENTATION

The principal activities which have the potential to cause soil erosion and generate sediment-laden runoff include the following.

- Site establishment and construction activities which will include:
  - earthworks for the processing area comprising soil removal and bund wall construction;
  - soil stripping and construction of bunding surrounding the initial extraction areas; and
  - construction of internal access roads.
- Activities associated with the realignment of Altona Road and the decommissioning of the existing Altona Road.
- Quarrying activities which will include:
  - soil stripping and formation of perimeter bunding surrounding the extraction area;
  - receipt and stockpiling of VENM on-site for processing;
  - backfilling of selected areas of the extraction pond with VENM; and
  - washing of sand and return of fines to the extraction pond from the processing areas and fill sites.

- Rehabilitation activities comprising:
  - site decommissioning including removal of all infrastructure not required for future land uses; and
  - final revegetation and wetland creation.
- Vehicle movements during all stages of the operation.

Note: elevated wind speeds may also result in erosion from any exposed surfaces during all stages of the operation.

4.3 EROSION AND SEDIMENTATION CONTROLS

The following best management practices will be implemented to reduce potential erosion and sediment generation. Erosion and sedimentation controls will be implemented for the site establishment and construction activities, and during quarrying and rehabilitation phases to mitigate potential impacts. Standard erosion and sediment control techniques will be used in accordance with the requirements of *Managing Urban Stormwater: Soils and Construction*, volume 1, 4th edition, (Landcom, 2004) and Tweed Shire Council's *Development Design Specification D7 Stormwater Quality*.

It should be noted that no mention of special considerations for site water courses has been made because, other than the constructed drainage channels north and south of the Quarry Site and adjacent Altona Road, no watercourses exist within or adjacent to the Quarry Site. The drainage channel adjacent Altona Road will be realigned during the realignment of Altona Road and will be constructed in accordance with Development Approval DA 05/1450. Therefore, specific controls relating to the construction of the realigned drain have not been included as part of this plan. Additionally, given the almost flat topography of the Quarry Site (ranging from approximately 0.8m AHD to 1.2m AHD) there is no need for upslope diversion banks and downstream sediment catchment and retention structures. However, if required, temporary silt fences will be utilised to prevent potential sediment laden runoff off site until disturbed areas have been stabilised.

Measures to minimise erosion and the generation of sediment will include the following.

- Clearly defining areas of disturbance and minimising any disturbance outside these areas.
- Stabilisation of areas not required for ongoing operations as soon as practicable.
- Construction of concrete culverts within the table drain adjacent Altona Road for each site access road / entrance and stabilisation with geotextile liners and / or rock armouring up and down flow of the culvert.
- Construction of bunding surrounding the extraction areas to a height of 1.8m AHD (approx. 1m high) to separate clean water runoff from the extraction ponds. The bunds will have slopes no steeper than 1:1 V:H.

- Provision of spillways ~50m long within the eastern and western section of the bunding surrounding the extraction ponds at a height of 1.3m AHD (approx. 0.5m high) to allow controlled overtopping of the bunds in the event of a flood.
- Ensuring VENM stockpiled for processing and backfilling activities is located within either the processing area or bunded area of the extraction pond.
- Installation of rock armouring around selected edges of the final extraction pond in the event that the area cannot be stabilised utilising vegetation.

4.4 MONITORING AND INSPECTIONS

Monitoring and inspections of the site will include:

- monitoring of water quality in accordance with the Surface Water Monitoring Program (see Section 7);
- regular inspections (monthly or following rainfall greater than 25mm / day resulting in runoff1) of all erosion and sediment controls, the banks of the extraction pond and any rehabilitated areas; and
- regular (monthly or following rainfall greater than 25mm / day resulting in runoff[1]) inspections of access tracks / unsealed roads to ensure that drainage is effective and that the tracks / unsealed roads are stable.

If maintenance is required or the type and / or location of erosion and sediment control strategies are identified during inspections as being ineffective, appropriate action will nominally be completed within 48 hours after the inspection. Maintenance may include grading of access tracks and addition of erosion protection e.g. mulch, seeding with suitable vegetation (terrestrial or aquatic) or rock armouring / stabilisation. Suitable vegetation species are outlined within the Rehabilitation Management Plan.

[1] During non-operational periods, following stabilisation of any earthworks, inspections would be undertaken on a quarterly basis.

5. ACID SULFATE SOIL AND SEDIMENT MANAGEMENT PLAN

5.1 INTRODUCTION

Schedule 3 Condition 20 of Project Approval 05_0103B requires that the Erosion and Sediment Control Plan:

a) is consistent with the NSW Acid Sulfate Soil Advisory Committee's *Acid Sulfate Soil Manual;*

b) identifies activities that could cause the generation of acid sulfate soils; and

c) describes procedures for managing potential acid sulfate soils on the site.

These matters have been addressed as part of a separate and specific Acid Sulfate Soil and Sediment Management Plan (ASSMP). The ASSMP also addresses the requirements of Water Supply Works Approval 30CA321269 (see Section 2.2).

5.2 ACTIVITIES REQUIRING MANAGEMENT

During operations, the following three types of activities will be undertaken which require the management of acid sulfate soils and sediments (ASS) or potentially acid sulfate soils and sediments (PASS).

- Extraction (through excavation and dredging) and processing of construction materials.
- Extraction of fill sand and hydraulic pumping to remote fill sites via the pipeline corridors.

  Includes hydraulically pumping sand to the fill sites via pipelines and pumping the silt-laden tailwater back to the extraction ponds via a separate tailwater pipeline.
- Receipt of VENM

  Two types of VENM will be accepted on site, namely.

  – VENM(a) – natural excavated material that does not contain any ASS or PASS.

  – VENM(b) – natural excavated materials that contain ASS or PASS.

  The receipt of VENM(a) will require appropriate validation and verification protocols to ensure that it does not contain ASS or PASS. Any material received as VENM(b) or verified as containing ASS or PASS will require specific management. VENM(b) materials will not be accepted to the Quarry until the required variations to EPL 12385 have been received and, if required, a specific Resource Recovery Exemption.

5.3 MANAGEMENT OF EXTRACTION AND PROCESSING OPERATIONS

5.3.1 Management Procedures

In order to minimise the potential for oxidation of PASS material, the following management procedures will be implemented.

Topsoil Stripping

Testing of topsoil material (from 0m to 0.25m depth) is not required. As the sandy topsoil remains above the water table and the associated reducing conditions, no potential acid sulfate soil is expected to be encountered within the topsoil material. This is supported by previous testing which demonstrated that the soil has extremely limited potential for acidification as a result of the oxidation of reduced inorganic sulfur, with all samples recording chromium reducible sulfur content (Scr) of 0.01% or less, except for one sample which recorded a Scr of 0.02%.

Loamy Sand Extraction

Loamy material between 0.25m and 1.0m depth may be targeted for production of brickies loam which requires recovery using an excavator rather than dredging and is not washed. As the silts and fines are not hydraulically separated through the dredging process, the following measures will be implemented.

- Collection and analysis of samples at a rate of four samples per hectare prior to excavation of loam (see **Table 5.1**).
- Incorporation of alkaline amendment[2] into the loam at the calculated rate (based on the results of sampling) either prior to excavation or within 48 hours following excavation.
- Completion of validation sampling of treated material at a rate of 1 sample per 1 000m^3 prior to sale or final placement.

Hydraulic Sand Extraction, Processing and Return of Fines from Fill Sites

- Ensuring that all surface water from dredging and placement of sand within the extraction and processing areas drains or is pumped into the extraction ponds.
- Pumping of return water from fill sites in a manner which ensures fines / silts remain in suspension and do not settle in the return pipelines.
- If a pipeline is not used, undertake sluicing in a manner that ensures turbulent flow and sufficient velocity to prevent the deposition of fines material within the drainage line.

[2] Alkaline amendments may include hydrated lime or aglime (with a purity preferably >90% and at least 85% by weight passing 1mm and 100% passing 2.5mm). Dolomitic aglime or magnesium blend aglime should not be used.

- Returning all separated fines to the extraction pond for final placement with the return outlet located at a minimum 3m below the water surface within the extraction pond.

- Settlement of silts / fines typically 8m below the surface of the extraction pond.

  Note: Written acceptance from DPIE and Water NSW would be required to reduce this to a more typical 4m below the surface.

- No extraction of residual clay material from the base of the extraction ponds.

5.3.2 Acid Sulfate Soil Testing

Testing of loamy material which is to be excavated will be undertaken as described in **Table 5.1**.

Table 5.1
Acid Sulfate Soil and Sediment Testing – Loam Material

Material	Period	Frequency	Tests	Action criteria
Excavated and unwashed loamy sand	Prior to extraction	4 samples/ha	S_{CR}	>0.03% S_{CR}
	Post treatment validation	1 sample/1000m^3	Total Actual Acidity	OR
			Acid Neutralising Capacity	Positive Net Acidity
			Net Acidity	

These testing procedures have been reviewed after 3 months of dredging operations and will continue to be reviewed annually to ensure only meaningful data is being collected. Should the review confirm a consistent conservative alkaline amendment application rate is applicable for the loamy unwashed sand, and / or sufficient intrinsic buffering capacity exists with no alkaline amendments being required, the sampling frequency may be reduced and / or ceased (through an approved revision of this SWMP).

5.3.3 Response Measures

In the event that validation testing criteria are exceeded, the following corrective actions will be implemented.

- If the measured Acid Neutralising Capacity is insufficient to neutralise the existing and potential acidity (i.e. the net acidity is positive), further alkaline amendments will be incorporated at the appropriate rate to completely neutralise the potential acidity.
- Following the additional treatment, further validation testing will be undertaken and additional alkaline amendments applied if required. This process will be repeated until the action criteria are no longer exceeded.

5.4 MANAGEMENT OF IMPORTED VENM

5.4.1 Verification Procedures

Prior to acceptance of any VENM on site, the following verification procedure will be followed.

1. Prior to agreeing to accept VENM, information about the waste will be collected and recorded including:
   - the location of the site from which the waste originates (the Waste Origin Site), including the street address;
   - a short general description of the Waste Origin Site and any improvements on the site;
   - a brief history of activities at the site with particular reference to the commercial or industrial activities which may have resulted in the site becoming chemically contaminated;
   - whether the Waste Origin Site has been the subject of contaminated site investigations and, if so, a summary of the findings of the investigations will need to be provided;
   - a brief description of the physical nature of the material(s) proposed to be transported from the Waste Origin Site to the premises;
   - sufficient other background information or analysis data to validate that the material has been properly classified as VENM; and
   - an estimate of the total amount of VENM proposed to be received from the Waste Origin Site where such amounts are greater than 100 tonnes.
2. All loads of VENM are to initially report to the processing area. Review of validation papers and verification of the load will be undertaken by a suitably qualified or trained person at the time of acceptance to provide reasonable assurance that the material is from the Waste Origin Site and has been properly identified in Step 1 and transported in accordance with the NSW ASS Manual.
3. Information to be obtained and recorded will include:
   - the date and time of entry of the transporting vehicle;
   - a description of the type(s) of VENM in the load;
   - the weight of each load;
   - the identification details of the source of the VENM (the VENM supplier) and site of origin;
   - the details of the transporting vehicle including its registration number and driver; and
   - identification details of the company / individual which has employed or contracted the driver to transport VENM to the premises.
4. Material identified not to be VENM will not be accepted.

5. A program of inspection and audit of deliveries will be undertaken to evaluate the overall effectiveness of Steps 1 and 2 and which:

   – provides confidence that waste being transported to the premises from a Waste Origin Site has been properly classified as VENM;

   – segregates, in a defined area, any load of waste which is the subject of inspection and / or sampling until such time as the results of the inspection and / or sampling are known; and

   – segregates material which is found to be improperly classified as VENM in a discrete, defined area for off-site disposal.

5.4.2 VENM(b) Management Procedures

The following management procedures will be implemented for the management of VENM(b).

- Placement of VENM(b), to be dredged or interned, at or near the base of the extraction pond within 24 hours of the time of its excavation at the originating site.
- Testing of the pH of the VENM(b) immediately prior to under-water disposal / backfilling to ensure the pH is not less than 5.5.
- Testing of the pH of the water into which the VENM(b) is placed to ensure the 90th percentile value is not less than 6.5 and no result is <5.0 (see Section 5.4.3).
- Termination of VENM(b) receipt at the premises if the 90th percentile pH value of the water falls below 6.5 or if any two consecutive results are less than 5.0, until approval to continue is received in writing from the EPA.

5.4.3 Monitoring

Monitoring as outlined in **Table 5.2** would be undertaken in relation to VENM(b) receipt and processing / internment.

Table 5.2
VENM(b) Testing and Related Monitoring

Monitoring Site	Period	Frequency	Tests	Action criteria
VENM(b)	Ongoing	1 sample from each load immediately prior to placement	pH(1)	<5.5
Extraction Pond Water	During placement of VENM(b)	1 sample/day	pH	90th percentile <6.5 or 2 consecutive results <5.0
	Minimum six months after final placement	1 sample/month	pH	<6.5
Notes: (1) In accordance with NSW Acid Sulfate Soil Manual (Method 21A and/or Method 21Af) or other approved method.				

All monitoring procedures will be reviewed annually as part of the Annual Review process to ensure only meaningful data is being collected.

5.4.4 Response Measures

In the event that the action criteria outlined in **Table 5.2** are exceeded or incorrect acceptance, handling or receipt practices are identified, the following corrective actions will be undertaken.

- Any VENM(b) which has dried out, undergone any oxidation of sulfidic minerals or which has a pH of less than 5.5 must be sampled at the maximum rate of 1 sample / 1 000m^3 to determine the %SCR, total actual acidity, acid neutralising capacity and net acidity. If analysis records SCR >0.03% or positive net acidity, the material is to be treated with the calculated amount of alkaline amendment. Prior to final placement or further processing, verification testing at the rate of 1 sample / 1 000m^3 will be undertaken.
- As soon as possible after becoming aware that any waste / material accepted at the premises is not VENM, the Proponent will:
  a) notify the EPA in writing;
  b) have the material / waste removed from the premises for disposal at a facility licenced to take such waste; and
  c) implement a procedure to audit all further incoming loads from that Waste Origin Site prior to accepting any further waste, until such time as the results of such audits demonstrate that the Waste Origin Site's screening and assessment procedures have been corrected to prevent further mis-classification of waste.
- If the extraction ponds water quality fails accepted background levels, hydrated lime or another suitable alkaline amendment would be introduced at the appropriate rate. Care would be taken to ensure that the target pH level is not "overshot" leading to strongly alkaline conditions (pH>9.5).
- In the unlikely event of a sustained decrease in pH levels in connected water sources which may be the result of ASS, the EPA and Water NSW would also be consulted.
- It is noted that, in accordance with Section 148 of the *Protection of the Environment Operations Act 1997*, in the event of any incident that causes (or may cause) harm to the environment, the Pollution Incident Response Management Plan would be enacted and the EPA and other relevant government agencies would be notified immediately.

6. GROUNDWATER MONITORING PROGRAM

6.1 INTRODUCTION

The Groundwater Monitoring Program (GWMP) has been prepared to address *Schedule 3 Condition 22* of Project Approval 05_0103. In accordance with this condition, the GWMP includes:

- detailed baseline data on groundwater levels and quality, based on statistical analyses (see Section 6.2);
- groundwater impact assessment criteria (see Section 6.3);
- a program to monitor and report on impacts on groundwater flow behaviour (see Section 6.4);
- a program to monitor and report on impacts on groundwater quality (see Section 6.4);
- a program to monitor groundwater level effects on groundwater dependent vegetation, and on groundwater supply to adjoining properties (see Section 6.4); and
- a protocol for the investigation, notification, and mitigation of any identified exceedances of the groundwater impact assessment criteria (see Section 6.5).

6.2 BASELINE GROUNDWATER LEVELS AND QUALITY

6.2.1 Baseline Groundwater Level Data

Standing water level measurements undertaken within the Quarry site between 2002 and 2005 at five monitoring bores (MB1 – MB5) indicate that the water table has a fluctuation range from -0.25m to 0.75m AHD, with a seasonal fluctuation of about ±0.5m and an average level of about 0.25m AHD, as shown in **Figure 6.1**. Note CRD refers to the Cumulative Rainfall Departure, measured in mm, and refers to the cumulative difference between average monthly and actual observed rainfall and was used to assess recharge to an aquifer. It was determined that the rainfall recharge to the sand aquifer is expected to be relatively high at between 20% and 35% of annual rainfall.

The water levels indicate a very slight gradient to the north of the Quarry, in the range 1 in 10 000 to 1 in 20 000.

Groundwater loggers were also installed within five monitoring bores during 2017 in advance of extraction commencing on 30 October 2017. The hydrographs for these bores are shown in **Figure 6.2** together with the daily rainfall. Groundwater levels responded rapidly to high rainfall events such as in March 2017 (ex-tropical cyclone Debbie) and October 2017 which resulted in surface flooding (natural surface levels at the monitoring sites range from approximately 0.8m AHD to 1.0m AHD with a peak recorded water level of 2.4m AHD on 1 April 2017). Gradual declines during low rainfall periods are evident during May 2017 and between mid-June to late September 2017. Given the high rainfall during this period, water levels generally fluctuated between approximately 0m AHD and 1m AHD.

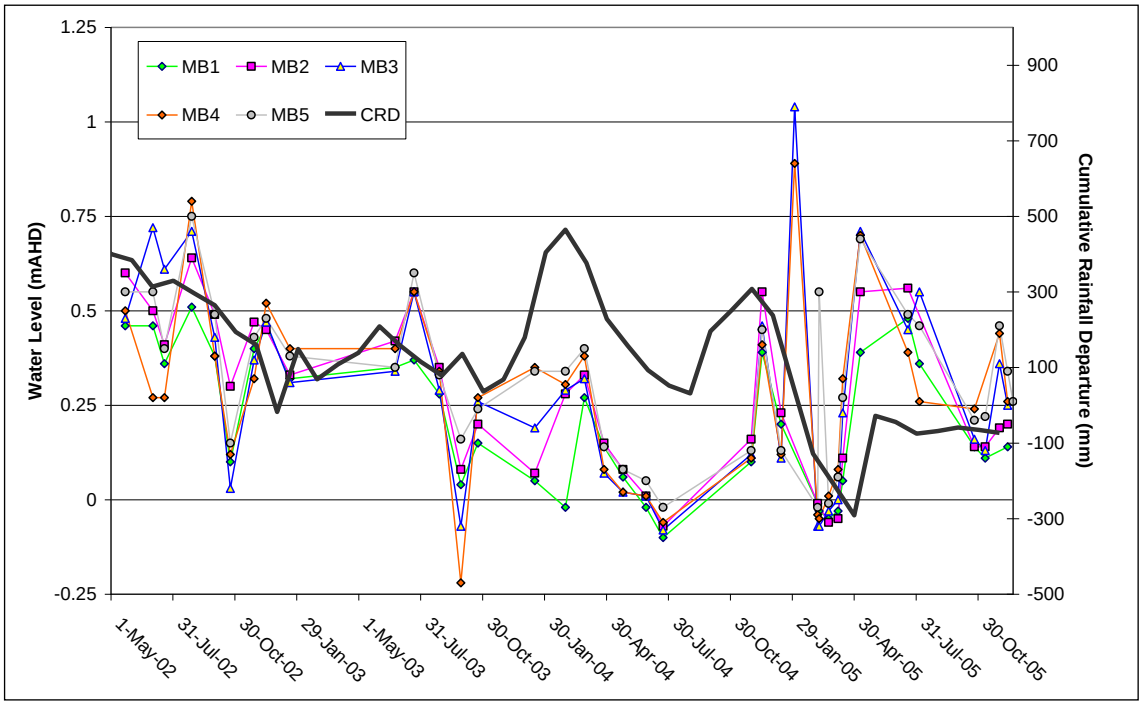

FIGURE 6.1
HYDROGRAPHS MONITORING BORES MB1 TO MB5 AT THE QUARRY

Source: AGEC (2008) – Figure 8

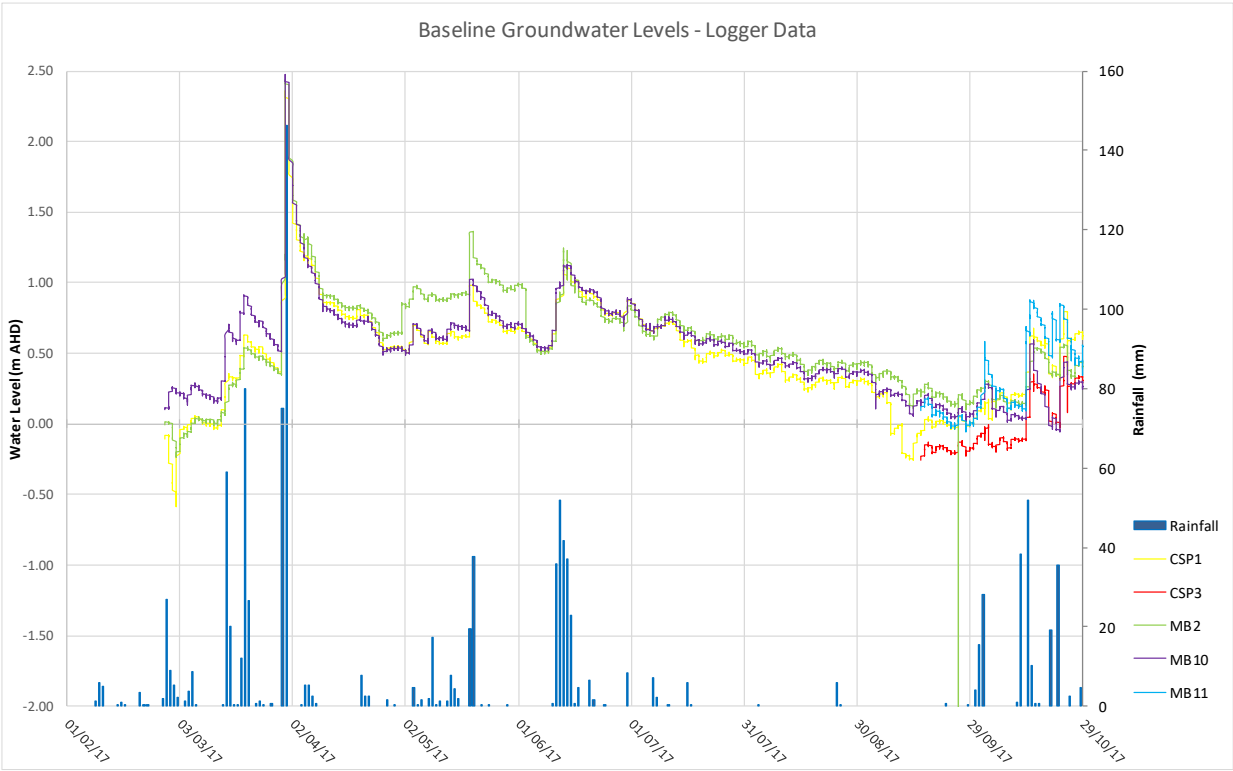

FIGURE 6.2
HYDROGRAPHS OF MONITORING BORES – LOGGER DATA 2017

6.2.2 Baseline Groundwater Quality Data

Significant baseline groundwater quality data is available for the Quarry site with intermittent sampling from a number of bores commencing in 1991. Ongoing sampling has also occurred at selected bores during the first extraction / dredging campaign (between 30 October 2017 and 8 February 2018) and has continued during the ensuing non-operational period. These results are strictly not 'baseline' data but provide useful additional data and have been utilised in the statistical analysis.

The location of the bores is shown in **Figure 6.3** and a summary of the range (minimum and maximum) recorded at each site for pre-extraction (baseline), operational, and 'non-operational periods is presented in **Table 6.1**. As the calculation of the 20th percentile and 80th percentile are recommended for determining derived groundwater quality monitoring trigger values in moderately disturbed systems (ANZECC/ARMCANZ, 2000), **Table 6.2** also provides a summary of these percentiles for all monitoring results recorded to date.

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 monitoring data to date supports this 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. The local drainage network is also tidally influenced and, during dry periods, can locally influence the upper groundwater quality. This is evident from the higher maximum electrical conductivity for shallow monitoring bores located in proximity to local drains compared to other shallow monitoring bores. Elevated levels of major cations and anions have also been recorded and are consistent with the higher salinity levels (being a constituent of salinity).

The pH generally remains near neutral to slightly alkaline with the exception of monitoring bore MB2 on the western Quarry boundary with the Tweed Sand Quarry and the off-site private groundwater bores GW62045 and GW00856 respectively located on the Cudgen Plateau and adjacent Tweed Coast Road (see **Figure 6.4**) which regularly record a pH less than 6.5. The 20th and 80th percentile range for bore MB2 is 5.2 to 6.5 (data recorded between 2002 and 2019) possibly indicating an interaction with acid sulfate soil in the vicinity of the bore. The elevated aluminium and iron levels are also reflective of the low pH.

Nutrient levels (both phosphorus and nitrogen / nitrogen containing species) are consistently elevated across all monitoring locations. 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 have also been 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.

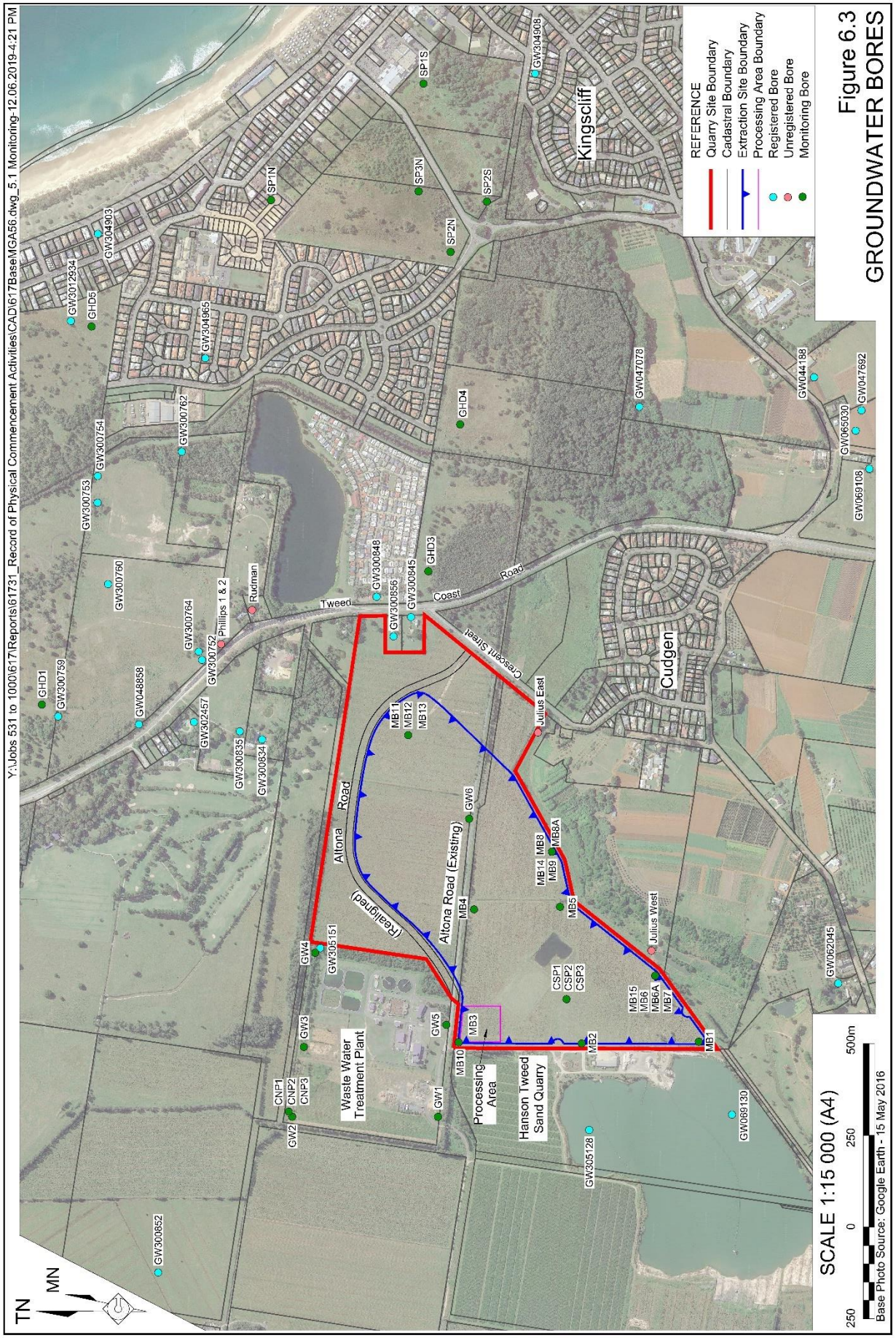
Figure 6.3
GROUNDWATER BORES
REFERENCE
Quarry Site Boundary
Cadastral Boundary
Extraction Site Boundary
Processing Area Boundary
Registered Bore
Unregistered Bore
Monitoring Bore
Kingscliff
Cudgen
Tweed Coast Road
Crescent Street
Julius East
Julius West
Altona Road
Altona Road (Existing)
(Realigned)
Waste Water Treatment Plant
Processing Area
Hanson Tweed Sand Quarry
Phillips 1 & 2
Rudman
SCALE 1:15 000 (A4)
250 0 250 500m
Base Photo Source: Google Earth - 15 May 2016
TN
MN
Y:\Jobs 531 to 1000\617\Reports\61731_Record of Physical Commencement Activities\CAD\617BaseMGA56.dwg_5.1 Monitoring-12.06.2019-4:21 PM

Table 6.1
Summary of Groundwater Quality Data (Measured Range)

Site Location	Bore	Screens (mbns)[1]	Data Type	Physical		Major Cations & Anions							Metals		Nutrients / Bacteria					
				pH	EC (µS/cm)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	SO_4 (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	Fe (mg/L)	Al (mg/L)	Total P (mg/L)	Total N (mg/L)	NOx (mg/L)	Ammonia (mg/L)	Faecal Coliforms	Enterococci
Southern (South of existing Altona Road)	MB1	2.6-5.6	Baseline	6.4-7.8	576-12720	77-193	13-36	23-61	4-6	10-528	35-154	142-292	5.04-12.8	0.01-0.12	0.11-0.46	0.6-0.7	0.01	0.28-0.39	10	10
			Operational[2]	7.0-7.8	526-722	77-107	9-13	27-38	3-4	3-27	24-115	268-320	0.05-8.29	0.01	0.08-0.18	0.6-1.2	0.01-0.22	0.14-0.78	2-10	8-10
			Non-Operational[3]	6.7-7.4	593-841	83-119	8-12	21-37	3-4	3-20	23-41	277-596	0.05-13.6	0.01-0.05	0.11-0.28	0.4-1.2	0.01-0.02	0.29-0.56	10	10
	MB2	2.3-5.3	Baseline	4.6-7.7	88-2394	0-2	0.33-2.5	12-19	4-17	1-27	10-40	6-146	2.26-17	0.42-12	0.07-0.08	0.6-0.8	0.01	0.19-0.29	10	10
			Operational[2]	5.2-5.8	470-749	4-20	2-9	57-119	7-26	51-159	102-182	1-23	16.8-37.4	0.04-0.20	0.03-0.14	0.5-1.5	0.01	0.2-0.77	1-10	1-560
			Non-Operational[3]	5.2-7.2	309-882	5-41	3-8	37-116	6-14	36-134	51-189	1-28	12-33.2	0.11-0.18	0.02-0.06	0.04-1.3	0.01-0.10	0.14-0.58	10-140	10
	MB3[4]	2.8-5.8	Baseline	6.6-7.5	874-3140	15-219	33-60	19-43	6-10	175-259	35-53	165-311	0.24-3.35	0.01-0.11	NA	NA	NA	NA	NA	NA
	MB10	19.0-21.0	Baseline	7.1-8.8	1605-74900	30-233	17-1150	94-7440	24-290	77-2490	194-12828	72-684	0.10-1.90	0.03-0.34	2.71-3.32	152-162	3.38-5.59	136-158	10	20
			Operational[2]	7.8-8.1	1866-10724	30-166	17-675	103-4470	25-152	71-826	199-7150	614-837	0.06-0.18	0.01-0.03	1.75-3.35	64-186	0.01-2.26	0.23-274	1-10	3-39000
			Non-Operational[3]	7.1-7.7	30959-43460	169-272	927-1150	6040-7610	198-254	1670-1910	10500-12300	1090-1170	0.05-0.27	0.05-0.10	0.97-1.24	2.94-36	0.01-0.06	22.8-31.2	10	10-520
	MB4[4]	2.6-5.6	Baseline	6.4-7.4	1056-6930	83-163	38-82	186-449	11-21	46-117	290-650	193-351	2.52-9.44	0.01-0.34	NA	NA	NA	NA	NA	NA
	MB5[4]	2.7-5.7	Baseline	5.8-7.8	171-4850	82-153	36-78	155-285	11-40	185-291	217-328	190-315	0.06-6.43	0.01-0.09	NA	NA	NA	NA	NA	NA
	MB6[4]	10.9-12.4	Baseline	7.6-7.9	4310-6800	89-121	87-126	879-1080	34-52	234-657	1700-4062	177-199	0.65-2.67	0.12-0.23	NA	NA	NA	NA	NA	NA
	MB6A	10.1-11.6	Baseline	7.5-8.0	4040	39-63	23-43	369-508	10-18	175-178	625-941	180-187	0.49-2.74	0.09-3.91	NA	NA	NA	NA	NA	NA
	MB7	14.4-15.9	Baseline	7.6-7.8	15060-15800	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	MB8[4]	15.5-17.0	Baseline	6.40	21070	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	MB8A[4]	9.1-10.6	Baseline	7.3-7.7	5500	52-87	51-87	523-832	23-34	257-340	810-1227	202-223	3.34-6.59	1.2-2.7	NA	NA	NA	NA	NA	NA
	CSP3	3.4-5.4	Baseline	6.3-8.1	300-1007	50-148	5-19	9-83	5-28	5-182	8-1123	135-271	0.59-9.82	0.01-0.26	0.24-0.28	0.6-2.0	0.01	0.28-0.60	10	30
			Operational[2]	7.4-7.5	931-1097	113-123	13-14	72-78	14-19	109-149	108-115	247-272	0.05	0.01	0.25-0.96	0.8-4.7	0.01	0.42-3.28	1-30	1-41000
			Non-Operational[3]	7.2-7.5	1028-1347	160-211	22-27	5-24	14-15	133-235	31-40	342-458	0.05-0.74	0.01-0.05	0.38-0.64	1.6-4.2	0.01-0.02	1.24-4.42	10-370	10-260
	CSP2	7.6-9.6	Baseline	6.8-7.9	350-757	61-251	4-427	12-2570	1-234	7.7-764	13-70	190-250	3-17	0.05-0.2	NA	NA	NA	NA	NA	NA
	CSP1	13.2-15.2	Baseline	6.8-8.0	320-1438	67-321	6-36	12-105	1-312	32-329	13-70	190-250	0.9-3	0.06-0.51	NA	NA	NA	NA	NA	NA
	MB14	4.4-5.9	Operational[2]	6.4-7.7	505-795	33-77	8-29	20-66	2-5	21-94	17-38	98-284	0.05-22.9	0.01-0.05	0.10-0.43	0.20-0.60	0.01-0.02	0.03-0.15	1-10	20-260
			Non-Operational[3]	6.8-7.8	797-2296	56-154	5	80-182	5-8	42-181	102-491	185-218	0.63-6.06	0.01-0.02	0.08-0.27	0.20-1.10	0.01-0.16	0.06-0.12	10	10
	MB15	4.4-5.9	Baseline	7.5-7.6	555-625	25-40	10-14	86-116	6-8	37-48	74-83	208-217	0.13-1.35	0.03-0.52	0.22-0.33	0.30-0.60	0.10	0.12-0.26	10	1900
			Operational[2]	7.5-7.9	614-948	28-41	12-18	68-144	8-14	47-138	60-119	176-217	0.05-0.81	0.01	0.15-0.28	0.20-1.40	0.01-0.05	0.19-0.66	1-10	50-43000
			Non-Operational[3]	3.2-8.4	627-990	41-83	13-17	60-124	8-13	14-91	79-98	186-206	0.05-0.58	0.01-0.05	0.12-0.23	0.20-0.80	0.10-0.22	0.04-0.48	10-490	10-310
Northern (North of existing Altona Road)	CNP3	2.0-4.0	Baseline	6.2-7.3	897-1500	75-123	18-108	58-769	5-5	5.2-313	105-1230	202-214	8-17	0.1-0.48	NA	NA	NA	NA	NA	NA
	CNP2	8.0-10.0	Baseline	6.3-7.5	10200-16700	134-251	316-601	2320-3410	9-51	537-888	4200-5850	353-415	3-25	0.07-0.6	NA	NA	NA	NA	NA	NA
	CNP1	13.0-15.0	Baseline	6.6-7.6	12500-22300	188-344	427-1060	3110-4380	12-85	1050-1560	5100-7500	563-670	3-25	0.15-0.8	NA	NA	NA	NA	NA	NA
	MB11	2.5-3.5	Baseline	6.8-7.6	1056-1743	168-289	45-72	34-220	9.19	328-520	47-311	23-432	0.87-11	0.01-3.13	0.42-0.64	2.8-4.6	0.01	1.48-1.80	10	10
			Operational[2]	7.0-7.6	1130-1365	33-192	8-55	20-41	2-11	21-347	17-50	98-352	0.06-3.58	0.01	0.10-0.31	0.20-2.20	0.02-0.72	0.04-1.66	1-10	1-34000
			Non-Operational[3]	6.9-7.8	1083-1744	43-201	41-54	33-85	9-12	174-387	43-115	320-500	0.08-1.25	0.01-0.05	0.2-1.37	1.30-11.80	0.01-0.59	0.47-9.71	10	20-4200
	MB12	6.7-9.7	Baseline	6.7-7.5	1433-2080	219-433	46-59	39-66	10-13	410-720	54-147	223-329	1.31-20.40	0.10-0.74	0.110	0.06	0.01	0.33-0.34	10	10
			Operational[2]	6.8-7.2	1795-1984	336-373	46-49	42-49	11	686-728	112-138	304-340	0.05-7.65	0.01	0.01-0.05	0.50-0.80	0.02-0.30	0.12-0.38	1-10	5-32000
			Non-Operational[3]	6.9-7.0	1580-2146	324-371	40-43	29-55	10-11	653-771	91-122	290-324	0.05-13.60	0.01-0.05	0.01-0.03	0.40-0.80	0.02-0.46	0.10-0.38	10	10-480
	MB13	17.6-20.6	Baseline	6.4-7.2	2826-38200	533-2350	888-2040	5700-6940	127-240	2110-4000	247-15198	33-534	0.05-19	0.01-0.75	0.27-0.56	0.80-2.90	0.02-0.30	0.14-2.59	10	750
			Operational[2]	6.8	30446-34036	541-629	908-1060	5970-7080	163-189	1540-2300	10900-12000	466-544	0.05-10.2	0.01-0.05	0.16-0.30	2.7-4.5	0.27-0.68	2.3-2.41	1-10	120-36000
			Non-Operational[3]	6.7-7.3	29235-37420	430-595	821-1020	5200-6820	147-186	1860-2270	10500-11400	468-582	0.05-11.70	0.05	0.06-1.00	1.4-4.8	0.01-0.08	1.03-4.49	10	10-780

Notes: 1. Mbns = metres below natural surface. 2. Data during operational period 30 October 2017 to 8 February 2018. 3. Data collected during non-operational period 9 February 2018 to April 2019. 4. Bores damaged / removed and no longer operational

Source: Modified after AGEC (2008). Additional data provided by HMC. NA = Not Available / Not Monitored

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Table 6.2
Groundwater Monitoring – 80th Percentiles of all Data^

		Shallow[1]												Mid-Depth[2]				Deep[3]						Private	
Parameter	**Units**	**MB1**	**MB2**	**MB3**	**MB4**	**MB5**	**MB11**	**MB12**	**MB14**	**MB15**	**CSP2**	**CSP3**	**CNP3**	**MB6**	**MB6A**	**MB8A**	**CNP2**	**MB7**	**MB8**	**MB10**	**MB13**	**CSP1**	**CNP1**	**GW 62045**	**GW 300856**
Screen Depth	mbns	2.6-5.6	2.3-5.3	2.8-5.8	2.6-5.6	2.7-5.7	2.5-3.5	6.7-9.7	4.4-5.9	4.4-5.9	7.6-9.6	3.4-5.4	2.0-4.0	10.9-12.4	10.1-11.6	9.1-10.6	8.0-10.0	14.4-15.9	15.5-17.0	19.0-21.0	17.6-20.6	13.2-15.2	13.0-15.0	ND	ND
pH^	-	6.8-7.2	5.2-6.5	7.0-7.3	7.0-7.3	6.9-7.5	7.2-7.5	6.8-7.2	6.8-7.7	7.3-7.9	6.9-7.2	6.9-7.5	7.2-7.3	7.6-7.8	7.5-7.8	7.3-7.5	7.1-7.4	7.5-7.7	6.2-6.3	7.2-7.7	6.7-7.1	7.2-7.5	7.0-7.3	5.5-6.8	6.1-7.0
EC	uS/cm	1130	710	1180	2612	2132	1553	1975	1043	916	694	977	1414	6128	3208	4750	22142	16490	44934	37344	36384	1071	22142	190	228
Na	mg/L	38	96	35	317	257	58	55	118	116	24	69	206	1027	545	770	3168	ND	ND	7204	6884	33	4044	16	10
Ca	mg/L	136	11	133	101	106	194	373	91	52	119	148	86	104	79	80	193	ND	ND	230	737	226	245	3	4
Mg	mg/L	21	7	38	42	51	54	55	25	17	11	20	22	104	55	80	392	ND	ND	1082	1146	25	615	5	2
K	mg/L	5	17	10	20	22	11	12	7	12	10	16	5	42	22	32	106	ND	ND	249	215	13	141	1	2
Cl	mg/L	70	156	51	586	312	84	132	229	98	54	108	276	1856	921	1144	5501	ND	ND	12811	12600	73	7288	23	21
SO_4	mg/L	238	92	238	94	278	365	722	89	83	36	162	26	526	254	323	875	ND	ND	1878	2276	313	1258	5	6
HCO_3	mg/L	317	17	212	246	246	393	326	213	206	250	342	214	198	177	219	444	ND	ND	1130	545	307	691	16	11
Al	mg/L	0.05	1.67	0.05	0.09	0.07	0.15	0.16	0.01	0.01	0.16	0.12	0.20	0.22	0.11	ID	0.42	ND	ND	0.09	0.20	0.19	0.61	0.28	0.72
As	mg/L	0.001	0.030	ND	ND	ND	0.001	0.001	0.001	0.001	ND	0.001	ND	ND	ND	ND	ND	ND	ND	0.005	0.005	ID	ND	0.007	0.019
Fe	mg/L	12.92	20.92	1.7	5.8	3.4	3.23	13.72	5.14	0.42	14.6	6.35	13.7	2.6	0.5	5.9	22.0	ND	ND	0.39	12.10	4.14	16.0	0.94	5.36
Total P	mg/L	0.19	0.06	ND	ND	ND	0.64	0.11	0.28	0.27	ND	0.82	ND	ND	ND	ND	ND	ND	ND	3.17	0.59	ID	ND	0.094	0.36
Total N	mg/L	1.10	1.00	ND	ND	ND	4.60	0.80	0.46	0.80	ND	4.2	ND	ND	ND	ND	ND	ND	ND	155	4.6	ID	ND	5.92	1.1
Ammonia	mg/L	0.55	0.42	ND	ND	ND	2.75	0.38	0.11	0.48	ND	3.28	ND	ND	ND	ND	ND	ND	ND	150	3.63	ID	ND	0.18	0.21
NOx	mg/L	0.02	0.01	ND	ND	ND	0.33	0.30	0.06	0.030	ND	0.01	ND	ND	ND	ND	ND	ND	ND	1.35	0.46	ID	ND	5.50	0.02
Faecal Coliforms	Cells /100mL	10	36	ND	ND	ND	10	10	10	106	ND	98	ND	ND	ND	ND	ND	ND	ND	10	10	ID	ND	57	10
Enterococci	Cells /100mL	10	440	ND	ND	ND	10160	6784	212	10120	ND	9640	ND	ND	ND	ND	ND	ND	ND	9240	7824	ID	ND	2228	30

^ pH is presented as the 20th percentile to 80th percentile range of all data. ID = Insufficient data to calculate a percentile. ND = No Data mbns = metres below natural surface

Notes:
1. Maximum screened depth <10m.
2. Maximum screened depth 10m to <15m
3. Maximum screened depth 15m and greater.

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As for nutrients, elevated levels of Enterococci have similarly been regularly recorded across most monitoring locations. The presence of both Enterococci and Faecal Coliforms is again reflective of previous and ongoing agricultural practices within the area, particularly cattle grazing and possibly poultry and birds, and are not related to or affected by Quarry operations. As such, these will be managed as a workplace health and safety (WHS) matter and are not further addressed within this SWMP.

6.3 GROUNDWATER ASSESSMENT CRITERIA

6.3.1 Groundwater Levels

Groundwater drawdowns are not to exceed 1.75m in any of the bores / piezometers over a 6-month (or shorter) period. This decrease represents the maximum drawdown predicted for Julius West dam in the early years of operation. Any decrease greater than 1.75m over a 6-month (or shorter) period is considered a 'significant decrease'. Refer to Section 6.5 for trigger action responses.

6.3.2 Groundwater Quality

The original conditions for PA 05_0103 included water quality objectives for the dredge pond and "*groundwater adjacent the dredge pond*". The condition also included the following notes.

- *The objectives for dissolved oxygen, turbidity and algae are relevant to surface water only.*
- *The Department acknowledges that short term exceedances of these objectives may occur during natural events such as heavy rainfall or flooding.*
- *The Department acknowledges that pre-existing water quality may not meet the objectives for some analytes, including salinity. The Proponent shall strive to meet the water quality objectives through implementation of the Soil and Water Management Plan (see condition 19 below), as far as is reasonable and feasible and within the Proponent's control, to the satisfaction of the Secretary.*

The pre-existing water quality is outlined in Section 6.2 and highlights that, for the deeper groundwater bores, the electrical conductivity and major anions and cations regularly exceed those objectives. Additionally, some bore locations have recorded pH consistently below those objectives and concentrations of aluminium and iron above those objectives. Bore MB10 also has consistently elevated ammonia levels. Therefore, the adopted groundwater quality objectives as outlined within **Table 6.3** reflect the original water quality objectives for all bores but also include modified objectives for selected bores and parameters as informed by the 20th and 80th percentiles (as applicable).

It is important to note that, as the modified parameters are based on 20th and 80th percentiles, the probability that a single observation will exceed the upper limit (or lower limit) is 20% of observations. Therefore, exceedances of these objectives will occur from time to time.

Table 6.3
Groundwater Quality Objectives

Parameter	Units	All bores*	MB2^	MB10^	MB13^	GW62045^	GW300856^
pH	-	6.5-8.5	5.2-6.5	-	-	5.5-6.8	6.1-7.0
EC	uS/cm	<3 000	-	37 344	36 384	-	-
Na	mg/L	<500	-	7 204	6 884	-	-
Mg	mg/L	<100	-	1 082	1 146	-	-
K	mg/L	<40	-	249	215	-	-
Cl	mg/L	<1 000	-	12 811	12 600	-	-
SO_4	mg/L	<800	-	1 878	2 276	-	-
HCO_3	mg/L	<400	-	1 130	545	-	-
Al	mg/L	<0.5	1.67	-	-	-	0.72
Fe	mg/L	<20	20.92	-	-	-	-
Ammonia	mg/L	<20	-	150	-	-	-

*Unless value otherwise specified in this table.

^Objectives based on 80th percentile of all previous data except pH which is presented as the 20th to 80th percentile range.

In relation to nutrients, given that the approved Quarry activities themselves will not influence nutrient levels within the surrounding groundwater bores, groundwater quality objectives are not specified. However, ongoing monitoring of nutrients within groundwater will be undertaken to inform of potential impacts from surrounding activities on the water quality within the dredge pond. Further discussion regarding nutrients and Blue-Green Algae is provided as part of the Blue-Green Algae Management Plan (see Section 8).

6.4 MONITORING LOCATIONS, PARAMETERS AND FREQUENCY

6.4.1 Introduction

This sub-section describes the parameters and analytes that would be monitored at selected groundwater monitoring locations at frequencies dependent on the Quarry operational phase. The parameter suite and frequency of monitoring is planned such that the data obtained would provide an indication of the environmental performance of the operational safeguards and mitigation measures adopted by the Quarry. This includes allowing assessment of any impacts upon surrounding groundwater users and groundwater dependent vegetation.

6.4.2 Groundwater Monitoring Locations

A description of the groundwater monitoring locations selected for the GWMP is given below. Note these monitoring locations are shown in **Figure 6.4** and the depths at which the slotted screens are installed in each piezometer are indicated in **Tables 6.1** and **6.2**.

- MB1: located at the southwestern boundary between the extraction area and the neighbouring (Hanson Tweed Sand Quarry) sand dredge pond.
- MB2: located at the central western boundary between the extraction area and the neighbouring (Hanson Tweed Sand Quarry) sand dredge pond.
- MB10: located at the north western boundary between the extraction area and the adjoining Waste Water Treatment Plant.

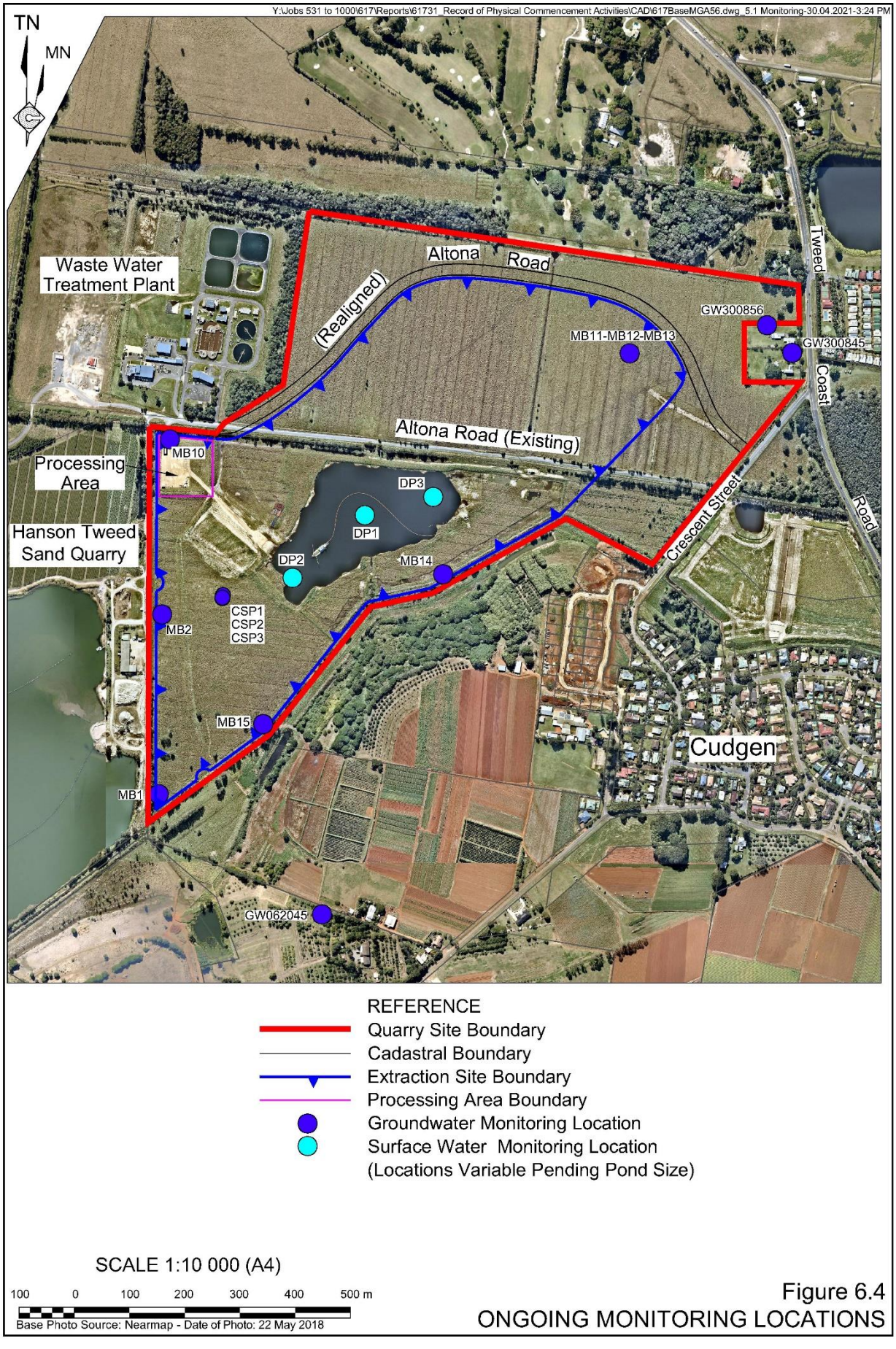

Figure 6.4
ONGOING MONITORING LOCATIONS

- CSP1–CSP2–CSP3: nested monitoring bore located west of the initial dredge pond and south of the existing Altona Road.
- MB11–MB12–MB13: Nested monitoring location within the north-eastern part of the extraction area, north of the existing Altona Road. Noble Lake is located approximately 1km to the northeast.
- MB14 and MB15: Replacement bores for MB8A, MB8, MB9 and MB6A, MB6, MB7 which have been damaged over time. Located on the southern boundary of the extraction area; these locations are closest to the two dams and spear points Julius West and Julius East (see **Figure 6.3**) located within the adjoining property owned by R. Julius to the southeast of the Quarry.
- GW062045 and GW300856: Registered groundwater bores located south and east of the Quarry Site.

As extraction progresses, the selected groundwater bore monitoring locations will be regularly reviewed and, as necessary, additional bores installed to offset those removed as a result of extraction.

6.4.3 Standing Groundwater Levels

Standing water levels will be monitored at all on-site groundwater monitoring locations noted in Section 6.4.2 and reported as elevation in m AHD. It is noted that seven locations will be monitored using loggers providing continuous readings. Standing water levels are not monitored at the two surrounding private groundwater bores due to the landholder's pumping systems making it impractical to measure.

6.4.4 Groundwater Quality Monitoring Suite

The analytes and parameters to be monitored for the groundwater samples collected from the monitoring locations identified in Section 6.4.2 are summarised in **Table 6.4**.

Table 6.4
Groundwater Quality Monitoring Suite

Field Water Quality Tests	• pH • Electrical conductivity (EC) • Temperature (°C) • Oxidation reduction potential (ORP)	
Laboratory Testing and Analysis (NATA-accredited Laboratory)	• Major cations - Sodium - Calcium - Magnesium - Potassium	• Major anions - Chloride - Sulfate - Bicarbonate
	• Metalloids and transition metal ions - Aluminium - Arsenic - Filterable iron	• Nutrients - Total phosphorus - Total nitrogen - Ammonia nitrogen - NOx–nitrogen

6.4.5 Groundwater Sampling Frequency

The sampling frequency for the monitoring parameters and sites during operational periods (when either extraction is occurring or VENM or fines are being placed into the extraction pond[3]) is summarised in **Table 6.5** and for non-operational periods is summarised in **Table 6.6**.

Table 6.5
Groundwater Parameters and Monitoring Frequency – Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
MB1, MB2, MB10, MB14, CSP1.	Continuous.	Water level (m AHD)[1] and temperature.
MB11, MB15.	Continuous.	Water level (m AHD)[1], EC, and temperature.
MB1, MB2, MB10, MB11, MB12, MB13, MB14, MB15, CSP1, CSP3, GW300856, GW062045.	Monthly	Field measurements: Temperature, pH, EC, ORP & water level (m AHD). Laboratory: major cations and anions, filterable iron, aluminium and arsenic.
	Quarterly	Laboratory: Total phosphorus, ammonia nitrogen, NOx nitrogen.
Notes 1: A barometric logger is also in place at CSP2 and is used to calibrate all logger water level readings.		

Table 6.6
Groundwater Parameters and Monitoring Frequency – Non-Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
MB1, MB2, MB10, MB14, CSP1.	Continuous.	Water level (m AHD)[1] and temperature.
MB11, MB15.	Continuous.	Water level (m AHD)[1], EC, and temperature.
MB1, MB2, MB10, MB11, MB12, MB13, MB14, MB15, CSP1, CSP3, GW300856, GW062045.	Quarterly	Field measurements: Temperature, pH, EC, ORP & water level (m AHD).
	Bi-annual (6-monthly)	Laboratory: major cations and anions, filterable iron, aluminium and arsenic, total phosphorus, ammonia nitrogen, NOx nitrogen.
Notes 1: A barometric logger is also in place at CSP2 and is used to calibrate all logger water level readings.		

The location of the seven continuous loggers will be reviewed annually as will the monitoring locations, parameters and frequency.

6.4.6 Additional Monitoring During Use of On-site Makeup Water

If make-up water from a spear-point extraction system is to be utilised during future dredging campaigns additional field monitoring will be undertaken. A spear-point extraction system involves the installation of multiple shallow spear points (uncased pipes driven through the sand into the water table), generally within a row / line. These are approved under the Water Supply Works Approval for placement within the approved extraction area to pump water from those spears into the dredge pond. This effectively provides an internal transfer of water at a

[3] In the event other activities such as product transportation occur without the need for extraction or placement of VENM or fines within the dredge pond, this is still considered a non-operational period for the purposes of groundwater monitoring.

faster rate than would occur via passive hydraulic inflow through the sand aquifer. As the size of the pond increases, the rate of passive hydraulic inflow will increase, removing the need for internal transfer.

The rationale for the additional monitoring is to manage water level drawdown in the vicinity of the spear points given that they will be the point of drawdown rather than the dredge pond. The additional monitoring points would be spear points located:

- at the end of each row / line of spear points and a further spear within 10 metres of each end; and
- at the centre of the row / line of spear points and a further spear on either side within 10 metres of the line.

This additional monitoring will be undertaken for the duration of the use of the spear-point extraction system and involve measurement of water levels and the field parameters as outlined within **Table 6.4**.

6.4.7 Groundwater Level Contour Plans

To assess the effect upon groundwater flow behaviour from activities at the Quarry groundwater flow contours will be generated as part of the annual hydrogeological report prepared in accordance with the requirements of the Water Supply Works Approval. As previously agreed with Water NSW, the groundwater level contours will be interpolated from groundwater levels and generated for months during which dredging occurs or during pumping of water from either the dredge pond or from spears for makeup water. Groundwater level contours will also be generated for the month prior to and following these activities.

6.5 GROUNDWATER RESPONSE MEASURES

A protocol for the investigation, notification, and mitigation of identified exceedances of the impacts on groundwater is presented in **Table 6.7**.

Table 6.7
Groundwater Trigger Action Response Plan

Trigger Level	Alert Level	Action	Response
Groundwater Levels			
Groundwater levels remain consistent with previously recorded and/or predicted levels.	Green	No action required	Nil.
Groundwater level trends indicate a continuing decline in drawdown levels exceeding 1.25m over a 6 month period (or shorter).	Amber	Conduct investigation: Review and assess monitoring results and relevant activities within and surrounding the Quarry.	• Review trends in water levels over time and determine if there is likely a causal link to Quarry-related activities or any other known surrounding activities. • Establish links (if any) between water levels and climatic conditions (e.g. rainfall). • Determine the need for an additional 'non-routine' groundwater logger download and review. • Review water return volumes to the dredge pond to ensure anticipated returns are being achieved. • Determine the need for use of 'make up' water or the need to adjust the dredging rate.
Adjoining property owner reports impact upon their groundwater supply.		Conduct investigation: Download water level logger data and complete review as above. Consult with adjoining property owner and provide copy of monitoring data.	• Compare water level data with the predicted drawdowns. • If water levels within the dredge pond and surrounding bores remain within predicted levels, resolve with the landowner if their water use practices are affecting their supply. • If water levels within the dredge pond remain within predicted and expected levels but water levels are lower than predicted or expected in one or more surrounding bores, review potential for surrounding land uses to be impacting the landholder's groundwater supply. • Assess need for off-site groundwater monitoring and, if recommended, seek landholder's approval. • Notify the landholder of their right to request a dispute resolution (in accordance with the Dispute Resolution Process within the Environmental Management Strategy). • If water levels within the dredge pond and surrounding bores exceed the predicted drawdown levels, proceed to implement Red Alert action and response.
Exceedance of drawdown criteria (see Section 6.3.1) in one or more monitoring locations.	Red	**Report as an incident** and submit formal report to DPIE and relevant agencies in accordance with the incident response process outlined within the Environmental Management Strategy.	• In addition to the responses outlined within the amber alert undertake the following. • If required, reduce the rate of dredging or temporarily cease dredging. • Seek a review of the monitoring data by a suitably qualified consultant. • Determine the need for use of 'make up' water or the need to adjust the ongoing dredging rate. • Review the need to temporarily increase the monitoring frequency. • Update this GWMP as applicable.

Table 6.7 (Cont'd)
Groundwater Trigger Action Response Plan

Trigger Level	Alert Level	Action	Response
Groundwater Quality			
All groundwater analytes within assessment criteria.	Green	No action required	Nil.
Single exceedances of the assessment criteria at one or multiple sample points.	Amber	Conduct investigation: Review and assess monitoring results and relevant activities within and surrounding the Quarry. Report the outcomes of the review as part of the next Annual Review.	• Review data from the monitoring event against previous monitoring data. Confirm if data remains within the range of previous results. • Review any trends in water quality over time and determine if there is likely to be a causal link to Quarry-related activities or any other known surrounding activities. • Establish links (if any) between water quality and climatic conditions (e.g. rainfall). • Establish any potential links with any changes in groundwater levels. • Determine the need for an additional 'non-routine' monitoring event. • Continue to monitor and assess groundwater quality data in accordance with this GWMP.
Two consecutive results for the same monitoring location exceed the assessment criteria.	Red	**Report as an incident*** and submit formal report to DPIE and relevant agencies in accordance with the incident response process outlined within the Environmental Management Strategy.	• In addition to the responses outlined within the amber alert undertake the following. • Seek a review of the monitoring data by a suitably qualified consultant. • Review the need to alter on-site activities or management practices. • Review the need to temporarily increase the monitoring frequency. • Update this GWMP as applicable.

7. SURFACE WATER MONITORING PROGRAM

7.1 INTRODUCTION

The Surface Water Monitoring Program has been prepared to address *Schedule 3 Condition 21* of Project Approval 05_0103B. In accordance with this condition, the Surface Water Monitoring Program includes:

- a detailed description of the surface water management system (Section 7.2);
- surface water impact assessment criteria (see Section 7.3);
- a program to monitor bank and bed stability (refer to Erosion and Sediment Control Plan – see Section 4.4);
- a program to monitor and manage pH in the dredge pond (Sections 7.5);
- a program to monitor and report on impacts on surface water flows and quality, including any surface water discharge (Sections 7.5 and 7.8); and
- a protocol for the investigation, notification and mitigation of identified exceedances of the surface water impact assessment criteria (see Section 7.7).

7.2 SURFACE WATER MANAGEMENT SYSTEM

The erosion and sediment control measures outlined in Section 4.4 are also the principal surface water management measures that will be implemented. In particular, the bunding surrounding the dredge pond provides for separation of clean surface runoff from the disturbed parts of the extraction area and prevents the uncontrolled release of ‘dirty’ water. However, the extraction area will still be subject to flood events. Flood events are provided for by the spillways which allow controlled overtopping of the bunding for flood waters to enter the extraction area. The need for and management of any controlled releases from the extraction area are discussed in Section 7.8.

In addition to the erosion and sediment control measures, all hydrocarbons would be securely stored within either self-bunded containers or a bunded area with impermeable surfaces and capacity to contain 110% of the largest storage tank capacity. This measure equally applies to the protection of groundwater.

Given the nature of the operation, no additional specific measures are currently considered necessary.

7.3 EXISTING MONITORING DATA REVIEW

Regular monitoring of the dredge pond has been undertaken since September 2015, initially at two surface locations and, since September 2017, at three surface locations and multiple depths. Monitoring occurred throughout the initial extraction campaign, commencing 30 October 2017 and concluding 8 February 2018, and has continued during the ensuing non-operational period.

The approximate locations of the sampling points within the dredge pond are shown in **Figure 6.4** and further described in Section 7.5.3. A summary of the range (minimum and maximum) for all recorded parameters is presented in **Table 7.1** whilst **Figures 7.1** and **7.2** graphically present the pH and EC results throughout the period of monitoring.

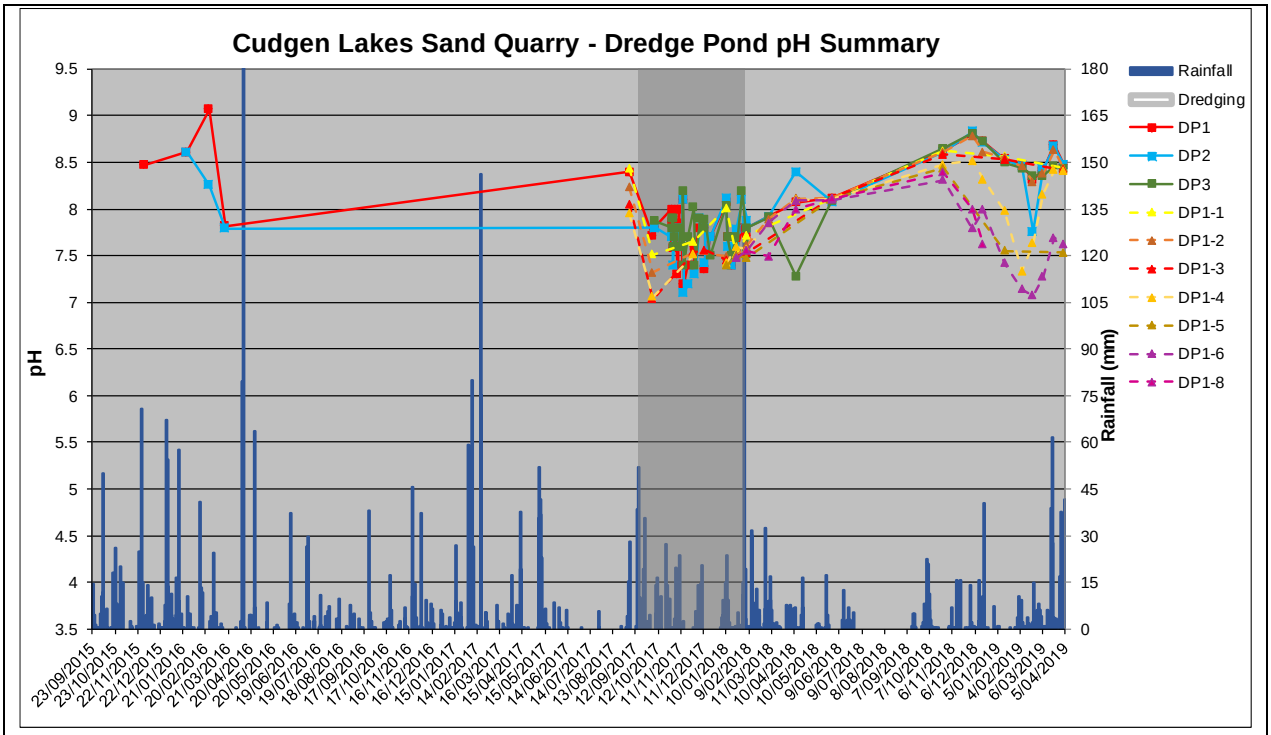

Figure 7.1
Dredge Pond pH Summary

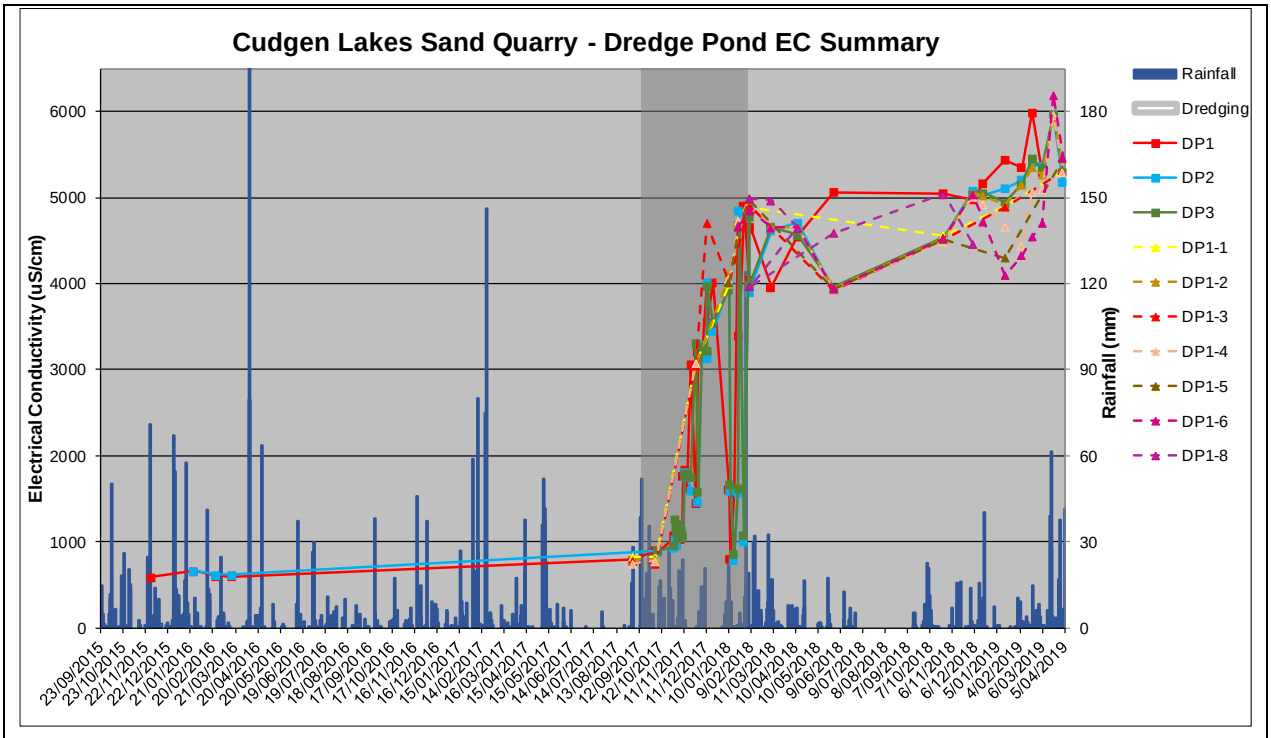

Figure 7.2
Dredge Pond EC Summary

Table 7.1
Summary of Dredge Pond Quality Data (Measured Range)

Location	Depth (m)	Physical			Major Cations & Anions							Metals			Nutrients / Bacteria					
		pH	EC (µS/cm)	Dissolved Oxygen (mg/L)	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 (mg/L)	Al (mg/L)	AS (mg/L)	Fe (mg/L)	Total P (mg/L)	Total N (mg/L)	NOx (mg/L)	Ammonia (mg/L)	Faecal Coliforms (cells/100mL)	Enterococci (cells/100mL)
DP1	Surface	7.2-9.07	591-5995	0.20-9.92	64-813	24-137	11-119	7-27	110-1390	14-364	57-270	0.01-0.19	0.001-0.005	0.01-0.07	0.01-0.15	0.50-1.06	0.01-0.12	0.01-0.32	20-4800	10-2160
DP2	Surface	7.1-8.85	613-5954	0.20-9.70	64-774	25-137	12-119	7-27	110-1380	14-335	94-270	0.01-0.10	0.001-0.005	0.01-0.07	0.01-0.10	0.34-1.40	0.01-0.05	0.01-0.21	60-240	50-1180
DP3	Surface	7.28-8.81	857-5954	0.19-9.71	456-767	96-136	73-115	18-26	845-1390	192-331	137-273	0.01-0.05	0.001-0.005	0.05-0.10	0.01-0.12	0.70-1.50	0.01-0.06	0.01-0.23	50-330	50-1620
DP1-1	1	7.51-8.62	819-5300	NA	98-766	33-153	17-114	7-27	179-1350	39-334	98-263	0.01-0.07	0.001-0.005	0.05-0.06	0.01-0.15	0.40-1.40	0.01-0.03	0.02-0.29	10-480	10-840
DP1-2	2	7.32-8.78	787-5968	NA	96-776	33-146	17-118	7-27	176-1380	44-345	97-270	0.01-0.11	0.001-0.005	0.05-0.10	0.01-0.11	0.40-1.40	0.01-0.05	0.01-0.31	30-450	10-1010
DP1-3	3	7.03-8.58	743-5308	NA	96-745	33-133	17-115	7-25	174-1370	43-330	96-270	0.01-0.05	0.001-0.005	0.05	0.01-0.14	0.50-1.60	0.01-0.09	0.02-0.30	10-400	10-770
DP1-4	4	7.06-8.52	746-5956	NA	90-765	33-146	17-114	6-26	173-1380	43-333	97-264	0.01-0.05	0.001-0.005	0.05-0.19	0.01-1.81	0.40-7.30	0.01-0.04	0.01-0.33	10-290	10-850
DP1-5	5	7.39-8.44	3936-5451	NA	626-742	114-146	95-111	22-26	1120-1370	229-338	180-270	0.01-0.11	0.002-0.005	0.05-0.30	0.01-0.09	0.70-1.40	0.01-0.03	0.03-0.35	10-120	30-150
DP1-6	6	7.07-8.31	3942-6192	NA	605-751	120-148	95-115	22-26	1140-1340	196-344	217-342	0.01-0.05	0.001-0.005	0.05-0.18	0.01-0.08	0.70-2.60	0.01-0.03	0.01-1.43	30-70	20-90
DP1-7	7	7.32-8.40	3971-5385	NA	630-727	127-145	96-110	22-24	1250-1270	240-342	221-326	0.01-0.05	0.002-0.005	0.05-0.16	0.01-0.02	0.70-2.70	0.01-0.03	0.03-1.67	20-60	40-270
DP1-8	8	7.49-8.39	3968-5042	NA	633-677	116-134	93-101	22-23	1120-1330	176-333	221-294	0.01-0.05	0.001-0.005	0.05-0.13	0.01-0.03	0.70-1.50	0.01-0.03	0.01-0.59	10-110	80-170
Minimum*		***7.03***	***591***	***0.19***	***64***	***24***	***11***	***6***	***110***	***14***	***57***	***0.01***	***0.001***	***0.01***	***0.01***	***0.40***	***0.01***	***0.01***	***10***	***10***
20th Percentile*		***7.53***	***1098***	***3.91***	***587***	***107***	***90***	***22***	***1046***	***229***	***161***	***0.01***	***0.001***	***0.05***	***0.01***	***0.80***	***0.01***	***0.02***	***30***	***50***
Median*		***7.82***	***3998***	***5.26***	***664***	***121***	***100***	***23***	***1250***	***293***	***217***	***0.02***	***0.002***	***0.05***	***0.03***	***1.10***	***0.01***	***0.05***	***90***	***100***
80th Percentile*		***8.42***	***4981***	***7.81***	***731***	***131***	***110***	***24***	***1320***	***311***	***260***	***0.04***	***0.002***	***0.05***	***0.06***	***1.40***	***0.02***	***0.16***	***190***	***270***
Maximum*		***9.07***	***6192***	***9.92***	***813***	***153***	***119***	***27***	***1390***	***364***	***342***	***0.19***	***0.005***	***0.30***	***1.81***	***7.30***	***0.12***	***1.67***	***4800***	***2160***

*Of all results for all locations/depths excluding dissolved oxygen which applies to surface samples only.

NA = Not applicable

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As the dredge pond is effectively a 'window' into the Quaternary sand aquifer, water quality within the dredge pond is largely a reflection of the groundwater but influenced by the mixing action of dredging. As discussed in Section 6.2.2, water within the Quaternary sand aquifer is essentially fresh in the upper 5m to 10m and becoming saline at depth with increasing salinity within the water profile towards the Tweed River. Elevated levels of major cations and anions have also been recorded and are consistent with the higher salinity levels (being a constituent of salinity).

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. It is noted that the further increase in EC within the dredge pond during 2019 (approximately 11 months following cessation of extraction) corresponds with increases in EC within both surrounding shallow and, in particular, deep groundwater monitoring bores and appears to be a result of natural fluctuation. As extraction continues, the EC within the dredge pond may 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. On a number of occasions the pond has recorded pH values >8.5 with a maximum recorded pH of 9.07. Levels above pH 8.5 generally occur in surface samples during summer and are likely the result of algal activity.

As for the groundwater, nutrient levels (both phosphorus and particularly nitrogen / nitrogen containing species) are consistently elevated. This is reflective of past and current agricultural activities both within and surrounding the Quarry both on the floodplain and the Cudgen Plateau. Similarly, elevated levels of Enterococci have regularly been recorded. As for groundwater, the presence of both Enterococci and Faecal Coliforms 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 and are not related to or affected by Quarry operations. As such, these will be managed as a WHS matter and are not further addressed within this SWMP.

7.4 SURFACE WATER ASSESSMENT CRITERIA

As discussed in Section 6.3.2, the original conditions for PA 05_0103 included water quality objectives for the dredge pond and "*groundwater adjacent the dredge pond*". The condition also included the following notes.

- *The objectives for dissolved oxygen, turbidity and algae are relevant to surface water only.*
- *The Department acknowledges that short term exceedances of these objectives may occur during natural events such as heavy rainfall or flooding.*
- *The Department acknowledges that pre-existing water quality may not meet the objectives for some analytes, including salinity. The Proponent shall strive to meet the water quality objectives through implementation of the Soil and Water Management Plan (see condition 19 below), as far as is reasonable and feasible and within the Proponent's control, to the satisfaction of the Secretary.*

The water quality recorded to date within the dredge pond is outlined in Section 7.3. As for the groundwater quality monitoring, the electrical conductivity and some of the major anions and cations (sodium, magnesium and chloride) regularly exceed the previous quality objectives. However, in contrast to some of the surrounding groundwater bores, the recorded pH within the dredge pond has exceeded the upper pH limit.

It is noted that the most recent monitoring results have regularly exceeded the 80th percentile limit for both pH and EC. Given that, as dredging progresses a greater volume of deeper saline water will be encountered, it is expected that both EC and the major cations and anions will continue to increase. Therefore, it is proposed that the maximum value recorded to date for EC and selected major anions and cations be adopted as the objective value and are reviewed annually in light of ongoing monitoring results. **Table 7.2** summarised the adopted objectives for the dredge pond water and identifies where the original objective has been retained or changed.

Table 7.2
Dredge Pond Water Quality Objectives

Parameter	Units	Objective	Comment
pH	-	6.5-9.0	Upper objective value reflects upper limit of recorded data.
EC	uS/cm	6 192	Objective value reflects upper limit of recorded data.
Dissolved oxygen^	mg/L	>6	Original objective value retained.
Turbidity	NTU	<20	Original objective value retained.
Na	mg/L	813	Objective value reflects upper limit of recorded data.
Mg	mg/L	119	Objective value reflects upper limit of recorded data.
K	mg/L	<40	Original objective value retained.
Cl	mg/L	1 390	Objective value reflects upper limit of recorded data.
SO_4	mg/L	<800	Original objective value retained.
HCO_3	mg/L	<400	Original objective value retained.
Al	mg/L	<0.5	Original objective value retained.
As	mg/L	<0.42	Derived from Australian and New Zealand Guidelines for Fresh and Marine Water Quality – 90% protection for freshwater species.
Fe	mg/L	<20	Original objective value retained.
Ammonia	mg/L	<20	Original objective value retained.
^Applicable to surface samples only			

In relation to nutrients, given that the approved Quarry activities themselves will not influence nutrient levels within the surrounding groundwater bores, groundwater quality objectives are not specified. However, ongoing monitoring of nutrients within dredge pond will be undertaken to determine if any impacts are occurring from surrounding activities and to inform the risk of Blue-Green Algae (in conjunction with other parameters). Further discussion regarding nutrients and Blue-Green Algae is provided as part of the Blue-Green Algae Management Plan (see Section 8).

For turbidity, whist the original objective value has been adopted, turbidity levels are principally a consideration in the event of a discharge from the dredge pond (see Section 7.8). Any exceedance of the turbidity levels will not be reported unless this coincides with a discharge from the dredge pond.

7.5 MONITORING LOCATIONS, PARAMETERS AND FREQUENCY

7.5.1 Introduction

This sub-section describes the parameters and analytes that will be monitored at identified frequencies dependent upon the Quarry operational phase. The parameter suite and frequency of monitoring is planned such that the data obtained would provide an indication of the environmental performance of the operational safeguards and mitigation measures adopted by the Quarry.

7.5.2 Standing Surface Water Levels

During operational periods, the pond water level (in m AHD) will be monitored twice daily, prior to commencing dredging and at cessation of dredging. Levels will be measured either via the calibrated height gauge, water level sensor, or calibrated water level monitor on the dredge.

7.5.3 Description of Surface Water Quality Monitoring Locations

The three dredge pond monitoring locations are shown indicatively on **Figure 6.4**. The three locations include two edge locations (DP2 and DP3) and one in the approximate middle of the pond (DP1). All depth measurements are to be taken at location DP1 in 1m intervals to the current floor of the dredge pond. Given the changing size and shape of the dredge pond the precise location of each monitoring point will vary over time and will be selected by the monitoring consultant based upon the pond condition at the time of sampling.

7.5.4 Surface Water Quality Monitoring Suite

The analytes and parameters to be monitored for the dredge pond samples are summarised in **Table 7.3**.

Table 7.3
Surface Water Quality Monitoring Suite

Field Water Quality Tests	• pH • Electrical conductivity (EC) • Temperature (°C) • Oxidation reduction potential (ORP)	• Turbidity (NTU) • Dissolved Oxygen • Oil and grease (visual)
Laboratory Testing and Analysis (NATA-accredited Laboratory)	• Major cations - Sodium - Calcium - Magnesium - Potassium	• Major anions - Chloride - Sulfate - Bicarbonate
	• Metalloids and transition metal ions - Aluminium - Arsenic - Filterable iron	• Nutrients - Total phosphorus - Total nitrogen - Ammonia nitrogen - NOx–nitrogen

7.5.5 Surface Water Sampling Frequency

The sampling frequency for the monitoring parameters and sites during operational periods (when either extraction is occurring or VENM or fines are being placed into the extraction pond[4]) is summarised in **Table 7.4** and for non-operational periods is summarised in **Table 7.5**.

Table 7.4
Surface Water Quality Monitoring Parameters and Frequency – Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
DP1, DP2, DP3 (Surface)	Weekly	Field measurements: Temperature, pH, EC, ORP, Turbidity, Dissolved Oxygen & visible oil & grease assessment.
	Monthly	Laboratory: total phosphorus, total nitrogen, orthophosphate, ammonia nitrogen & NOx nitrogen.
	Quarterly	Laboratory: major cations and anions, filterable iron, aluminium and arsenic.
DP1-1, DP1-2, etc (at 1m depth and then 2m depth intervals to base of dredge pond)	6-Monthly (Summer and Winter)	Field measurements: Temperature, pH, EC, ORP, Turbidity & Dissolved Oxygen. Laboratory: major cations and anions, filterable iron, aluminium and arsenic. Total phosphorus, orthophosphate, total nitrogen, ammonia nitrogen, NOx nitrogen.

Table 7.5
Surface Water Quality Monitoring Parameters and Frequency – Non-Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
DP1, DP2, DP3 (Surface)	Quarterly	Field measurements: Temperature, pH, EC, ORP, Turbidity, Dissolved Oxygen & visible oil & grease assessment. Laboratory: total phosphorus, orthophosphate, total nitrogen, ammonia nitrogen, NOx nitrogen.
DP1, DP2, DP3 (Surface) DP1-1, DP1-2, etc (at 1m depth and then 2m depth intervals to base of dredge pond)	6-Monthly (Summer and Winter)	Field measurements: Temperature, pH, EC, ORP, Turbidity, Dissolved Oxygen& visible oil & grease assessment. Laboratory: major cations and anions, filterable iron, aluminium and arsenic. Total phosphorus, orthophosphate, total nitrogen, ammonia nitrogen, NOx nitrogen.

7.6 VISUAL INSPECTIONS

In addition to the quantitative surface water quality analyses noted in Section 7.5, visual inspections of the extraction pond will be undertaken during sample collection (monthly during operations and quarterly during non-operational periods). The following indicators will be recorded as applicable during the visual inspections.

- Qualitative weather conditions (e.g. sunny vs overcast, raining vs dry) at the time of the visual inspection.

[4] In the event other activities such as product transportation occur without the need for extraction or placement of VENM or fines within the dredge pond, this is still considered a non-operational period for the purposes of surface water monitoring.

- Colour and appearance (cloudy vs clear) of water.
- Presence of odour or frothing.
- Presence of floating debris.
- Presence of oily films on surface or on shoreline.
- Presence of nuisance organisms (e.g. macrophytes, phytoplankton scums, algal mats, Blue Green algae).

Photographs will also be taken of all monitoring locations at the time of sample collection with additional photographs of the extraction ponds. These photographs (labelled with location, date and time) will assist in interpreting the monitoring data and provide a way of monitoring changes (if any) over time.

7.7 SURFACE WATER RESPONSE MEASURES

A protocol for the investigation, notification, and mitigation of identified exceedances of the impacts on surface water is presented in **Table 7.6**.

7.8 SURFACE WATER DISCHARGE OFF SITE

As discussed in Section 4.3, bunding will be progressively constructed around the dredge pond as it progresses. This effectively separates external 'clean water' and contains any runoff from around the dredge pond. Therefore, discharges are not required from the site except in the case of a flood or extreme rainfall. In these instances, Condition L1.2 of EPL 12385 provides a 'wet weather discharge' in which, if discharge occurs as a result of rainfall exceeding 82.5mm over any consecutive 5-day period, the licenced quality limits for discharge are permitted to be exceeded.

In the unlikely event that a discharge was to be required outside of such a flood or rainfall event, water would be effectively irrigated over grassed areas within the Quarry Site at a rate that avoids erosional velocity. Monitoring would be undertaken within 24 hours prior to such a discharge and daily during discharge to ensure that the water meets the following EPL 12385 criteria.

- pH between 6.5 and 8.5.
- No visible oil or grease.
- Total suspended solids <50mg/L.

For the purpose of EPL 12385, the point of discharge is considered to be the spillways. These spillways will be maintained and access will be available to authorised government officers.

Table 7.6
Surface Water Trigger Action Response Plan

Trigger Level	Alert Level	Action	Response
Surface Water Levels			
Water levels within the dredge pond remain consistent with previously recorded and/or predicted levels.	Green	No action required	Nil.
Trends in the water levels within the dredge pond indicate a continuing decline in drawdown levels exceeding 1.25m over a 6 month period (or shorter).	Amber	Conduct investigation: Review and assess monitoring results and relevant activities within and surrounding the Quarry.	• Review trends in water levels over time and determine if there is likely a causal link to Quarry-related activities or any other known surrounding activities. • Establish links (if any) between water levels and climatic conditions (e.g. rainfall). • Review water return volumes to the dredge pond to ensure anticipated returns are being achieved. • Determine the need for use of 'make up' water or the need to adjust the dredging rate.
Exceedance of drawdown criteria (see Section 6.3.1) within the dredge pond.	Red	**Report as an incident** and submit formal report to DPIE and relevant agencies in accordance with the incident response process outlined within the Environmental Management Strategy.	• In addition to the responses outlined within the amber alert undertake the following. • If required, reduce the rate of dredging or temporarily cease dredging. • Seek a review of the monitoring data by a suitably qualified consultant. • Determine the need for use of 'make up' water or the need to adjust the ongoing dredging rate. • Review the need to temporarily increase the monitoring frequency. • Update this SWMP as applicable.
Surface Water Quality			
All analytes within assessment criteria.	Green	No action required	Nil.
Single exceedances of the assessment criteria at one or multiple sample points.	Amber	Conduct investigation: Review and assess monitoring results and relevant activities within and surrounding the Quarry. Report the outcomes of the review as part of the next Annual Review.	• Review data from the monitoring event against previous monitoring data. Confirm if data remains within the range of previous results. • Review any trends in water quality over time and determine if there is likely to be a causal link to Quarry-related activities or any other known surrounding activities. • Establish links (if any) between water quality and climatic conditions (e.g. rainfall). • Establish any potential links with any changes in pond or surrounding groundwater levels. • Determine the need for an additional 'non-routine' monitoring. • Continue to monitor and assess groundwater quality data in accordance with this SWMP.
Two consecutive results for the same monitoring location exceed the assessment criteria.	Red	**Report as an incident*** and submit formal report to DPIE and relevant agencies in accordance with the incident response process outlined within the Environmental Management Strategy.	• In addition to the responses outlined within the amber alert undertake the following. • Seek a review of the monitoring data by a suitably qualified consultant. • Review the need to alter on-site activities or management practices. • Review the need to temporarily increase the monitoring frequency. • Update this SWMP as applicable.

8. BLUE-GREEN ALGAE MANAGEMENT PLAN

8.1 INTRODUCTION

The hydraulic extraction of sand involves the extraction of a sand-water slurry from a water body (dredge pond), with water and unwanted fines being returned to the pond following the selective removal of sand. Returned fines will be released to settle at the bottom of the pond. The base of the extraction pond will ultimately be approximately -20m AHD. Other than the continual recycling of water created during dredging and the rare flood event, the water will not be readily 'refreshed'.

Standing bodies of fresh water in temperate and warmer latitudes often experience high concentrations of blue-green algae (cyanobacteria), especially in the summer months when the temperature is warmer and more daylight is available to fuel photosynthesis. While cyanobacteria are naturally present in low numbers in most water bodies, elevated nutrient concentrations, warmer temperatures and more hours of daylight per day are conducive to elevated growth of cyanobacteria and may lead to bloom events.

Schedule 3 Condition 23 of Project Approval 05_0103B requires the Blue-Green Algae Management Plan to:

a) be consistent with extant guidelines for blue-green algae management including the NHMRC's *Guidelines for Managing Risks in Recreational Water* (see Section 8.2);

b) describe the measures that would be implemented to prevent and control the sources of algal blooms over the short, medium and long term (see Section 8.5);

c) include a detailed recovery plan that aims to reduce algae levels to meet the water quality completion criteria in the Rehabilitation Management Plan (see Section 8.5);

d) include reasonable and feasible measures to reduce nutrient levels in the pond/s over the short, medium and long term, and include interim water quality targets for nutrients based on continual improvement and established water quality objectives for the Tweed River catchments (see Section 8.5); and

e) define procedures for the management and notification of identified algal blooms (see Section 8.8).

8.2 APPLICABLE GUIDELINES

The *Guidelines for Managing Risks In Recreational Water*, produced by the National Health and Medical Research Council (2008) (herein referred to as the NHMRC Guidelines) provide guidelines for managing risks associated with cyanobacteria and algae in fresh recreational water bodies (Section 6 of the guidelines) and coastal and estuarine waters and bodies (Section 7 of the guidelines). The guidelines are not aimed at managing non-recreational water bodies and water bodies which are not accessible to the public. Given that the dredge pond is not accessible to the public and is not utilised for recreational purposes, the guidelines are not directly applicable during operations. However, aspects of the guidelines can be applied during operations to guide management. The guidelines will also be applicable to the proposed post-Quarry land use as a recreational lake.

Newcombe et al. (2010), a document which describes strategies for managing cyanobacteria for water utilities, has also been consulted in the preparation of this section.

8.3 BASELINE DATA

Cudgen Lakes Sand Quarry

Sections 6.2 and 7.3 provide a summary of the existing groundwater and surface water monitoring data collected for the Cudgen Lakes Sand Quarry. This data has confirmed that elevated levels of nutrients, including both phosphorous and nitrogen, are present within the surrounding groundwater and the dredge pond. Ranges for phosphorous and nitrogen recorded to date are summarised as follows.

- Groundwater
  - Total phosphorous absolute range: 0.01mg/L to 3.35mg/L
  - Total phosphorous 80th percentile range: 0.06mg/L to 3.17mg/L
  - Total nitrogen absolute range: 0.20mg/L to 36mg/L (and one site 64mg/L to 186mg/L)
  - Total nitrogen 80th percentile range: 0.46mg/L to 5.92mg/L (and one site at 155mg/L)
- Surface Water (dredge pond)
  - Total phosphorous absolute range: 0.01mg/L to 1.81mg/L
  - Total phosphorous 80th percentile (all results): 0.06mg/L
  - Total nitrogen absolute range: 0.40mg/L to 7.30mg/L
  - Total nitrogen 80th percentile (all results): 1.4mg/L

The NHMRC Guidelines state that total phosphorus of 0 to 0.01mg/L, 0.01mg/L to 0.025mg/L, and >0.025mg/L represent a low, moderate and high risk of cyanobacterial growth respectively. Accordingly, the 80th percentile total phosphorous levels in both groundwater and surface water represent a high risk of cyanobacterial growth.

Monitoring of both chlorophyll a and cyanobacteria has also been undertaken since November 2017 within both groundwater and surface water. All samples in all groundwater monitoring bores have returned results for both chlorophyll a and cyanobacteria as below the limit of reporting. This indicates that cyanobacteria have not been migrating from the dredge pond and other surrounding blue-green algal sources into local groundwater.

Within the dredge pond elevated levels of potentially toxic cyanobacteria were recorded during the initial extraction campaign (30 October 2017 and 8 February 2018) but remained below the trigger levels specified in the 2017 SWMP. However, during the 2018/2019 summer months, 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 and the 80th percentile for all recorded data to date is 37 400cells/mL.

Given these results 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.

8.4 BLUE-GREEN ALGAE MANAGEMENT CRITERIA

In order to indicate the potential hazard represented by cyanobacteria as well as appropriate management actions, alert levels have been adopted as presented in **Table 8.1**. These alert levels have been modified after the NHMRC Guidelines and in light of previous on-site monitoring.

Table 8.1
Cyanobacterial Alert Levels for Recreational Waters

Level	Criteria
Green Level (Surveillance Mode)	<5 000cells/mL of potentially toxic cyanobacteria species; or <0.5mm^3/L total biovolume of all potentially toxic cyanobacteria.
Amber Level (Alert Mode)	≥5 000 to <50 000cells/mL potentially toxic cyanobacteria species; or ≥0.5 to <2.1mm^3/L* total biovolume of all potentially toxic cyanobacteria where a known toxin producer is dominant in the biovolume.
Red Level (Action Mode)	≥10µg/L total toxins (CYN^); or ≥50 000cells/mL potentially toxic cyanobacteria species; or ≥2.1mm^3/L* total biovolume of all cyanobacteria where a known toxic producer is dominant in the biovolume. Cyanobacterial scums are consistently present.
*Based upon the previously recorded dominant species *Cylindrospermopsis raciborskii* and an average cell volume of 42µm^3. ^CYN = cytotoxic cylindrospermopsin – toxin produced by the cyanobacteria *Cylindrospermopsis raciborskii*.	

8.5 BLUE-GREEN ALGAE MANAGEMENT STRATEGY

8.5.1 Human Risk Reduction Measures – All Alert Levels

Ongoing management measures to protect the health and safety of staff and visitors will include the following. These measures will be implemented during all alert levels.

- A general warning sign will be placed at the entrance to the Quarry to inform all visitors of the potential risk of blue-green algae and to dissuade unauthorised access.
- An information sign will be placed within the Quarry (in a location not easily visible from Altona Road[5]) to specify to staff and visitors the current alert level (green, amber or red) and key precautions to be taken during red alert levels.
- All staff and visitors to be informed as part of the induction process of the risks associated with blue-green algal blooms, including toxins produced by some species and potential health effects.
- No fishing or recreational activities will be permitted within the dredge pond.

[5] So as not to encourage illegal access to the pond during periods of green alert levels.

8.5.2 Human Risk Reduction Measures – Amber Alert Levels

During an Amber Alert the following additional management measures will be implemented.

- Ensure that the staff and visitor alert level sign has been adjusted to display that the site is at the Amber Alert level.
- Inform staff of the change in alert level and notify visitors at sign in.
- Ensure that appropriate personal protective equipment is available for staff and visitors who wish to utilise this as a precautionary measure or who have pre-existing sensitivity to cyanobacteria.

8.5.3 Human Risk Reduction Measures – Red Alert Levels

During a Red Alert the following additional management measures will be implemented.

- Ensure that the staff and visitor alter level sign has been adjusted to display that the site is at the Red Alert level.
- Inform staff of the change in alert level and notify visitors at sign in.
- Appropriate personal protective equipment and clothing to be worn while working within or handling water from the dredge pond (e.g. gumboots, waders, gloves).
- Any staff or visitors with a history of allergic reactions to cyanobacteria are to avoid contact with the dredge pond water.
- Misting / spraying of pond water is to be avoided and employees and visitors advised to avoid water spray.
- Personnel are to wash equipment and themselves after contact with dredge pond water to remove any cyanobacteria or toxins.

8.5.4 Measures to Reduce and Prevent Algal Blooms

8.5.4.1 Overview

Algal blooms require the presence of algae, sufficient nutrients, warm temperatures and sufficient light. Prevention and control measures include managing one or more of these requirements.

Management measures included in this plan essentially follow the approach within a document entitled "*Proposal for Ecosystem Management of Tweed Sands Lake*" by Peter Gehrke (CSIRO, 2006) that states:

> *"a critical component of this strategy is to reduce the risk of cyanobacterial blooms into the future by applying sound ecological principles. The strategy is based on a fish habitat creation program supplemented by stocking of approved fish species to extract nutrients from the sediments and water column, and to facilitate grazing of cyanobacteria to reduce cells counts by natural processes".*

The overall means of minimising cyanobacterial blooms is to encourage the establishment of a self-sustaining ecosystem including active wetlands and the introduction of suitable grazers and fish species.

Although prevention is clearly the most effective response, cyanobacterial blooms are highly likely to occur in the dredge pond, particularly during the operational phase and prior to the establishment of fringing wetlands and fish habitat. Therefore, during operations, measures to manage human health risk will be implemented as outlined in Sections 8.5.1 to 8.5.3 whilst the following measures are progressively implemented.

8.5.4.2 Reducing Nutrient Availability

A variety of techniques for nutrient control are discussed in detail in Newcombe et al. (2010).

Nutrient flux into the dredge pond has been minimised by the installation of bunding to prevent surface water inflow. The bunding on the southern boundary of the final dredge pond was originally proposed to be removed following completion of extraction. However, further assessment will be made during operations and this bunding may be retained in the long-term to minimise surface flows from the agricultural areas of the Cudgen Plateau.

Groundwater borne nutrients are less easily managed. Nutrients in the dredge pond water can be removed by organisms other than cyanobacteria. In particular, the progressive creation of wetlands around the perimeter of the dredge pond will provide a variety of partially submerged plants that will draw down on the available inorganic nutrients in the water column. The additional benefit of wetlands is the provision of significant habitat for many organisms including invertebrates that contribute to grazing, and juvenile fish species.

Phosphorus is usually the critical nutrient promoting cyanobacterial growth and bloom formation (Newcombe et al. 2010) and is released from sediments that become anoxic. Therefore, maintenance of well oxygenated conditions throughout the water column will assist in reducing phosphorous availability. The pumping action of the dredge will also assist by encouraging mixing the water column. During non-operational periods however, no practicable, financially viable solutions have yet been identified to artificially mix the dredge pond water column.

In the long term and following the completion of dredging operations, artificial mixing and oxygenation of the final recreational lake may be possible through the installation of a diffusion system which effectively pumps compressed air to the base of the pond. The rising air bubbles displace water as they rise and create a current, thereby mixing the water column. However, the dominant cyanobacteria species, *C.raciborskii,* has been shown to tolerate and flourish in well mixed water bodies as much as in stratified water bodies. It is possible that cyanobacterial growth during operational periods has been inhibited by a combination of factors produced by dredging operations including water column mixing, increased turbidity, and rapid changes to environmental conditions. Therefore, the potential value of a diffusion system in controlling cyanobacteria will be re-assessed if further information becomes available within the literature to suggest that it may be an effective control.

The use of phosphate–binding materials has been considered but is not a suitable long-term solution given that elevated nutrients are a feature of the surrounding aquifer. Furthermore, continued nutrient inputs are expected as a result of surrounding agricultural activities, water birds, and from material deposited into the pond during future flood events. Therefore use of phosphate-binding materials would require ongoing application to the pond. Given the final water volume of the lake will be in the order of 6 500ML to 7 000ML, such ongoing treatment would be both impractical and economically infeasible.

8.5.4.3 Reducing the Number of Cyanobacteria

Algaecides can be effective at reducing the number of cyanobacteria and potentially preventing blooms. However, algaecides such as copper sulphate may result in undesirable levels of active constituents in pond sediments which may adversely affect aquatic life in the pond. The application of algaecides would also be required on an ongoing basis. Therefore, the use of algaecides is not supported as a feasible or desirable control method.

The preferred approach to the management of cyanobacteria levels is through the establishment of a self-supporting, self-regulating ecosystem which would naturally control cyanobacterial concentrations in the absence of human intervention. In particular, establishing an ecosystem capable of supporting both grazing animals which consume cyanobacteria as well as predatory animals which regulate grazer populations would represent a sustainable long-term management solution. By encouraging the formation of an ecosystem which supports sustainable populations of both grazers and predator species, the potential for cyanobacterial blooms and grazer population collapses would be minimised. Establishment of grazer and fish populations will be reviewed as dredging operations progress and terminal areas are established in which ecosystem establishment can begin. Identification of acceptable grazer and fish species will be undertaken in consultation with the NSW Department of Primary Industries.

In conjunction with this approach, further investigation will be undertaken into promoting the growth of select algal species, in particular diatoms. The introduction of floating plants (in addition to the wetland species) to compete with potentially toxic cyanobacteria species for sunlight and nutrients will also be undertaken, however, due to the potential for floating plants to become weeds this is currently not a favoured option. Investigation into competitive algal and plant species will similarly be undertaken as the dredge pond size sufficiently increases to allow these to be established.

8.6 MONITORING LOCATIONS, PARAMETERS AND FREQUENCY

8.6.1 Introduction

This sub-section describes the parameters and analytes that will be monitored at identified frequencies as relevant to Blue-Green Algae. The Blue-Green Algae monitoring program will effectively compliment the surface water monitoring program as outlined within Section 7.5 of this SWMP.

8.6.2 Blue-Green Algae Monitoring Locations

The Blue-Green Algae monitoring locations are the same locations as for surface water monitoring, namely DP1, DP2 and DP3 with depth samples taken at DP1 (see Section 7.5.3 and **Figure 6.4**). The surface samples will be taken as a single composite sample. All depth measurements are to be taken as individual samples from 1m depth and then 2m intervals to the current floor of the dredge pond. Given the changing size and shape of the dredge pond the precise location of each monitoring point will vary over time and will be selected by the monitoring consultant based upon the pond condition at the time of sampling.

8.6.3 Blue-Green Algae Monitoring Parameters

The analytes and parameters to be monitored in relation to Blue-Green Algae are summarised in **Table 8.2**.

Table 8.2
Blue-Green Algae Monitoring Suite

Field Water Quality Tests	• pH • Electrical conductivity (EC) • Oxidation reduction potential (ORP)	• Temperature (°C) • Turbidity (NTU) • Dissolved Oxygen
Laboratory Testing and Analysis (NATA-accredited Laboratory)	• Major cations - Sodium - Calcium - Magnesium - Potassium	• Major anions - Chloride - Sulfate - Bicarbonate
	• Metalloids and transition metal ions - Aluminium - Arsenic - Filterable iron	• Nutrients - Total phosphorus - Orthophosphate - Total nitrogen - Ammonia nitrogen - NOx–nitrogen
	• Biological Parameters - Chlorophyll a - Total algal cell count & biovolume	- Toxin analysis (CYN*) - Potentially toxic species cell count and biovolume
* CYN = cytotoxic cylindrospermopsin – toxin produced by the cyanobacteria *Cylindrospermopsis raciborskii* which has previously been recorded as the dominant species at both the Cudgen Lakes Sand Quarry and Hanson Tweed Sand Quarry		

8.6.4 Blue-Green Algae Sampling Frequency

The sampling frequency for the blue-green algae (BGA) monitoring parameters during operational periods (when either extraction is occurring or VENM or fines are being placed into the extraction pond[6]) is summarised in **Table 8.3** and for non-operational periods is summarised in **Table 8.4**. The parameters specified are to be collected <u>in addition to</u> the surface water monitoring parameters specified in **Tables 7.4** and **7.5**.

[6] In the event other activities such as product transportation occur without the need for extraction or placement of VENM or fines within the dredge pond, this is still considered a non-operational period for the purposes of surface water monitoring.

Table 8.3
Blue-Green Algae Monitoring Parameters and Frequency – Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
DP1, DP2, DP3 (Surface) – composited	Monthly (BGA only)	Laboratory (BGA only): chlorophyll a, total algal cell count & biovolume, potentially toxic cyanobacteria cell count & biovolume, toxins.
DP1-1, DP1-2, etc (at 1m depth and then 2m depth intervals to base of dredge pond)	6-Monthly (Summer and Winter)	Laboratory (BGA only): chlorophyll a, total algal cell count & biovolume, potentially toxic cyanobacteria cell count & biovolume, toxins..
DP1, DP2, DP3 (Surface) – composited	Quarterly	Laboratory (BGA only): chlorophyll a, total algal cell count & biovolume, potentially toxic cyanobacteria cell count & biovolume, toxins.
DP1-1, DP1-2, etc (at 1m depth and then 2m depth intervals to base of dredge pond)	6-Monthly (Summer and Winter)	Laboratory (BGA only): chlorophyll a, total algal cell count & biovolume, potentially toxic cyanobacteria cell count & biovolume, toxins.

Following a further 12 months of data collection, should the data confirm that Red Alert trigger levels are not exceeded during the cooler months, it is intended that laboratory monitoring will be restricted to warmer 'at risk' months. Conditional testing of toxin levels will also be assessed, e.g. toxin analysis may only occur once cell counts exceed 5 000cells/mL.

8.7 VISUAL INSPECTIONS AND ASSESSMENT

In addition to the formal sampling, during operations, informal visual inspections for cyanobacterial presence will be undertaken daily. Observations will be directed to downwind parts of the ponds where windblown surface cells will accumulate. Any obvious scums will be photographed and copies supplied to the monitoring consultant for sampling at the next monthly operational monitoring event.

The Quarry Operator will also undertake regular inspections / assessments to ensure the following.

- The staff and visitor alert level sign displays the correct alert level.
- Staff and visitors are utilising appropriate PPE during red alert levels.
- Information regarding the potential health effects of cyanobacteria is available for use during inductions.

8.8 RESPONSE MEASURES

Procedures for the management and notification of identified algal blooms are incorporated in a Trigger Action Response Plan presented in **Table 8.5**. These measures are based upon the criteria and alert levels as outlined in Section 8.4.

Table 8.4
Blue-Green Algae Trigger Action Response Plan

Trigger Level	Alert Level	Action	Response
Surface Water Levels			
<5 000cells/mL of potentially toxic cyanobacteria species; or <0.5mm^3/L total biovolume of all potentially toxic cyanobacteria.	Green	No action required	Continue monitoring and implementation of management measures applicable to all alert levels (see Section 8.5.1).
≥5 000 to <50 000cells/mL potentially toxic cyanobacteria species; or ≥0.5 to <2.1mm^3/L total biovolume of all potentially toxic cyanobacteria where a known toxin producer is dominant in the biovolume.	Amber	No action required.	• Ensure that the staff and visitor alert level sign has been adjusted to display that the site is at the Amber Alert level. • Check that adequate PPE is available for staff and visitors who wish to utilise this as a precautionary measure or who have pre-existing sensitivity to cyanobacteria.
≥10µg/L total toxins (CYN); or ≥50 000cells/mL potentially toxic cyanobacteria species; or ≥2.1mm^3/L total biovolume of all cyanobacteria where a known toxic producer is dominant in the biovolume; or Cyanobacterial scums are consistently present.	Red	**Report** to Tweed Shire Council's Environmental Health division and DPIE (to be reported for notification purposes, not as an incident). As part of report, including monitoring results and confirm work place health and safety measures implemented.	• Ensure that the staff and visitor alert level sign has been adjusted to display that the site is at the Red Alert level. • Ensure that the Red Alert management measures as outlined in Section 8.5.2 are being implemented. • Undertake regular review / assessment of the proper implementation of the Red Alert management measures.

9. DATA REVIEW AND REPORTING

9.1 GENERAL DATA REVIEW AND REPORTING

The protocol to be adopted for all monitoring data collected as part of this SWMP as follows.

- All monitoring results will be reviewed upon receipt against any criteria and trigger action response levels within this SWMP. Where relevant, any trends in monitoring data will also be reviewed.
- Any exceedance with relevant trigger action response levels will be reported as an incident as specified in the trigger action response plan and in accordance with the incident reporting process outlined in the Environmental Management Strategy.
- An electronic database of monitoring data, field sheets, photographs and other relevant records (e.g. calibration certificates) will be maintained.
- A summary of all relevant monitoring data will be reported as part of the Annual Review.

As part of each Annual Review consideration will be given to the current analytes and monitoring frequencies to ensure that these are sufficient for assessing potential impacts and that unnecessary data is not being collected.

9.2 DATA RECORDING AND REPORTING – ACID SULFATE SOILS

Records of acid sulfate soil test results will be kept by the Quarry Operator and provided to the Administration Officer together with the application rates of the alkaline amendment used as neutralising agents. These records will be made available to the statutory authorities upon request.

A summary of the test results and volumes of alkaline amendments will be reported annually as part of the Annual Review process.

9.3 DATA RECORDING AND REPORTING - VENM

The volumes of all VENM(a) and VENM(b) will recorded and reported annually as part of the Annual Review process.

The following records will also be retained for each truck load of VENM(b) received at the site and made available to relevant agencies upon request.

a) the details of the originating site (name, address, owner & developer, contact details);

b) the details of the transporter (name, address, contact details, vehicle registration);

c) date and time of the extraction of the VENM(b);

d) pH of the VENM(b) at the time of its extraction, and at the time immediately prior to its placement underwater; and

e) the name of the person (certified practicing soil scientist) who assessed the material and classified it as VENM(b).

f) documentation on VENM(b) received will be retained for at least four years from the date of receipt of the VENM(b).

9.4 REPORTING OF WATER TAKE

Annual reporting of water take will be undertaken as part of the Annual Review process. Additionally, as required by *Condition DS4777-00001* of Water Supply Works Approval 30CA321269, a Groundwater Management Report will be prepared annually by a suitably qualified person. The Groundwater Management Report will be prepared in conjunction with the Annual Review.

10. PLAN REVIEW

In accordance with *PA Condition 5(4)*, this SWMP will be reviewed and, if required, revised within 3 months of:

- the submission of an incident report under PA Condition 5(10);
- the submission of an Annual Review under PA Condition 5(13);
- the submission of an Independent Environmental Audit report under PA Condition 5(14); and
- any modification to the conditions of PA05_0103.

Where this review leads to revisions in any such document, then within 6 weeks of the review, the revised document will be submitted to DPIE for approval.

11. RESPONSIBILITIES AND ACCOUNTABILITIES

11.1 RESPONSIBILITIES – EROSION & SEDIMENT CONTROL

The Quarry Operator will have the ultimate responsibility for the implementation of the ESCP. **Table 11.1** outlines the accountable positions and tasks.

Table 11.1
Accountable Positions and Tasks (Erosion and Sediment Control)

Position	Accountable Task
Quarry Operator (Quarry Manager)	• Ensuring that all water management and sediment and erosion control structures have been constructed to the appropriate standard. • Undertaking (or delegating) inspections of water management and erosion and sediment control structures during operational periods. • Ensuring that all procedures contained within this Plan are available to relevant employees and discussed through induction sessions or toolbox talks / meetings.
Administration Officer	• Coordinate inspections during non-operational periods. • Coordination of reporting through the Annual Review. • Review this plan on at least an annual basis and revise where required.
All employees	• Reporting any failure of water management and erosion and sediment control structures to the Quarry Manager.

11.2 RESPONSIBILITIES – ACID SULFATE SOILS AND VENM

The Quarry Operator will have the ultimate responsibility for the implementation of the ASSMP. **Table 11.2** outlines the accountable positions and tasks.

Table 11.2
Accountable Positions and Tasks (Acid Sulfate Soil and Sediments Management)

Position	Accountable Task
Quarry Operator (Quarry Manager)	• Ensure all acid sulfate soil and sediment monitoring and management is undertaken in accordance with the ASSMP. • Analyse monitoring data upon receipt to ensure compliance. • Ensure all VENM received is inspected in accordance with the ASSMP and appropriate records retained. • Reject any loads of material received to site identified as not being VENM and / or cross contaminated with other materials (this responsibility may be delegated). • Ensure that all procedures contained within this Plan are available to relevant employees and discussed through induction sessions or toolbox talks / meetings. • Ensure monitoring data and records are accurately recorded and supplied to the Administration Officer.
Administration Officer	• Coordinate all reporting, through the Annual Review. • Review this plan on an annual basis and revise where required.
All employees	• Report to the Quarry Manager any material received suspected of not being VENM.

11.3 RESPONSIBILITIES – WATER AND BLUE-GREEN ALGAE

The Quarry Operator will have the ultimate responsibility for the implementation of the Groundwater Monitoring Program, Surface Water Monitoring Program. **Table 11.3** outlines the accountable positions and tasks.

Table 11.3
Accountable Positions and Tasks (Water and Blue-Green Algae)

Position	Accountable Task
Quarry Operator (Quarry Manager or delegate)	• Coordinate all weekly water quality and level monitoring and analyse that monitoring data upon receipt to ensure compliance. • Ensure site inspections and management measures are undertaken in accordance with the Blue Green Algae Management Plan and Surface Water and Groundwater Monitoring Programs. • Ensure that staff and visitors are informed of changes to the current alert level. • Ensure that all procedures contained within these plans & programs are available to relevant employees and discussed through induction sessions or toolbox talks / meetings. • Ensure monitoring data and records are accurately recorded and supplied to the Administration Officer. • Provide access to any authorised government officer to inspect water monitoring locations or monitoring data collected in accordance with the SWMP.
Administration Officer / Monitoring Contractor	• Coordinate all monthly and quarterly water quality and level monitoring and analyse that monitoring data upon receipt to ensure compliance. • Ensure monitoring data and records are accurately recorded and supplied to the Quarry Operator. • Coordinate all reporting through the Annual Review. • Review these plans and programs on an annual basis and revise where required.

12. REFERENCES

Australasian Groundwater & Environmental Consultants Pty Ltd, 2008. *Groundwater Assessment for Cudgen Lakes Sand Extraction Project*.

HMC Environmental Consulting Pty Ltd, 2008. *Acid Sulfate Soils, Soil Contamination & Agricultural Suitability Assessment*.

Landcom, 2004. *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition.*

National Health and Medical Research Council, Australian Government, 2008. *Guidelines For Managing Risks In Recreational Water*.

Newcombe, G., House, J., Ho, L., Baker, P., and Burch, M. 2010. *Management Strategies for Cyanobacteria (blue-green algae): Guide for Water Utilities*. Research Report 74, Water Quality Research Australia Limited

NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC), 1998. *Acid Sulfate Soils Manual*

Peter Gehrke, Land and Water Research, CSIRO, 2006. *Proposal for ecosystem management of Tweed Sands Lake*.

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Appendix 1

Consultation and Response

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A summary of how the above consultation comments have been addressed within the SWMP is provided in **Table A1-1**.

Table A1-1
Coverage of Consultation Comments

Agency	Comment	Coverage
DPIE (22/11/19)	VENM containing Acid Sulfate Soils (ASS) or Potentially Acid Sulfate Soils (PASS): Page 25 of the SWMP states: "Two types of VENM will be accepted on site, namely. – VENM(a) – natural excavated material that does not contain any ASS or PASS. – VENM(b) – natural excavated materials that contain ASS or PASS." However, Council's comments of 28 June 2019 raise concern that VENM imported to the site cannot contain sulfidic ores or soils. I note your response to Council dated 1 July 2019 that states "It is intended to seek EPA's approval for material that would otherwise be considered VENM except for it containing pyrite material to be accepted at the site for placement below the water within the dredge pond". Can you please update the SWMP to discuss the intent to lodge the above request with the EPA.	Section 5.2 of the SWMP has been updated to confirm that VENM(b) materials will not be received until the required variations to EPL 12385 have been received and, if required, a specific Resource Recovery Exemption.
	Throughout the SWMP it is stated that "Any exceedance of the objectives for Faecal Coliforms or Enterococci will be reported for notification purposes but will not be considered an incident." However, any exceedance of the soil and water impact assessment criteria must be reported to the Department as an 'incident' in accordance with condition 1 of Schedule 4 and conditions 9 to 12 of Schedule 5 of the project approval. Please revise the incident notification procedure to reflect this requirement.	The Project Approval no longer specifies water quality criteria (only air and noise). However, it does require the SWMP to specify relevant criteria as well as the notification protocols. Therefore, following the protocols outlined within the SWMP will satisfy the incident and notification conditions within the Project Approval. The elevated Enterococci and Faecal Coliforms are due to previous and ongoing agricultural activities and are not related to the Quarry operations. As such, these analytes will be managed as a WHS matter and have been removed from the SWMP to remove any confusion.
	The Department notes that several surface water and ground water impact assessment criteria have been revised in this version of the SWMP. The Department must await advice from DPIE Water before it is able to confirm these changes are acceptable. I note you have been awaiting comments from DPIE-Water / NRAR for some time. The Department will follow up the agency to obtain the status of their response.	Noted. NRAR have subsequently provided comments on 12/01/2021 and raise no objections to the impact assessment criteria.

Table A1-1 (Cont'd)
Coverage of Consultation Comments

Agency	Comment	Coverage
Tweed Shire Council (28/06/19)	NSW EPA advise that Virgin Excavated Natural Material (VENM) cannot contain sulfidic ores or soils. Page 25 of the report advises that material containing actual or potential acid sulfate soil will be accepted as VENM at the site. It is recommended that contact with the EPA Waste Unit for further information regarding VENM.	Consultation has previously been undertaken with EPA and discussed with the (then) DPE. Given that the waste classification and definitions have been changing since the original Environmental Assessment was written, the Project Approval now includes in Condition 2(10) which reads. "*The Proponent must not import more than 45,000 tonnes of VENM (or material that otherwise meets the classification of VENM as approved by the EPA) to the site in any financial year. The Proponent must ensure that all VENM imported to the site does not contain waste*." It is intended to seek a variation to EPL 12385 and, if required, a specific Resource Recovery Exemption from EPA for material that would otherwise be considered VENM except for it containing pyrite material (referred to in previously documentation as VENM(b)) to be accepted to the site for placement below the water within the dredge pond.
	Groundwater quality monitoring suite in Section 6.4.4 **Table 6.4** should include turbidity (field test) and suspended solids (laboratory test).	The approved operations will not affect the turbidity or total suspended solids in surrounding groundwater bores nor are there relevant groundwater criteria for these parameters. Turbidity will, however, be monitored within the dredge pond.
	No objection raised to the intent of the Plan. I am satisfied with the provisions for flooding, site discharge and sediment control in the draft report.	Noted.
Water NSW (05/07/19)	No comments.	Noted.
EPA (02/07/19)	No comments.	Noted.
NRAR (12/01/21)	Additional nested monitoring bores be installed in the area to the north of the Altona Road realignment and included in the SWMP "Groundwater Monitoring Program" for the purpose of managing site impacts on private bores to the north and northeast of the site.	Nested monitoring bores MB11, MB12 and MB13 are currently located to the northeast between the operations and surrounding private groundwater monitoring bores. Installation of an additional set of nested monitoring bores prior to extraction reaching (and subsequently destroying) MB11, MB12 and MB13 is superfluous.

Table A1-1 (Cont'd)
Coverage of Consultation Comments

Agency	Comment	Coverage
NRAR (12/01/21) Cont'd	Cont'd	Notwithstanding, Section 6.4.1 of the SWMP states the following. "*As extraction progresses, the selected groundwater bore monitoring locations will be regularly reviewed and, as necessary, additional bores installed to offset those removed as a result of extraction.*" Given that the SWMP requires review on at least an annual basis as part of the Annual Review process, this is an appropriate measure to ensure that checks of the continues suitability of the groundwater monitoring bore network are undertaken.
	Groundwater Work No. GW300847 should be referenced in the text to be included under the site Groundwater Monitoring Program as per **Figure 6.4**	GW300847 is not referenced within the SWMP text as the owner of the property previously advised that the bore was removed. The inclusion of GW300847 on **Figure 6.4** was inadvertent and has now been removed.

From: Bailey Williams <Bailey.Williams@planning.nsw.gov.au>
Sent: Friday, 22 November 2019 11:42 AM
To: Scott Hollamby
Cc: Gen Lucas
Subject: Cudgen Lakes - Soil and Water Management Plan

Good Morning Scott,

The Department has reviewed the Cudgen Lakes Sand Quarry Soil and Water Management Plan (SWMP) and requests a couple of revision/clarifications as described below.

- VENM containing Acid Sulfate Soils (ASS) or Potentially Acid Sulfate Soils (PASS):
  - Page 25 of the SWMP states:
  - "Two types of VENM will be accepted on site, namely.
    - VENM(a) – natural excavated material that does not contain any ASS or PASS.
    - VENM(b) – natural excavated materials that contain ASS or PASS."
  - However, Council's comments of 28 June 2019 raise concern that VENM imported to the site cannot contain sulfidic ores or soils.
  - I note your response to Council dated 1 July 2019 that states "It is intended to seek EPA's approval for material that would otherwise be considered VENM except for it containing pyrite material to be accepted at the site for placement below the water within the dredge pond".
  - Can you please update the SWMP to discuss the intent to lodge the above request with the EPA.
- Incident reporting procedures:
  - Throughout the SWMP it is stated that "Any exceedance of the objectives for Faecal Coliforms or Enterococci will be reported for notification purposes but will not be considered an incident." However, any exceedance of the soil and water impact assessment criteria must be reported to the Department as an 'incident' in accordance with condition 1 of Schedule 4 and conditions 9 to 12 of Schedule 5 of the project approval.
  - Please revise the incident notification procedure to reflect this requirement.
- Revised surface and ground water impact assessment criteria:
  - The Department notes that several surface water and ground water impact assessment criteria have been revised in this version of the SWMP. The Department must await advice from DPIE Water before it is able to confirm these changes are acceptable. I note you have been awaiting comments from DPIE-Water / NRAR for some time. The Department will follow up the agency to obtain the status of their response.

Kind Regards,

Bailey Williams
Student Planner, Resource Assessments
Planning and Assessment | Department of Planning, Industry and Environment
T 02 8275 1306 | **E** bailey.williams@planning.nsw.gov.au
Level 30, 320 Pitt Street, Sydney NSW 2000
www.dpie.nsw.gov.au

The Department of Planning, Industry and Environment acknowledges that it stands on Aboriginal land. We acknowledge the traditional custodians of the land and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

From: Denise Galle <DGalle@tweed.nsw.gov.au>
Sent: Friday, 28 June 2019 5:03 PM
To: Scott Hollamby
Cc: Marte Blaker
Subject: RE: 617: Cudgen - Updated SWMP for Consultation (DA08/1266)

Hi Scott,

Staff have reviewed this and said:

It is noted that the Cudgen Lakes Sand Project is approved by the Minister for Planning and regulated by the NSW EPA.

There is reference to the NSW EPA license for land based extractive industry (EPL 12385) and NSW Office of Water for monitoring bore (30BL207143 & 30BL207146) and water supply works (30CA321269). These limit pollution of waters, concentration limits, waste, noise limits, operating hours, and operating conditions. The applicant also notes that a separate and specific Acid Sulfate Soil and Sediment Management Plan has been prepared that addresses the requirements of Office of Water's approval.

Some suggestions include:

1. *NSW EPA advise that Virgin Excavated Natural Material (VENM) cannot contain sulfidic ores or soils. Page 25 of the report advises that material containing actual or potential acid sulfate soil will be accepted as VENM at the site. It is recommended that contact with the EPA Waste Unit for further information regarding VENM. https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste/virgin-excavated-natural-material*

2. *Groundwater quality monitoring suite in Section 6.4.4 Table 6.4 should include turbidity (field test) and suspended solids (laboratory test).*

No objection raised to the intent of the Plan.

I am satisfied with the provisions for flooding, site discharge and sediment control in the draft report.

Hope that helps

Denise Galle
Acting Manager Development Assessment & Compliance
Planning and Regulation Division
Murwillumbah Office
NSW Time

TWEED SHIRE COUNCIL

p (02) 6670 2459
e dgalle@tweed.nsw.gov.au

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Your actions matter: print less to save more

From: Scott Hollamby [mailto:scott@rwcorkery.com]
Sent: Monday, 24 June 2019 2:58 PM
To: Denise Galle
Cc: Colleen Forbes
Subject: 617: Cudgen - Updated SWMP for Consultation

Dear Denise,

Per my phone message, please find attached email and updated Soil and Water Management Plan for the Cudgen Lakes Sand Quarry.

Please don't hesitate to call if you would like to discuss anything.

Many thanks

Scott Hollamby
Senior Environmental Consultant
Mobile: 0437 858 511

RW Corkery & Co Pty Limited
Geological and Environmental Consultants

Local Government PROCUREMENT APPROVED CONTRACTOR

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From: Melissa Hundy <Melissa.Hundy@waternsw.com.au>
Sent: Friday, 5 July 2019 4:13 PM
To: Scott Hollamby
Subject: RE: 617: Cudgen - Updated RMP for Consultation

Hi Scott,

WaterNSW does not have any comments itself in relation to the Soil Water Management Plan and the Rehabilitated Management Plan, however, these documents have been forwarded to Department of Industry – Water (DoI Water) for their review.

DoI Water may respond to you directly or through the Natural Resource Access Regulator, however, if DoI Water provides comments to WaterNSW we will be sure to pass them on.

Regards

Melissa Hundy
Water Regulation Officer

WaterNSW

135 Murwillumbah Street, Murwillumbah NSW 2484
PO Box 796, Murwillumbah NSW 2484
T: 02 9849 9940 **M: 0447 202 523**
melissa.hundy@waternsw.com.au
www.waternsw.com.au

From: Scott Hollamby <scott@rwcorkery.com>
Sent: Monday, 1 July 2019 2:53 PM
To: Melissa Hundy <Melissa.Hundy@waternsw.com.au>
Cc: Peter Hackett <Peter.Hackett@waternsw.com.au>
Subject: 617: Cudgen - Updated RMP for Consultation

Dear Melissa,

Per previous correspondence, please find attached an email and updated Rehabilitated Management Plan for the Cudgen Lakes Sand Quarry.

I will call later in the week to touch base, however, please don't hesitate to call in the meantime if you would like to discuss any matter.

Many thanks

Scott Hollamby
Senior Environmental Consultant
Mobile: 0437 858 511

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From: Scott Hollamby
Sent: Tuesday, 25 June 2019 9:05 AM
To: 'Melissa Hundy' <Melissa.Hundy@waternsw.com.au>
Subject: RE: 617: Cudgen - Updated SWMP for Consultation

Thanks Melissa.

For your information, I have already sent a copy to water.referrals@nrar.nsw.gov.au as well as EPA and Tweed Shire Council.

I am working on the Rehabilitation Management Plan today which also requires consultation. Once circulated I will call to touch base.

If you would like to discuss anything in the meantime, please don't hesitate to call.

Many thanks

Scott Hollamby
Senior Environmental Consultant
Mobile: 0437 858 511

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From: Melissa Hundy <Melissa.Hundy@waternsw.com.au>
Sent: Tuesday, 25 June 2019 8:47 AM
To: Scott Hollamby <scott@rwcorkery.com>
Subject: RE: 617: Cudgen - Updated SWMP for Consultation

Thanks Scott,

I will forward this information onto Department of Industry – Water for their hydrogeologists to make comment.

I doubt, however, that they will provide comments by the 5th July due to current workloads.

Regards
Melissa Hundy
Water Regulation Officer

WaterNSW

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PO Box 796, Murwillumbah NSW 2484
T: 02 9849 9940 **M: 0447 202 523**
melissa.hundy@waternsw.com.au
www.waternsw.com.au

From: Scott Hollamby <scott@rwcorkery.com>
Sent: Monday, 24 June 2019 3:05 PM
To: Melissa Hundy <Melissa.Hundy@waternsw.com.au>
Cc: Peter Hackett <Peter.Hackett@waternsw.com.au>
Subject: 617: Cudgen - Updated SWMP for Consultation

Dear Melissa,

Per discussions with Peter Hackett, please find attached an email and updated Soil Water Management Plan for the Cudgen Lakes Sand Quarry. Per the attached email, a copy of this plan has also been sent to Mr Dane Clarke, Water NSW Algal Coordinator.

Please don't hesitate to call if you would like to discuss any matter.

Many thanks

Scott Hollamby
Senior Environmental Consultant
Mobile: 0437 858 511

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From: Geff Cramb <Geff.Cramb@epa.nsw.gov.au>
Sent: Tuesday, 2 July 2019 5:58 PM
To: Scott Hollamby
Subject: RE: 617: Cudgen - Updated SWMP for Consultation

Dear Scott

In relation to your email correspondence dated 4 June 2019, specifically the update of the Soil and Water Management Plan for the Cudgen Lakes Sand Quarry, as a result of the January 2019 modification of the Project Approval 05_0103 (MOD2).

The EPA do not intend to review and provide comment upon the updated management plan. However, the EPA will undertake compliance reviews against the requirements of Environment Protection Licence 12385 and the implementation of the management plans at their discretion.

Regards
Geff

Geff Cramb
Operations Officer – Environment Management Unit
North Coast, NSW Environment Protection Authority
+61 2 6640 2510

Mon	Tues	Wed	Thurs	Fri
✓	✓	✓	✓	x

geff.cramb@epa.nsw.gov.au www.epa.nsw.gov.au @EPA_NSW
Report pollution and environmental incidents 131 555 (NSW only) or +61 2 9995 5555

From: Scott Hollamby <scott@rwcorkery.com>
Sent: Monday, 24 June 2019 3:02 PM
To: Geff Cramb <Geff.Cramb@epa.nsw.gov.au>
Subject: 617: Cudgen - Updated SWMP for Consultation

Dear Geff,

Per my phone message, please find attached email and updated Soil and Water Management Plan for the Cudgen Lakes Sand Quarry.

Please don't hesitate to call if you would like to discuss anything.

Many thanks

Scott Hollamby
Senior Environmental Consultant
Mobile: 0437 858 511

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Department of Industry

Scott Hollamby
Senior Environmental Consultant
RW Corkery & Co Limited

email: scott@rwcorkery.com

Our ref: OUT21/164

Dear Scott,

12 January 2021

Cudgen Lakes – Soil and Water Management Plan

Thank you for giving the Department of Planning, Industry and Environment – Water (DPIE-Water) the opportunity to review the Cudgen Lakes Soil and Water Management Plan. DPIE-Water has reviewed the plan and has the following comments:

1. Additional nested monitoring bores be installed in the area to the north of the Altona Road realignment and included in the SWMP "Groundwater Monitoring Program" for the purpose of managing site impacts on private bores to the north and northeast of the site.
2. Groundwater Work No. GW300847 should be referenced in the text to be included under the site Groundwater Monitoring Program as per Figure 6.4.

Should you have any further queries in relation to this submission please do not hesitate to contact the Natural Resources Access Regulator's Service Support Team at nrar.servicedesk@dpie.nsw.gov.au.

Yours sincerely

Jane Curran
Acting Licensing and Approvals Manager (East)
Natural Resources Access Regulator
Department of Planning, Industry and Environment

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