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 MP05_0103B (MOD2)

Prepared by:

RWCorkery&co

In conjunction with:

Australasian Groundwater & Environmental Consultants Pty Ltd

HMC Environmental Consulting Pty Ltd

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, Jarrod Blane,
On 23 September 2025

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ABN: 75 093 540 080

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RWCorkery&co

Document Control

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Version 1 – Original document	28/02/14	S. Hollamby (Senior Env Consultant)	NSW P&I	Comments 01/03/14
Version 2 – Address NSW P&I Comments	03/04/14	S. Hollamby (Senior Env Consultant)	NSW P&I	Approved 14/05/14
Version 3 – Update to reflect approved modification to Project Approval (Mod 1) & additional baseline monitoring data.	15/05/17	S. Hollamby (Senior Env Consultant)	NSW DPE	Approved 22/05/17
Version 4 – Updated to reflect Project Approval (MOD2) & revised monitoring & management practices.	24/06/19	S. Hollamby (Senior Env Consultant)	Water NSW Council EPA NRAR	No comments Comments No comments Comments
Version 4b – Updated to reflect comments received.	08/07/19	S. Hollamby (Senior Env Consultant)	DPIE	Comments
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Version 5 – Updated to reflect status of water monitoring bores, water monitoring analytes, and other minor updates.	08/12/2023	I. Devane (Env Consultant) / S. Hollamby (Senior Env Consultant)	Water NSW Council EPA DPE Water	No comments Comments Comments Comments
Version 5b – Update to reflect comments received by EPA, Council, DCCEEW - Water. Update government agency names. Reflect outcomes of Condition 3(25) Groundwater Assessment	31/01/2025	S. Hollamby (Senior Env Consultant)	DPHI	Comments
Version 5c – Update to reflect request for information received from DPHI/DCCEEW	30/05/2025	S. Hollamby (Senior Env Consultant)	DPHI	Comments
Version 5c – Update to reflect request for information received from DCCEEW	11/09/2025	S. Hollamby (Senior Env Consultant)	DPHI	Approved 23/09/2025

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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 previously endorsed by the (then) NSW Department of Planning and Environment (DPE)[1] on 31 May 2019.

The SWMP has been prepared in consultation with the Environment Protection Authority (EPA), Water NSW, the Department of Climate Change, Energy, the Environment and Water (DCCEEW) – Water Group, and Tweed Shire Council. Additionally, Water NSW's Coastal Regional Algal Coordinating Committee was previously consulted and reviewed aspects of the SWMP relating to Blue-Green Algae. A summary of comments received and how these have been addressed and copies of received correspondence is presented in **Appendix 1**.

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. It is noted that filling operations have been approved to occur within the boundaries of the Quarry and are managed separately in accordance with DA 22/0145 (and formerly DA 20/0965) issued by Council. Notwithstanding, Section 4 of the SWMP acknowledges where management aspects may interact between the Quarry activities and approved filling operations.

2. STATUTORY REQUIREMENTS

2.1 PROJECT APPROVAL MP05_0103B

Gales operates the Quarry in accordance with Project Approval (PA) MP05_0103B 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 MP05_0103B 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.

[1] Now Department of Planning, Housing and Infrastructure (DPHI).

Table 2.1
Project Approval Requirements Relating to Soil and Water Management

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
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

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

Cond No.	Requirement	Plan Section
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
5(2)	The Proponent must ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:	6.2, 7.3, 8.3
	a) a summary of relevant background or baseline data;	
	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;	
	- complaints;	EMS
	- non-compliances with statutory requirements;	11.2, 11.3
	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
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

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)		
Minimisation of PASS and VENM(b) acidification and adequate treatment and storage of these materials.	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
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

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)		
Demonstration that adverse impacts arising from Potentially Acid Sulfate Soils and Sediments are not evident on site.	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
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

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

Desired Outcome	Action	Plan Section
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	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.

It is noted that initial discussions with the Natural Resources Access Regulator (NRAR) in 2019 indicate that the Water Supply Works and Use Approval may have been issued in error. This is supported by the fact that, as the Quarry is a State Significant Development, Section 4.41 of the

Environmental Planning and Assessment Act 1979 states that a water use approval or water management work approval under the *Water Management Act 2000* is not required. Notwithstanding, the Water Access Licence and associated water allocation remain valid and are required for the ongoing operations.

Table 2.4
EPL 12385 Requirements Relating to Soil and Water Management

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<table>
<tr><th>Cond No.</th><th>Requirement</th><th>Plan Section</th></tr>
<tr><td>P1</td><td colspan="2">Discharges to Air and Water and Applications to Land</td></tr>
<tr><td>P1.2</td><td>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.
<table>
<tr><th>EPA ID No.</th><th>Type of Monitoring Point</th><th>Type of Discharge Point</th><th>Location Description</th></tr>
<tr><td>1</td><td>Water Quality Monitoring Point</td><td>Water Quality Monitoring Point</td><td>Dredge Pond South Spillway West</td></tr>
<tr><td>2</td><td>Water Quality Monitoring Point</td><td>Water Quality Monitoring Point</td><td>Dredge Pond South Spillway East</td></tr>
<tr><td>4</td><td>Groundwater Monitoring – MB15</td><td>-</td><td>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.</td></tr>
<tr><td>5</td><td>Groundwater Monitoring – MB10</td><td>-</td><td>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.</td></tr>
<tr><td>6</td><td>Groundwater Monitoring – MB11</td><td>-</td><td>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.</td></tr>
</table></td><td>7.8

6.4.2</td></tr>
<tr><td>L1</td><td colspan="2">Pollution of Waters</td></tr>
<tr><td>L1.1</td><td>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.</td><td>4, 7.2</td></tr>
<tr><td>L1.2</td><td>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.</td><td>7.8</td></tr>
<tr><td>L1.3</td><td>The licensee must take all practical measures to avoid or minimise TSS, pH etc. contained in wet weather discharges.</td><td>7.2</td></tr>
<tr><td>L2</td><td colspan="2">Concentration Limits</td></tr>
<tr><td>L2.1</td><td>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.</td><td>6.4, 7.5, 8.6</td></tr>
<tr><td>L2.2</td><td>Where a pH quality limit is specified in the table, the specified percentage of samples must be within the specified ranges.</td><td>6.4, 7.5, 8.6</td></tr>
<tr><td>L2.3</td><td>To avoid any doubt, this condition does not authorise the pollution of waters by any pollutant other than those specified in the table\s.</td><td>6.4, 7.5, 8.6</td></tr>
<tr><td>L2.4</td><td>Water and/or Land Concentration Limits.
Point 1, 2
<table>
<tr><th>Pollutant</th><th>Unit of Measure</th><th>50 Percentile Concentration Limit</th><th>90 Percentile Concentration Limit</th><th>3DGM Concentration Limit</th><th>100 Percentile Concentration Limit</th></tr>
<tr><td>Oil & Grease</td><td>Visible</td><td>-</td><td>-</td><td>-</td><td>Nil</td></tr>
<tr><td>pH</td><td>pH</td><td>-</td><td>-</td><td>-</td><td>6.5 – 8.5</td></tr>
<tr><td>TSS</td><td>mg/L</td><td>-</td><td>-</td><td>-</td><td>50</td></tr>
</table></td><td>6.4, 7.5</td></tr>
</table>

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

Cond No.	Requirement	Plan Section
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
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

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

<table>
<tr><th>Cond No.</th><th>Requirement</th><th>Plan Section</th></tr>
<tr><td>M2.1</td><td>Water and/ or Land Monitoring Requirements
Point 1, 2
<table>
<tr><th>Pollutant</th><th>Unit of Measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Oil and Grease</td><td>Visible</td><td>Special Frequency 1</td><td>Visual Inspection</td></tr>
<tr><td>pH</td><td>pH</td><td>Special Frequency 1</td><td>Probe</td></tr>
<tr><td>Total Suspended Solids</td><td>Milligrams per Litre</td><td>Special Frequency 1</td><td>Grab Sample</td></tr>
</table>
Point 4, 5, 6
<table>
<tr><th>Pollutant</th><th>Unit of Measure</th><th>Frequency</th><th>Sampling Method</th></tr>
<tr><td>Ammonia</td><td>Milligrams per Litre</td><td>Yearly</td><td>Grab Sample</td></tr>
<tr><td>Chloride</td><td>Milligrams per Litre</td><td>Yearly</td><td>Grab Sample</td></tr>
<tr><td>Electrical Conductivity</td><td>Microsiemens per Centimetre</td><td>Yearly</td><td>Grab Sample</td></tr>
<tr><td>Oil and Grease</td><td>Milligrams per Litre</td><td>Yearly</td><td>Grab Sample</td></tr>
<tr><td>pH</td><td>pH</td><td>Yearly</td><td>Grab Sample</td></tr>
<tr><td>Standing Water Level</td><td>Metres (AHD)</td><td>Yearly</td><td>No Method Specified</td></tr>
<tr><td>Sulfate</td><td>Milligrams per Litre</td><td>Yearly</td><td>Grab Sample</td></tr>
<tr><td>Total Suspended Solids</td><td>Milligrams per Litre</td><td>Yearly</td><td>Grab Sample</td></tr>
</table></td><td>6.4, 7.5</td></tr>
<tr><td>M2.3</td><td>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.</td><td>7.8</td></tr>
<tr><td>M3</td><td>Testing Methods – Concentration Limits</td><td></td></tr>
<tr><td>M3.1</td><td>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.</td><td>6.4, 7.5</td></tr>
</table>

Table 2.5
Monitoring Bore Licences - 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

3. SITE WATER BALANCE

3.1 INTRODUCTION

Schedule 3 Condition 19 of Project Approval MP05_0103B 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. This water balance was further reviewed by AGE Consultants (2024) as part of an updated Groundwater Assessment required by *Schedule 3 Condition 25*. 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.

Water inputs to the system include:

- rainfall;
- groundwater inflows from the surrounding sand aquifer; and
- return tailwater (from processing and return water from sand hydraulically transferred to fill sites).

Table 3.1 presents the rainfall and evaporation data from surrounding Bureau of Meteorology Stations. Rainfall in the region is high, and a range of factors including the flat floodplain, the highly permeable sandy soils, the shallow water table, lack of significant deep rooted vegetation cover, and the fact that net rainfall regularly exceeds evaporation combine to result in very high recharge rates to the sand aquifer system.

As the extraction pond is surrounded by bunding to separate external stormwater runoff from the extraction area, the catchment for rainfall recharge is effectively only the area of the extraction pond (i.e. the pond does not capture surface water runoff).

Rainfall recharge to the surrounding sand aquifer is expected to be relatively high at between 20% and 40% of annual rainfall. Rain falling on the extraction pond itself represents a 100% recharge rate. Rainfall within the bunded area surrounding the lake would also represent close to 100% recharge.

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 processing 100% of the 'tailwater' is returned to the extraction pond. However, when hydraulically transferring sand to surrounding fill sites approximately 90% of the water will be returned to the extraction pond via a 'tailwater' pipeline. This accounts for seepage at the capture point in the fill site and, 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 associated with Quarry operations include the following.

- Water lost through inflows to replace the physical component of sand extracted below the water table (up to a maximum of 455ML/year).
- 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 up to 55ML per year) It is noted that since operations have commenced revegetation has occurred with no watering required.
- 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. 450,000m3 of sand hydraulically transferred to fill sites), this would equate to 135ML (assuming 1:3 sand to water ratio).
- Evaporation from the extraction pond (rainfall generally exceeds evaporation).

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.

During years in which evaporation exceeds rainfall (5 years in the past 54 years) an overall loss from the system may be considered to occur when assessed on a single water year (i.e. not accounting for any carry over of excess water recharge). Based on the recorded net annual evaporative losses of between 49mm and 554mm and the maximum approved extraction pond size of 46ha, this equates to a 'loss' of between 22.5ML and 255ML. Given that the extraction pond is considered likely to have reached a 'dynamic equilibrium' with the surrounding aquifer, as agreed with the (then) DPE Water for the adjoining Tweed Sand Plant, evaporation is not considered a licensable water take.

It is highly unlikely that all outputs would be required and/or required at the maximum estimated output during any one water year. 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). 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.

In addition to water losses resulting from Quarry operations, it is noted that water losses also occur via the large network of shallow drains across the Tweed River Flood Plain which ultimately drain to the Tweed River. These drains were established in the early 1900s to minimise inundation, originally for cane farming and other agricultural activities, including grazing. As such, 'discharge' into the drains has and will continue to occur with or without Quarry operations. As the Quarry operations do not act to increase discharge via the drainage network, water losses via the drainage network are not included within the Quarry water balance. However recent hydrological modelling by Venant has shown that the large drain in the northern part of the site is not needed for local drainage, but can "discharge" groundwater into the drains, which has been confirmed by AGE Consultants. Discussions are ongoing with Council relating to this matter. Notwithstanding, water quality interactions have been considered and are further addressed in Section 7.

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.

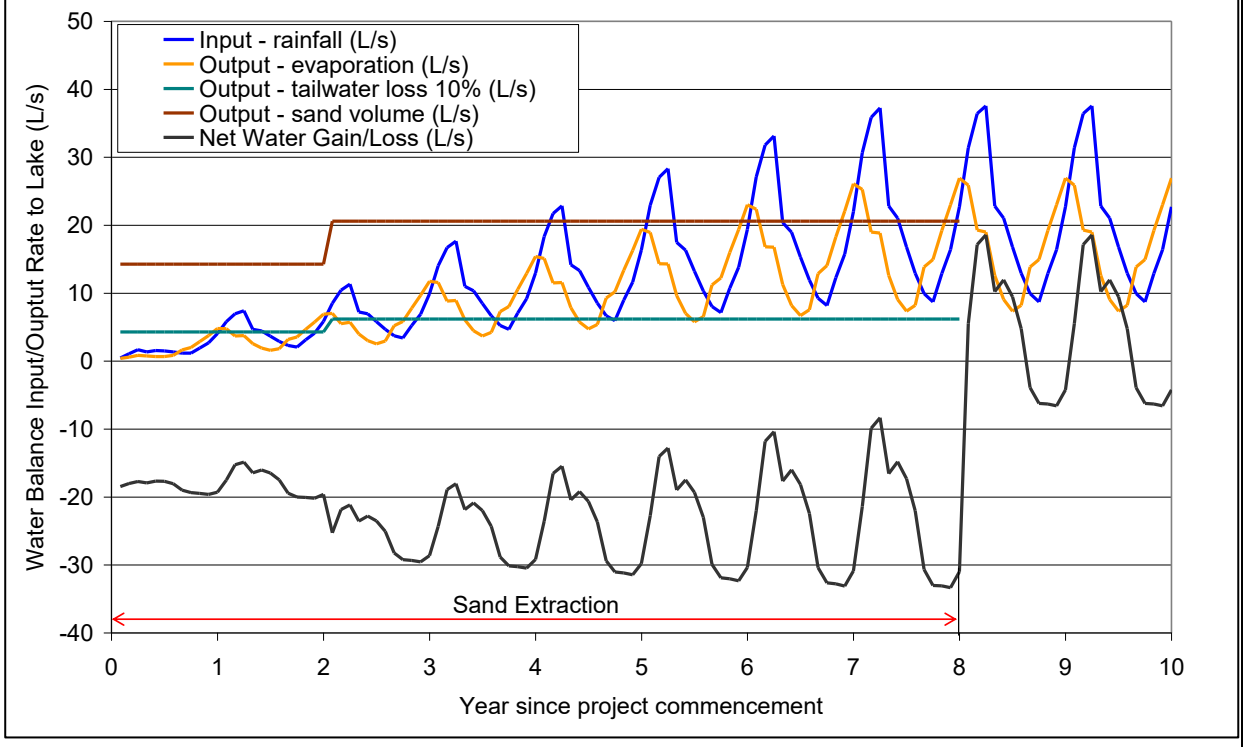

Figure 3.1
WATER BALANCE FOR EXTRACTION POND

(Source: AGEC (2008) – Figure 16)

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.

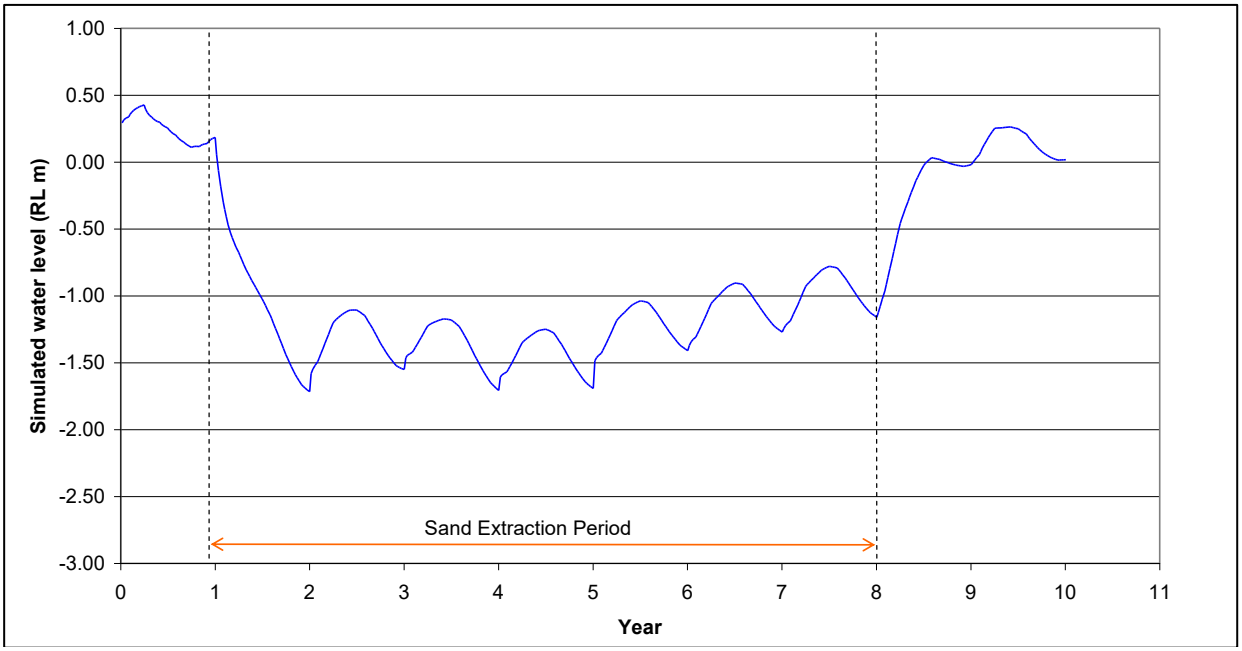

Figure 3.2
SIMULATED EXTRACTION POND WATER LEVEL

(Source: AGEC (2008) – Figure 20)

Table 3.2 presents the peak water take for two scenarios, namely years during which hydraulic transfer occurs to fill sites, and years in which no hydraulic transfer occurs.

Table 3.2
Peak Water Take

Peak Water Take Component	With Hydraulic Transfer (ML)	Without Hydraulic Transfer (ML)
Inflows due to sand removal	455	140
Incorporation into products	20	20
Dust suppression	35	35
Watering rehabilitation	55	55
Tailwater loss	135	0
Total	**700**	**250**
Evaporative loss	Variable	Variable

As outlined in Section 3.3, in the majority of years there is a net positive input of rainfall above evaporative outputs. However, the maximum net evaporative loss based upon the maximum lake size and highest evaporative loss over the past 54 years is 255ML.

As such, in the event that long-range weather forecasts predict a below average rainfall year a review of the planned activities will be undertaken to ensure that total water take does not exceed the licenced water allocation (currently 700ML). This could readily be achieved for even an extreme drought year through delay or reduction in any planned hydraulic transfer of sand to fill sites.

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 when hydraulically transferring to fill sites.
- Daily inspections of the piped water transfer point between extraction operations north of the existing Altona Road and the processing area when operations are occurring north of the existing Altona Road.
- Avoidance of unnecessary or excessive use of the water cart.
- Seeking approval to fill in the large drain near the northern boundary of the site to reduce groundwater "drainage". This has already been discussed with Council but without Council agreement to date.

If required, the intensity of activities (specifically hydraulic transfer to fill sites) will be reduced to ensure that drawdown and water take remain within the predicted and licensed limits.

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 MP05_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).

Some activities within the Quarry will be subject to defined erosion and sediment controls from other approvals, such as fill approvals DA 20/0965 and DA 22/0145 and Altona Road relocation. **Figure 4.1** displays the location of the approved filling operations in relation to the approved Quarry activities. The following applies where specific controls have not been required by other specific approvals and, where relevant, management aspects that may interact with the Quarry activities are identified.

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;
  - placement of pipes and channels related to hydraulic transfer of water and sand between the lakes north and south of Altona Road; and
  - construction of internal access roads.
- Activities associated with the realignment of Altona Road and the decommissioning of the existing Altona Road.

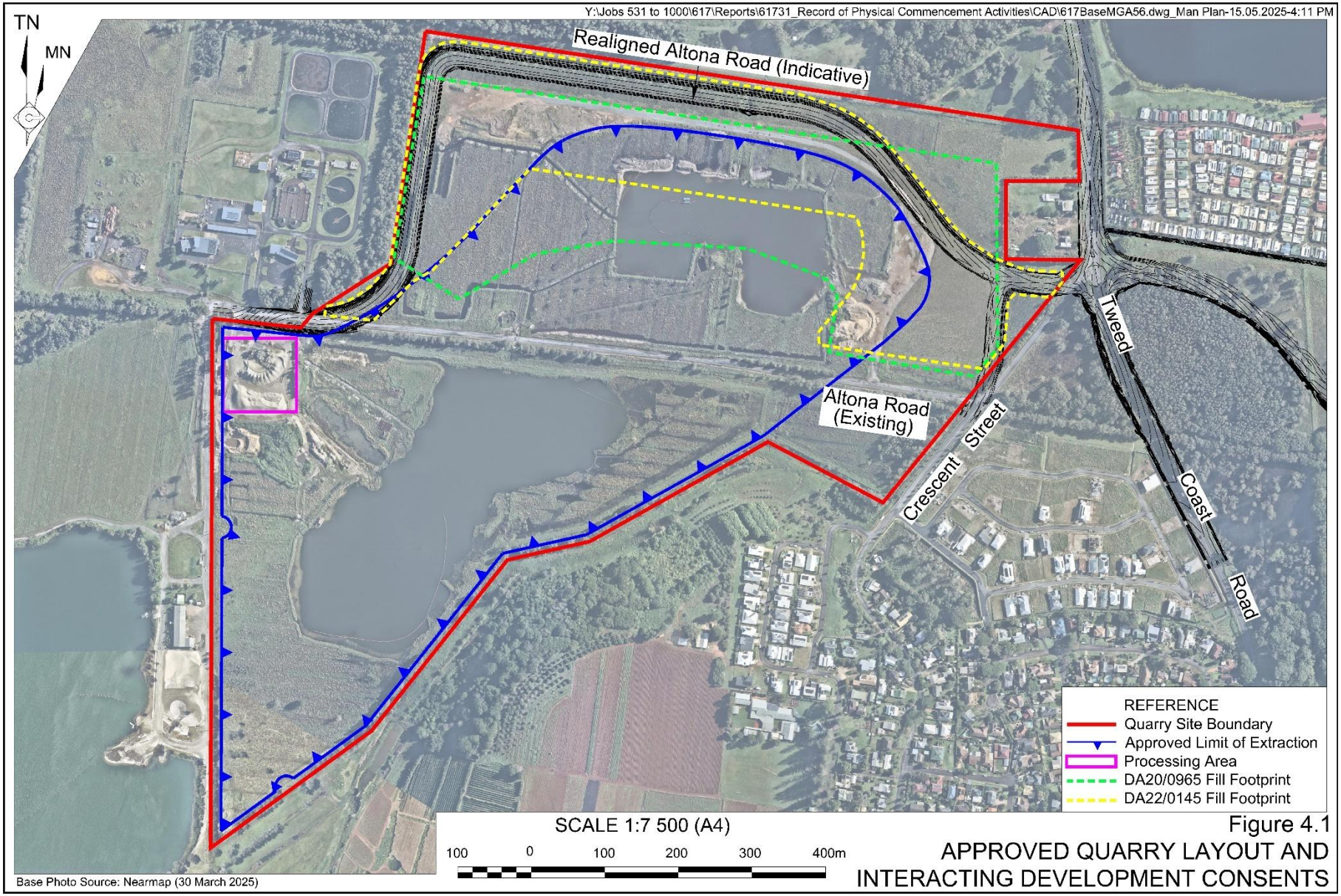

Figure 4.1
APPROVED QUARRY LAYOUT AND INTERACTING DEVELOPMENT CONSENTS

- 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.

Filling activities approved under DA 20/0965 and DA 22/0145 also have the potential to cause erosion and generate sediment laden runoff through both soil stripping activities and placement of fill material (prior to stabilisation with groundcover).

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 removed during the realignment of Altona Road with drainage for the new alignment in accordance with the development approval for the Altona Road realignment. Therefore, specific controls relating to the construction of a 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 consistent with Council approvals.
- Construction of bunding surrounding the extraction areas up to a maximum height of 1.8m AHD 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 to allow controlled overtopping of the bunds in the event of a flood.
- Ensuring material stockpiled for processing and backfilling activities is located within either the processing area or bunded area within the Quarry.
- Installation of rock armouring around selected edges of the final extraction pond in the event that the area cannot be stabilised utilising vegetation.

Erosion and sediment control measures for filling operations approved under DA 20/0965 and DA 22/0145 will be managed in accordance with the Erosion and Sediment Control Plan approved as part of those operations. As the approved fill areas will raise the level of the land to 2.2m AHD, where areas have been filled to 2.2m AHD adjacent the extraction area, additional bunding to 1.8m AHD would not be constructed. It is noted that runoff from filled areas in DA 22/0145 (which supersedes DA 20/0965) is to be directed southwards, i.e. towards the extraction area whilst the external batters of the filled areas direct water away from the extraction area. This effectively provides the function of clean and dirty water diversion as intended to be provided by the 1.8m AHD bunding.

Topsoil stripped in advance of filling operations may also be stockpiled within the bunded area. No further management measures are required given this will be located within the bunded area, as per topsoil stripped for Quarry activities.

Although filling will follow extraction wherever possible, where filled areas are required to be extracted, extraction will occur from the inner boundary adjacent the active extraction area with any runoff from disturbed areas continuing to be internally draining. Any retained batters with filled areas will be subsequently stabilised with groundcover.

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);

- daily inspections of the piped water transfer point and any penetrations of bunds between extraction operations north of the existing Altona Road and the processing area when operations are occurring north of the existing Altona Road;
- regular inspections (monthly or following rainfall greater than 25mm / day resulting in runoff[2]) 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[2]) inspections of access tracks / unsealed roads outside of bunded areas 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.

[2] 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 MP05_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).

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. Hereafter VENM(a) is referred to as VENM in accordance with current nomenclature.

  – VENM(b) – natural excavated materials that contain ASS or PASS. Hereafter VENM(b) is referred to as Acid Sulfate Soil Material (ASSM) in accordance with current nomenclature.

The receipt of VENM will require appropriate validation and verification protocols in accordance with the standard EPA VENM certificate. Any ASSM received will require specific management. ASSM 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. Received material will be managed in accordance with the requirements of EPL 12385 and the applicable 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. In this case 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[3] 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.
- 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.

[3] 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.

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

  Note: Written acceptance from DCCEEW – Water 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 Acid Neutralising Capacity Net Acidity	OR Positive 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 AND ASSM

5.4.1 VENM Verification Procedures

Prior to acceptance of any VENM on site, the Quarry Operator will receive and review the VENM Certificate to ensure it confirms to all requirements of the standardised NSW EPA VENM Certificate and is appropriately signed and dated.

5.4.2 Imported ASSM Management Procedures

The following management procedures will be implemented for the management of imported ASSM.

- Confirmation of the material in accordance with the requirements of the standardised NSW EPA VENM Certificate with the exception that the material is ASSM.
- Placement of ASSM 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 ASSM 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 ASSM 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 ASSM 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 ASSM receipt and processing / internment.

Table 5.2
Imported ASSM Testing and Related Monitoring

Monitoring Site	Period	Frequency	Tests	Action criteria
Imported ASSM	Ongoing	1 sample from each load immediately prior to placement	pH(1)	<5.5
Extraction Pond Water	During placement of imported ASSM	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 following 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 imported ASSM 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.

- Prepare a 'Rejected Loads Register' to record all relevant information about any loads of material that are rejected from the premises (or that are accepted and then identified as not being VENM or ASSM).
- As soon as possible after becoming aware that any waste / material accepted at the premises is not VENM or ASSM, the Proponent will:
  a) have the material returned to the point of origin and add this to the 'Rejected Loads Register';
  b) in the event that material cannot be returned to the point of origin (for any reason), notify the EPA in writing;
  c) classify the material in accordance with EPA's Waste Classification Guideline to determine how and demonstrate that it can be disposed of lawfully;
  d) have the material / waste removed from the premises for disposal at a facility licenced to take such waste;
  e) record all relevant details on the 'Rejected Loads Register'; and
  f) 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 ASSM, 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 MP05_0103B. 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.

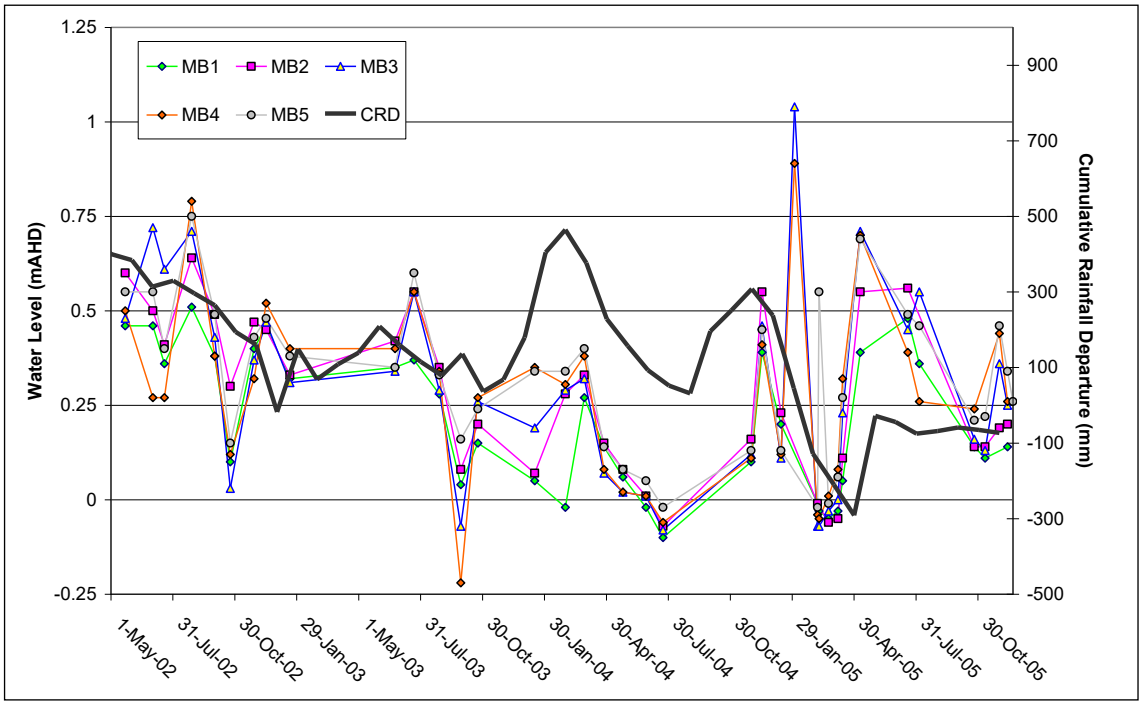

Figure 6.1
HYDROGRAPHS MONITORING BORES MB1 TO MB5 AT THE QUARRY

Source: AGEC (2008) – Figure 8

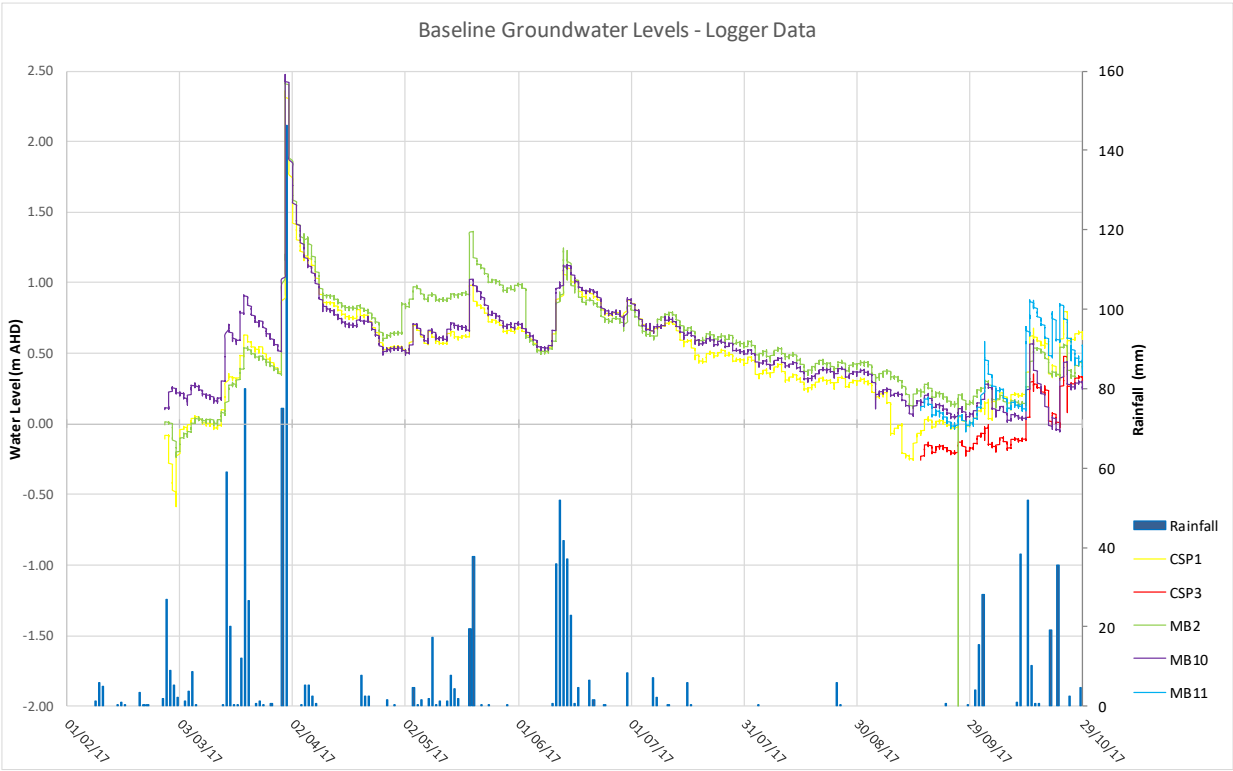

Figure 6.2
HYDROGRAPHS OF MONITORING BORES – LOGGER DATA 2017

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 6.1 (data recorded between 2002 and 2024) 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.

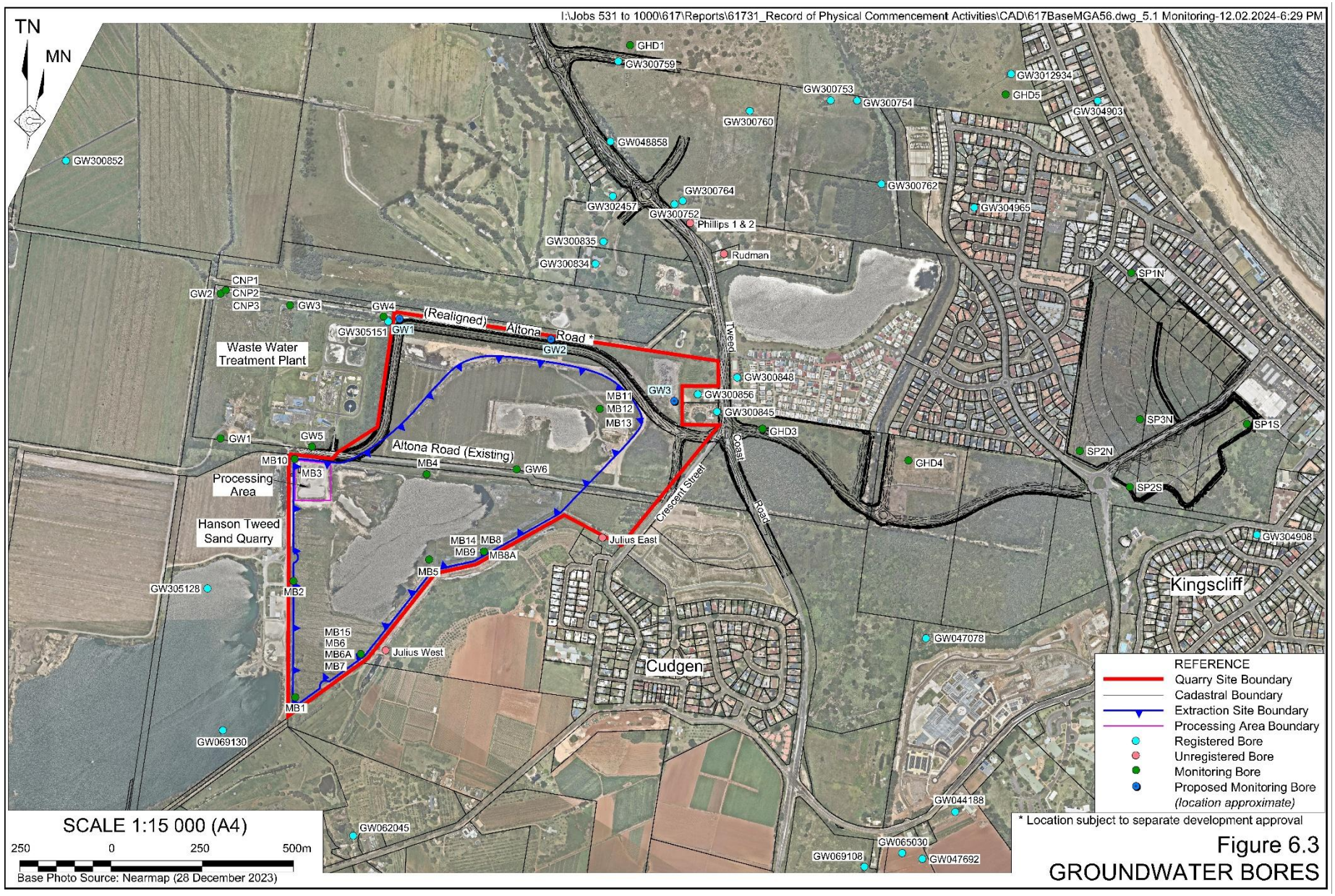
I:\Jobs 531 to 1000\617\Reports\61731_Record of Physical Commencement Activities\CAD\617BaseMGA56.dwg_5.1 Monitoring-12.02.2024-6:29 PM
TN
MN
GHD1
GW300759
GW300753
GW300754
GW3012934
GHD5
GW304903
GW300760
GW048858
GW300852
GW300764
GW300762
GW302457
GW300752
GW304965
Phillips 1 & 2
GW300835
Rudman
GW300834
SP1N
CNP1
GW2
CNP2
CNP3
GW3
GW4
(Realigned) Altona Road *
GW305151
GW1
GW2
Tweed
Waste Water Treatment Plant
GW300848
GW3
MB11
GW300856
MB12
GW300845
MB13
GHD3
SP3N
SP1S
GW1
GW5
Altona Road (Existing)
SP2N
MB10
MB4
GW6
GHD4
MB3
Processing Area
Coast
Crescent Street
Road
SP2S
Hanson Tweed Sand Quarry
GW304908
MB14
MB8
MB9
MB8A
Julius East
MB5
Kingscliff
GW305128
MB2
MB15
MB6
MB6A
MB7
Julius West
GW047078
Cudgen
MB1
GW069130
GW044188
GW062045
GW065030
GW069108
GW047692
REFERENCE
Quarry Site Boundary
Cadastral Boundary
Extraction Site Boundary
Processing Area Boundary
Registered Bore
Unregistered Bore
Monitoring Bore
Proposed Monitoring Bore
(location approximate)
* Location subject to separate development approval
SCALE 1:15 000 (A4)
250 0 250 500m
Base Photo Source: Nearmap (28 December 2023)
Figure 6.3
GROUNDWATER BORES

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	576-1854	77-193	13-36	23-58	4-5	10-492	35-124	110-292	0.24-22.00	0.01-0.14	0.11-0.46	0.6-0.7	0.01	0.28-0.39	10	10
			Operational[2]	6.13-9.0	74-1327	6-132	3-13	11-44	3-9	1-27	20-115	24-596	0.05-19.40	0.01-0.05	0.04-1.28	0.01-6.60	0.01-0.34	0.01-4.99	2-40	8-20
			Non-Operational[3]	6.6-7.4	593-1327	83-132	8-12	21-44	3-5	1-20	23-48	277-596	0.05-19.40	0.01-0.05	0.11-0.28	0.4-2.6	0.01-0.02	0.29-1.44	10	10-20
	MB2	2.3-5.3	Baseline	4.6-7.7	88-2394	0-2	0.2-2	12-23	4-20	1-27	10-45	7-60	3.12-9.5	0.43-6.37	0.07-0.08	0.6-0.8	0.01	0.19-0.29	10	10
			Operational[2]	4.7-7.42	38-882	1-25	1-15	2-119	3-26	1-159	6-189	1-40	0.05-37.4	0.04-0.62	0.02-0.26	0.01-2	0.01-0.28	0.01-0.77	1-930	1-560
			Non-Operational[3]	4.9-7.2	158-882	2-25	1-8	17-116	4-14	11-134	33-189	1-28	4.66-35.5	0.11-0.27	0.02-0.12	0.0-1.6	0.01	0.14-0.58	10-930	10
	MB3[4, 5]	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	94-7500	24-292	77-2490	194-14750	247-852	0.01-1.96	0.01-0.34	2.71-3.32	152-162	0.18-1.20	136-158	10	20
			Operational[2]	6.5-8.1	73-52530	30-293	16-1170	27-7610	6-254	64-1910	39-12300	342-1170	0.01-0.10	0.01-0.10	0.01-3.35	0.34-186	0.01-2.26	0.13-174	1-1600	3-39000
			Non-Operational[3]	7.1-7.7	73-52530	169-272	927-1170	6040-7610	198-254	1600-1910	10500-12300	955-1170	0.05-0.27	0.01-0.10	0.88-2.71	2.9-78.2	0.01-0.17	22.4-31.2	10-1600	10-520
	MB4[4, 5]	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, 5]	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, 5]	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[5]	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[5]	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, 5]	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, 5]	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	8-123	135-271	0.59-9.82	0.01-0.26	0.24-0.28	0.6-2.0	0.01-3.10	0.28-0.60	10	30
			Operational[2]	6.5-9.8	599-1643	113-211	13-27	5-78	13-19	9-294	22-115	243-555	0.05-0.74	0.01-0.05	0.11-0.96	0.01-5	0.01-0.37	0.01-5.44	1-370	1-41000
			Non-Operational[3]	7.2-7.6	741-1643	160-211	22-27	5-24	14-16	133-268	27-40	267-458	0.05-0.74	0.01-0.05	0.20-0.64	0.8-4.2	0.01-0.35	0.01-4.42	10-370	10-260
	CSP2[5]	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	6-33	12-36	1-16	1-329	20-177	172-327	0.59-6.3	0.01-0.41	0.46-0.50	1.2-1.4	0.01	0.37-0.66	10	10
	MB14	4.4-5.9	Operational[2]	6.4-8.2	137-2296	22-154	6-39	20-182	2-10	7-181	17-491	71-321	0.05-22.9	0.01-0.16	0.05-0.43	0.01-3.2	0.01-0.37	0.01-3.29	1-20	10-1450
			Non-Operational[3]	6.8-8.2	487-2296	44-154	12-39	30-182	5-8	25-181	42-491	154-218	0.05-6.06	0.01-0.02	0.08-0.36	0.10-1.10	0.01-0.15	0.01-0.12	10	10-50
	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	0.01	0.12-0.26	10	1900
			Operational[2]	3.9-8.4	450-1170	28-83	8-23	10-144	6-14	4-138	23-121	128-228	0.05-0.81	0.01-0.10	0.05-0.78	0.01-4.8	0.01-0.46	0.01-1.41	1-490	10-43000
			Non-Operational[3]	3.2-8.4	627-1170	41-83	13-20	60-124	8-13	4-91	79-121	178-228	0.05-0.58	0.01-0.05	0.12-0.23	0.20-4.80	0.01-0.34	0.04-0.65	10-490	10-310
Northern (North of existing Altona Road)	**CNP3[5]**	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[5]	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[5]	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	235-432	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]	5.3-7.7	158-2871	2-592	1-173	13-103	2-17	11-2240	14-155	3-500	0.05-57	0.01-0.27	0.08-1.37	0.1-11.8	0.01-1.3	0.01-9.71	1-1120	1-440000
			Non-Operational[3]	5.3-7.8	158-1935	2-201	1-54	17-85	4-12	11-387	33-115	3-500	0.08-4.66	0.01-0.27	0.2-1.37	1.2-11.8	0.01-0.56	0.24-9.71	10	10-4200
	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	0.01-0.74	0.11	0.06	0.01	0.33-0.34	10	10
			Operational[2]	6.4-7.6	996-2667	140-373	16-49	21-108	8-12	94-814	35-474	193-378	0.05-17.70	0.01-0.05	0.01-0.32	0.01-1.50	0.01-0.50	0.01-0.67	1-20	5-57000
			Non-Operational[3]	6.9-7.3	1580-2667	259-371	35-43	29-79	10-12	596-771	72-122	268-324	0.05-13.60	0.01-0.05	0.01-0.03	0.20-0.80	0.02-0.44	0.01-0.38	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	194-534	0.05-19.0	0.01-0.75	0.27-0.56	0.80-2.90	0.02-0.30	0.14-2.59	10	750
			Operational[2]	6.0-7.4	5784-46890	276-632	169-1070	458-7080	37-204	1130-2320	1100-12100	397-597	0.05-11.7	0.01-0.05	0.02-1.2	0.01-11.5	0.01-2.05	0.02-9.21	1-67000	10-78000
			Non-Operational[3]	6.0-7.3	29235-46890	430-609	821-1070	5200-6820	147-186	1860-2270	10500-11500	468-597	0.05-11.70	0.05	0.06-1.00	1.4-11.5	0.01-0.05	1.03-9.21	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 17 April 2020
4. Bores damaged / removed and no longer operational
5. Data sourced from AGE (2008)

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

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*	-	6.7-7.2	5.2-6.1	7.0-7.3	7.0-7.3	6.9-7.5	7.0-7.5	6.8-7.3	7.0-7.7	7.3-7.8	6.8-7.3	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	6.7-7.2	6.9-7.4	7.0-7.3	5.1-6.4	5.6-7.0
EC	uS/cm	1022	525	1180	2612	2132	1619	2039	800	752	689	1039	1414	6128	3208	4750	22142	16490	44934	37644	33594	1021	22142	228	164
Na	mg/L	36	70	35	317	257	44	87	81	87	24	25	206	1027	545	770	3168	ND	ND	7104	6518	25	4044	16	13
Ca	mg/L	117	8	133	101	106	193	333	70	56	136	187	86	104	79	80	193	ND	ND	235	606	183	245	3	4
Mg	mg/L	12.2	5	38	42	51	53	46	20	17	18	24	22	104	55	80	392	ND	ND	1100	1016	23	615	5	2
K	mg/L	5	14	10	20	22	11	12	6	10	13	15	5	42	22	32	106	ND	ND	241	174	9	141	1	2
Cl	mg/L	48	118	51	586	312	52	257	105	97	54	63	276	1856	921	1144	5501	ND	ND	12280	11480	44	7288	23	20
SO_4	mg/L	102.2	77	238	94	278	358	705	46	53	108	225	26	526	254	323	875	ND	ND	1798	2150	216	1258	5	7
HCO_3	mg/L	329	22	212	246	246	360	329	203	215	330	364	214	198	177	219	444	ND	ND	1124	540	270	691	10	10
Al	mg/L	0.01	0.78	0.05	0.09	0.07	0.02	0.01	0.01	0.01	0.16	0.05	0.20	0.22	0.11	ID	0.42	ND	ND	0.05	0.05	0.11	0.61	0.03	0.57
As	mg/L	0.001	0.065	ND	ND	ND	0.001	0.001	0.001	0.001	ID	0.001	ND	ND	ND	ND	ND	ND	ND	0.005	0.005	ID	ND	0.001	0.019
Fe	mg/L	11.62	19.82	1.71	5.76	3.41	3.57	7.65	2.10	0.27	14.60	3.00	13.68	2.28	0.52	5.94	22.00	ND	ND	0.27	7.00	6.07	16.00	0.05	4.78
Total P	mg/L	0.23	0.13	ND	ND	ND	0.62	0.09	0.25	0.28	ID	0.65	ND	ND	ND	ND	ND	ND	ND	2.08	0.58	0.82	ND	0.05	0.32
Total N	mg/L	1.4	1.5	ND	ND	ND	3.02	0.6	0.5	0.88	ID	3.8	ND	ND	ND	ND	ND	ND	ND	104.9	5.0	2.0	ND	5.4	1.1
Ammonia	mg/L	0.68	0.41	ND	ND	ND	2.01	0.37	0.10	0.45	ID	3.04	ND	ND	ND	ND	ND	ND	ND	44.5	4.62	0.95	ND	0.05	0.20
NOx	mg/L	0.05	0.01	ND	ND	ND	0.25	0.38	0.02	0.03	ID	0.02	ND	ND	ND	ND	ND	ND	ND	0.99	0.45	0,07	ND	5.31	0.02

^ Data recorded up to October 2023. *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.

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.

In response to feedback from DCCEEW Water further review has also been undertaken of iron concentrations. To understand the iron results, it is necessary to understand the environmental behaviour of iron in water. The adjacent Tertiary basalt plateau is comprised of ferromagnesian rocks rich in pyroxenes, amphibole, biotite and magnetite that are rich in iron, and a source for the adjacent and downgradient sand aquifer. The concentration of dissolved iron in aqueous solution is affected by environmental conditions especially the oxidation reduction conditions (redox state) and pH. Generally reducing conditions with the absence of dissolved oxygen allow for considerable concentrations of dissolved ferrous iron to occur in solution. When these waters become oxygenated by exposure to the atmosphere dissolved ferrous iron will precipitate to the ferric form, ferric hydroxide.

The sensitivity of iron concentrations to redox state and the availability of dissolved oxygen is evident in the water quality data recorded within and surrounding the site. As shown in **Table 6.1**, the pre-extraction baseline concentrations of iron in all groundwater monitoring bores exceeded the DECCW Water objective for Tweed River of 0.3mg/L (noting that the adopted Tweed River Water Quality Objectives do not specify an objective for iron and that a concentration of 0.3mg/L is consistent with the Australian Drinking Water Guidelines). Because of the naturally reducing environment and lack of dissolved oxygen in the groundwater regime a number of samples also exceed the 20mg/L objective within the previously approved versions Soil and Water Management Plan and original Project Approval 05_0103.

6.3 GROUNDWATER ASSESSMENT CRITERIA

6.3.1 Groundwater Levels

Groundwater levels within the dredge pond are not to reduce below minus 1.5m AHD. This drawdown is slightly above the maximum predicted drawdown (AGE Consultants, 2008) and also ensures that drawdown beyond the extraction pond cannot exceed the Aquifer Interference Policy minimal impact consideration of 2m decline at any water supply work.

Any decrease below this level is considered a ‘significant decrease’ and requires investigation in accordance with the trigger action responses (see Section 6.5).

6.3.2 Groundwater Quality

The original conditions for PA MP05_0103B 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 and should not be considered as a non-compliance.

Table 6.3
Groundwater Quality Objectives

Parameter	Units	All bores*	MB2^	MB10^	MB13^
pH	-	6.5-8.5	5.2-8.5	-	-
EC	uS/cm	<3,000	-	37,644	33,594
Na	mg/L	<500	-	7104	6,518
Mg	mg/L	<100	-	1,100	1,016
K	mg/L	<40	-	241	174
Cl	mg/L	<1,000	-	12,280	11,480
SO_4	mg/L	<800	-	1,798	2,1500
HCO_3	mg/L	<400	-	1,124	540
Al	mg/L	<0.5	0.78	-	-
Fe	mg/L	<20	-	-	-
Ammonia	mg/L	<20	-	105	-

*Unless value otherwise specified in this table.

^Objectives based on 80th percentile of all previous data except pH which utilises the 20th percentile as the lower limit.

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. This bore was damaged and will be re-instated as a nested (shallow and deep) bore.
- 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 close to the bores being replaced and 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.

CSP1–CSP2–CSP3: nested monitoring bores located west of the initial dredge pond and south of the existing Altona Road was removed during 2023 with that area being incorporated into the dredge pond (and therefore monitored via the monitoring locations within the pond). Existing bores MB1, MB2, MB10, MB14, and MB15 provide adequate geographic coverage for ongoing monitoring in this area.

It is noted that nested bores MB11-MB12-MB13 will be removed due to ongoing extraction activities are the nested bores. Prior to their removal they will be replaced through the installation of an additional three nested bores (each with one shallow and one deep bore) to the northwest, north, and northeast of the extraction area. These bores are currently notated as GW1, GW2 and GW3 (see **Figure 6.4**).

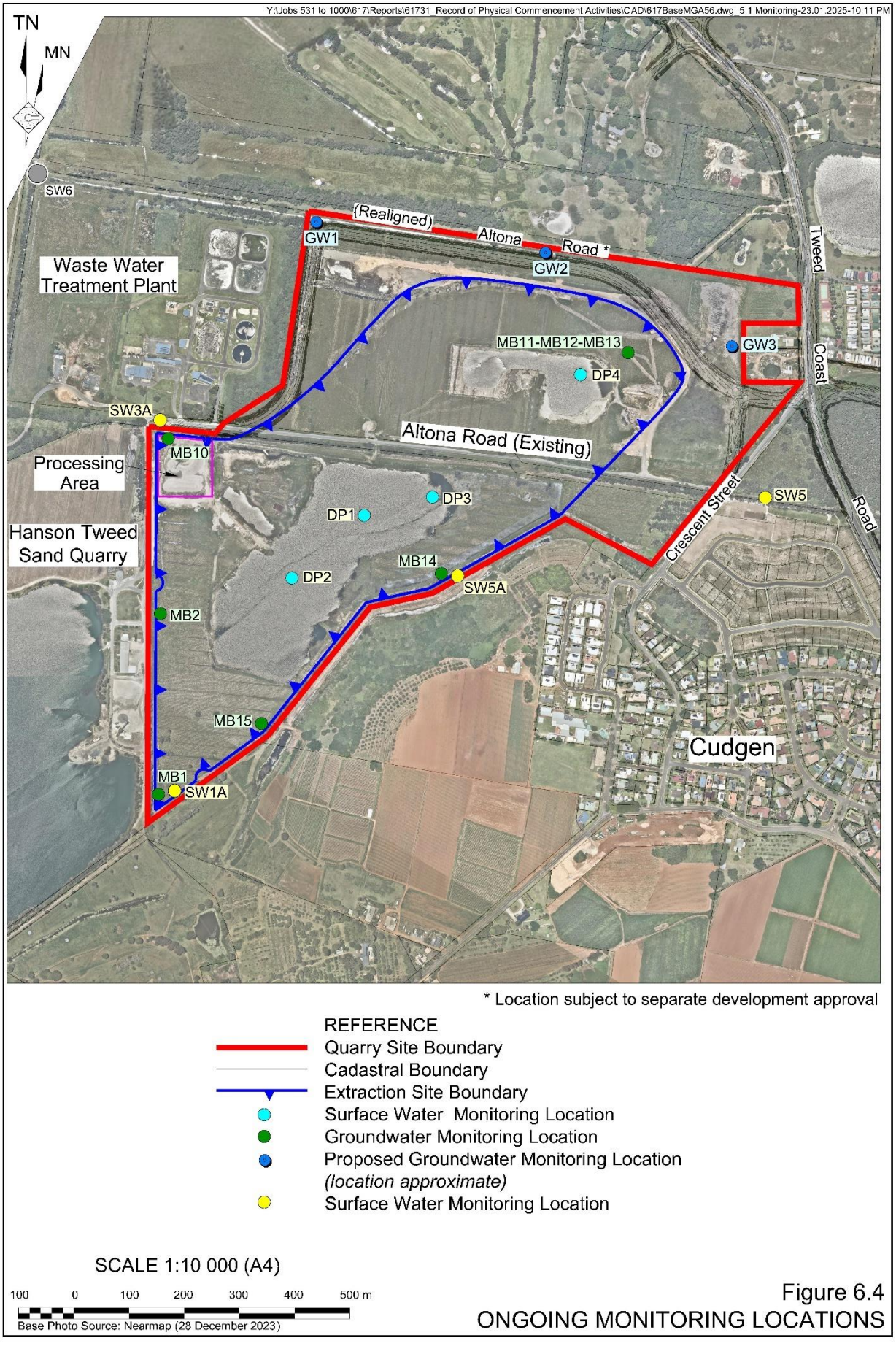

Figure 6.4
ONGOING MONITORING LOCATIONS

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 surrounding private groundwater bores due to both access issues and landholder's pumping equipment making it impractical to measure. It is considered that the on-site monitoring locations provide adequate coverage for measuring any fluctuations in groundwater levels.

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/ASSM or fines are being placed into the extraction pond[4]) is summarised in **Table 6.5** and for non-operational periods is summarised in **Table 6.6**.

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

Table 6.5
Groundwater Parameters and Monitoring Frequency – Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
MB1, MB2, MB10, MB14.	Continuous[3]	Water level (m AHD)[1] and temperature.
MB11, MB15.	Continuous[3]	Water level (m AHD)[1], EC, and temperature.
MB1, MB2, MB10, MB11, MB12, MB13, MB14, MB15, planned monitoring bores GW1, GW2, GW3[2].	Monthly	Field measurements: Temperature, pH, EC, ORP & water level (m AHD).
	Quarterly	Laboratory: Major cations and anions, filterable iron, aluminium and arsenic, total phosphorus, ammonia nitrogen, NOx nitrogen.

Notes 1: A barometric logger is also utilised to calibrate all logger water level readings.
2: Following installation.
3. Continuous recording excluding periods of calibration / repair or other maintenance requiring the logger to be removed.

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

Location	Monitoring Frequency	Monitoring Parameters
MB1, MB2, MB10, MB14, CSP1.	Continuous[3].	Water level (m AHD)[1] and temperature.
MB11, MB15.	Continuous[3].	Water level (m AHD)[1], EC, and temperature.
MB1, MB2, MB10, MB11, MB12, MB13, MB14, MB15, planned monitoring bores GW1, GW2, GW3[2].	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.
2: Following installation.
3. Continuous recording excluding periods of calibration / repair or other maintenance requiring the logger to be removed.

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 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**.

6.5 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**.

In the event that a surrounding groundwater user was to be impacted due to Quarry-related activities consultation would be undertaken and, if appropriate, an agreement for the supply of 'make up' water or other compensation would be negotiated. Options for provision of 'make up' water could include, but are not limited to:

- deepening the existing bore or installation of a replacement bore;
- paying a cash compensation equal to the assessed cost of deepening the bore;
- providing an alternative water supply, such as from the extraction ponds or groundwater bore registered to Gales; or
- providing an appropriately sized rainwater storage tank to enhance property water storage.

Contingency measures that could be considered in the event it is identified that the Quarry has/is resulting in unacceptable groundwater quality include (but are not limited to) the following. Actual measures implemented would be determined on a case by case basis and taking into consideration specialist advice.

- If groundwater quality issues are identified to have likely been caused by localised drawdown and oxidation, water may be transferred between extraction ponds to ensure water levels are buffered to prevent ongoing oxidation. If the area of oxidation is within the approved Extraction Area and it is practicable to do so, the area may be dredged out and the material processed in the wash plant to remove the materials of concern.
- Water could be pumped out of the groundwater bore network within the Quarry Site and water returned to the dredge pond, with or without specific treatments.

  For example, if high iron levels require a response the principal measure to reduce soluble iron is through aeration. As such water pumped back into the pond would be completed in a turbulent manner to maximise oxygenation, or aeration applied directly. If required a flocculant could be added to aid the precipitation of iron into the interned sediments.

  In the event that low pH was the matter of concern, alkaline amendments such as hydrated lime could be added to pumped water or directly to the dredge pond.

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.
Adjoining property owner reports impact upon their groundwater supply.	Amber	Conduct investigation: Dip landholder bore to confirm water levels. Download water level logger data and complete review. 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 (-1.5m AHD) within the dredge pond.	Red	**Report as an incident** and submit formal report to DPHI and relevant agencies in accordance with the incident response process outlined within the Environmental Management Strategy.	• In addition to the applicable 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. Refer to Section 6.5 for potential 'make up' water options. • 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.
Two consecutive exceedances for the same monitoring location exceed the assessment criteria.	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.
Three consecutive results for the same monitoring location exceed the assessment criteria.	Red	**Report as an incident** and submit formal report to DPHI 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 MP05_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 7.4);
- 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 contains runoff from disturbed areas and excludes surface runoff external to the bunding. The bunding also 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

7.3.1 Dredge Pond

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. A fourth monitoring location was included since July 2023 to cover dredging north of the

existing Altona Road. Monitoring occurred throughout the initial extraction campaign, commencing 30 October 2017 and concluding 8 February 2018, continued during the ensuing non-operational period up to April 2020, and ongoing operations since that time.

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.

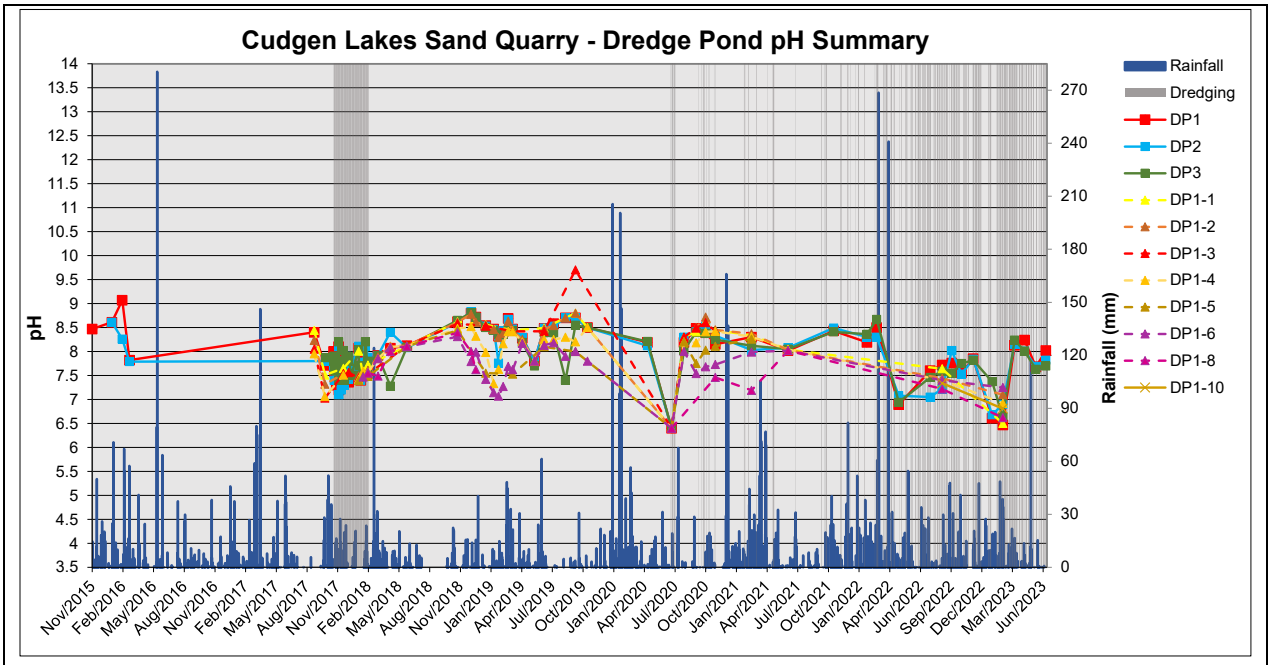

Figure 7.1
DREDGE POND pH SUMMARY

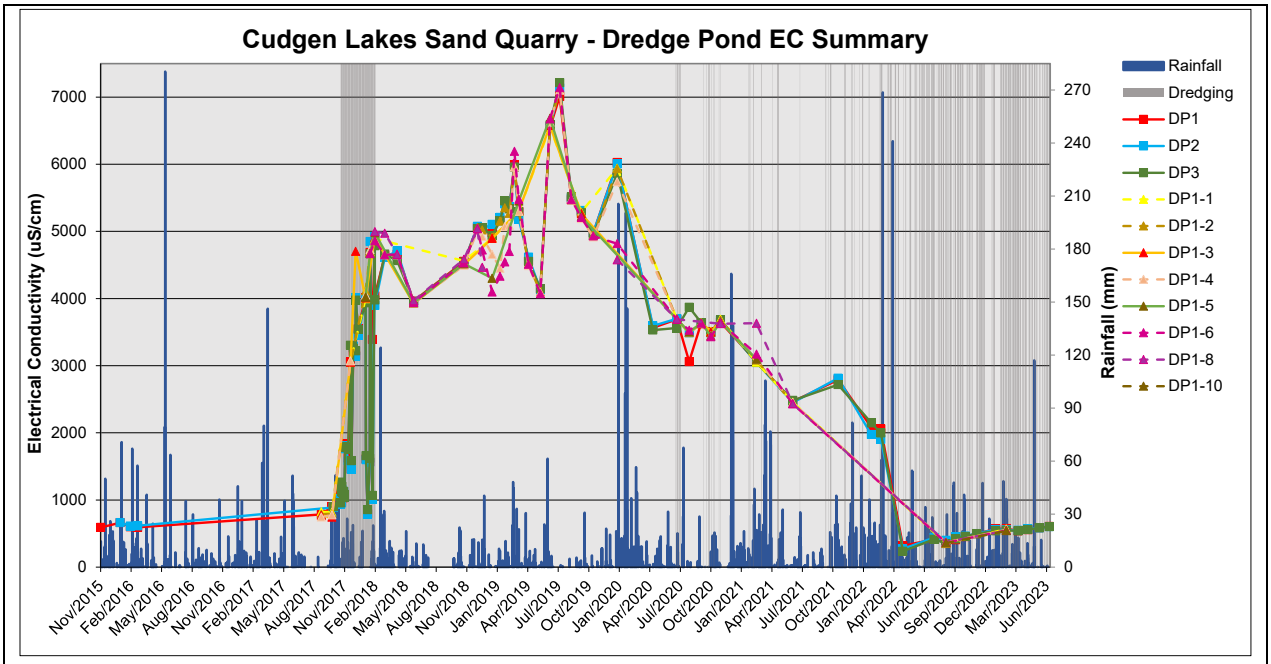

Figure 7.2
DREDGE POND EC SUMMARY

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	6.40-9.07	318-45597	0.20-10.67	41-833	14-153	6-125	3-28	75-1400	14-407	33-270	0.01-0.19	0.001-0.005	0.01-0.07	0.01-0.36	0.40-2.10	0.01-0.60	0.01-0.37	10-4800	10-2160
DP2	Surface	6.40-8.83	271-7136	0.19-10.60	37-844	14-151	6-126	2-28	64-1420	14-406	36-270	0.01-0.10	0.001-0.005	0.01-0.07	0.01-0.96	0.60-5.80	0.01-0.60	0.01-0.36	10-820	10-1180
DP3	Surface	6.40-8.81	236-7215	0.19-10.50	46-846	13-155	6-126	3-28	71-1400	21-405	35-273	0.01-0.05	0.001-0.005	0.05-0.10	0.01-1.29	0.30-1.80	0.01-0.60	0.01-0.55	10-330	10-1620
DP4	Surface	7.45-8.49	686-3956	3.99-9.77	63-437	63-150	16-73	6-18	101-625	94-355	107-200	0.01-0.15	0.001	0.05	0.01-0.07	0.40-1.10	0.01-0.90	0.01-0.11	NA	NA
DP1-1	1	6.40-8.80	353-6553	2.16-10.71	49-838	24-153	7-121	3-28	84-1410	30-334	50-274	0.01-0.07	0.001-0.005	0.05-0.06	0.01-0.29	0.40-1.40	0.01-0.43	0.01-0.29	10-480	10-840
DP1-2	2	6.40-8.80	367-7123	2.17-10.72	50-831	24-146	7-123	3-28	86-1410	31-345	49-270	0.01-0.11	0.001-0.005	0.05-0.10	0.01-0.15	0.30-1.40	0.01-0.45	0.01-0.36	10-450	10-1010
DP1-3	3	6.40-9.70	743-6577	1.07-10.78	96-765	33-133	17-115	7-25	174-1380	43-330	96-270	0.01-0.05	0.001-0.005	0.05	0.01-0.14	0.50-1.60	0.01-0.13	0.01-0.30	10-400	10-910
DP1-4	4	6.40-8.52	370-7103	0.33-9.60	48-833	25-146	7-124	3-28	85-1410	30-333	49-264	0.01-0.05	0.001-0.005	0.05-0.19	0.01-1.81	0.40-7.30	0.01-0.48	0.01-0.37	10-420	10-850
DP1-5	5	6.40-8.44	3095-6687	0.36-9.50	540-764	85-146	81-117	18-26	1020-1370	185-338	159-270	0.01-0.11	0.001-0.005	0.05-0.30	0.01-0.09	0.70-1.40	0.01-0.12	0.01-0.35	10-330	20-360
DP1-6	6	6.40-8.31	363-7141	0.11-9.00	47-791	24-148	7-119	3-27	86-1360	31-344	50-342	0.01-0.05	0.001-0.005	0.05-0.22	0.01-0.15	0.70-2.60	0.01-0.46	0.01-1.43	10-260	10-210
DP1-7	7	6.40-8.40	3025-6713	0.31-8.90	486-736	80-145	72-112	17-24	1020-1360	190-342	173-326	0.01-0.05	0.001-0.005	0.05-0.17	0.01-0.02	0.70-2.70	0.01-0.13	0.03-20.0	10-230	10-270
DP1-8	8	6.40-8.39	371-5042	0.64-8.80	42-759	26-139	7-111	4-25	87-1330	31-333	49-294	0.01-0.05	0.001-0.005	0.05-0.13	0.01-0.17	0.40-2.40	0.01-0.44	0.01-1.30	10-120	10-280
DP1-10	10	6.81-7.34	359-542	5.46-6.50	49-54	27-44	8	4	85-90	31-41	50-73	0.01	0.001	0.05	0.08-0.18	1.0-1.3	0.43-0.44	0.01	NA	NA
Minimum*		***6.40***	***271***	***0.11***	***37***	***13***	***6***	***2***	***64***	***14***	***33***	***0.01***	***0.001***	***0.01***	***0.01***	***0.30***	***0.01***	***0.01***	***10***	***10***
20th Percentile*		***7.55***	***1029***	***3.44***	***424***	***78***	***65***	***16***	***777***	***183***	***136***	***0.01***	***0.001***	***0.05***	***0.01***	***0.70***	***0.01***	***0.01***	***20***	***20***
Median*		***8.03***	***3632***	***5.77***	***624***	***111***	***95***	***22***	***1170***	***276***	***178***	***0.01***	***0.002***	***0.05***	***0.02***	***1.00***	***0.01***	***0.03***	***60***	***80***
80th Percentile*		***8.40***	***4994***	***8.39***	***728***	***129***	***110***	***24***	***1320***	***313***	***231***	***0.03***	***0.002***	***0.05***	***0.05***	***1.20***	***0.12***	***0.12***	***170***	***190***
Maximum*		***9.7***	***7215***	***10.78***	***846***	***155***	***126***	***28***	***1420***	***407***	***342***	***0.19***	***0.005***	***0.30***	***1.81***	***7.30***	***0.90***	***1.67***	***4800***	***2160***

* Of all results for all locations/depths
NA = Not applicable

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. Levels of major cations and anions have also been recorded consistent with the higher salinity levels.

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. EC levels have subsequently decreased following a number of years of above average rainfall. 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. 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.

In response to feedback from DCCEEW Water further review has also been undertaken of iron concentrations. As outlined in Section 6.2 the adjacent Tertiary basalt plateau is comprised of ferromagnesian rocks rich in pyroxenes, amphibole, biotite and magnetite that are rich in iron, and a source for the adjacent and downgradient sand aquifer. The concentration of dissolved iron in aqueous solution is affected by environmental conditions especially the oxidation reduction conditions (redox state) and pH. Generally reducing conditions with the absence of dissolved oxygen allow for considerable concentrations of dissolved ferrous iron to occur in solution. When these waters become oxygenated by exposure to the atmosphere dissolved ferrous iron will precipitate as the ferric form, ferric hydroxide.

The data for the dredge pond provided in **Table 7.1** demonstrates that, in the more oxygenated surface water environment, iron concentrations have remained at or below 0.3mg/L. The surface water data also shows a relationship with depth, due to reducing oxygenation below the surface with the highest concentration recorded at 0.30mg/L at DP1-5 at 5m depth. Iron concentrations are lower close to the lake surface with a maximum of 0.10mg/L and an average concentration of 0.05mg/L at DP1, DP2, DP3, and DP4 sample sites collected from the surface.

Given the connectivity between the sand aquifer and the dredge pond it is expected that naturally high loads of iron within the groundwater are precipitated and collect in the base of the pond when groundwater enters the dredge pond. When the dredge pond water moves into the adjacent drains it would therefore be expected to be somewhat depleted in iron.

7.3.2 Surrounding Drainage Network

The Tweed River Flood Plain in the Cudgen area was cleared and drained in the early 1900s by a network of shallow open drains, excavated to lower the water table and discharge the water to the Tweed River. The site is traversed by several of these drains running east / west located adjacent to the northern and southern boundaries and adjacent to the existing Altona Road.

Baseline data was previously collected at a number of locations within and surrounding the Quarry Site (see **Figure 6.4**) at variable intervals from between 2003 and 2016. Data has also been collected during operational and non-operational periods up until 2021. **Table 7.2** provides a summary of data collected to date. Collection of additional data will recommence in 2025.

In general, the water quality within the surface water drainage system is more variable than the dredge pond and surrounding groundwater. This is consistent with the fact that the drainage system receives surface water runoff influenced by a range of surrounding land uses and groundwater inflows from the adjacent sand aquifer, and can be affected by tidal influences. As such, water quality can vary based on the sample location and recent climatic conditions.

The majority of the samples collected from the drains show pH values that range from approximately 6 to 9, i.e. from slightly acidic to slightly basic, with the exception of one measurement from sample SW5 which recorded a pH of 2.73. Similar to the dredge pond, higher pH values are expected to be the result of algal activity (which is a feature of the region).

Samples collected from the drain along the southern boundary of the Quarry Site (SW1A and SW5A) have generally been fresh (EC <500µS/cm) although brackish to saline conditions have also been recorded (EC up to 19,510µS/cm) during low flow conditions. The fresher conditions are likely the result of freshwater inputs from rainfall and groundwater seepage from Cudgen Plateau. Conversely, average EC within the drains further north of the Cudgen Plateau are higher, generally EC >1000µS/cm with saline conditions also recorded (EC up to 24,200µS/cm). Elevated levels of major cations and anions are recorded at times when elevated salinity levels are recorded (being the cause of salinity).

Similar to the dredge pond and 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.

Table 7.2
Summary of Surface Water Drain Quality Data

			Physical			Major Cations & Anions							Metals			Nutrients				Bacteria / Algae	
Site			pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Total Nitrogen mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml
SW1A	Baseline	Average	6.99	387	2	73	19	12	7	123	15	72	0.08	0.83	3.78	0.29	1.57	0.04	0.02	828	1610
		Maximum	8.42	652	8	378	49	43	17	695	66	110	0.45	5.00	25.00	0.64	4.27	0.08	0.02	2040	4160
		80th Percentile	7.41	567	3	106	24	16	9	166	28	94	0.13	3.00	4.91	0.56	2.24	0.08	0.02	2008	3520
		50th Percentile	6.86	403	1	38	18	9	6	61	8	67	0.03	0.00	1.32	0.17	1.10	0.02	0.02	380	1295
		20th Percentile	6.52	207	0	21	13	7	5	27	3	46	0.01	0.00	0.22	0.10	0.60	0.01	0.01	90	156
		Minimum	6.34	189	0	17	8	5	1	22	1	41	0.01	0.00	0.17	0.08	0.23	0.01	0.01	30	80
	Operational	Average	7.16	337	4	139	41	22	7	268	83	90	0.02	0.00	0.65	0.17	1.90	0.09	0.36	273	1483
		Maximum	8.00	2599	6	334	92	49	15	682	232	130	0.05	0.00	1.04	0.18	2.20	0.20	0.85	370	3650
		80th Percentile	7.48	337	5	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		50th Percentile	7.17	206	4	59	22	12	4	90	10	87	0.01	0.00	0.46	0.16	1.90	0.05	0.21	290	640
		20th Percentile	6.87	183	3	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		Minimum	6.38	107	2	25	8	5	2	33	6	53	0.01	0.00	0.45	0.16	1.60	0.02	0.01	160	160
	Non-operational	Average	6.72	706	3	31	19	9	3	42	4	88	0.01	0.00	1.21	0.20	1.12	0.04	0.01	573	2487
		Maximum	7.05	3145	5	47	27	12	5	51	8	118	0.01	0.00	4.59	0.26	1.80	0.12	0.02	1560	6000
		80th Percentile	6.93	1485	4	41	27	12	4	50	8	115	0.01	0.00	3.39	0.25	1.64	0.10	0.02	ID	ID
		50th Percentile	6.74	309	3	27	18	10	3	40	4	92	0.01	0.00	0.46	0.21	1.25	0.02	0.01	120	1010
		20th Percentile	6.46	235	2	26	11	6	2	36	1	58	0.01	0.00	0.08	0.15	0.44	0.01	0.01	ID	ID
		Minimum	6.40	227	1	26	9	6	2	36	1	54	0.01	0.00	0.06	0.14	0.20	0.01	0.01	40	450
SW3A	Baseline	Average	7.52	2198	5	531	84	75	30	1049	147	207	0.33	0.72	1.31	0.37	1.91	0.04	0.04	845	1077
		Maximum	8.93	5470	9	1330	161	169	60	3030	335	360	2.32	5.00	5.66	0.64	3.50	0.16	0.14	2410	3880
		80th Percentile	8.07	4475	7	1104	116	136	55	1801	282	350	0.55	2.00	3.22	0.62	2.73	0.10	0.10	1850	2824
		50th Percentile	7.68	1453	6	332	87	52	22	650	145	250	0.03	0.00	0.36	0.39	2.10	0.02	0.02	620	540
		20th Percentile	6.71	842	2	120	41	38	14	228	26	62	0.02	0.00	0.22	0.14	0.54	0.02	0.02	192	106
		Minimum	6.00	552	0	76	13	9	5	110	15	51	0.01	0.00	0.08	0.09	0.11	0.02	0.02	140	10
	Operational	Average	7.34	397	4	267	133	63	14	496	524	108	4.35	0.00	29.96	0.11	1.90	0.33	0.02	705	730
		Maximum	8.00	3202	6	470	163	74	18	911	775	214	8.69	0.01	59.80	0.12	2.30	0.63	0.02	1400	1400
		80th Percentile	7.80	319	5	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		50th Percentile	7.50	194	4	267	133	63	14	496	524	108	4.35	0.00	29.96	0.11	1.90	0.33	0.02	705	730
		20th Percentile	7.03	176	3	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		Minimum	3.99	16	3	63	103	51	10	80	273	1	0.01	0.00	0.11	0.10	1.50	0.03	0.01	10	60
	Non-operational	Average	6.90	1000	5	123	54	26	7	219	49	184	0.02	0.00	0.34	0.32	1.36	0.04	0.01	37	277
		Maximum	7.31	1539	7	196	95	43	14	365	83	346	0.03	0.00	0.58	1.09	3.00	0.08	0.02	90	540
		80th Percentile	7.24	1440	7	170	86	40	12	322	74	309	0.03	0.00	0.56	0.81	2.16	0.07	0.02	ID	ID
		50th Percentile	6.80	1044	5	134	52	26	6	218	51	152	0.01	0.00	0.30	0.12	1.00	0.03	0.01	10	160
		20th Percentile	6.58	605	3	73	26	14	4	132	22	99	0.01	0.00	0.19	0.07	0.86	0.01	0.01	ID	ID
		Minimum	6.40	599	2	71	24	13	4	127	15	85	0.01	0.00	0.17	0.05	0.80	0.01	0.01	10	130

ID = Insufficient data to calculate a percentile.

Table 7.2 (Cont'd)
Summary of Surface Water Drain Quality Data

Site			Physical			Major Cations & Anions							Metals			Nutrients				Bacteria / Algae	
			pH	Electrical Conductivity uS/cm	Dissolved Oxygen mol/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Chloride mg/L	Sulfate mg/L	Bicarbonate mg/L	Aluminium mg/L	Arsenic mg/L	Iron (filterable) mg/L	Total Phosphorous mg/L	Total Nitrogen mg/L	Ammonia mg/L	NOx mg/L	Faecal coliforms cells/ml	Enterococci cells/ml
SW5A	Baseline	Average	7.07	418	2	69	22	12	6	95	28	60	0.27	0.83	0.91	0.19	1.28	0.02	0.40	413	1637
		Maximum	9.30	1886	4	298	72	38	18	567	96	107	1.18	5.00	5.14	0.26	1.93	0.02	1.20	960	3120
		80th Percentile	7.93	513	3	144	30	18	9	103	63	90	0.76	3.00	1.05	0.25	1.74	0.02	1.16	932	3036
		50th Percentile	6.71	313	1	31	16	9	5	39	17	59	0.03	0.00	0.55	0.22	1.16	0.02	0.02	260	1460
		20th Percentile	6.55	204	0	24	9	6	4	26	6	28	0.01	0.00	0.12	0.11	0.96	0.01	0.02	46	364
		Minimum	6.50	62	0	13	6	3	1	16	1	20	0.01	0.00	0.06	0.11	0.87	0.01	0.02	10	80
	Operational	Average	7.06	460	4	232	82	39	9	447	171	148	0.01	0.00	0.14	0.22	1.40	0.02	0.01	1240	957
		Maximum	7.90	3865	8	495	166	82	18	997	410	208	0.01	0.00	0.31	0.30	1.90	0.04	0.01	2640	1400
		80th Percentile	7.41	500	4	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		50th Percentile	7.06	237	4	164	63	27	8	301	92	132	0.01	0.00	0.06	0.25	1.30	0.01	0.01	650	740
		20th Percentile	6.80	190	3	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		Minimum	4.60	92	1	36	18	9	2	43	11	105	0.01	0.00	0.06	0.12	1.00	0.01	0.01	430	730
	Non-operational	Average	6.92	335	3	40	16	9	2	53	12	75	0.02	0.00	1.24	0.21	1.21	0.04	0.01	418	895
		Maximum	7.23	451	5	54	22	13	3	73	22	110	0.08	0.00	3.44	0.42	1.90	0.07	0.01	1140	1880
		80th Percentile	7.20	383	4	52	21	11	2	70	21	105	0.05	0.00	2.69	0.31	1.60	0.07	0.01	1140	1880
		50th Percentile	6.94	342	3	42	16	9	2	53	15	75	0.01	0.00	0.92	0.21	1.20	0.04	0.01	210	795
		20th Percentile	6.64	287	2	23	12	7	1	37	1	52	0.01	0.00	0.19	0.13	0.88	0.02	0.01	110	110
		Minimum	6.40	190	2	19	10	5	1	26	1	36	0.01	0.00	0.18	0.13	0.70	0.01	0.01	110	110
SW5	Baseline	Average	7.00	3130	4	161	41	27	9	273	79	149	0.15	0.00	0.88	0.18	1.83	0.23	0.48	208	567
		Maximum	8.55	24200	8	255	77	40	14	424	316	250	0.38	0.00	2.15	0.45	4.00	0.98	2.70	430	1760
		80th Percentile	7.86	5150	4	247	67	40	12	418	217	238	0.38	0.00	1.84	0.24	2.46	0.72	1.66	422	1376
		50th Percentile	7.30	1160	4	156	39	28	9	271	27	171	0.06	0.00	0.53	0.16	1.75	0.02	0.04	185	320
		20th Percentile	6.42	452	3	72	18	11	6	114	19	40	0.01	0.00	0.32	0.11	1.06	0.01	0.02	18	96
		Minimum	2.73	257	1	29	13	6	5	44	15	32	0.01	0.00	0.25	0.06	0.25	0.01	0.02	10	80
	Operational	Average	7.25	761	3	458	145	77	17	863	289	263	0.01	0.00	0.24	0.11	1.90	0.31	0.05	243	473
		Maximum	7.98	4296	5	579	190	96	23	1050	395	304	0.01	0.00	0.52	0.14	2.20	0.82	0.12	460	530
		80th Percentile	7.55	1292	4	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		50th Percentile	7.20	298	3	530	171	90	18	1020	352	267	0.01	0.00	0.12	0.12	2.10	0.09	0.01	180	520
		20th Percentile	6.91	200	2	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID	ID
		Minimum	6.76	174	2	265	75	46	11	520	119	218	0.01	0.00	0.08	0.08	1.40	0.01	0.01	90	370
	Non-operational	Average	7.10	1474	4	155	125	40	8	266	236	204	0.02	0.00	0.57	0.16	1.86	0.08	0.02	338	653
		Maximum	7.85	2162	13	228	348	69	11	395	692	338	0.06	0.00	1.42	0.64	4.20	0.12	0.05	1080	1840
		80th Percentile	7.76	1983	5	221	219	56	10	384	408	288	0.03	0.00	0.94	0.33	3.66	0.12	0.04	1080	1840
		50th Percentile	7.00	1575	4	175	95	43	9	306	189	217	0.01	0.00	0.54	0.11	1.10	0.10	0.01	125	355
		20th Percentile	6.60	882	2	74	56	22	4	118	102	116	0.01	0.00	0.22	0.04	0.96	0.04	0.01	20	60
		Minimum	6.40	356	0	28	31	8	2	45	46	58	0.01	0.00	0.16	0.03	0.90	0.03	0.01	20	60
All Results		Average	7.13	1337	4	94	131	0.23	0.24	2.06	0.22	178	54	31	10	326	1.58	0.09	0.11	516	1102
		Maximum	9.30	24200	13	775	360	8.69	5.00	59.80	1.09	1330	348	169	60	3030	4.27	0.98	2.70	2640	6000
		80th Percentile	7.61	1540	5	165	218	0.08	0.00	1.45	0.28	255	93	48	15	443	2.20	0.08	0.02	960	1840
		50th Percentile	7.10	336	4	26	102	0.02	0.00	0.49	0.16	75	27	14	6	122	1.40	0.03	0.01	270	640
		20th Percentile	6.78	198	2	7	54	0.01	0.00	0.19	0.10	28	15	8	3	41	0.94	0.02	0.01	90	130
		Minimum	2.73	6	0	1	1	0.01	0.00	0.06	0.01	13	6	3	1	16	0.11	0.01	0.01	10	10

ID = Insufficient data to calculate a percentile.

As for other analytes, iron concentrations within the surface water drainage system is more variable than the groundwater and dredge pond. The minimum and 20th percentile values are generally consistent with the dredge pond (below 0.3mg/L), however, the average, 80th percentile and maximum values all exceed 0.3mg/L and two results exceed the objective of 20mg/L. This variability can be attributed to the environmental behaviour of iron and the sources of water in the drains. The drains have very gentle slopes and are commonly well vegetated meaning flow of water is slow resulting in limited oxygenation and consumption of oxygen by bacteria processing organic matter. The source of water in the drains is also expected to be a mixture of both dredge pond water and iron rich groundwater, the proportions depending on the location and the drain invert, with a lower invert introducing more groundwater. These factors combine to naturally increase the concentrations of dissolved iron in the water samples collected from perimeter drains, particularly in drains with a lower invert with low flow and deoxygenated conditions.

7.4 SURFACE WATER ASSESSMENT CRITERIA

As discussed in Section 6.3.2, the original conditions for PA MP05_0103B 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 and surrounding surface water drains 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 original quality objectives. However, in contrast to some of the surrounding groundwater bores, the recorded pH within the dredge pond and surface drains has exceeded the upper pH limit while the pH within the surface drains has exceeded the lower pH limit on multiple occasions.

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 7.3** summarised the adopted objectives for both the dredge pond water and surrounding surface water drains and identifies where the original objective has been retained or changed.

Table 7.3
Water Quality Objectives

Parameter	Units	Objective	Comment
pH	-	6.5-9.7	Upper objective value reflects upper limit of recorded data.
EC	uS/cm	7250	Objective value reflects upper limit of recorded maximum of 7215 rounded up.
Dissolved oxygen^	mg/L	>6	Original objective value retained.
Turbidity*	NTU	<20	Original objective value retained.
Na	mg/L	850	Objective value reflects upper limit of recorded maximum of 846 rounded up.
Mg	mg/L	130	Objective value reflects upper limit of recorded maximum of 126 rounded up.
K	mg/L	<40	Original objective value retained.
Cl	mg/L	1450	Objective value reflects upper limit of recorded maximum of 1420 rounded up.
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	<3.05	Objective reflects 80th percentile of previous monitoring within surface drains.
Ammonia	mg/L	<20	Original objective value retained.

^Applicable to surface samples only during periods of nil operation (i.e. when mixing action of dredging / pumping of water is not effecting surface oxygen levels). Does not apply to samples from surrounding surface water drains.

*Applicable during discharge 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 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 within the dredge pond or surface water drains 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 reflect 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 extraction pond water level (in m AHD) will be monitored daily prior to commencing 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 four dredge pond monitoring locations are shown indicatively on **Figure 6.4**. The pond locations include two edge locations (DP2 and DP3) and one in the approximate middle of the main pond (DP1) and a fourth location (DP4) within the northern pond. All depth measurements are to be taken at location DP1 in 1m intervals to the current floor of the main 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.

The four surface drain monitoring locations are also shown on **Figure 6.4**. Surface drain monitoring locations include surface samples only with sampling subject to water being present within the drain at the time of monitoring.

7.5.4 Surface Water Quality Monitoring Suite

The analytes and parameters to be monitored for the dredge pond and surface drain samples are summarised in **Table 7.4**.

Table 7.4
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/ASSM or fines are being placed into the extraction pond[5]) is summarised in **Table 7.5** and for non-operational periods is summarised in **Table 7.6**.

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

Location	Monitoring Frequency	Monitoring Parameters
SW1A, SW3A, SW5A, SW5, DP1, DP2, DP3, DP4 (Surface)	Monthly	Field measurements: Temperature, pH, EC, ORP, & visible oil & grease assessment.
	Quarterly	Field measurements: Dissolved Oxygen Laboratory: total phosphorus, total nitrogen, orthophosphate, ammonia nitrogen & NOx nitrogen, major cations and anions, filterable iron, aluminium and arsenic.
DP1 Depth Samples (central pond location) (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 7.6
Surface Water Quality Monitoring Parameters and Frequency – Non-Operational Periods

Location	Monitoring Frequency	Monitoring Parameters
SW1A, SW3A, SW5A, SW5, DP1, DP2, DP3, DP4 (Surface)	Quarterly	Field measurements: Temperature, pH, EC, ORP, Turbidity, Dissolved Oxygen & visible oil & grease assessment.
SW1A, SW3A, SW5A, SW5, DP1, DP2, DP3 (Surface) DP1 Depth Samples (central pond location) (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.

[5] 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.

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.
- 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 7.7**.

Contingency measures that could be considered in the event that it is identified that the Quarry has/is resulting in unacceptable water quality include (but are not limited to) the following. Actual measures implemented would be determined on a case by case basis and taking into consideration specialist advice

- If groundwater inflows to the surrounding surface water drains are the principal cause of poor water quality, water may be pumped out of the groundwater bore network with water returned to the dredge pond, with or without specific treatments.

  For example, if high iron levels are the matter of concern the principal measure to reduce soluble iron is through aeration. As such water pumped back into the pond would be completed in a turbulent manner to maximise oxygenation. If required a flocculant could be added to aid the precipitation of iron into the interned sediments.

  If low pH was the matter of concern, alkaline amendments such as hydrated lime could be added to pumped water or directly to the dredge pond.
- If elevated sediments are recorded a review of any on-site sources of sediment laden-run off would be identified and stabilisation measures implemented, such as installation of temporary silt-stop fencing and seeding of stabilising grass species.

Table 7.7
Surface Water Trigger Action Response Plan

Trigger Level	Alert Level	Action	Response
Surface Water Levels (Dredge Pond)			
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 DPHI 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 (Dredge Pond and Surface Drains)			
All analytes within assessment criteria.	Green	No action required	Nil.
Two consecutive for the same monitoring location exceed the assessment criteria.	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.

Table 7.7 (Cont'd)
Surface Water Trigger Action Response Plan

Trigger Level	Alert Level	Action	Response
Surface Water Quality (Dredge Pond and Surface Drains) (Cont'd)			
Three consecutive results for the same monitoring location exceed the assessment criteria.	Red	**Report as an incident** and submit formal report to DPHI 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. • Temporarily increase the monitoring frequency to monthly for a period of 3 months (i.e. to next quarterly sampling round) and reassess the need for further increased monitoring. • Update this SWMP as applicable.

7.8 SURFACE WATER DISCHARGE OFF SITE

As discussed in Section 4.3, bunding will be progressively constructed around and/or setback from the dredge pond as it progresses. This effectively separates external stormwater runoff water and contains any runoff from 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.

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 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, groundwater inflows, rain 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 MP05_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 for workplace health and safety (WHS) purposes. 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

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 2.08mg/L
  - Total nitrogen absolute range: 0.10mg/L to 36mg/L (and one site up to 186mg/L)
  - Total nitrogen 80th percentile range: 0.46mg/L to 5.92mg/L (and one site at 105mg/L)
- Surface Water (dredge pond)
  - Total phosphorous absolute range: 0.01mg/L to 1.81mg/L
  - Total phosphorous 80th percentile (all results): 0.05mg/L
  - Total nitrogen absolute range: 0.40mg/L to 7.30mg/L
  - Total nitrogen 80th percentile (all results): 1.2mg/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 and 2019/2020 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.

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. As such, it is considered appropriate that, during operational periods, blue-green algae is managed as a WHS matter.

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*.	

In lieu of undertaking ongoing monitoring during operations, the operator may elect to implement WHS measures consistent with the Red Level of alert, including placement of the alert level on the information sign on Red alert (refer to Section 8.5).

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[6]) 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.

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 (or in lieu of monitoring) 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.

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

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. In the event that the Quarry Operator elects not to undertake this monitoring, the blue-green algae risk can be appropriately managed in accordance with the measures outlined in the Red Level alert (see Section 8.5).

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/ASSM or fines are being placed into the extraction pond[7]) is summarised in **Table 8.3**. The parameters specified are to be collected in addition to the surface water monitoring parameters specified in **Tables 7.4** and **7.5**. In the event that the Quarry Operator elects to manage the blue-green algae risk in accordance with the measures outlined in the Red Level alert (see Section 8.5) monitoring is not required to be undertaken.

Table 8.3
Blue-Green Algae Monitoring Parameters and Frequency

Location	Monitoring Frequency1	Monitoring Parameters
DP1, DP2, DP3, DP4 (Surface) – composited	Monthly (September to April) (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)	Annually (one event during Summer)	Laboratory (BGA only): chlorophyll a, total algal cell count & biovolume, potentially toxic cyanobacteria cell count & biovolume, toxins.
Where management is not already being undertaken in accordance with the Red Level alert		

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 recorded.

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 8.4**. These measures are based upon the criteria and alert levels as outlined in Section 8.4.

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

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**[1] to Tweed Shire Council's Environmental Health division and DPHI (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.

1. If the Quarry Operator elects to manage the site on Red Level alert in lieu of monitoring, Tweed Shire Council and DPHI are to be notified of this approach. Further reporting is not required unless management measures are to be reduced to Green or Amber alert level.

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 / following 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 AND ASSM

The quantities of all VENM and ASSM will be recorded and reported annually as part of the Annual Review process.

The following records will also be retained for each truck load of ASSM 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 ASSM;

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

e) the name of the person (certified practicing soil scientist) who assessed the material and classified it as ASSM; and

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

9.4 REPORTING OF WATER TAKE

Annual reporting of water take will be undertaken as part of the Annual Review process.

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 PA MP05_0103B or EPL 12385.

Where this review leads to revisions in any such document, then within 6 weeks of the review, the revised document will be submitted to DPHI 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	• 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 and VENM 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 ASSM 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 or ASSM 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 water quality and level monitoring and ensure that monitoring data is analysed 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 analysis of 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*.

Appendix 1

Consultation and Response

(No. of pages including blank pages = 11)

A summary of how the consultation comments have been addressed within the SWMP is provided in **Table A1-1**. Copies of requests for information and associated responses are also provided following **Table A1-1**.

Table A1-1
Coverage of Consultation Comments

Agency	Comment	Coverage
EPA (21/12/23)	In the second dot point of 5.4.4 of the SWMP the response to receiving material that is not Virgin Excavated Natural Material (VENM) or Acid Sulphate Soil Material (ASSM) should include: - A process is developed for classifying the waste (in accordance with EPA's Waste Classification Guidelines) to demonstrate that it can be disposed of lawfully. - A rejected load register is prepared and maintained to record all relevant information about any loads of material that are rejected from the premises.	Section 5.4.4 has been updated to include the preparation and maintenance of a 'Rejected Load Register' and a step within the process for classifying any waste material in accordance with the EPA's Waste Classification Guidelines.
Tweed Shire Council (12/01/24)	Soil and Water Management Plan for the Cudgen Lakes Sand Quarry Project Approval MP05_0103B (MOD2) is to be updated upon amendment of Environment Protection Licence number 12385 issued under the Protection of the Environment Operations Act 1997 by the NSW Environment Protection Authority (or any subsequent EPL issued by NSW EPA), or amendment of any other State Agency Approval or Licence relating to the site and/or operation.	Section 10 of the SWMP has been updated to include the review of the SWMP following receipt of updated conditions for Environment Protection Licence 12385.
	It is noted however that reference to the Altona Road realignment has been made throughout the report. Council is currently assessing a proposed relocation of Altona Road (DA23/0630). It is considered that Figures 6.3 and 6.4 within the SWMP (shown as Figures 1 and 2 below) need to be updated to reflect the approved layout of Altona Road (as per Mod 2 of MP05_0103B shown below in Figure 3) or Figures 6.3 and 6.4 be amended to identify the Altona Road alignment as a future / proposed location (subject to the approval of DA23/0630).	Notations have been included on these figures to confirm that "Location is subject to separate development approval".
Water NSW	Response received 18 January 2024 confirming that Water NSW has no comments on the updated SWMP.	
DCCEEW-Water	That the proponent quantifies maximum potential groundwater take and compare this to the entitlement held for the project. Insufficient information has been provided in the SWMP to understand maximum potential groundwater take for the project. Groundwater take should be calculated as inflows to into the pond as per the NSW Aquifer Interference Policy (2012). The SWMP appears to mention inflows due to sand removal and direct take to meet site water demands (dust suppression and rehabilitation works) but does not include inflows due to evaporation. Table 3.1 indicates during the summer months there is higher evaporation than rainfall which would likely cause inflows. All groundwater inflows into the dredge pond should be quantified and compared to the held entitlement.	Section 3.4 has been updated to calculate peak water take, including consideration of evaporation, consistent with outcomes of the AGEC 2024 Groundwater Assessment (prepared in accordance with Condition 3(25)). .

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

Agency	Comment	Coverage
DCCEEW - Water (Cont'd)	Provide detailed year by year site water balance to justify adequacy of account water on a yearly basis.	The water balance provided within the SWMP provides for peak water take in order to demonstrate that the water allocation held is adequate. As production levels (and therefore water take) vary from year to year in practice, it is not possible to provide a yearly water balance in advance. However, as part of the Annual Review process (in accordance with the guidelines for reporting on water take), a water balance / water take is calculated and presented annually.
	That the proponent provide further information to confirm how it is addressing approval conditions 5.3, 5.6, 5.7 and 5.8 that relate to minimising potential impacts to nearby groundwater users. The proponent has not fully addressed the approval conditions 5.3, 5.6, 5.7 and 5.8 which involves minimisation of potential groundwater quality or quantity impacts upon surrounding groundwater users including make good provisions. There is no comment on post VENM monitoring, and no options given for alternative water supplies or make good provisions in the event of any impacts.	Only one landholder was predicted to be potentially impacted by the extraction operations. A compensation agreement was entered into with this landholder in December 2006 and a copy of the agreement provided to the Department. Notwithstanding, Section 6.5 of the SWMP has been updated to provide further detail on the types of actions that could be taken in the event that a surrounding groundwater user was to be impacted – as outlined in Statement of Commitment 5.6. In relation to monitoring post placement of VENM, the operational monitoring remains appropriate during both active placement of VENM and post-placement of VENM. Notably, Statement of Commitment 5.3 relates to monitoring following the cessation of extraction and VENM placement. The Quarry remains operational and will remain operational for the foreseeable future. Notwithstanding, the SWMP will continue to be reviewed on at least an annual basis and, if required, updates will be proposed for the monitoring frequency, location and analytes.
	Install an additional nested monitoring bore at the northern boundary midway between the proposed nested monitoring bores GW1 and GHW2 and include in the SWMP "Groundwater Monitoring Program".	Additional nested monitoring bores have been included within the SWMP consistent with the approved Condition 3(25) Groundwater Assessment. Refer to **Figure 6.4** and Section 6.4.

DOC23/1081739-3

Planning and Assessment Division
Department of Planning, Industry and Environment
Locked Bag 5022
PARRAMATTA NSW 2124

EPA Submission on Planning Advice Request

To the Proper Officer

Thank you for requesting advice from the Environment Protection Authority (EPA) for the Post Approval Consultation (PAE-65668976), regarding the Soil and Water Management Plan (SWMP) for the Cudgen Lakes Quarry.

Please find the EPA's comments and recommendations below:

In the second dot point of 5.4.4 of the SWMP – the response to receiving material that is not Virgin Excavated Natural Material (VENM) or Acid Sulphate Soil Material (ASSM) should include:

- A process is developed for classifying the waste (in accordance with EPA's Waste Classification Guidelines) to demonstrate that it can be disposed of lawfully.
- A rejected load register is prepared and maintained to record all relevant information about any loads of material that are rejected from the premises.

The EPA would like to reaffirm the statement made in section 5.2 of the SWMP; that ASSM cannot be accepted on site until the Environment Protection Licence has been varied to authorise it. Licence variations can be applied for via the EPA's eConnect portal.

Yours sincerely,

Luke Davison
Unit Head – Operations

Council Reference: DA08/1266 LN71273
Your Reference:

TWEED SHIRE COUNCIL

Customer Service | 1300 292 872 | (02) 6670 2400

tsc@tweed.nsw.gov.au
www.tweed.nsw.gov.au

PO Box 816
Murwillumbah NSW 2484

Please address all communications to the General Manager

ABN: 90 178 732 496

12 January 2024

Scott Hollamby
R.W. Corkery & Co. Pty Limited

scott@rwcorkery.com

Dear Sir/Madam

Development Application DA08/1266 - sand extraction and processing operation (MP 05_0103B) at Lot 1 DP 828298 & Lot 4 DP 727425; Chinderah Road CHINDERAH; Lot 2 DP 216705 & ROAD 1435; Crescent Street CUDGEN; Part Lot 3 DP 828298; Cudgen Road CUDGEN; ROAD 1865; Elrond Drive KINGSCLIFF; Lot 21 DP 1082482; No. 2 Altona Road CHINDERAH; Lot 26C DP 10715 & Lot 26D DP 10715; Quigan Street KINGSCLIFF; Lot 11 DP 871753 & Lot 12 DP 871753 & ROAD 5605; Turnock Street KINGSCLIFF; ROAD 2301; Tweed Coast Road CHINDERAH; Part Lot 3 DP 828298; Tweed Coast Road CUDGEN

I refer to the request for advice on a post approval matter for the Cudgen Lakes Quarry via the Department of Planning & Environment Major Project website.

Council officers have reviewed the Soil and Water Management Plan, prepared by R.W. Corkery & Co. dated December 2023 and provide the following comments:

1. Environmental Protection Licence

It is noted that Schedule 3 Condition 18 requires the production of a plan that includes technical balances / plans / programs. The attached 'Soil and Water Management Plan for the Cudgen Lakes Sand Quarry Project Approval MP05_0103B (MOD2)' prepared by R.W. Corkery & Co. Pty Limited, and dated 8 December 2023, is noted (the 'SWMP').

Section 2.2 of the SWMP states:

> *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.*

'EPL 12385' refers to Environment Protection Licence number 12385 issued under the *Protection of the Environment Operations Act* 1997 by the NSW Environment Protection Authority. A review of the NSW EPA POEO Public Register confirms that this EPL is in place (refer https://app.epa.nsw.gov.au/prpoeoapp/Detail.aspx?instid=12385&id=12385&option=licence&searchrange=licence&range=POEO%20licence&prp=no&status=Issued). It is noted that the EPL references a/the soil and water management plan. The appropriate regulatory authority for environmental management and

potential pollution under the *Protection of the Environment Operations Act* 1997 at the site is NSW EPA.

In addition to EPL 12385, Section 2.2 of the SWMP refers to other State Agency Approvals and Licences. The SWMP appears to be a relatively comprehensive technical document that includes sections relating to (a) to (e) of Condition 18. Given this, and regulation of the site by NSW EPA and other State Agencies, additional comment/suggestion provided is as follows:

Soil and Water Management Plan for the Cudgen Lakes Sand Quarry Project Approval MP05_0103B (MOD2) is to be updated upon amendment of Environment Protection Licence number 12385 issued under the *Protection of the Environment Operations Act* 1997 by the NSW Environment Protection Authority (or any subsequent EPL issued by NSW EPA), or amendment of any other State Agency Approval or Licence relating to the site and/or operation.

2. <u>Accuracy of Figures 6.3 and 6.4</u>

It is noted however that reference to the Altona Road realignment has been made throughout the report. Council is currently assessing a proposed relocation of Altona Road (DA23/0630). It is considered that Figures 6.3 and 6.4 within the SWMP (shown as Figures 1 and 2 below) need to be updated to reflect the approved layout of Altona Road (as per Mod 2 of MP05_0103B shown below in Figure 3) or Figures 6.3 and 6.4 be amended to identify the Altona Road alignment as a future / proposed location (subject to the approval of DA23/0630).

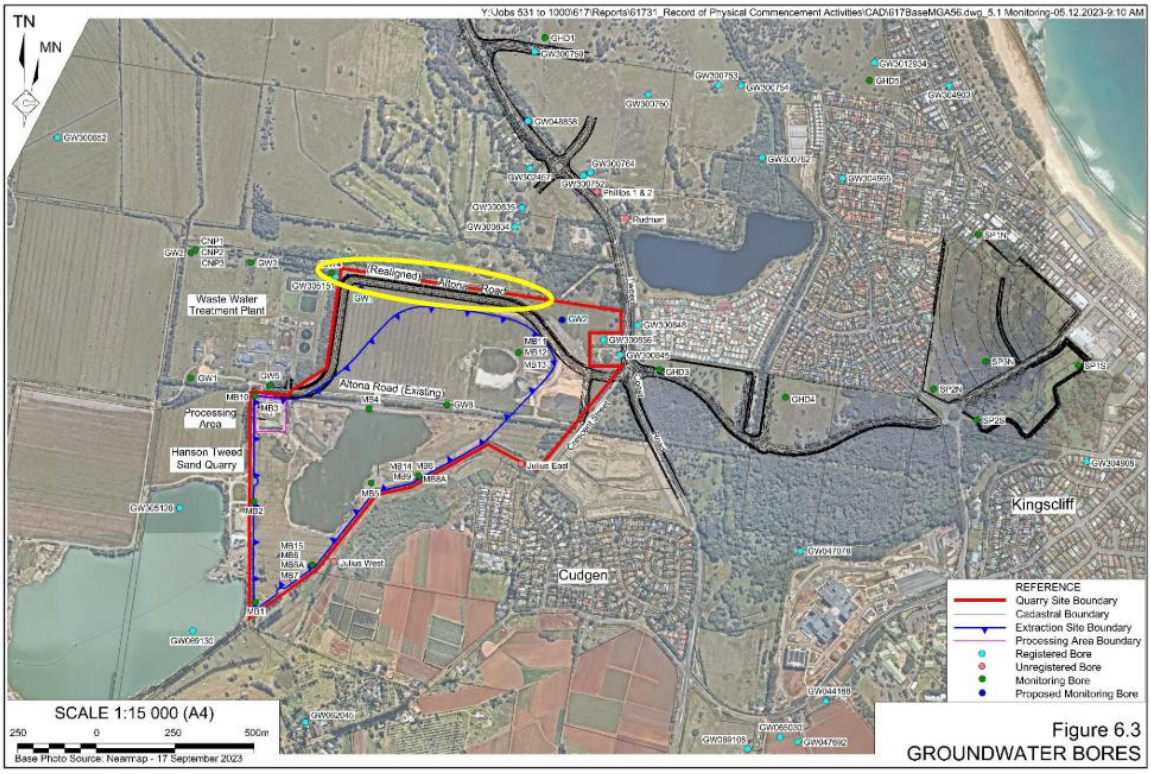

Figure 1 - SWMP Fig 6.3 - Altona Road location circled in yellow

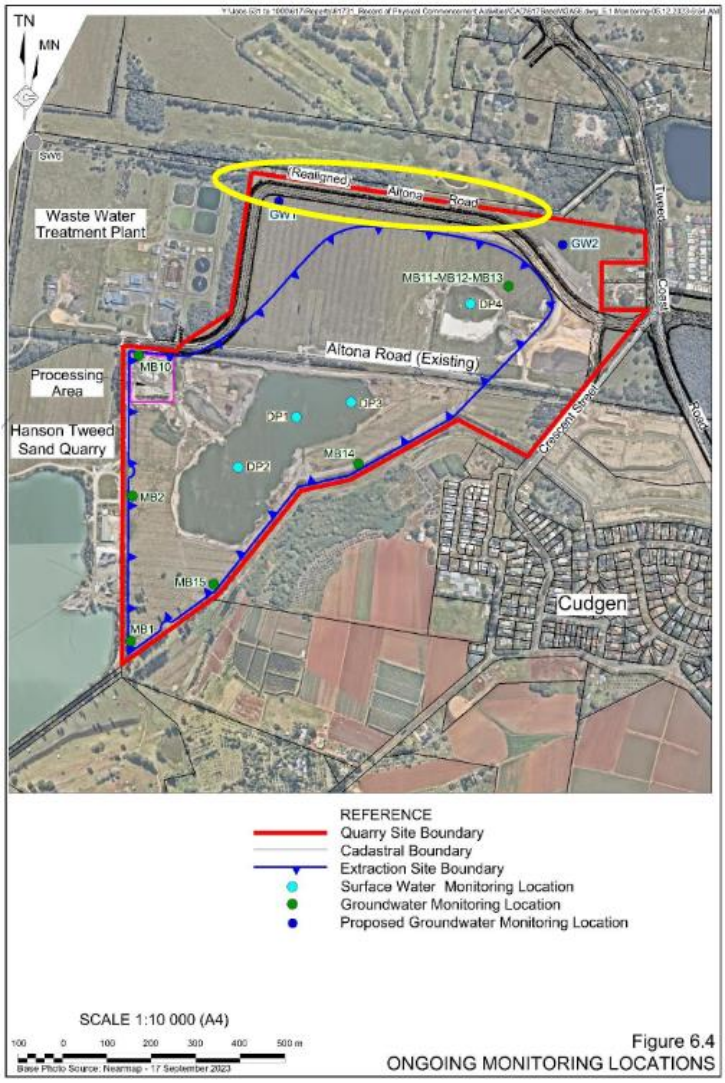

Figure 2 - SWMP Fig 6.4 - Altona Road location circled in yellow

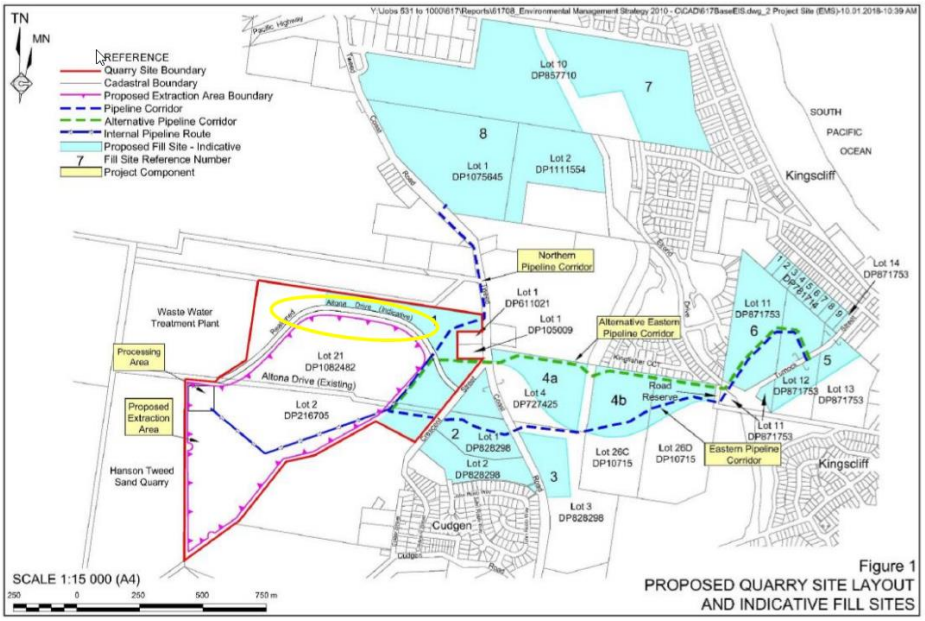

Figure 3 - Approved site layout (approved 22 Jan 2019) under MP05_0103B – Altona Road circled in yellow

For further information regarding this matter please contact Colleen Forbes on (02) 6670 2459.

Yours faithfully

12/01/2024

Colleen Forbes
Acting Manager Development Assessment and Compliance

Department of Climate Change, Energy, the Environment and Water

Our ref: OUT24/1313

Scott Hollamby

Email: scott@rwcorkery.com

2 February 2024

Subject: **Cudgen Lakes Quarry - Soil and Water Management Plan (MP05_0103B-PA-11)**

Dear Scott Hollamby,

I refer to your request for advice sent on 11 December 2023 to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Water Group about the above matter.

DCCEEW Water Group has reviewed the Soil and Water Management Plan (SWMP) and has recommendations regarding groundwater impacts, and water supply, take and licensing. Please see **Attachment A** for more detail.

Should you have any further queries in relation to this submission please do not hesitate to contact DCCEEW Water Assessments water.assessments@dpie.nsw.gov.au.

Yours sincerely,

Rob Brownbill
Manager, Assessments, Knowledge Division
Department of Climate Change, Energy, the Environment and Water

Attachment A

Detailed advice regarding the Cudgen Lakes Quarry - Soil and Water Management Plan

1.0 Water supply, take and licensing

1.1 Recommendation – pre-determination

That the proponent quantifies maximum potential groundwater take and compare this to the entitlement held for the project.

Explanation

Insufficient information has been provided in the SWMP to understand maximum potential groundwater take for the project. Groundwater take should be calculated as inflows into the pond as per the NSW Aquifer Interference Policy (2012). The SWMP appears to mention inflows due to sand removal and direct take to meet site water demands (dust suppression and rehabilitation works) but does not include inflows due to evaporation. Table 3.1 indicates during the summer months there is higher evaporation than rainfall which would likely cause inflows. All groundwater inflows into the dredge pond should be quantified and compared to the held entitlement.

1.2 Recommendation – pre-determination

Consistent with recommendation 1.1, provide detailed year by year site water balance to justify adequacy of account water on a yearly basis.

Explanation

Approval Condition 3(19) requires details and estimations of all water inputs and outputs of the project. Section 3.3 of the SWMP-V5 identifies all components of water use and off-site transfers (outputs) and has estimates for all components except the evaporation losses. DCCEEW-Water acknowledges the proponent's explanation that the site water balance estimates is assessed at maximum sand extraction of 650,000 cubic metres per year; but usage/outputs will vary year to year during the operations, commensurate to the extraction of sand each year. Therefore, detailed year by year site water balance is required to justify adequacy of account water on a yearly basis.

2.0 Groundwater impacts

2.1 Recommendation – pre-determination

That the proponent provide further information to confirm how it is addressing approval conditions 5.3, 5.6, 5.7, and 5.8 that relate to minimising potential impacts to nearby groundwater users.

Explanation

The proponent has not fully addressed the approval conditions 5.3, 5.6, 5.7, and 5.8 which involves minimisation of potential groundwater quality or quantity impacts upon surrounding groundwater users including make good provisions. There is no comment on post VENM monitoring, and no options given for alternative water supplies or make good provisions in the event of any impacts.

2.2 Recommendation – post approval

Install an additional nested monitoring bore at the northern boundary midway between the proposed nested monitoring bores GW 1 and GW 2 and include in the SWMP "Groundwater Monitoring Program".

Explanation

This recommendation is to fulfil DCCEEW Water Groups previous recommendation (OUT21/164) dated 12 January 2021 which requires additional nested monitoring bores to be installed at the northern boundary of the project. The current proposal of installing two nested monitoring bores (GW 1 and GW 2) is not sufficient to adequately and timely identify any groundwater impacts to the private bores which are located directly north of the project area. Therefore, DCCEEW Water Group requires an additional nested monitoring bore to be installed at the northern boundary midway between the proposed nested monitoring bores GW 1 and GW 2. This would total three new nested monitoring bores to be installed at the northern boundary and included in the SWMP "Groundwater Monitoring Program".

End Attachment A