Peppertree Quarry
WATER MANAGEMENT PLAN

March 2022

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Rev No.	Date	Prepared By	Approved By	Comments
1	20th January 2011	ERM	Rod Wallace (Boral)	WMP prepared as part of project approval 2007
2		Sharon Makin (Boral)	Angus Shedden (Boral)	Revision based upon Modification 3 requirements. No changes required
3	22nd November 2016	Alison Tourle (Advisian)	Sharon Makin (Boral)	Draft WMP based upon Modification 4 requirements
4	29th November 2016	Sharon Makin (Boral)	Angus Shedden (Boral)	Final WMP based upon Modification 4 requirements
5	8th April 2017	Sharon Makin (Boral)	Angus Shedden (Boral)	Final WMP
6	12 July 2017	Sharon Makin (Boral)	Angus Shedden (Boral)	Final WMP – DPI Water review
7	20th May 2020	Sharon Makin (Boral)	Michael Higgins (Boral)	Draft WMP based upon Modifications 5 & 6 requirements
8	26th July 2021	Brogan Addison South east Engineering	Sharon Makin / Michael Higgins (Boral)	Peer review and final draft WMP
9	22nd February 2022	Sharon Makin (Boral)	Michael Higgins (Boral)	Final WMP with DPE updates
10	3rd March 2022	Sharon Makin (Boral)	Michael Higgins (Boral)	Final WMP with DPE updates

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Abbreviations

ADWG	Australian Drinking Water Guideline
AEMR	Annual Environmental Management Report
ANZECC Guidelines	Australian and New Zealand Environment Conservation Council Guidelines 2000
CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
DO	Dissolved Oxygen
DPE	Department of Planning, and Environment
EA	Environmental Assessment
EC	Electrical Conductivity
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act, 1979*
EPL	Environment Protection Licence
HSEQMS	Health, Safety, Environment and Quality Management System
MHRDC	Maximum Harvestable Right Dam Capacity
NRAR	Natural Resources Access Regulator
NHRMC	National Health and Medical Research Council
NorBE	Neutral or Beneficial Effect
NTU	Non Turbidity Units
OB	Abbreviation for OverBurden
PAH	Polycyclic Aromatic Hydrocarbons
PoEO Act	*Protection of Environment Operations Act 1997*
SEPP	State Environmental Planning Policy
SWA	Surface Water Assessment
SWMOP	State Water Management Outcomes Plan
TDS	Total Dissolved Solids
TN	Total Nitrogen
TP	Total Phosphorus
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
WMP	Water Management Plan
WM Act	*Water Management Act 2000*
WQO	Water Quality Objectives
WSP	Water Sharing Plan

1 INTRODUCTION

1.1 BACKGROUND

Boral Resources (NSW) Pty Ltd (Boral) was granted Project Approval (06_0074) to establish and operate the Peppertree Quarry (a granodiorite hard rock quarry, formerly called the Marulan South Quarry) including all in-pit quarrying activities and supporting infrastructure such as a rail siding and loading facility, processing plant and water supply dams under Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) in February 2007.

The 2007 Project Approval required the preparation and implementation of a number of management plans to guide the environmental management of the quarry throughout its operational life. In accordance with the Project Approval, a Water Management Plan (WMP) was first prepared by ERM for Boral in 2011.

In October 2019, the Project Approval was modified for the fifth time (hereafter referred to as Mod 5) under Section 75W of the EP&A Act, to establish a new overburden emplacement area southwest of the existing quarry (South-west Overburden Emplacement – SWOE) along with minor changes to the site to accommodate the proposed SWOE. No changes are proposed with respect to approved methods of extraction, blasting frequency, processing, transport or stockpiling activities.

In April 2020, the Project Approval modified for the sixth time (hereafter referred to as Mod 6) under Section 4.55 (1A) of the EP&A Act, to allow for the replacement of the existing air filtration network with two baghouse air filtration units and associated ducting attached to the existing and approved secondary and tertiary processing facilities (i.e. crushing and screening plant). The baghouses are located within the current operating plant footprint.

Application for Modification 7 was made in July 2021, in regards to the relocation of sediment basin P2 outside of the existing approved footprint, for safety reasons. Its approval is pending.

This document updates the 2017 WMP to incorporate changes associated with Mod 5, Mod 6, recommendations from the Independent Audit undertaken in November 2018 and actions identified from the 2018 and 2019 Annual Review outlining water management associated with current quarry activities.

In accordance with the requirements of CoA B38, this updated WMP will be submitted to the Secretary of the Department of Planning, Industry and Environment (DPE) for approval prior to the commencement of construction of the Mod 5 overburden emplacement area.

The WMP is a dynamic document which will be updated over the life of quarry operations until the Project Approval end date of December 2038.

1.2 OVERVIEW OF OPERATIONS

The Quarry is located in Marulan South, 10 km south-east of Marulan, 35 km east of Goulburn and approximately 175 km south-west of Sydney, within the Goulburn Mulwaree Local Government Area (LGA) in the Southern Tablelands of NSW.

Peppertree Quarry has an identified resource area of approximately 250 million tonnes which, depending on extraction rates, would allow quarrying for 70 years or more over an area of approximately 104 ha, within a 650 ha parcel of land owned by Boral.

The 2007 Project Approval was issued for an initial operation period of 30 years. Operations commenced in the northern portion of the resource area with an area of approximately 70 ha. This area is bordered by a densely vegetated area to the east, which flanks a steep gorge that extends into Morton National Park. A rail spur runs adjacent to the western site boundary and there are a small number of rural properties located to the north and west of the quarry. The nearest residences are located approximately 1.5 km from the quarry to the west in Marulan South and to the east on Long Point Road. The Boral Cement limestone mine is located immediately south of the quarry.

Quarry construction commenced in 2011 and operations commenced in early 2014.

Typical quarrying operations involve the stripping of overburden and the extraction of hard rock using open-cut drill and blast techniques. Overburden is stripped by dozer, loaded onto trucks using excavators and/or front-end loaders and transported to the overburden emplacement areas, where it is spread and shaped by dozer.

Traditional drill and blast methods are then used to break up the hard rock. A drill rig stationed on top of each production bench drills a series of holes that are later charged with explosives, detonators and delays. Boral apply a standard practice of limiting the maximum instantaneous charge to stay within the relevant noise and vibration criteria.

Blasted rock is then processed on-site using various crushers and screens to obtain the desired product. Material is initially crushed in a primary mobile crusher located within the pit, with blasted rock fed directly into the primary mobile crusher by excavator.

After passing through the primary crusher, the crushed material is taken from the pit along a series of conveyors to the first set of screens located to the northwest of the pit and material is stockpiled in a surge pile. Material in the surge pile is reclaimed and conveyed to the main processing area where it undergoes further crushing, screening and shaping. Product material is stored in the various covered storage bins prior to being dispatched off-site by train.

The proposed project layout is outlined in Figure **1.1**.

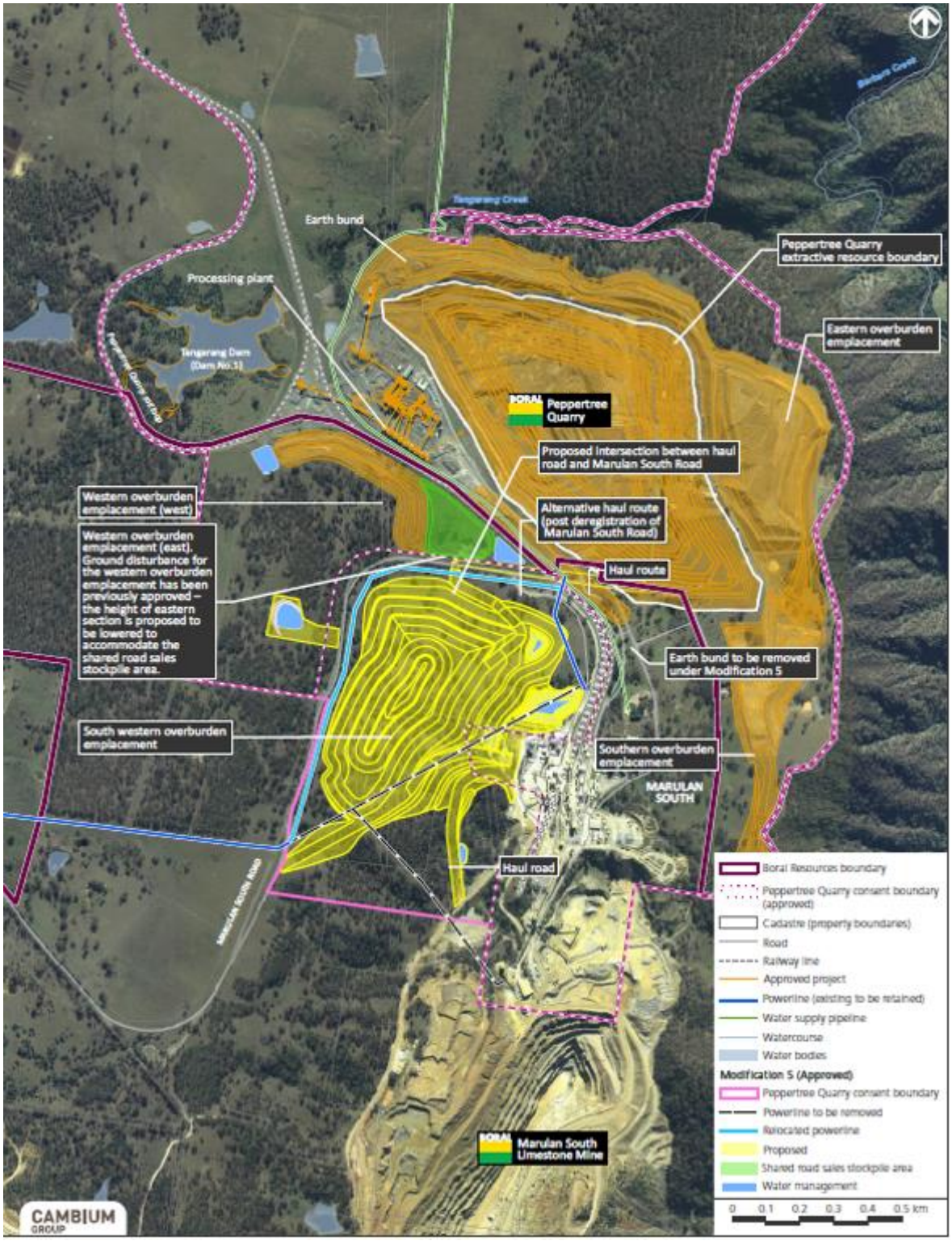


Figure 1.1: Site Layout

1.3 WMP Scope and Objectives

The primary objective of this Water Management Plan (WMP) is to provide guidance and direction for the management and reuse of water through the operation of the Peppertree Quarry.

This WMP applies to all activities undertaken by Peppertree Quarry including quarrying, crushing, screening, stockpiling and transportation of quarries products, maintenance activities, and associated service and support functions.

The WMP provides the framework and guidance for quarry activities to be conducted in a manner that:

- Complies with regulatory requirements including water licences, the Project Approval and the EPA Environment Protection Licence (EPL);
- meets the obligations and commitments identified in the Environmental Assessment (EA) (ERM, 2006) and subsequent Mods including 5 and 6 Environmental Assessments (Boral, 2019 and 2020).
- ensures compliance with relevant environmental legislation.
- minimises dirty water generation by implementation of appropriate erosion and sediment controls.
- maintains water balances for sustainable use and provision of environmental flows to Tangarang Creek.
- protects surface and groundwater quality and availability.
- ensures appropriate water control systems are planned and established prior to commencement of any new quarrying activities with potential to impact water;
- ensures appropriate and representative monitoring is conducted for verification that the WMP is effectively implemented and meeting its objectives; and
- ensures appropriate contingencies and resources for mitigating adverse impacts to surface and groundwater from quarrying activities.

The performance criteria to be used to assess the success of the management actions are identified in Table 1.1.

Table 1.1: Water Management Objectives and Performance Criteria

Objective	Performance criteria
Compliance with regulatory requirements including water licences, Project Approval and EPA Environment Protection Licence	No non compliances
Minimisation of dirty water generation by implementation of appropriate erosion and sediment controls	Erosion and sediment controls in place
Maintain water balances for sustainable use and provision of environmental flows to Tangarang Creek;	10% environmental flow to Tangarang creek achieved 100% of the time.
Protection of surface and groundwater quality and availability	Controls as outlined in this WMP in place
Ensure appropriate water control systems are planned and established prior to commencement of any new quarrying activities with potential to impact water	Controls in place
Conduct appropriate and representative monitoring for verification that WMP is effectively implemented and meeting its objectives	Undertake monitoring as outlined in WMP
Having contingencies and resources for mitigating adverse impacts to surface and groundwater from quarrying activities.	Protocol as outlined in WMP to be in place and trained

1.4 BORAL COMMITMENT TO WATER MANAGEMENT

The Quarry operates under a Boral integrated Health, Safety, Environment and Quality Management System (HSEQMS). The HSEQMS has commitments that support the Boral Environmental Policy through established standards and procedures which require internal conformance to high levels of environmental performance with continual improvement objectives. The HSEQMS Water Standard (GRP-HSEQ-8-02) requires each Boral operation quarry to ensure that Activities that may impact on water resources are considered with measures put in place to comply with water usage and discharges on all internal and external requirements.

The minimum mandatory requirements under his guideline are:

All sites shall comply with applicable licences, permits, guidelines and standards for water quality.

All sites shall identify clean and dirty water flows and shall segregate clean water flows from dirty water flows.

Recycling and reusing wastewater shall be carried out wherever possible to reduce the consumption of potable water.

All sites shall minimise any offsite discharge – any discharge shall be controlled and monitored.

1.5 ALIGNMENT WITH OTHER PLANS

A Biodiversity and Rehabilitation Management Plan (Boral 2017) including land stabilisation, fencing, planting and weed control has been prepared for the quarry. Water management outcomes included in this WMP have been developed to complement the rehabilitation objectives for the quarry.

This WMP incorporates the recommendations of the *Marulan South Environmental Assessment Report* (ERM, 2006) and the Surface Water Assessment (SWA) (Advisian, 2019) that was prepared as part of the Mod 5 application to assess potential impacts on drainage systems downstream of the South Western Overburden Emplacement (SWOE) and associated with the Western Overburden Emplacement (WOE) and the Statement of Environmental Effects prepared to support Mod 6.

The existing management strategies, plans and monitoring programs approved prior to the approval of MOD 5 are still being applied to the project, until modified documents are approved.

In accordance with Condition B38 the Water Management Plan will be submitted for approval by the Secretary, with six months of the approval of Modification and will be implemented once approved.

1.6 CONSULTATION

In accordance with the requirements of CoA B33 (a), consultation is required to be undertaken with the DPIE Water, EPA, NRAR and WaterNSW in the revision of the plan.

A copy of this revised plan was forwarded to representatives of each department (NRAR, NSW Water, EPA and DPIE Water) for review and discussion, via the DPIE portal mid 2021.

Comments have been received from the EPA, NSW Water and DPIE Water, all with no changes to the plan.

NRAR have advised late October 2021 that they were not aware of the need to comment on the Water Management Plan.

Correspondence associated with this Water Management plan is contained in Appendix A.

1.7 DOCUMENT STRUCTURE

The structure of the Management plan is outlined in Table 1.2

Table 1.2: Structure of the Management Plan

section	Content
1	Provides an overview of the project, and objectives of the plan
2	Details the statutory requirements as outlined in the conditions of consent dated April 2020
3	Describes the existing environment of the site
4	Describes the baseline water quality
5	Describes the water management actions in place and to be implemented in the operation of the quarry
6	Erosion and sediment controls – design, management and maintenance
7	Water monitoring protocols
8	Outlines incident planning and responses – Surface and ground water response plans
9	Specifies training requirements
10	Outlines the reporting and review requirements
11	Lists references used in the plan preparation

2 STATUTORY REQUIREMENTS AND GUIDELINES

2.1 NSW LEGISLATION

2.1.1 Environmental Planning and Assessment Act 1979

The project was declared a 'major development' under the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and State Environmental Planning Policy (Major Development) 2005. Since Project Approval was granted in 2007, there have been six approved modifications:

1. **Modification 1 (2009)** approved for exploratory blasting and test pitting in order to verify the design of the processing plant.
2. **Modification 2 (2011)** approved for the construction of a new rail line rather than use the existing rail facilities to the Limestone Mine.
3. **Modification 3 (2012)** approved the construction of a high voltage power line from an existing substation to the processing plant and to provide a rail siding near the junction with the Main Southern Railway Line.
4. **Modification 4 (2016)** approved for the extension of daily in-pit operating hours and Establishment of a new overburden emplacement area.
5. **Modification 5 (2019)** approved for development of a new overburden emplacement (South-west Overburden Emplacement – SWOE) among other minor amendments to the site, including additional sediment dams associated with the Western Overburden Emplacement (WOE)
6. **Modification 6 (2020)** approved for the replacement of existing dust extraction units with two baghouses and associated duct work.
7. **Modification 7 (2021)** was made in July 2021, in regards to the relocation of sediment basin P2 outside of the existing approved footprint, for safety reasons. Its approval is pending.

The quarrying operations will continue to be subject to the provisions of the EP&A Act for any subsequent changes or modifications to the operations. The operations will need to be able to demonstrate compliance against the consolidated Project Approval issued under the provisions of the EP&A Act.

Table 2.1 summarises the Conditions of Approval (CoA) relevant to this WMP and a cross-reference to the location within this WMP where the requirement is addressed.

Table 2.1: Consolidated Surface Water and Groundwater related Conditions of Approval

CoA	Condition of Project Approval	Referenced in WMP
	Compliance	
A26	The Applicant must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this consent relevant to activities they carry out in respect of the development	**9.1**
	Water supply	
B27	The Proponent must ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of the project to match its available water supply.	5.6

CoA	Condition of Project Approval	Referenced in WMP
B28	The Proponent must obtain the necessary approvals for the project under the *Water Act 1912*. *Note: The Water Management Act 2000 may apply to the project. The Proponent must consult with DPIE Water on the relevant approvals at the time the application is made.*	2.2
	Discharges	
B29	Except as may be expressly provided for by an EPL, the Proponent must not discharge any dirty water from the quarry or ancillary operational areas.	5.2
B30	The Proponent must prepare an onsite wastewater report for the proposed effluent management system consistent with the requirements of *WaterNSW – "Developments in Sydney's Drinking Water Catchment" – Water Quality Information Requirements, 2011.* The effluent management system must be designed and constructed to be in accordance with this onsite wastewater report and its design must be approved by Council prior to construction.	5.3.6, Appendix B
	Tangarang Creek Environmental Flow	
B31	The Proponent must provide an environmental flow to Tangarang equivalent to 10% of average daily flows. Details of the management of these environmental flows must be included in the Site Water Balance required under condition B34 of this schedule	4.2, 7.2, 5.6
	Sediment Dams	
B32	For sediment dams described in the EA, the Proponent must ensure that: (a) critical structures such as "dirty water" dams are designed, constructed and maintained to accommodate a 1 in 100-year ARI 24-hour event; and (b) other dams and water management structures are designed, constructed and maintained to accommodate a 1 in 20-year ARI 24-hour event.	5.2, 5.3, 6.3
	Water Management Plan	
B33	The Proponent must prepare a Water Management Plan for the project to the satisfaction of the Secretary. This plan must	This WMP
	(a) be prepared in consultation with the DPEI Water, EPA, NRAR and WaterNSW; and	1.6
	(b) Include a:	
	• Site Water Balance;	5
	• Erosion and Sediment Control Plan;	6, App D
	• Surface Water Monitoring Program;	7
	• Ground Water Monitoring Program; and	7
	• Surface and Ground Water Response Plan to address any potential adverse impacts associated with the project.	8
	Site Water Balance	
B34	The Site Water Balance must: (a) include details of all water extracted (including make-up water), dewatered, transferred, used and/or discharged by the project; and (b) describe measures to minimise water use by the project.	5.6, 7.4 5.2.1., 5.5
	Erosion and Sediment Control	
B35	The Erosion and Sediment Control Plan must: (a) be consistent with the requirements of *Managing Urban Stormwater: Soils and*	6, App D

CoA	Condition of Project Approval	Referenced in WMP
	Construction, Volume 1, 4th Edition, 2004 (Landcom); (b) identify activities that could cause soil erosion and generate sediment. (c) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters; (d) describe the location, function, and capacity of erosion and sediment control structures; (e) describe what measures would be implemented to maintain (and if necessary decommission) the structures over time; (f) include interim surface water management for Catchment C of the SWOE (see Figure 5 of Appendix 4) pending possible future expansion of the emplacement area; and (g) include detailed performance and completion criteria to ensure the SWOE is geomorphologically stable following the completion of works including triggers for remedial action, where these performance or completion criteria are not met.	5.2 5.2 5.3.3, 6.3, Table 5.2 6.7 5.3 7.5, 8.4
	Surface Water Monitoring	
B36	The Surface Water Monitoring Program must include: (a) detailed baseline data on surface water flows and quality in Tangarang Creek and Barbers Creek; (b) surface water impact assessment criteria; (c) a program to monitor surface water flows and quality; (d) a protocol for the investigation of identified exceedances of the surface water impact assessment criteria; and (e) a program to monitor the effectiveness of the Erosion and Sediment Control Plan which includes: periodic review of sheet, rill and gully erosion risks; and monitoring of the geomorphologically stability of the SWOE, in consultation with Water NSW.	4.1, 4.3 7.1 7.1 8.2 App E, 7.5
	Ground Water Monitoring Program	
B37	The Ground Water Monitoring Program must include: (a) detailed baseline data on ground water levels, flows, and quality, based on statistical analysis; (b) groundwater impact assessment criteria for monitoring bores; (c) a program to monitor regional ground water levels and quality; and (d) a protocol for the investigation of identified exceedances of the ground water impact assessment criteria.	3.3, 4.3 7.3 7.3 8.3
B38	The Proponent must submit the Water Management Plan for approval of the Secretary, within six months of the approval of Modification 5.	1.5
B39	The Proponent must implement the Water Management Plan approved by the Secretary.	1.5
	Overburden Emplacements	
B40	In constructing and operating the Southern Overburden Emplacement Area, the Proponent must ensure that: (a) the surface water management system is constructed in accordance with the plan shown on figure 4 in Appendix 4; and (b) the surface water management system includes appropriate scour protection at discharge points to ensure the potential for erosion and transport of sediment to downstream waters is minimised.	5.1, 5.3 6.3, App D
B41	On completing of the construction of the surface water management system for the Southern Overburden Emplacement Area, the Proponent must commission an audit by a	10.3.2

CoA	Condition of Project Approval	Referenced in WMP
	suitably qualified, experienced and independent person, approved by the Secretary, to determine whether the system has been constructed in accordance with this approval. A copy of the audit report and the Proponent's response to its recommendations must be provided to the Secretary and WaterNSW within 12 weeks of its commissioning.	
	Management Plan Requirements	
D4	Management plans required under this approval must be prepared in accordance with relevant guidelines, and include:	
	(a) a summary of relevant background or baseline data;	4
	(b) details of:	
	(i) the relevant statutory requirements (including any relevant approval, licence or lease conditions);	2
	(ii) any relevant limits or performance measures and criteria; and	7
	(iii) 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;	10.1
	(c) any relevant commitments or recommendations identified in the document/s listed in condition A2(c);	5, 6
	(d) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures and criteria;	5, 6
	(e) a program to monitor and report on the:	
	(i) impacts and environmental performance of the project; and	7
	(ii) effectiveness of the management measures set out pursuant to condition D4(d);	7
	(f) 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;	8
	(g) a program to investigate and implement ways to improve the environmental performance of the project over time;	10
	(h) a protocol for managing and reporting any:	
	(i) incident, non-compliance or exceedance of the impact assessment criteria or performance criteria;	8
	(ii) complaint; or	10.2
	(iii) failure to comply with statutory requirements;	8
	(i) public sources of information and data to assist stakeholders in understanding environmental impacts of the development;	10
	(j) a protocol for periodic review of the plan; and	10
	(k) a document control table that includes version numbers, dates when the management plan was prepared and reviewed, names and positions of people who prepared and reviewed the management plan, a description of any revisions made and the date of the Secretary's approval.	Document table
	Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.	
	Adaptive Management	
D5	The Proponent must assess and manage project-related risks to ensure that there are no exceedances of the criteria and/or performance measures in PART B. Any exceedance of these criteria and/or performance measures constitutes a breach of this approval and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.	
	Where any exceedance of these criteria and/or performance measures has occurred, the	

CoA	Condition of Project Approval	Referenced in WMP
	Proponent must, at the earliest opportunity: (a) take all reasonable and feasible measures to ensure that the exceedance ceases and does not re-occur; (b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and (c) implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary.	10.1
	Revision of Strategies, Plans and Programs	
D6	Within three months of: (a) the submission of an incident report under condition D9; (b) the submission of an Annual Review under condition D11; (c) the submission of an Independent Environmental Audit under condition D13; (d) the approval of any modification of the conditions of this approval (unless the conditions require otherwise); (e) notification of a change in project stage under condition A15; or (f) the issue of a direction of the Secretary under condition A2(b) which requires a review, the suitability of existing strategies, plans and programs required under this approval must be reviewed by the Proponent.	10.4
D7	If necessary, to either improve the environmental performance of the project, cater for a modification or comply with a direction, the strategies, plans and programs required under this approval must be revised, to the satisfaction of the Secretary and submitted to the Secretary for approval within six weeks of the review. Note: This is to ensure strategies, plans and programs are updated on a regular basis and to incorporate any recommended measures to improve the environmental performance of the project.	10.4
D8	The Proponent must continue to apply existing management plans, strategies or monitoring programs approved prior to the determination of Modification 5, until the approval of a similar plan, strategy or program following the determination of Modification 5	1.5
	Reporting and Auditing	
D9	– Incident Notification The Proponent must immediately notify the Department and any other relevant agencies immediately after it becomes aware of an incident. The notification must be in writing to compliance@planning.nsw.gov.au and identify the project (including the project application number and name) and set out the location and nature of the incident.	10.2
D10	Non-Compliance Notification Within seven days of becoming aware of a non-compliance, the Proponent must notify the Department of the noncompliance. The notification must be in writing to compliance@planning.nsw.gov.au and identify the project (including the project application number and name), set out the condition of this approval that the project is noncompliant with, the way in which it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the non-compliance. Note: A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.	10.2
D11	Annual Review By the end of March in each year after the commencement of project, or other timeframe agreed by the Secretary, a report must be submitted to the Department reviewing the	10.2

CoA	Condition of Project Approval	Referenced in WMP
	environmental performance of the project, to the satisfaction of the Secretary. This review must: (a) describe the project (including any rehabilitation) that was carried out in the previous calendar year, and the project that is proposed to be carried out over the current calendar year; (b) include a comprehensive review of the monitoring results and complaints records of the project over the previous calendar year, including a comparison of these results against the: (i) relevant statutory requirements, limits or performance measures/criteria; (ii) requirements of any plan or program required under this approval; (iii) monitoring results of previous years; and (iv) relevant predictions in the documents listed condition A2(c). (c) identify any non-compliance or incident which occurred in the previous calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence; (d) evaluate and report on: (i) the effectiveness of the noise and air quality management systems; and (ii) compliance with the performance measures, criteria and operating conditions in this approval; (e) identify any trends in the monitoring data over the life of the project; (f) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and (g) describe what measures will be implemented over the next calendar year to improve the environmental performance of the project.	
D12	Copies of the Annual Review must be submitted to Council and made available to the CCC and any interested person upon request.	10.2
D13	Independent Environmental Audit Within three years of the date of the commencement of construction, and every three years after, unless the Secretary directs otherwise, the Proponent must commission and pay the full cost of an Independent Environmental Audit of the project. The audit must: (a) be led by a suitably qualified, experienced and independent auditor whose appointment has been endorsed by the Secretary; (b) be conducted by a suitably qualified, experienced and independent team of experts (including any expert in field/s specified by the Secretary) whose appointment has been endorsed by the Secretary; (c) be carried out in consultation with the relevant agencies and the CCC; (d) assess the environmental performance of the project and whether it is complying with the relevant requirements in this approval, any relevant EPL, water licences and mining leases for the project (including any assessment, strategy, plan or program required under these approvals); (e) review the adequacy of any approved strategy, plan or program required under the abovementioned approvals and this approval; (f) recommend appropriate measures or actions to improve the environmental performance of the project and any assessment, strategy, plan or program required under the abovementioned approvals and this approval; and (g) be conducted and reported to the satisfaction of the Secretary. Within three months of commencing an Independent Environmental Audit, or within another timeframe agreed by the Secretary, the Proponent must submit a copy of the audit report to the Secretary, and any other NSW agency that requests it, together with its response to any recommendations contained in the audit report, and a timetable for the	10.2

CoA	Condition of Project Approval	Referenced in WMP
	implementation of the recommendations. The recommendations must be implemented to the satisfaction of the Secretary.	
D14	Monitoring and Environmental Audits Any condition of this approval that requires the carrying out of monitoring or an environmental audit, whether directly or by way of a plan, strategy or program, is taken to be a condition requiring monitoring or an environmental audit under Division 9.4 of Part 9 of the EP&A Act. This includes conditions in respect of incident notification, reporting and response, non-compliance notification, compliance report and independent audit. For the purposes of this condition, as set out in the EP&A Act, "monitoring" is monitoring of the project to provide data on compliance with the approval or on the environmental impact of the project, and an "environmental audit" is a periodic or particular documented evaluation of the project to provide information on compliance with the approval or the environmental management or impact of the project.	10.2
D16	Before the commencement of construction until the completion of all rehabilitation required under this consent, the Applicant must: *NSW Government 23 Department of Planning, Industry and Environment* (a) make the following information and documents (as they are obtained, approved or as otherwise stipulated within the conditions of this consent) publicly available on its website: — (i) the document/s listed in condition A2(c); — (ii) all current statutory approvals for the development; — (iii) all approved strategies, plans and programs required under the conditions of this consent; — (iv) minutes of CCC meetings; — (v) regular reporting on the environmental performance of the development in accordance with the reporting requirements in any plans or programs approved under the conditions of this consent; — (vi) a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs; — (vii) a summary of the current stage and progress of the development; — (viii) contact details to enquire about the development or to make a complaint; — (ix) a complaints register, updated monthly; — (x) the Annual Reviews of the development; — (xi) audit reports prepared as part of any Independent Environmental Audit of the development and the Applicant's response to the recommendations in any audit report; — (xii) any other matter required by the Planning Secretary; and (b) keep such information up to date, to the satisfaction of the Planning Secretary.	10.2.5

The *Marulan South Environmental Assessment Report* (ERM, 2006) recommended a range of measures to avoid, manage, mitigate, offset and/or monitor the environmental impacts of the project, as set out in the Statement of Commitments. The commitments that relate to water management and a cross-reference to the location within this WMP where the commitment is addressed are set out in Table 2.2 below.

Table 2.2: Statement of Commitments

Statement of Commitment	XRef in WMP
EA (2006)	
Water resources will be managed through a management system designed to target 100% self-sufficiency in water supply, provide environmental flows equivalent to 10% of average daily flows, optimise recycling within the quarry operations and minimise impacts to receiving waters.	5
Boral will monitor the potential impacts of the project on surface and groundwater quality, to ensure water is suitable for intended use and that operations are not impacting on receiving waters.	7
Water quantity will also be monitored to manage water supply balances and assess groundwater drawdown impacts from the project	5.5
The water management system will include: • installation of a permanent drainage network to divert clean and dirty water flows to appropriate storages. These diversions will have capacity to convey critical flows of at least a 1 in 20 year average recurrence interval (ARI) storm event, and up to a 1 in 100 year ARI event in critical locations; • installation of erosion control devices including sediment traps, check dams, spreaders, dissipaters, lined or vegetated drains, and the limitation of longitudinal gradients of drains to 1%; • diversion of all dirty water from haul roads, disturbed areas and overflow from dirty water storages to in-pit dirty water storages. All dirty water is to be filtered or treated prior to release; • package treatment unit for potable water supply to treat rainwater runoff to drinking water standards. This will store at least 20 kL (six days supply) of treated water; • package treatment plant with capacity to treat 3 kL/day of sewage to secondary standard with disinfection prior to release; • filtration of all excess pit water through a constructed wetland prior to release into Dam 1; • provision of bunding and spill kits, and the locating of any activities with potential for spills within the pit drainage area; and • release of environmental flows to Barbers Creek equivalent to 10% of average daily flows.	5.3.1.1. 5, 6 5.3.4 5.3.6 5.2.6 5.3.1 8.2.3 5.2.3, 7.2
A water quality monitoring program will be implemented including: • monitoring of surface water quality in supply dams and downstream of Tangarang Creek to ensure water is suitable for intended use and that operations are not impacting on receiving waters. Baseline monitoring will be followed by quarterly monitoring with additional sampling following rainfall events and/or known discharges from the site. Results will be compared to ANZECC 2000 (now ANZG 2018) guidelines; • monitoring of supply quantity and quarry use to manage water supply balances; • recording of environmental flows and flood spills to Tangarang Creek; • at least annual inspection and cleaning of water quality devices; • monitoring of water in pit storage and Dam 1 to ensure water meet secondary contact criteria; • monitoring of storage dams for algal blooms; • baseline and quarterly monitoring of groundwater around the quarry boundary to assess local drawdown impacts; and • annual groundwater quality monitoring.	4, 7 5.3, 5.5, 7.4 4, 7 6.7 4, 7 4, 7.1.2 4.3 4.3
Mod 1 - – as per the EA – no changes to water management	
Mod 2 – as per the EA – no changes to water management	
Mod 3	
The control measures identified in the conceptual sediment and erosion control plans (Figures 3.4 and 3.5) will be implemented. Following construction all disturbed areas will be stabilised and rehabilitated.	5.3

Statement of Commitment	XRef in WMP
Mod 4	
• Proposed sediment basins would be constructed between the toe of the emplacement and the development consent boundary;	5.3.3
• Diversion drains would be constructed to direct surface water runoff from the emplacement into the sediment basins	6.4
• Sediment fencing would be installed down-slope of any proposed disturbance, where surface water runoff from that area of disturbance is not diverted to either a sediment basin or the Quarry pit;	6.1
• During overburden emplacement, the area of disturbance must be limited to the minimum area necessary for the proposed phase of work..	6.1
• The surface water monitoring program, as dictated by the Project Approval conditions, *Peppertree Quarry Water Management* Plan and Environment Protection Licence would continue to be implemented and reported as per existing requirements.	7.1.2
• The *Peppertree Quarry Water Management Plan* would be updated to incorporate the findings of the SWA undertaken as part of this EA and the recommended additional management strategies including construction of additional sediment basins and diversion structures.	1.5
Mod 5	
• These Water Management Plan would be amended to include the new sediment basins and management measures associated with the proposed SWOE and WOE.	1.5
• In accordance with the Water Management Plan, an Erosion and Sediment Control Plan (ESCP) would be prepared for the overburden emplacements and new haul road prior to construction.	
• The proposed water management system would capture runoff from the SWOE and WOE in sediment basins that would be designed and operated in accordance with the relevant requirements of Managing Urban Stormwater and would become part of the integrated site water management system.	
• Water retained in the sediment basins would be transferred for reuse in either the Quarry or the Limestone Mine for processing and dust suppression.	5.4
	5.4, 6.3
Mod 6 - no changes to water management – no different commitments	
Mod 7 - no changes to water management – no different commitments	

2.1.2 Protection of Environment Operations Act 1997

The objectives of the *Protection of Environment Operations Act 1997* (PoEO Act) are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied, under the PoEO Act to achieve these objectives include reduction of pollution at source, monitoring and reporting of environmental quality.

Based on annual production volumes, Peppertree Quarry has been determined to be a 'Scheduled Activity' under Schedule 1 of the POEO Act which requires site operations to be the subject of an Environmental Protection Licence (EPL No. 13088).

Section 120 of the POEO Act and Condition L1.1 of the EPL 13088 deem it an offence to pollute waters. Pollution is defined as a change in water quality. A key objective of the WMP is that quarrying operations are undertaken with appropriate controls and monitoring so that water quality meets statutory requirements.

2.1.3 Water Management Act 2000

Water Sharing Plan

The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use, benefiting both present and future generations. Water sharing plans (WSP) prepared in accordance with the WM Act include rules for protecting the environment and administrating water licencing and trading.

Peppertree Quarry is located within the area of the Greater Metropolitan Region Unregulated Area WSP, and three surface water sources within the WSP as follows:

- Bungonia Creek Management Zone (commenced July 2011);
- Barbers Creek Management Zone (commenced July 2011); and
- Shoalhaven River Gorge Management Zone (commenced July 2011).

Peppertree Quarry is located within the Barbers Creek Management Zone and has a Water Access Licence issued under the WM Act to extract up to 145 megalitres of surface water from Tangarang Creek per year (Licence Number 10WA102701). The licence also allows for the construction and use of a 110 ML dam. In addition, a water bore licence (10WA116000) was transferred to the quarry allowing an annual extraction of up to 15 ML. These licences were initially issued under the Water Act 1912.

Boral have recently purchased 300ML of water rights under a Water Access Licence to account for groundwater entering the pit void. Approval is currently being sought for operation of a pump and possible production well to access the water.

Harvestable Rights

The WM Act provides formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for the protection of catchment conditions. Chapter 3, Part 1 identifies basic landholder rights including harvestable water rights and when access licences are required. The harvestable water right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). Any capacity of the total of all dams on the property greater than the MHRDC may require a licence.

Schedule 1 of the *Water Management (General) Regulation 2004* (WM Regulation) identifies classes of dam which are exempt from licensing requirements. Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority to prevent the contamination of a water source, provided such dams are located on a minor stream referred to in section 53 (3)(b) of the Act. Based on the NSW Department of Water & Energy, *Farm Dams – Do you need a licence (2008)*: "*Minor streams are defined by the Strahler stream ordering method as 1st and 2nd order streams that do not have permanent river flow*".

As the on-site pits (dams) receive water from intermittent overland and through flow as opposed to a permanent river flow, the water source for the pits can be classed as minor stream. Therefore, the provisions of Schedule 1 (3) of the WM Regulation are satisfied and the pits (dams) are exempt from the need to obtain a licence under the WM Act.

2.1.4 SEPP (Sydney Drinking Water Catchment) 2011

The Project is located within the Sydney Drinking Water Catchment. The *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* (SEPP) aims to provide for healthy water catchments, delivering high quality water while permitting development that is compatible with that goal. The Policy also aims to support the maintenance or achievement of the water quality objectives

for the Sydney drinking water catchment and requires developments to demonstrate a neutral or beneficial effect (NorBE) on water quality.

The sediment control basins that will collect runoff from the eastern side of the proposed Southern Overburden Emplacement (which will discharge to Barbers Creek) will be constructed and operated in accordance with the requirements for discharge to 'sensitive environments' as set out in *Managing Urban Stormwater: Soils & Construction, Volume 2E – Mines and Quarries* (DECC, 2008). Following construction, the emplacement will be revegetated to a standard that minimises erosion and transport of sediment into the catchment. These management actions will ensure that the Project complies with the requirements of SEPP (Sydney Drinking Water Catchment).

2.2 STRATEGIES, POLICIES AND PLANS

2.2.1 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) is a joint national approach to improving water quality in Australian and New Zealand waterways. It was originally endorsed by the former Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ) and the former Australian and New Zealand Environment and Conservation Council (ANZECC). Since 1992 the NWQMS has been developed by the Australian and New Zealand Governments in cooperation with state and territory governments.

The NWQMS aims to protect the nation's water resources by improving water quality while supporting the businesses, industry, environment and communities that depend on water for their continued development. The main mechanism for promoting this aim has been the publication of a number of water quality guidelines, including the NSW Water Quality and River Flow Objectives and the Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018). However, in the case of the Shoalhaven River catchment, the specific requirements of the *Independent Inquiry to Shoalhaven River System* (Healthy Rivers Commission, 1999) take precedence (refer Section 2.2.3 below).

2.2.2 Australian and New Zealand Water Quality Guidelines

The Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018) identify water quality criteria to support water use objectives and inform investigation thresholds for receiving waters.

The default ANZG guidelines for current uses of receiving waters have been considered in this WMP, to inform trigger values for on and off site uses. These uses include:

- Stock and Domestic (off site)
- Industrial (on site)
- Aquatic ecosystems (off site).

Application of water use objectives are used to inform the most sensitive water use for the site, and thereby focus on maintaining water quality to enable continued use for all objectives.

2.2.3 Healthy Rivers Commission

Barbers Creek is a sub-catchment of the Shoalhaven River. The Healthy Rivers Commission's (HRC) *Independent Inquiry into the Shoalhaven River System* (HRC, 1999) endorsed the following environmental values for the Shoalhaven River and its tributaries:

- Healthy waters – protection of aquatic ecosystems;
- Recreation – protection of primary and secondary recreation and visual amenity;

- Water supplies – protection of livestock, irrigation and farmstead water; and
- Protection of drinking water to be treated with coarse screening and disinfection, within sections of stream where water is extracted for use in urban water supply.

The HRC (1999) recommended that the water quality criteria specified in the prevailing water quality guidelines published by NHMRC/ ARCANZ/ANZECC for primary and secondary contact recreation and for drinking water supplies should be adopted as water quality objectives (WQOs) throughout the Shoalhaven catchment. The ANZG 2018 Guidelines and NHMRC 2011 update the ANZECC / ARMCANZ guidelines and have been used to provide technical guidance to assess the water quality needed to protect the WQOs in this update of the WMP

2.2.4 State Water Management Outcomes Plan

The *Water Management Act 2000* provides for the establishment of the *State Water Management Outcomes Plan* (SWMOP) to set out the over-arching policy context, targets and strategic outcomes for the development, conservation, management and control of the State's water sources.

The SWMOP promotes the objects of the WMA and its water management principles and seeks to give effect to the NSW Government's salinity management strategies. The SWMOP provides for the protection and enhancement of the environmental services provided by aquatic ecosystems while delivering a framework for the use of water to meet human needs, including more secure access licences. The SWMOP details the Government's commitment to manage the linkages between environment, human health, communities and industries.

This WMP is consistent with the objectives of the SWMOP, both within the site and on downstream users, as avoidance and mitigation measures would be implemented to minimise potential impacts on the creeks and rivers associated with release of treated water.

2.2.5 Southern Rivers Catchment Action Plan

The *Southern Rivers Catchment Action Plan (CAP) 2013–2023* is an overarching 10-year plan that has been developed to guide the implementation of natural resource management in the Southern Rivers region, in collaboration with a range of partners.

The Southern Rivers CAP 2023 lists a number of objectives and targets for the Southern Rivers region, which includes the Shoalhaven River catchment. This includes the following objectives pertaining to surface water:

- Private and public land and water managers make well-informed decisions about use and care of natural resources;
- Private and public land and water managers effectively respond and adapt to change;
- Diverse, healthy, connected and productive natural environments;
- Health and integrity of natural habitat supports people and the environment; and
- Fresh water, estuarine and marine assets support people and the environment.

The *Southern Rivers CAP 2023 Paper – Water* describes the desired state of rivers within the region that support water quality, quantity and movement:

- Good geomorphic condition, close to reference condition for the particular River style;
- Natural hydraulic function—balance for surface and base flows;
- Functional connectivity within stream, to adjacent floodplains, between surface and groundwater;
- Healthy and diverse native aquatic fauna;

- Water quality supports community uses and values suitable for human consumption that meet ANZECC guidelines 100% of the time (noting the update to ANZG 2018 for this version of the WMP); and
- Sufficient riparian buffers to manage pollution sources.

2.2.6 NSW State Groundwater Protection Policy and Framework

The NSW State Groundwater Quality Protection Policy provides a comprehensive set of policy principles for groundwater quality protection. It also provides guidance on groundwater quality protection to resource managers. The protection framework involves the identification of the specific beneficial uses of every major aquifer, with strategies which can be applied to protect those beneficial uses. Management of sub surface waters on the site will be in accordance with guideline documents.

2.2.7 NSW Non-Urban Water Metering Policy

This policy outlines the implementation of a new metering framework to measure and meter non-urban water usage in NSW. The objectives of the policy are to ensure that:

- the vast majority of licensed water take is accurately metered
- meters are accurate, tamper proof and auditable
- undue costs on smaller water users are minimised
- metering requirements are practical and can be implemented effectively

Peppertree holds two (2) licences which are required to be metered. Under the policy, new meters will be required by December 2023 unless the current meters are needed to be replaced earlier.

3 SURFACE AND GROUNDWATER ENVIRONMENT

3.1 CATCHMENT DESCRIPTION

Peppertree Quarry is located within the Shoalhaven River Catchment in the Southern Tablelands of New South Wales. The Quarry is situated toward the edge of a plateau and adjacent to steep gullies that plunge into the ravine of the Barbers Creek system.

Barbers Creek is the primary receiving watercourse for any discharges or runoff from the site. Barbers Creek is a tributary of the Shoalhaven River (a drinking water supply) and is located immediately to the east of the quarry. The overall quarry resource area intersects three small catchments, two of which drain northwards to Tangarang Creek. Tangarang Creek is an ephemeral creek which has a catchment area of approximately 753 ha to the north-western corner of the quarry and flows into Barbers Creek that subsequently flows southward to meet the Shoalhaven River.

The land is mainly open grassland with a few scattered clumps of trees. Slopes range from less than 1% on the ridge line to about 20% near the drainage lines. The catchments are generally gently undulating and have been substantially cleared for agricultural uses, predominantly grazing.

3.2 CLIMATE

3.2.1 Rainfall

Collection of continuous weather records at the Quarry commenced in 2005/6. However, the Bureau of Meteorology (BoM) daily rainfall records provide a more comprehensive record of the long-term climate of the area. Table 3.1 provides the rainfall statistics for daily rainfall records (1883 – 2014), sourced primarily from the BoM weather station at Marulan (George St) (BoM Stn No 70063), while Figure 3.1 provides the monthly statistics graphically.

Table 3.1: Rainfall Statistics for Combined Rainfall Record

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average	70	70	69	53	51	63	48	45	47	59	59	63	696
Minimum	0	0	0	0	0	0	0	0	0	1	0	0	288
5%ile	8	3	4	3	4	6	7	5	14	8	5	2	418
Median	62	55	49	41	31	41	32	33	39	48	51	53	669
95%ile	172	178	190	142	148	189	146	132	105	142	126	160	1,065
Maximum	262	298	330	233	406	406	319	224	197	263	248	204	1,469

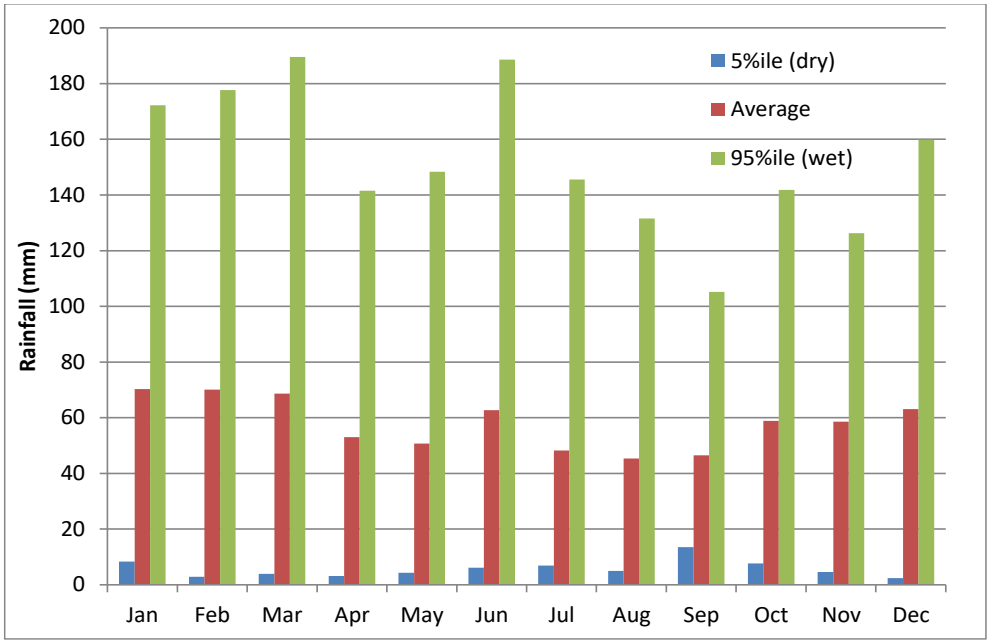


Figure 3.1: Monthly Rainfall Analysis (1883 - 2014)

The statistics show that average annual rainfall in the vicinity of the Quarry is approximately 696 mm. Peak precipitation occurs in the summer months, with lower rainfall in winter. On average, January and February are the wettest months of the year and August is the driest.

3.2.1.1 Rainfall Intensity

For purposes of assessing the required capacity of water management structures, BoM 2013 rainfall frequency- duration-depth data has been used. Relevant aspects of this data are summarised in Table 3.2.

Table 3.2: Rainfall Frequency / Duration / Depth (mm) Data for Marulan South

Duration	Annual Exceedance Probability (AEP)					
	0.5	0.2	0.1	0.051	0.02	0.01
5 min	6.3	8.5	10.1	11.7	13.8	15.5
10 min	9.9	13.6	16.3	19.0	22.7	25.6
15 min	12.2	16.9	20.2	23.6	28.2	31.9
30 min	16.4	22.4	26.7	31.0	36.9	41.5
1 hour	20.7	27.8	32.8	37.8	44.6	49.9
2 hour	25.9	34.2	40.0	45.8	53.6	59.8
3 hour	29.7	39.1	45.6	52.2	61.0	68.0

3.2.1.2 Five Day Rainfall

Sediment basins constructed under Mods 3, 4 and 5 have been sized to comply with the requirements for capture of fine and dispersive sediments as set out in Table 6.1 of *Managing Urban Stormwater: Soils and Construction: Volume 2E Mines and Quarries* (DECC, 2008). The table specifies the adoption of the 95th percentile rainfall as the basis for sizing sediment basins that potentially overflow into 'sensitive' environments. Table 3.3 lists the 95th percentile rainfall depths for various durations for Mittagong and Goulburn (as set out in Table 6.3 of *Managing Urban Stormwater:*

Soils & Construction – Volume 1). The value for Marulan South has been derived on the basis of the relative proximity of the Quarry to Mittagong and Goulburn.

Table 3.3: 95th Percentile Rainfall Depths

Duration (days)	Mittagong (mm)	Goulburn (mm)	Marulan South (mm)
2	49.1	27.4	35.0
5	75.2	40.8	52.8
10	110.4	60.8	78.2
20	164.6	97.1	120.7

3.2.2 Evaporation

Mean daily evaporation data for the period 1971 to 2016 at BoM Station Goulburn TAFE (Stn No 070263) is provided in Table 3.4.

Table 3.4: Mean Daily Evaporation (mm) - Goulburn TAFE (Stn No 070263)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
6.3	5.2	4.0	2.5	1.6	1.1	1.2	1.9	2.8	3.9	5.0	6.1	3.5

3.3 GROUNDWATER

3.3.1 Hydrogeological Environment

Hydrogeological and hydrochemical assessments carried out for the Environmental Assessment (ERM, 2006) indicate that the granodiorite unit comprises a low-yielding fractured aquifer with groundwater occurring in localised, discrete and potentially discontinuous fracture zones. The most significant of these zones comprises the water table at the weathered horizon between the overburden and the more competent, underlying granodiorite approximately 15 to 30 m below ground.

No evidence was found for significant vertical or lateral connection between the various fracture zones. Recharge of groundwater was predicted to occur via direct infiltration where fractures and weathered bedrock is exposed or covered by only a thin layer of overburden. Annual average recharge rates were predicted to be 90 mm/y.

A groundwater gradient of 0.02 m/ m occurs across the majority of the site, dipping in a north-easterly direction to discharge in the gorges and creeks surrounding the resource area. The exception to this is the mound of groundwater with a steeper gradient (0.12 m/m) at the south of the resource area resulting from the permeability contrast between the granodiorite and limestone formations.

Groundwater migration rates across the site were calculated at 0.95 m/y with discharge rates of 0.013 m^3/day/m of exposed fracture zone, indicating a very low rate of groundwater migration. Groundwater seepage rates (into the pit) of 52 m^3/d, or approximately 19 ML/y are expected.

Ongoing quarrying may have changed groundwater conditions in the immediate area of the quarry. However, the impacts on the groundwater surrounding the quarry are likely to be minimal, as the confined nature of the aquifer limits the hydrogeological impact of the pit on the surrounding groundwater, and the existing well head data (2017 to 2021), do not suggest a significant drawdown impact from the pit. It is likely that regional groundwater flow remains in a north-easterly direction.

3.3.2 Groundwater Use

A total of 43 registered wells are located within a 5 km radius of the Quarry, based on the Water NSW database of registered bores. Of these, 19 wells are located between 4 and 5 km from the Quarry. Some wells, located on the opposite side of the Barbers Creek gorge, are not hydraulically connected to groundwater from the quarry, as the gorge acts as a physical hydraulic barrier.

4 WATER QUALITY

4.1 BASELINE SURFACE WATER QUALITY

4.1.1 Location of Monitoring Sites

Boral has implemented a comprehensive surface water quality monitoring program in accordance with the requirements of CoA B36 with water quality monitoring at Tangarang Creek having been conducted since February 2012 and Barbers Creek since September 2014. The surface water sites relevant to this WMP are listed in Table 4.1 and the locations of the sites are shown on Figure 4.1.

Table 4.1: Routine Creek Water Quality Monitoring Sites and Locations

Site	Description	Easting	Northing	Monitoring frequency
U1	Tangarang Creek upstream of Dam 1	226950	6149970	quarterly
T1	Tangarang Creek downstream of Dam 1	228730	6150550	quarterly
Marulan Up	Marulan Creek upstream of track crossing	225825	6151504	Monthly till 2017 now quarterly
Marulan Down	Marulan Creek downstream of track crossing	228002	6151977	Monthly till 2017 now quarterly
Barbers Up	Barbers Creek upstream	229518	6148416	Monthly till 2017 now six monthly
Barbers Down	Barbers Creek downstream	229542	6147306	Monthly till 2017 now six monthly
SR1	Shoalhaven River site 1 (sampled by MSL)	229183	6145620	Monthly till 2017 now six monthly
SR2	Shoalhaven River site 2 (sampled by MSL)	229940	6146335	Monthly till 2017 now six monthly
SR3	Shoalhaven River site 3 (sampled by MSL)	231172	6146891	Monthly till 2017 now six monthly

Table 4.1 includes Marulan Creek, which is a tributary of Barbers Creek located to the north of Tangarang Creek and upstream of the Barbers Creek, Tangarang Creek confluence. Marulan Creek provides additional data showing the typical runoff quality from the open grazing land on the plateau to the west of Barbers Creek from which both Marulan Creek and Barbers Creek drain. In addition, routine monitoring is undertaken at three locations in the Shoalhaven River at locations SR1, SR2 and SR3, as part of Marulan South Limestone monitoring program.

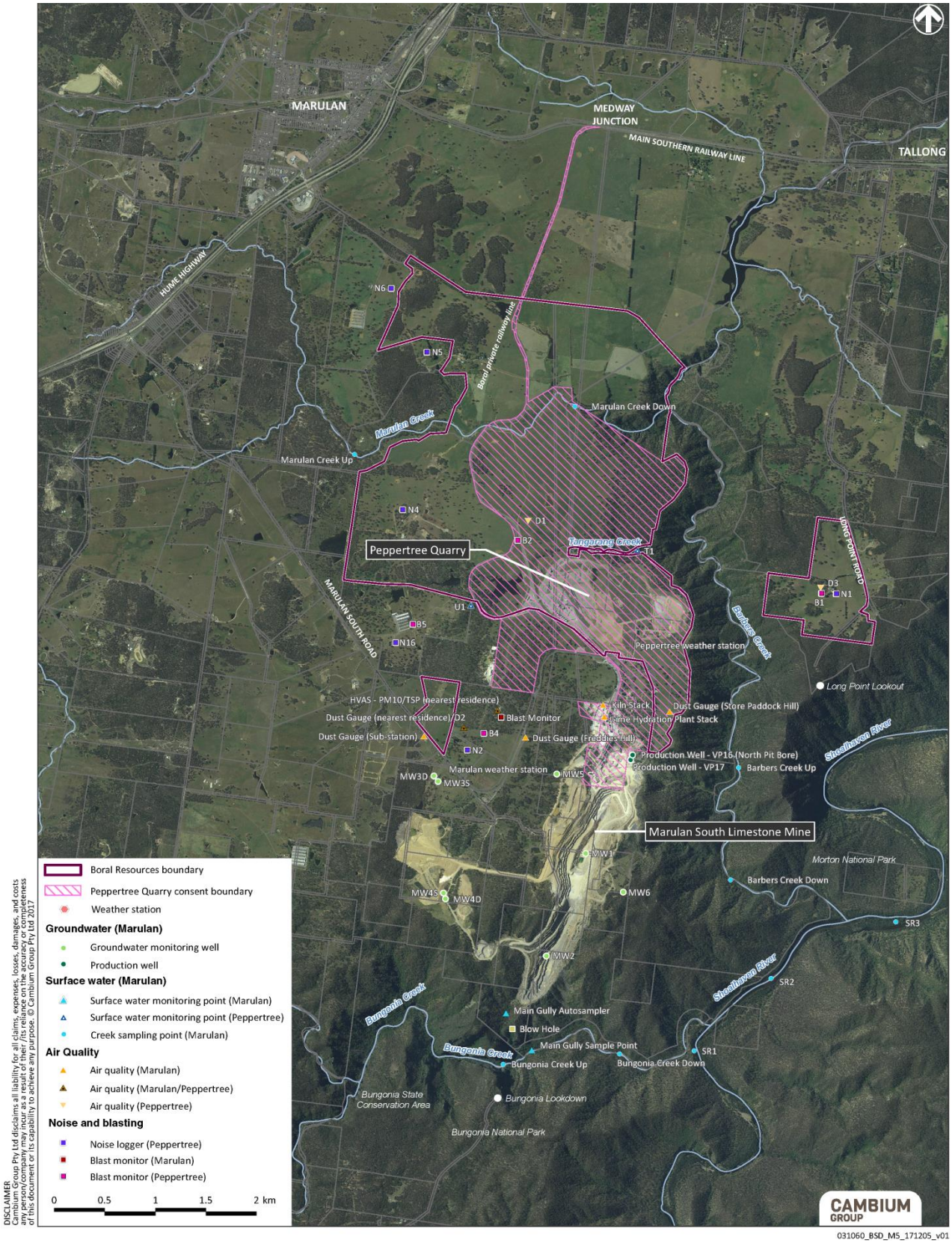


Figure 4.1: Surface Water and Groundwater Monitoring Sites

4.1.2 Analytes Monitored

The suite of parameters analysed for each water quality sample is listed in Table 4.2.

Table 4.2: Water Quality Analytes

Field Analysis		
Dissolved oxygen (mg/L)	Electrical conductivity (µS/cm)	Oil and Grease
Turbidity (Water Quality Meter)	pH (field)	
Laboratory Analysis		
Total Dissolved Solids (mg/L)	Potassium (K+)	Bicarbonate (HCO_3-)
Total Suspended Solids (mg/L)	Magnesium (Mg2+)	Nitrate (NO_3-)
Turbidity – Laboratory (NTU)	Sodium (Na+)	Nitrite (NO_2-)
TPH C10-C36 / TRH	Ammonia (NH4+)	Total Nitrogen
BTEX	Chloride (Cl-)	Total Phosphorous
PAHs	Sulphate (SO42-)	Faecal coliforms (cfu/100mL)
Calcium (Ca2+)		

All data in measured in µg/L unless otherwise specified

More details on the surface water quality monitoring regime are provided in Section 7.1.

4.1.3 Creek Water Quality

Table 4.3 contains key water quality statistics from the various monitoring locations in the vicinity of the Quarry through till 2020 from samples taken through the Peppertree Quarry sampling program. The relevant ANZG 2018default trigger values for ecosystem protection (upland rivers) are also provided in Table 4.3 along with the Peppertree Quarry site specific trigger levels. These trigger levels were established as part of the Modification 5 assessment.

Refer Section 7.1 for further discussion on the surface water quality trigger values adopted for the WMP based on the statistics presented in Table 4.3.

Table 4.3: Summary of Creek Water Quality Statistics

Analyte	Unit	Statistic	U1	T1	Marulan creek	Barbers Up	Barbers Down	ANZG2018* Default	Site specific trigger levels
pH	pH value	Count	6	36	13	35	34	6.5-7.5	6.5 – 8.5
		20%ile	6.7	7.76	7.2	7.78	7.85		
		Median	7.5	8	7.6	7.95	8.02		
		80%ile	8.12	8.2	7.72	8.05	8.09		
Total Nitrogen as N (TN)	mg/L	Count	6	29	13	35	34	0.25	1.1
		20%ile	1.24	0.3	0.98	0.28	0.2		
		Median	1.65	0.5	1.5	0.4	0.4		
		80%ile	3.12	1.5	1.96	0.6	0.6		
Total Phosphorus as P (TP)	mg/L	Count	6	36	13	35	34	0.02	0.09
		20%ile	0.14	0.01	0.05	0.01	0.01		
		Median	0.18	0.01	0.17	0.01	0.01		
		80%ile	0.31	0.03	0.23	0.01	0.02		
Total Dissolved Solids (TDS)	mg/L	Count	6	36	13	35	34		500
		20%ile	120	319	218.4	273.2	293.2		
		Median	190	430	352	420	453		

Analyte	Unit	Statistic	U1	T1	Marulan creek	Barbers Up	Barbers Down	ANZG2018* Default	Site specific trigger levels
		80%ile	285	493.2	663	601.3	652.4		

*ANZG2018 Default Trigger Value for ecosystem protection, South East Australis, slightly disturbed ecosystems in upland rivers

**EC values for U1 and T1 have been calculated from TDS results using a conversion factor of 0.65

Long term trend analysis has been undertaken on pH, TDS, total Phosphorus and total Nitrogen

pH is consistently between the range of 6.5 to 8.5. Levels at T1 downstream have consistently remained within the trigger levels. Barber Creek samples are also consistently below the trigger levels.

Long term TDS levels recorded at, T1 and U1 sites have remained below the site-specific triggers, for the majority of the time since rain events in 2013. Marulan South and Barbers Creek levels have fluctuated over time and will be influenced by other factors rather than the quarry.

Total Phosphorus levels fluctuate over time at all sampling sites. Levels are below the site specific trigger levels for T1 and Barbers creek sites. Levels at Marulan south creek and U1 are higher than the trigger which may be attributed to outside activities associated with local farming practices.

Total Nitrogen levels have fluctuated over time. Samples collected from the T1 location have continued to be below trigger levels since 2014, with the exception of storm related events. Barbers creek sites are also below trigger levels.

The initial EA and management plans predicted compliance with the appropriate ANZECC (now ANZG 2018) and ADWG criteria based on limited background sampling. With the exception of periods of storm events, the results obtained from surface water analysis has been in line with the EA predictions and the criteria.

Overall, there would appear to be no impact to T1 and Barbers Creek from quarry operations.

4.2 SURFACE WATER FLOWS

CoA B36 of the Project Approval requires that *"the Surface water monitoring program must include: detailed baseline data on surface water flows and quality in Tangarang Creek and Barbers Creek"*.

Baseline surface water flow data in Tangarang Creek was not collected prior to the commencement of operations at Peppertree Quarry as there was no means of measuring flow until a V notch weir was constructed below the Main Dam as part of the development of the quarry. Continuous surface water flows (environmental flows) downstream of the Quarry have been monitored above the weir on Tangarang Creek since January 2015. Analysis of the Tangarang Creek environmental flows for the period January 2015 to December 2019 is provided in Section 7.2..

No surface water flow data is collected from Barbers Creek. This area is difficult to access, and the use of solar powered flow monitoring equipment has been investigated and found not to be suitable. Flow data is available further downstream in the Shoalhaven River at a NSW Water monitoring site (Fossickers Flat). This site has been in operation since July 1977. Barbers creek enters the Shoalhaven River, upstream of Fossickers Flat. It is considered that Fossickers Flat water data is an appropriate replacement for flow measurements in Barbers creek. As Fossickers Flat has been in operation since 1977, should there be any significant reduction or increase in flow in Barnes creek it should be apparent in the data.

Fossickers Flat data shows a consistent water level in the river with increases in water level and flow associated with rainfall events,

4.3 BASELINE GROUNDWATER QUALITY

4.3.1 Ground water 2005

As part of the groundwater investigations undertaken for the EA (ERM, 2006) groundwater samples were collected from boreholes P12, P34, P39, DDH04, and from the existing domestic water supply well (W1) located on site. These sampling locations are shown on Figure 4.3.

Field parameters including temperature, DO, EC, pH and Oxidation-Reduction Potential (ORP) were recorded during the groundwater sampling. The results of the sampling are provided in Table 4.4.

Table 4.4: Field Groundwater Quality Parameters

Well ID	Sampling Date	Temperature °C	Dissolved Oxygen (mg/L)	EC (µS/cm)	pH	ORP (mV)
DDH04	11/11/05	15.8	3.70	548	7.08	+11
P34	11/11/05	15.5	4.94	3650	7.16	-236
P39	10/11/05	16.4	5.23	2,830	7.00	+193
P12	10/11/05	16.6	1.83	1,632	7.14	+58
W1	11/11/05	19.4	6.34	1,972	6.99	+46

Source: Marulan South Quarry Environmental Assessment Report (ERM, 2006)

Table 4.4 indicates that EC values ranged from fresh (550 µS/cm, DDH04) in the deeper sections of the aquifer to brackish (3,650 µS/cm, P34) in the pegmatite unit. Total Dissolved Solids (TDS) ranged from 370 mg/L (DDH04) in the deepest groundwater sample to 2,240 mg/L (P39). A plot of EC and TDS versus aquifer depth indicates that both generally decrease with depth, indicating that fresh groundwater is present at depth (Figure 4.2).

Groundwater pH was relatively neutral with samples ranging from 6.99 (W1) to 7.16 (P34), indicating natural groundwater influenced by water-rock interaction. ORP values ranged from oxidising (+193 mV, P39) to reducing (-234 mV, P34) in the pegmatite unit.

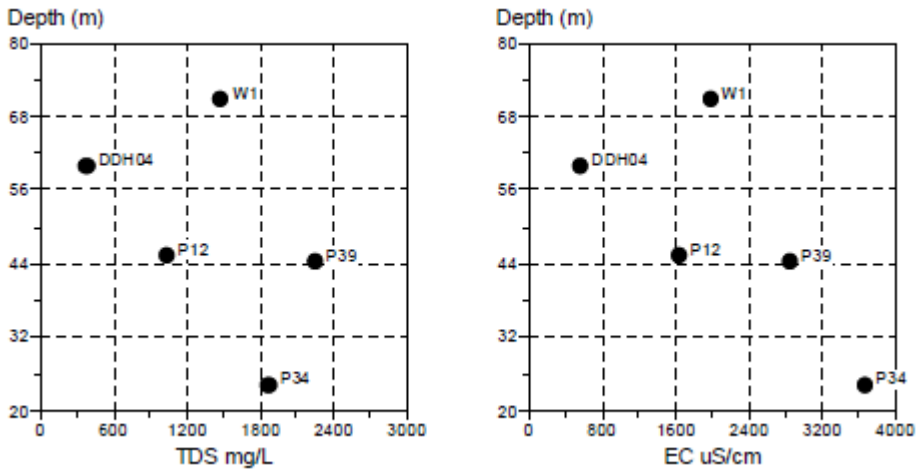


Figure 4.2: TDS and EC vs Depth

The groundwater samples were analysed for dissolved metals and the observed concentrations were assessed with reference to the ANZECC (2000) guideline values for 95% protection level for a freshwater ecosystem protection (updated to ANZG 2018) as shown in Table 4.5. The concentrations of most dissolved metals in the groundwater samples obtained from the granodiorite and the pegmatite indicated that these waters are slightly elevated with respect to the ANZG (2018) guideline values.

Major cations and anions were analysed to delineate different hydrochemical water types. The concentrations of the major ions were found to be moderately elevated, suggesting water-rock interactions that are generally characteristic of local to intermediate groundwater systems (e.g. limited groundwater residence time relative to typical regional groundwater flow systems in similar lithologies).

Figure 4.3: Baseline Groundwater Sampling Locations

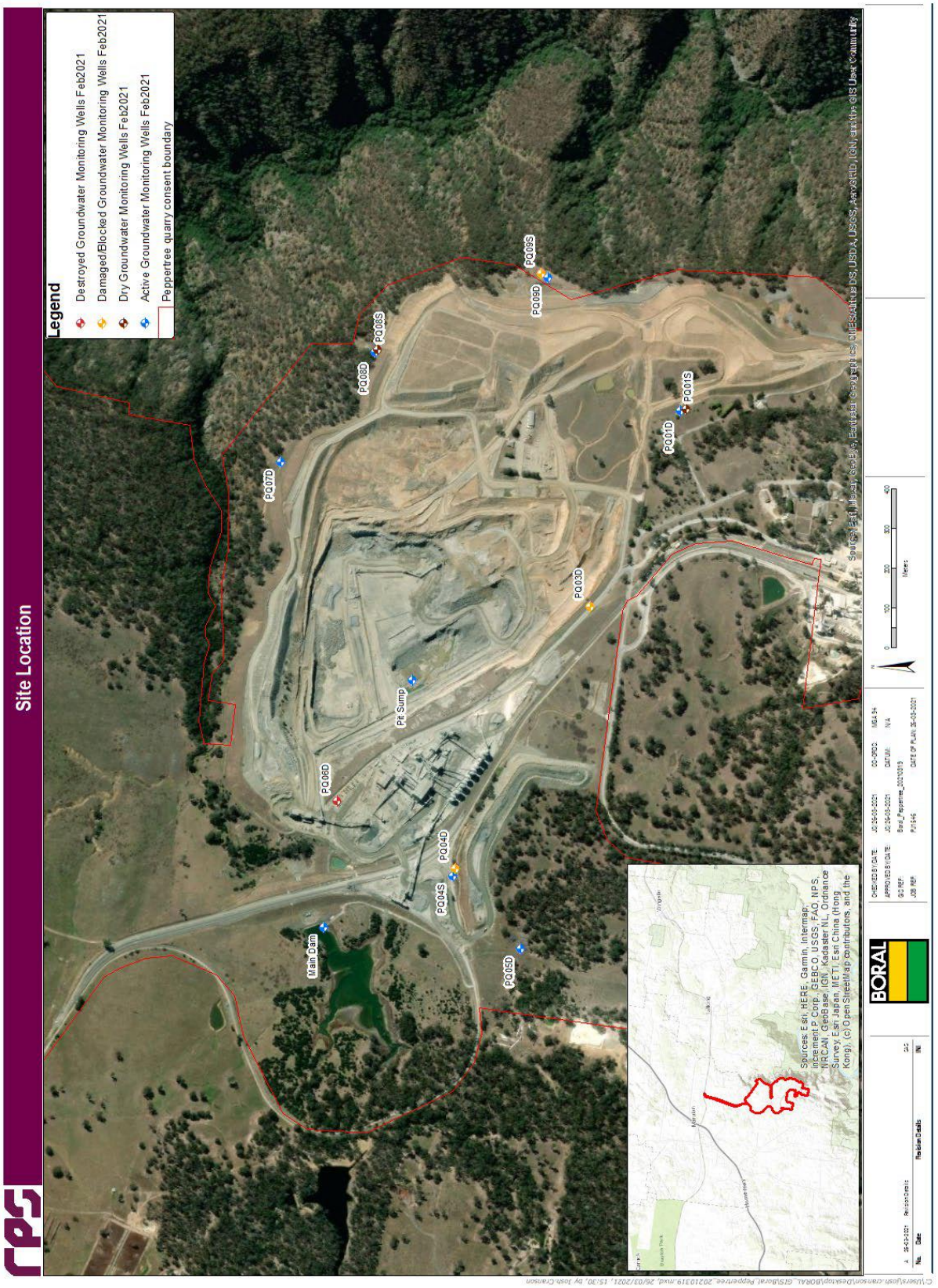


Table 4.5: Major Groundwater Ions and Metals

		TDS	Calcium	Magnesium	Sodium	Potassium	Sulphide	Chloride	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Iron	Manganese
EQL		1	0.1	0.1	0.1	0.1	2	1	0.001	0.0001	0.001	0.001	0.001	0.0001	0.001	0.005	0.05	0.001
ANZECC 2000 95%									0.024	0.0002	0.001	0.0014	0.0034	0.0006	0.011	0.008		1.9
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample ID	Date																	
P39	10-11-05	2240	212	220	190	9.9	60	1020	<0.001	0.0002	0.003	0.009	<0.001	<0.0001	0.011	0.056	0.12	0.086
P12	10-11-05	1030	119	67	130	3.4	27	340	0.001	0.0001	<0.001	0.004	<0.001	<0.0001	0.003	0.012	0.08	0.180
W1	10-11-05	1470	140	114	152	4.3	44	470	0.001	<0.0001	<0.001	0.001	<0.001	<0.0001	0.002	0.011	0.34	0.350
01011-1	10-11-05	1490	141	115	152	4.3	44	480	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.0001	0.002	0.007	0.31	0.360
DDH04	11-11-05	370	48	29	48	4.1	4	38	0.001	0.0002	0.002	0.004	0.006	<0.0001	0.003	0.016	0.2	0.330
P34	11-11-05	1860	289	90	190	58	4	38	0.009	<0.0001	0.002	0.003	0.001	0.0003	0.008	0.025	0.51	1.820
Statistics																		
Average		1410	158.2	105.8	143.7	14	30.5	397.7	0.002	0.00017	0.001	0.004	0.002	0	0.005	0.021	0.26	0.521
Std Dev		652.3	82.84	64.57	52.48	21.69	23.03	363.7	0.003	5.8E-05	0.001	0.003	0.002	0	0.004	0.018	0.159	0.646
95% UCL		2483	294.4	212	230	49.67	68.38	995.9	0.008		0.003	0.009	0.005		0.011	0.051	0.522	1.583

Source: Marulan South Quarry Environmental Assessment Report (ERM, 2006)

Note: red font indicates Guideline criteria exceeded.

4.3.1 Ground water 2015-2016

In 2015, a more comprehensive network of groundwater wells was installed.

The regional groundwater monitoring network comprises eight locations: eight deep piezometers and four shallow piezometers as outlined in Table 4.6 and shown in Figure 4.1. Quarterly monitoring of the groundwater network commenced in 2016 with four rounds completed prior to the commencement of below water table mining in late 2016. It is considered that these four rounds of data are representative of baseline conditions, as no impacts to groundwater flow have been observed as a result of mining activities during this period of monitoring.

Table 4.6: Groundwater Monitoring Network

Location	Easting	Northing	Depth (m)	Location	Comment
PQ01S	228788.200	6149364.768	25	South of quarry	Dry
PQ01D	228783.234	6149374.990	100	South of quarry	Monitors water flowing towards pit
PQ03	228287.593	6149608.358	100	South of quarry	Monitors water flowing towards pit
PQ04S	227607.030	6149950.634	15.7	West of quarry	Shallow groundwater
PQ04D	227625.617	6149946.868	103	West of quarry	Flow of groundwater towards pit
PQ05	227423.409	6149780.299	100	West of quarry	Sentinel bore
PQ06	227796.309	6150246.769	100	West of quarry	Located adjacent to pit entry ramp
PQ07	228654.336	6150385.320	101	North of quarry	Regional water flow
PQ08S	228941.804	6150143.768	30	North of quarry	Dry
PQ08D	228931.821	6150145.926	100	North of quarry	Downgradient monitoring
PQ09S	229132.282	6149729.457	66	East of quarry	Shallow groundwater
PQ09D	229120.479	6149710.338	100	East of quarry	Downgradient monitoring

All piezometers were installed into granitic bedrock that Boral quarries at Peppertree.

Figure 4.4 depicts the deep groundwater flow in May 2016 which indicates that groundwater is flowing towards the east. Shallow groundwater appears to be localised and perched with two of the four shallow piezometers being dry since initial installation.

Figure 4.4: Groundwater Flow

Table 4.7 provides a statistical review of the water level data from the 2016 monitoring rounds for each piezometer (excluding PQ01S and PQ08S which were both dry during the 2016 monitoring period). The majority of the piezometers show relatively stable groundwater levels as evidenced by the low standard deviations.

Table 4.7: 2016 Groundwater Level Statistics

Location	Maximum SWL (m AHD)	Minimum SWL (m AHD)	Average SWL (m AHD)	Standard Deviation
PQ01D	574.05	576.19	574.66	1.38
PQ03D	570.92	576.90	573.18	2.29
PQ04S	590.22	590.69	590.48	0.17
PQ04D	584.05	585.94	585.02	0.66
PQ05D	591.83	592.15	591.95	0.13
PQ06D	568.01	580.69	577.03	5.22
PQ07D	572.66	574.51	573.99	0.34
PQ08D	575.27	575.86	575.54	0.24
PQ09S	574.98	575.22	575.09	0.10
PQ09D	575.96	576.27	576.06	0.13

Water quality samples were collected during each quarterly monitoring event in 2016. Field parameters were collected and samples sent to the laboratory for analysis of major cations and anions, nutrients and a suite of organic analytes (oil and grease, polycyclic aromatic hydrocarbons, total recoverable hydrocarbons and volatile aromatic hydrocarbons i.e. BTEX).

Table 4.8 provides the statistical analysis of the field chemistry data for the 2016 groundwater monitoring period. The results for pH, electrical conductivity (EC) and dissolved oxygen (DO) are presented.

Table 4.8: Field Chemistry Statistics

Location	Parameter	Maximum	Minimum	Average	Standard Deviation
PQ01D	pH	11.78	9.10	10.44	1.30
	EC	4,318	3,560	4,043	332
	DO	3.8	0.6	1.36	0.60
PQ03D	pH	12.87	12.55	12.67	0.15
	EC	5,770	4,208	4,679	731
	DO	2.73	0.85	1.66	0.78
PQ04S	pH	7.91	7.01	7.41	0.45
	EC	4,535	2,520	3,077	973
	DO	4.06	1.73	2.49	1.06
PQ04D	pH	8.49	6.24	7.46	1.14
	EC	1,187	1,040	1,094	81
	DO	6.01	2.78	4.64	1.67
PQ05D	pH	8.04	7.11	7.68	0.41

Location	Parameter	Maximum	Minimum	Average	Standard Deviation
	EC	1,917	1,655	1,761	121
	DO	1.78	0.25	0.84	0.66
PQ06D	pH	12.63	12.25	12.42	0.16
	EC	3,730	3,257	3,429	207
	DO	1.49	0.61	1.10	0.45
PQ07D	pH	12.48	11.9	12.16	0.30
	EC	4,070	1,777	2,579	1,017
	DO	2.82	0.77	1.85	0.90
PQ08D	pH	7.64	7.08	7.33	0.24
	EC	3,718	2,720	3,051	457
	DO	5.97	0.8	2.85	2.38
PQ09S	pH	7.97	7.03	7.37	0.41
	EC	3,596	1,902	2,719	6,93
	DO	4.76	1.71	3.21	1.29
PQ09D	pH	8.39	7.22	7.59	0.54
	EC	1,734	1,473	1,623	118
	DO	7.9	0.96	2.92	3.33

Notes: Units - EC is in µs/cm / DO is in mg/L

The following observations can be made:

- pH is slightly alkaline to highly alkaline across the site with pH over 10.00 common (PQ01D, PQ03D, PQ06D and PQ07D). The elevated pH is considered to be due to natural water-rock interactions associated with weathering granitic rock profiles.
- Electrical conductivity ranges from brackish to saline with concentrations generally between 1,000 µs/cm and 6,000 µs/cm.
- Average dissolved oxygen has typically ranged from around 1 to 5 mg/L. Dissolved oxygen levels have become more stable as the monitoring program has matured.

Table 4.9 provides a statistical assessment of key parameters from the laboratory analysis. This dataset was utilised to develop the trigger levels presented in Section 7. Figure 4.5 presents a piper diagram of laboratory results from May 2016. The key findings from the interpretation of the laboratory analysis from 2016 were:

- Due to poor yields, development of the bores was difficult. As a result, early monitoring rounds had multiple detections of organic analytes which were identified as likely being associated with drilling and piezometer installation activities. Concentrations reduced over the course of 2016 with the November 2016 monitoring round showing no detectable concentrations of petroleum hydrocarbons and other organic analytes tested.
- Nitrogen species (TKN, nitrate, nitrite, Total Nitrogen) were identified variably across the site up to approximately 5 mg/L and has been interpreted to be associated with the farming activities present currently and historically on site as well as to the west and south of the Quarry.
- Total Phosphorous is also slightly elevated across the site (up to 1 mg/L) for the same reasons as for the nitrogen species.

- The piper diagram (Figure 4.5) indicates that groundwater is dominated by chloride along with bicarbonate and carbonate (pH dependent with carbonate present as pH rises).
- The cations are less dominated by one ion with a trend towards sodium/potassium being dominant.
- The anions are also not dominated by one ion although there is a slight trend towards chloride.
- The presence of sodium and chloride indicate a likely rainwater source with potassium and alkalinity being impacted upon by water-rock interactions, particularly where active weathering is occurring.

Table 4.9: **Key Laboratory Analytes Statistical Assessment**

Bore		TDS	Alkalinity	Sulfate	Chloride	Calcium	Magnesium	Sodium	Potassium	Fluoride	Nitrite + Nitrate	TKN	Total N	Total P
PQ01D	Maximum	3180	459	83	1290	320	300	363	124	0.2	4.43	0.7	4.7	0.27
	Minimum	2040	104	70	1010	87	1	323	9	0.1	0.14	0.3	0.5	0.01
	Average	2615	314	78	1155	216	189	340	46	0.15	1.29	0.5	1.75	0.1
PQ03D	Maximum	1740	1230	15	214	216	1	201	404	0.4	0.05	1.5	1.5	0.22
	Minimum	1140	719	4	179	83	1	197	239	0.3	0.01	1	1	0.01
	Average	1383	929	12	198	149	1	199	318	0.38	0.023	1.33	1.35	0.07
PQ04S	Maximum	2320	568	66	968	90	92	640	5	1	1.64	0.8	2.4	0.6
	Minimum	1250	438	5	596	72	57	398	3	0.6	0.04	0.3	0.6	0.04
	Average	1688	505	36	691	84	69	480	4	0.8	0.81	0.55	1.4	0.29
PQ04D	Maximum	694	97	30	335	39	20	191	8	1.7	0.21	0.2	0.3	0.02
	Minimum	551	80	29	312	36	18	165	2	1.5	0.02	0.1	0.1	0.01
	Average	639	91	30	327	37	19	180	6	1.63	0.12	0.13	0.2	0.013
PQ05D	Maximum	1260	650	1	381	145	48	260	9	0.3	0.04	1.5	1.5	1
	Minimum	1080	518	1	348	133	42	237	7	0.2	0.01	0.3	0.3	0.03
	Average	1178	587	1	369	139	45	249	7.5	0.25	0.018	0.73	0.73	0.33
PQ06D	Maximum	1590	547	228	210	69	1	260	246	0.6	0.03	1.7	1.7	0.11
	Minimum	1030	480	182	190	28	1	253	224	0.5	0.01	1.1	1.1	0.02
	Average	1310	501	201	201	53	1	257	233	0.58	0.015	1.48	1.48	0.05
PQ07D	Maximum	1480	641	236	326	287	1	168	137	0.2	0.05	0.6	0.6	0.06
	Minimum	845	204	134	302	110	1	142	92	0.1	0.01	0.4	0.4	0.01
	Average	1120	346	175	315	178	1	156	108	0.18	0.03	0.55	0.55	0.035
PQ08D	Maximum	2160	428	60	798	258	177	145	6	0.2	0.06	0.1	0.1	0.15

Bore		TDS	Alkalinity	Sulfate	Chloride	Calcium	Magnesium	Sodium	Potassium	Fluoride	Nitrite + Nitrate	TKN	Total N	Total P
	Minimum	2010	404	47	719	228	152	134	3	0.2	0.01	0.1	0.1	0.01
	Average	2083	416	55	770	242	165	141	4	0.2	0.03	0.1	0.1	0.08
PQ09S	Maximum	1950	509	21	727	194	196	155	7	0.3	4.3	0.8	4.5	0.96
	Minimum	1640	466	7	663	168	178	151	6	0.2	1.1	0.2	1.9	0.01
	Average	1845	493	16	700	180	185	153	6.5	0.23	2.3	0.53	2.85	0.32
PQ09D	Maximum	1190	514	21	334	133	110	104	4	0.3	2.09	1.6	2.4	2.23
	Minimum	944	489	9	309	113	96	97	3	0.2	0.01	0.1	0.1	0.03
	Average	1051	502	18	326	123	102	102	3.75	0.25	0.53	0.55	1.08	0.62

Notes: Units
EC is in µs/cm
All other analytes are in mg/L

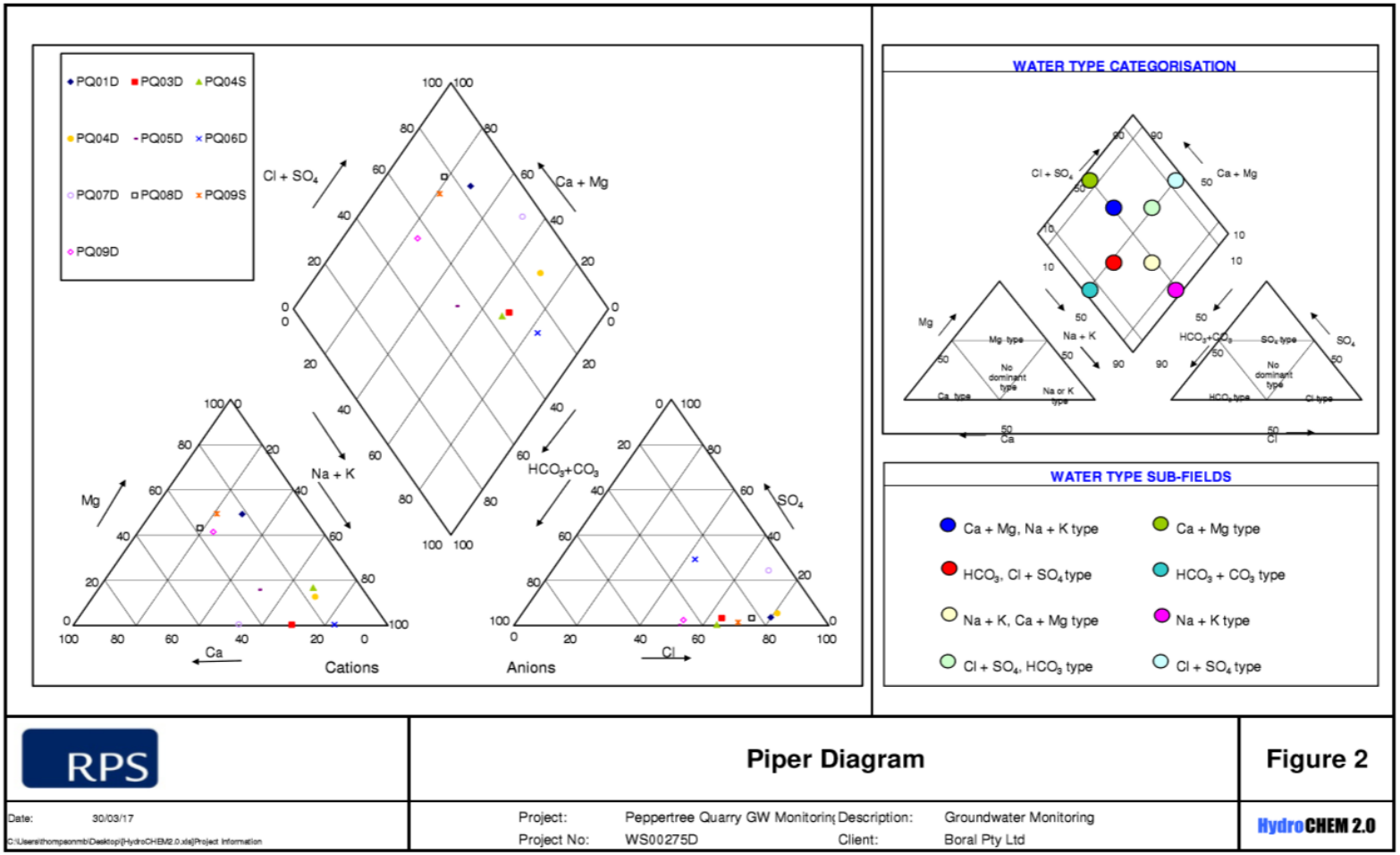


Figure 4.5 Piper Diagram of Results

4.3.2 Ground water 2017 – 2020

A hydrogeological assessment based on data collected during quarterly monitoring events from 2017 to 2021 has identified that maintaining the current groundwater well network is appropriate. However, a recommendation from the assessment is the PQ06D be moved from its current location to the northern side of the existing quarry. This new point would facilitate monitoring of groundwater level and quality on the north, i.e. between Tangarang Creek and the project site. The well completion for the new location is not necessarily as deep.

Two shallow wells have been dry since 2017 (PQ01S and PQ08S). It is recommended that these wells are replaced with adjusted screen depths to improve chance of recovering water in the future.

This work will procced in the later part of 2021.

Collated water quality parameters 2017-2020

Standing water levels remained stable in each of the piezometers, with some fluctuation due to infrequent rainfall events. PQ5 is identified as the sentinel water bore and shows very little fluctuation of water level (Refer Figure 4.6)

For clarity and brevity, data in this section are only included for parameters identified for ongoing triggers as identified in Section 7.3.

Field measured water quality parameters requiring trigger values are summarised in **Table 4.10**. Laboratory nutrients measurements are summarised in Table 4.11. Data are summarised as median values with 5th and 95th percentiles. Lower and upper percentile values are included as both low and high values can indicate a change in water quality.

The data for deep wells from 2017 to 2020 indicate that groundwater in wells PQ03D, PQ06D have very high pH (pH > 11) and relatively high conductivity (> 3000 µS/cm). PQ04D, PQ05D, PQ08D, PQ09D, Pit Sump and Main Dam generally display a pattern of neutral to slightly alkaline water (pH 7 to 9), with relatively lower EC, typically < 3000 µS/cm, but EC was quite variable and higher values occur periodically in some wells. Groundwater in PQ01D is somewhat between the other two groups with relatively high pH (typically 8 to 10) and EC (> 3000 µS/cm). Groundwater in PQ07D was consistent with the very alkaline wells PQ03D, PQ06D until February 2019, when the water transitioned to lower pH values consistent with the other wells.

The shallow wells PQ04S and PQ09S display a pattern of neutral to slightly alkaline water (pH 7 to 9). Conductivity in these wells was variable with initially high EC (> 3000 µS/cm) transitioning to lower EC from about October 2017.

Median salinity (EC) values since 2017 are generally consistent with those reported in the April 2017 WMP (Table 4.8). The pH values are somewhat different for three of the wells, PQ03D and PQ07D having pH higher than the earlier data, and PQ05D being lower. However, none of the data for EC or pH indicate a trend of degrading water quality, suggesting the ongoing data are useful for recalculating trigger values.

Qualitatively the pattern of pH was very similar for the 2017 – 2020 data to the data summarised in the WMP Table 4.8: Field chemistry statistics with highly elevated pH in wells PQ01D, PQ03D and PQ06D and the earlier data (2017) from PQ07D. The other wells summarised in the WMP were slightly alkaline in pH, consistent with the 2017 – 2020 data.

The general pattern of differences in EC between wells was very similar in the 2017 – 2020 data compared to the WMP data (Table 4.8: Field Chemistry Statistics), however average ECs in the WMP

data were typically somewhat higher than the medians from the 2017 – 2020 data, especially for the more saline wells.

Overall, the field measured data demonstrate general consistency between earlier and more recent data. This supports a conclusion that general water quality parameters have not changed materially during this period of quarry operations, except for PQ07D.

It is possible that freshwater from Tangarang Creek is seeping to groundwater and influencing PQ07D, particularly following higher than average rainfall since the end of drought conditions in early 2020.

Nutrients

Total nitrogen (TN) concentrations vary significantly between wells. Consistently lower TN concentrations (< 1 mg/L) occur in PQ04D, PQ05D, PQ08D and PQ09D. Slightly elevated TN (<2 mg/L) has been measured in PQ03D, PQ04S, PQ06D, PQ07D and in surface water in the Main Dam. Significantly elevated TN concentrations (up to 9 mg/L) have been measured in PQ01D and PQ09S with much higher values reported in surface water at Pit Sump (up to 30 mg/L).

Where measured TN concentrations are not elevated, total Kjeldahl nitrogen (TKN) accounts for much of the TN. TKN is the measured sum of ammonia and organic nitrogen. As ammonia has not been measured, the proportion of organic nitrogen to ammonia cannot be calculated. Where measured TN concentrations are elevated, inorganic nitrogen (nitrate and nitrite) comprise a higher proportion of the total nitrogen. TN in the Pit Sump is almost entirely dominated by inorganic nitrogen. As noted in the 2017 WMP, off-site agriculture may be responsible for the higher nitrogen values in groundwater. This is consistent with evidence in the literature that elevated nitrogen in the absence of elevated phosphorus can be a result of applying animal faecal waste for fertiliser. However, the sites impacted with higher TN are not so obviously impacted by the farm sites to the west. Also, the fact most TN in the surface water samples from the pit sump is inorganic, suggests a source of inorganic nitrogen may exist more directly related to the quarry.

Total nitrogen concentrations are higher in some wells in 2017 – 2020 compared to the WMP dataset (WMP, Table 4.9: Key Laboratory Analytes Statistical Assessment). Therefore, a more quantitative comparison of the data was undertaken. Average concentrations of TN, nitrate+nitrite and TKN for 2017-2018 were within an order of magnitude of the WMP dataset except PQ07D. Average TN in this well was 119 times greater in the more recent data and whereas the earlier data for TN were dominated by TKN (100%), the more recent data for this well were dominated by nitrate+nitrite (117%, noting the result > 100% may be explained by the analytical error). This suggests a step change in the nutrient status of that well. Despite the increase, the median (0.85 mg/L) and average (3.57 mg/L) TN concentrations in PQ07D were within the range of TN values for other wells at the site and suggest a change at that well, rather than a change in overall groundwater quality

Similar or lower concentrations of reactive phosphorus (RP) were reported in 2017 – 2020 compared to the WMP dataset, suggesting the dataset can be applied to updating the trigger values.

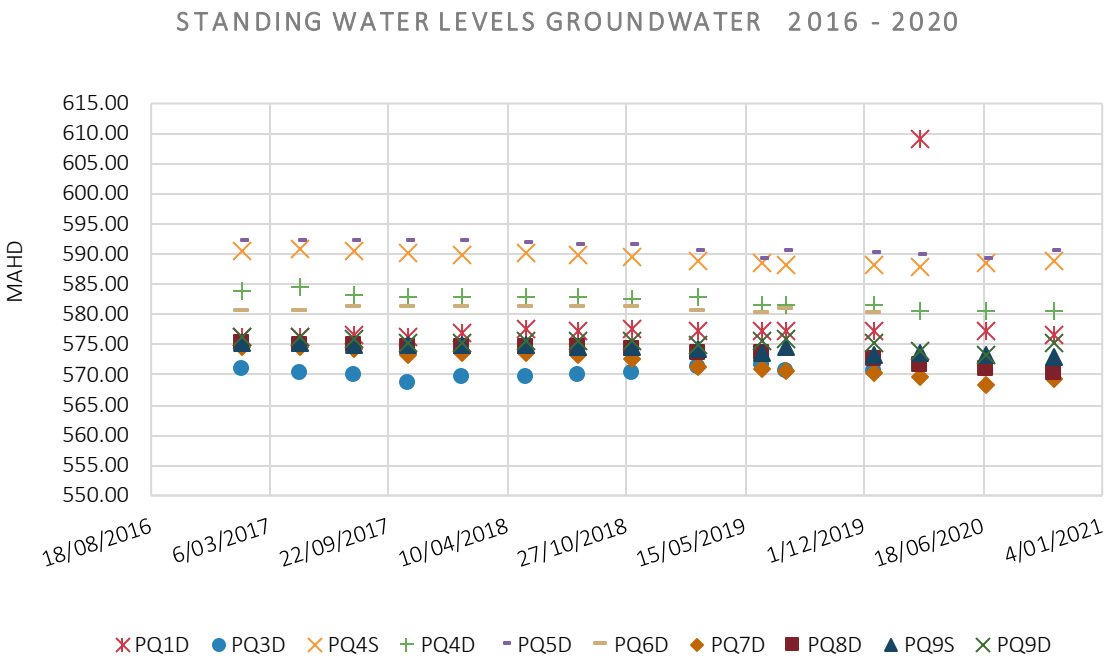


Figure 4.6: Ground water standing levels

Table 4.10**: General Groundwater Quality Parameters, 2017 – 2020**

Well ID	EC (uS/cm) Median	EC (uS/cm) 5th%ile	EC (uS/cm) 95th%ile	pH Median	pH 5th%ile	pH 95th%ile
PQ01D	3280	2160	4210	8.7	8	10
PQ03D	2630	715	3920	12.3	11.5	12.7
PQ04S	2630	2020	4350	8.1	7.1	8.9
PQ04D	1230	670	1470	8.5	7.9	9.9
PQ05	1610	1440	1840	7.9	7.1	9.1
PQ06	2920	2310	4310	12.2	11.5	12.6
PQ07	1220	420	1640	10.5	7.9	12.2
PQ08D	2650	1640	3670	7.6	6.8	8.2
PQ09S	1550	1370	1780	8	7.1	8.7
PQ09D	2430	1920	3710	7.4	6.8	8.1

whited text indicates decommissioned or inactive wells

Table 4.11**: Groundwater nutrient concentrations 2017 – 2020**

Well ID	TN Median	TN 5th%ile	TN 95th%ile	NOx Median	NOx 5th%ile	NOx 95th%ile	TKN Median	TKN 5th%ile	TKN 95th%ile	RP Median	RP 5th%ile	RP 95th%ile
PQ01D	3.5	1.7	5.6	3.05	0.96	3.61	0.5	0.3	2.2	0.06	0.01	0.96
PQ03D	1.3	1.15	2.12	0.02	0.02	0.21	1.3	1.15	1.96	0.04	0.01	0.14
PQ04S	0.58	0.2	1.55	0.09	0.02	0.45	0.5	0.2	1.48	0.07	0.02	0.23
PQ04D	0.6	0.34	0.6	0.37	0.26	0.46	0.2	0.13	0.2	0.02	0.01	0.13
PQ05	0.45	0.27	0.83	0.03	0.01	0.24	0.45	0.23	0.69	0.06	0.01	0.19
PQ06	1.7	0.96	2.06	0.04	0.03	0.05	1.7	0.86	2.06	0.02	0.01	0.05
PQ07	0.85	0.4	14.7	0.07	0.02	15.5	0.6	0.32	1.6	0.02	0.02	1.1
PQ08D	0.25	0.1	1.73	0.08	0.02	0.25	0.3	0.12	1.72	0.02	0.01	0.03
PQ09S	6.95	3.14	8.18	6.35	3.2	7.01	0.9	0.3	1.8	0.17	0.02	1.74
PQ09D	0.3	0.1	0.39	0.03	0.01	0.09	0.25	0.1	0.39	0.04	0.01	0.27

All concentrations in mg/L. ANZG default value included for reference. TN = total nitrogen. NOx = nitrate + nitrite. TKN = total Kjehldahl nitrogen. RP = reactive phosphorus

5 WATER MANAGEMENT SYSTEM

5.1 RESPONSIBILITY FOR IMPLEMENTATION

The Quarry Manager carries ultimate responsibility for the implementation of this WMP and providing the necessary resources as required. As such, the Surface Water Management system will be constructed in accordance with the plan shown on Figure 5.3 of this plan and in Appendix 4 of the Approval.

The site Environmental Officer is responsible for carrying out and/or coordinating the monitoring and reporting requirements of this plan.

Operations personnel (Quarry Supervisors) are responsible for responding to adverse site water quality conditions and adjusting quarry operations as appropriate to minimise impacts on the environment. Other site personnel are responsible for reporting adverse site water quality conditions and reporting them to the shift Supervisor.

The Production Manager, Superintendents and Pit Supervisor are responsible for the maintenance of the water management system infrastructure.

5.2 POTENTIAL IMPACTS

5.2.1 Surface water flows

Potential impacts on surface water flows are primarily associated with disturbed operational areas.

The steeper slopes of the emplacements areas (compared to the original topography) may lead to increased rates of runoff compared to the existing conditions. Sediment basins are designed to moderate this increase in runoff by capturing stormwater from emplacement areas before overflowing to being pumped to the quarry pit or Dam 1.

Under normal operating conditions, water from the sediment basins would be transferred to either the Limestone Mine (as outlined in Mod 4 and 5) or Peppertree Quarry's Main dam or pit.

Basins N1, N3 and P1 and areas associated with the Southern Overburden (mod 4) would overflow (during rainfall events greater than the design event) to either the Limestone Mine or Quarry pit. Sediment basin N2 would overflow to a tributary of Tangarang Creek, which discharges to Dam 1. Basin P2 would overflow to Dam 1.

Under Modification 5, N2 would overflow to a tributary of Tangarang Creek in high rainfall events, approximately 1 to 2 times per year. Therefore, during high rainfall events, there may be a slight increase in flows in Tangarang Creek and a slight reduction in runoff to the Limestone Mine compared to existing conditions. However, as Tangarang Creek discharges to Dam 1, which is part of the Quarry water management system, no impacts are likely to be experienced by downstream users. Other sediment basins associated with the SOE, potentially overflow offsite during rainfall events greater than the design event, however pumps in place during such rainfall events minimise any potential for overflows.

In summary, only a redistribution of flow would occur compared with existing conditions.

5.2.2 Surface water quality

Exposed surfaces on emplacement areas, operational areas and haul roads have the potential to generate sediments during rainfall events that without suitable controls could flow into local waterways.

Diversion drains and sediment basins would be constructed and operated in accordance with the requirements of *Managing Urban Stormwater*. Relatively few overflow events (1 to 4 times per year) would be expected each year on average. Overflows from the basins would be contained within either the Quarry or Limestone Mine water management systems and no overflow from the basins would discharge directly to the environment, except during rainfall events greater than the design event, of the sediment dams. The potential for overflows are minimised through the management of water levels via pumping during rain events.

Discharges from Dam 1, into the receiving environment, may occur after heavy rainfall, when significant runoff and dilution can be expected from other parts of the landscape.

5.3 SURFACE WATER MANAGEMENT

5.3.1 Overview

The water management system is based on capturing and reusing stormwater runoff for use in the quarry processes, dust suppression and environmental controls. Figure 5.1 contains a schematic of the site surface water management system.

The water management system is implemented in order to minimise/mitigate impacts to the flow and quality of the surrounding surface water and groundwater environment. This system is based on the following approach:

- diversion of clean water runoff away from site activities;
- containment of potentially contaminating activities within sealed and bunded areas and the inclusion of interceptor systems and spill kits to contain contamination
- appropriate storage of potentially contaminating substances;
- stabilising emplacement areas as quickly as possible to prevent erosion;
- providing specific erosion and sediment control systems immediately downstream of emplacement areas;
- retention and treatment of “dirty water” to prevent sediment laden or contaminated runoff leaving the site;
- capturing and reusing stormwater runoff for use in the quarry processes, dust suppression and irrigation to establish vegetation on emplacement areas
- monitoring emplacement areas to minimise the development of sediment laden runoff;
- recycling and treatment of all water used in quarrying activities to minimise demand for top-up water from the clean water dams and to minimise the flow of dirty water to the Pit storage;
- release of environmental flows, equivalent to a minimum of 10% of average daily flows, to mimic natural flow patterns; and
- monitoring of surface water and groundwater quality and quantity to confirm the efficiency of the proposed water management system and to ensure there are no detrimental impacts upon groundwater systems or surface receiving waters.

Reviews of the water management system are undertaken following rain events, and in response to changes to the pit arrangements or operations within the crushing and screening process. This allows improvements to be continually made in the management and use of water.

5.3.1.1 Segregation of Stormwater

Stormwater runoff from clean, non-operational areas (i.e. undisturbed land) will be directed away from water flows interacting with potentially dirty operational areas (i.e. areas of the site where spills and/or leaks may occur— workshops, wash bays, chemical storage facilities, refuelling facilities etc) by use of controls such as:

- Site contouring
- diversion trenches
- roof guttering
- rainwater pipes
- drains

Segregated, clean stormwater can then be discharged directly off site while dirty stormwater will be contained, treated and, if necessary, tested for compliance with the relevant water quality criteria before it can be discharged off site.

'Clean' runoff from undisturbed areas will be diverted around operational areas where practical. This reduces the risk of flooding in the pit as well as the potential for clean runoff to be impacted by quarry activities. Diversion of clean water is affected by diversion drains, contour drains and, where necessary, bunds, levees, weirs and pipe culverts. Clean water will be diverted to the main water storage dam for subsequent reuse wherever possible.

'Dirty' water runoff from disturbed areas that is associated with the transport of sediment (interacting with overburden emplacements, haul roads and the processing plant area) is directed to sediment basins and then directed into Dam K or Dam 1 via pumping or gravity flow, through a constructed bioswale.

Excess water from Dam K is discharged into Dam No. 1, when necessary.

A permanent drainage network is in place to manage clean and dirty water flows. Diversion drains have a capacity to convey critical flows of at least a 1 in 20-year average recurrence interval (ARI) storm event, and up to a 1 in 100-year ARI event in critical locations

5.3.1.2 Use of Recycled Water

Where possible, measures will be implemented to allow for conservation of potable water (i.e. drinking water) resources through recycling or reuse of water for activities such as truck washing or dust suppression etc. The site's water supply is generally provided from Dam No. 1, located on Tangarang Creek. The water supply dam captures water prior to being reused on the site or released to Tangarang Creek as environmental flow.

Demand on water resources can be reduced through:

- site water balance assessment and minimisation programs
- capturing and harvesting of stormwater for on site reuse
- recycling and reuse of processed water
- treatment and reuse of wastewater

5.3.1.3 Control and Monitoring of Offsite Discharges

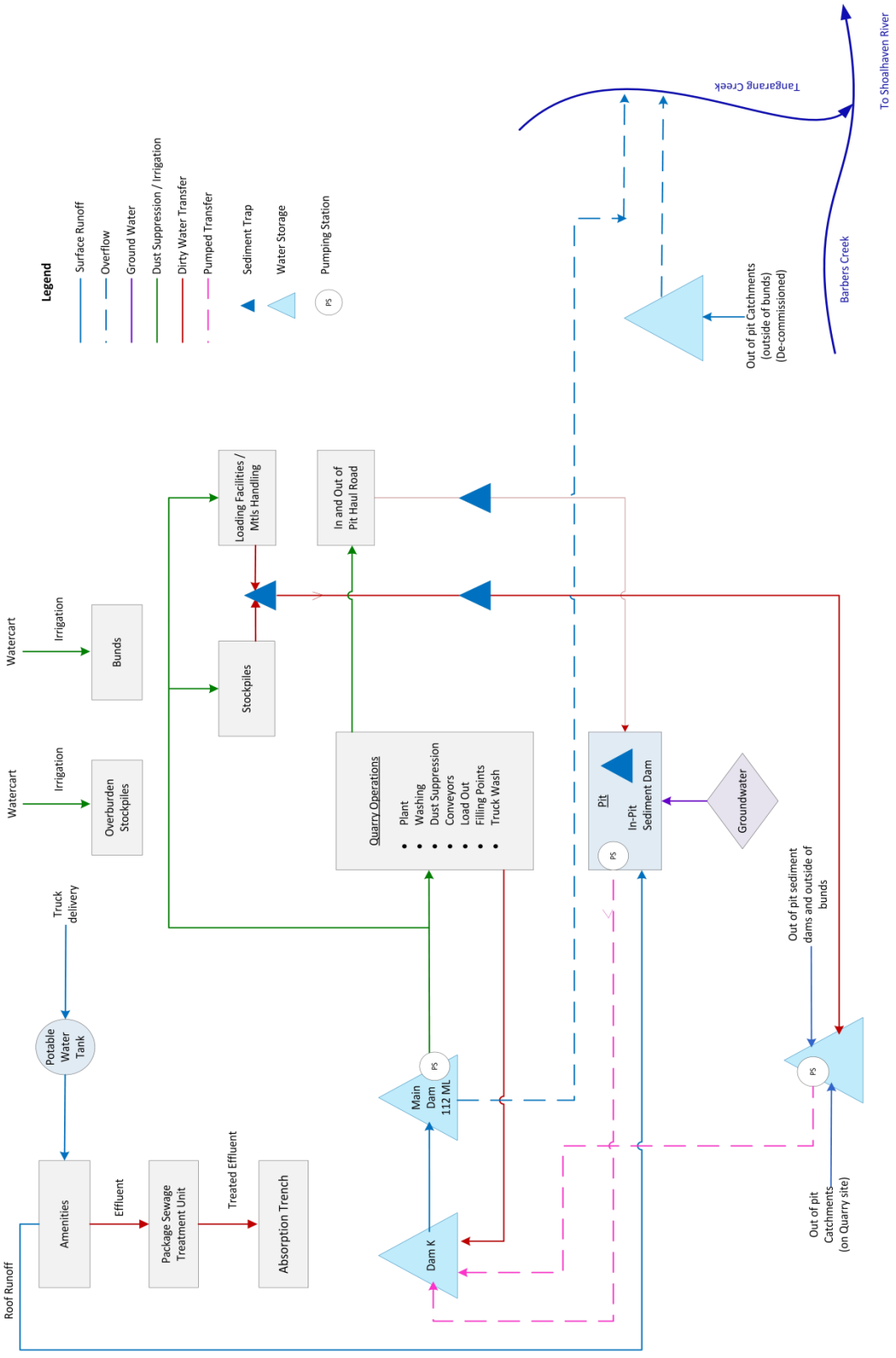
Potentially dirty water is directed and captured in appropriate on site storage facilities (i.e. tanks and dams) for treatment (if necessary) and on site reuse (where possible).

A water sampling and testing program is in place to meet relevant regulatory requirements associated with offsite discharges. (Refer Section 7.1.2 and 7.1.3)

Appropriate management and monitoring of volume levels within water storage devices will be carried out. This is to minimise the potential for uncontrolled off site discharges due to overflows and heavy rainfall events.

A protocol for the inspection and pumping of ponds prior to forecasted extreme rainfall events is in place. Refer section 5.7.

Figure 5.1: Flow Diagram of Water Management System



5.3.2 Site Sub-Catchments

The site is subdivided into twelve sub catchment areas, four of which are clean water catchments where water is diverted around the site and the remainder are dirty water catchments. The locations of the dams and associated catchments are shown in Figure 5.2 and 5.3 with details of each provided in Table 5.1.

A number of catchments within the site drain to the quarry pit, Dam K and Dam 1 from where water is either used for dust suppression purposes, reused in operations or discharged to Tangarang Dam for discharge as environmental flows. Other catchments within the quarry drain to a series of small sediment dams, mainly located on the outer edge of the northern noise bund or the eastern side of the Eastern Overburden Emplacement. In large storm events these dams drain directly to either Tangarang Creek or Barbers Creek.

Table 5.1: Site Drainage Sub-Catchments

Catchment	Area (ha)	% disturbed	Land usage	Water Management
Dirty Water Catchments				
Processing area (1)	13.98	100	Crushing and processing plant with rock storage	Graded to boundary drains discharging to Dam K with overflow to Dam 1. Boundary drains are rock lined.
Pit floor (2)	34.87	100	Quarry extraction area with some rock storage	Internal sumps with pumps with fixed permanent pipe to Dam K and Main dam
Eastern Overburden emplacement (3)	13.97	100	weathered granidiorite engineered emplacements	Top of overburden graded to drain via a large rubble drain into pit area for reuse. Western slope drains to previously striped area adjacent to pit. Eastern slope drains to the OVERBURDEN east dam. This dam is pumped to the Shotcrete dam, which in turn is pumped back into the farm dam and is used as a water cart supply.
farm office (4)	17.08	80	Workshop for HME, office and area of future stripping campaign	Overground flow and drains to the stripped area adjacent to the pit
Train load out (5)	971 (m2)	100	Rail operations with rock storage	Gravity drainage to sediment pit to allow sediment to be collected as well as drainage to grass swale at the head of Dam 1
Workshop (6)	1.57	100	Servicing of HME and equipment with carpark and storage	Drains to boundary rock lined drain to Dam K. Oily water areas drain to oil separator and reused oil tank, with clean water overflow to boundary drain
Turkeys nest – this catchment is now part of 2 due to the extension of the pit (previously catchment 7)	nil	100	Stripped area	Drainage from farmland and disturbed area drain to the pit.

Catchment	Area (ha)	% disturbed	Land usage	Water Management
Southern overburden emplacement (11 – A, B, C, D E & F) Refer figure 5.3	12.8	100	weathered granidiorite engineered emplacements	This overburden has a number of catchments. Catchment A drains to the east to the shotcrete dam which is pumped to the internal farm dam on the west of the Overburden. Catchment B drains to the Burtons dam with Catchment C draining to both the TRN dam and the southern OVERBURDEN point dam. Catchment D and E drain to internal sediment dams before discharging into the Marulan south limestone pit. Catchment F drains to the internal farm dam.
Western overburden (8) Refer figure 5.4	16.99	100	weathered granidiorite engineered emplacements	Water collected in diversion drain and directed to the head waters of Dam 1. West OVERBURDEN dam in place for sediment and flow control. Additional water controls are to be installed to manage stormwater runoff as the overburden area extends to the east. These are part of the Mod 5 works for additional dirty water management
Clean Water Catchments				
Noise bund (9)	12.2	Revegetated	Noise bunds	Clean water runoff collected in remaining sediment ponds from construction of the bund. OVERBURDEN North dam pumped to OVERBURDEN east dam. All others evaporate between rain events or overflow in excessive storms.
Habitat management area (10)	28.72	Revegetated	Protected	Surface water runoff only occurs during storm events to dam 1 and Tangarang Creek
Southern parkland (12)	11.17	nil	Open grassland	Clean water is captured by a diversion drain and discharged to the road drainage.

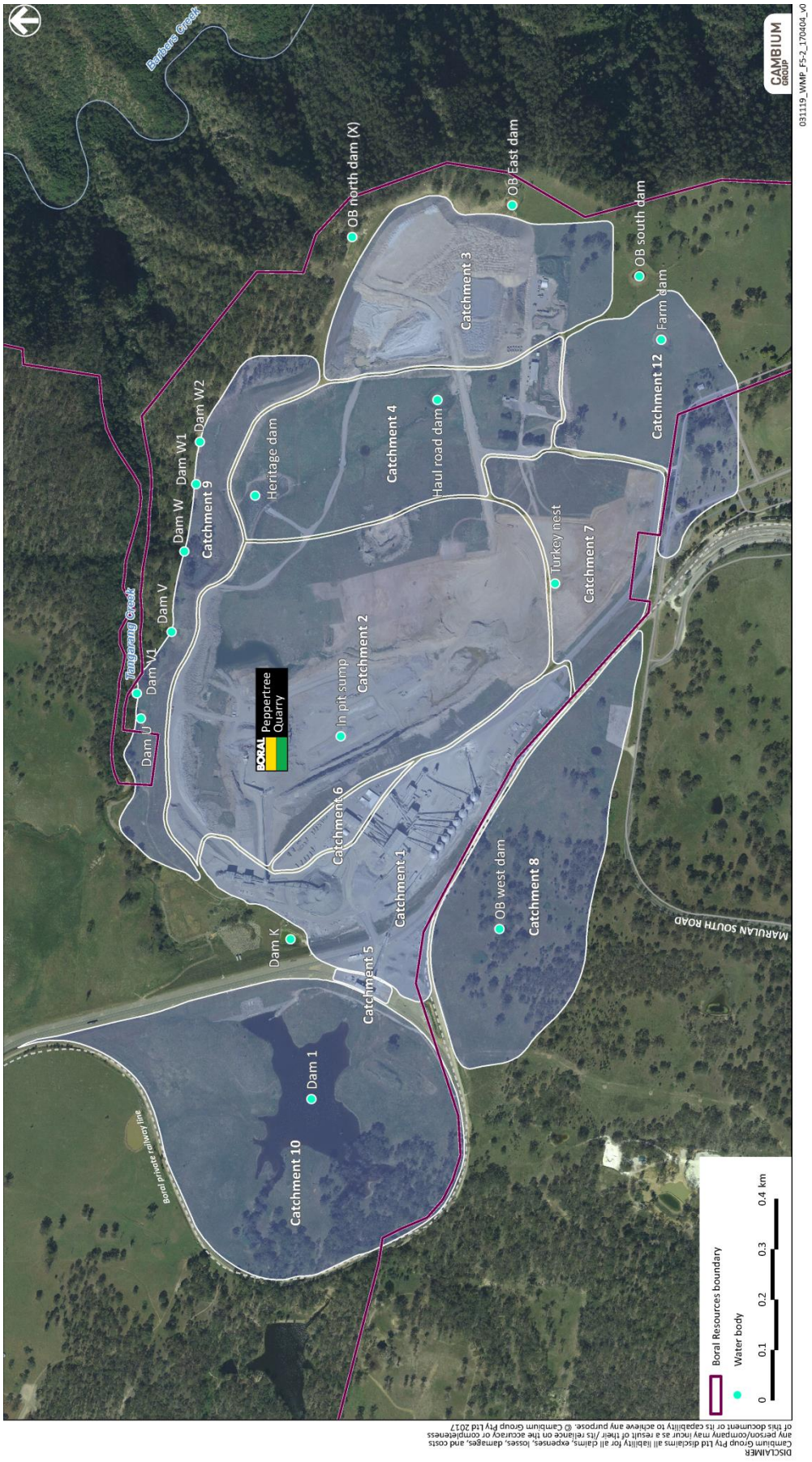


Figure 5.2: Location of Site Dams and Catchments

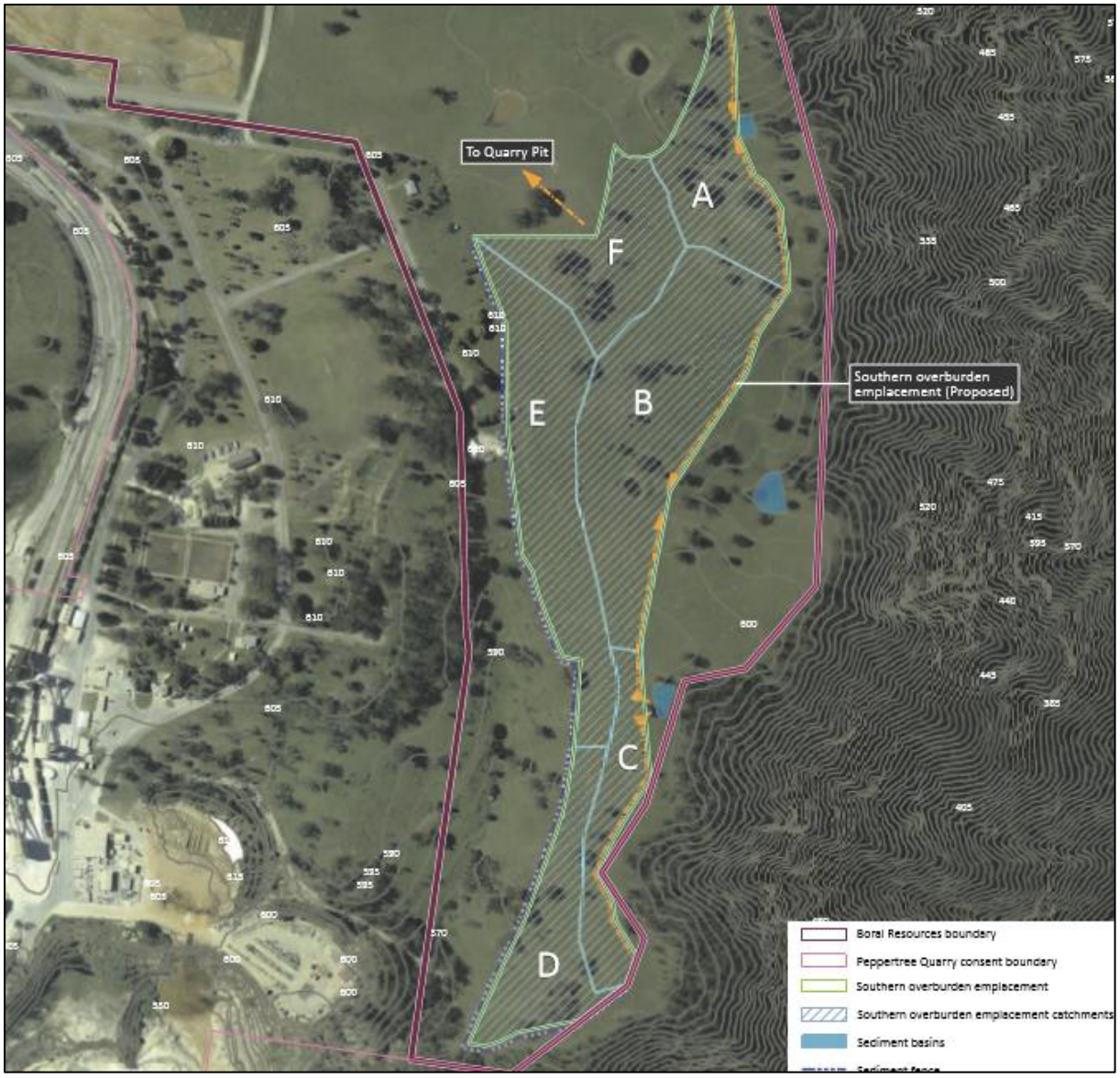


Figure 5.3: Location of Site Dams and Catchments – Southern Overburden Emplacement

5.3.3 Dams and Sediment Basins

There are a total of 17 dams/sediments basins located within the site as shown in Figure 5.2. and 5.3, with 5 additional dams to be installed as per Modification 5 and shown in Figure 5.4.

Information about the operation of the dams is summarised in Table 5.2. Sediment dams constructed as described in the initial EA have been sized to capture flow from a 100 year ARI 24 hour rainfall event in accordance with CoA B32. Most of these dams now capture clean water from the rehabilitated noise bund.

Other dams associated with Modification 4 and 5 have been sized as per the Blue Book, to capture the 95th percentile five day rainfall including a 50% allowance for sediment storage (refer section 5.3)

When flow in excess of this volume occurs, the sediment dams are designed to overflow. The sediment dams, however are managed such that they are emptied, within 5 days of the storm event. Pumping of water from the dams also occurs during rain events to minimise the potential for any overflow offsite.

The main water supply dam (Dam 1) is located within Tangarang Creek. It provides water to meet the quarry's operational water supply. Water from Dam 1 is reused via a pump and fixed pipe line. Dam 1 receives inflow from the quarry operations as well as overflow from the surrounding farm dams via the three tributaries of Tangarang Creek which enter the site. The dam wall is constructed such that there is an underflow which provides the required 10% environmental flow to Tangarang Creek.

Three new sediment dams, N1, N2 and N3 will be constructed prior to the emplacement of material for the SWOE. These dams are shown on Figure 5.4 in association with each of the relevant catchments.

Two new dams (P1 and P2) are to be constructed in association with the WOE. These 2 dams will manage water in this area as the emplacement extends to the east. These dams and the catchments are shown in Figure 5.4.

Table 5.2: Site Dam Details

Name	Estimated Dam area (m^2)	Estimated volume (m^3)	Associated Catchments	Comments
Dam 1		112 ML	1,2,5,6, 8,10	Main water supply dam for the site Dam wall height is 7 m AHD
In pit sump	4	12	2,4,7,12	Collects water in pit
Dam K	2331	9324	1, 2, 6,	Receives water from the pit and processing areas. Discharges to main dam. Used for water tanker. Arrangements being made to supply plant operations in preference to Dam 1
OB east dam	899	2697	3	Sed dam receiving runoff from eastern face of the OB. Drains to the east to the shotcrete dam which is pumped to the internal farm dam on the west of the Overburden.. Spillway in place and 2 small sediment traps in case of intense storm overflows
OB north Dam (X)	1913	5739	9	Sed dam receiving runoff from small north portion of OB. Pumped to OB dam east (see above)
OB south dam				No longer in place. This dam was removed as part of the overburden campaign with water now directed to the farm dam.
Turkeys nest				No longer in place. This dam was removed as part of the overburden campaign with water now directed to the pit.
Heritage dam				No longer in place. This dam was removed as part of the overburden campaign with water now directed to the pit.
OB west dam	354	354	8	Small dam collecting runoff from clean water diversion drain at WOE
Haul road dam	.	.	.	No longer in place. This dam was removed as part of the overburden campaign with water now directed to the pit.

Name	Estimated Dam area (m^2)	Estimated volume (m^3)	Associated Catchments	Comments
Dam W1	459	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam W2	459	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam W	180	540	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation. Geofab installed on the face of the dam wall initially to ensure clean water discharge
Dam V	720	2160	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam V1	459	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
Dam U	437	1377	9	Installed during construction to collect runoff from noise bund. Runoff now clean due to revegetation
SOE Dam A (shotcrete dam)	400	0.8	11A	Collects runoff from Catchment A of the southern overburden. Water is pumped to the internal farm dam.
SOE Dam B (Burtons Dam)	600	1.8	11B, C	Collects runoff from Catchment Band C of the southern overburden. Water is pumped to the internal farm dam.
SOE Dam C (TRN Dam)	280	0.6	11C	Collects runoff from Catchment C of the southern overburden. Water is pumped to the internal farm dam.
SOE point dam		1410	11C, D	This small sediment dam is installed in the footprint of the SOE to capture runoff from catchment C and D. Collected water is discharged in to the drainage system to the Marulan south Limestone operations.
Farm dam	varies	fluctuates	11F, 9	This dam is a large depression in an undisturbed paddock adjacent to the SOE. It is not a formalised dam and has no formalised infrastructure. It is a closed system with no overflow. This dam collects pumped water from the SOE dams. Water is reused for water cart.
P1 WOE		2.1	8	P1 will collect water from the eastern batters of the WOE and the proposed shared road sales stockpile area and discharge to the pit
P2 WOE		5.8	8	P2 will collect water from the WOE before overflowing to the bioswale and Dam 1
N1 SWOE		12.7	1A	N1 collects water from middle portion of the SWOE and discharges to the Kiln dam for reuse (part of the Limestone Mine water

Name	Estimated Dam area (m^2)	Estimated volume (m^3)	Associated Catchments	Comments
				management system)
N2 SWOE		9.6	A	N2 is located on the west of Marulan South Road. Water from the west of the SWOE will be pumped to this dam. N2 will overflow to Tangarang Creek or be pumped to the Kiln Dam
N3 SWOE		2.6	C	N3 collects water from the southern slopes of the SWOE and will discharge into the limestone pit

5.3.4 Potable Water

Potable water is used for toilet flushing and hand-washing, dishwashing, showering and drinking. The site is not connected to a reticulated potable water supply and as such water is purchased and delivered to site by a water tanker. Potable water is stored in a dedicated tank adjacent to the workshop and office. Certificates to validate the quality of the water are provided on request. Bottled water is provided for drinking. Initially it was proposed to install a package treatment plant to treat rainwater runoff to drinking water standards. This was found not to be feasible and the provision of water via tanker a preferable option. Rainwater on the operating site is collected for use.

5.3.5 Production Bore

The site has access to a licensed production bore for up to 15ML per annum of water, which was already in place prior to the quarry being established.

Water was drawn from this bore infrequently during 2019. Approximately 0.296ML of water was used for dust suppression purposes. The use of the production well was discontinued as the recharge to the well was very slow due to the drought conditions.

5.3.6 Waste Water Sewage Management

Sewage is managed onsite via an Aerated Wastewater Treatment System (AWTS) with land application to an aboveground transpiration bed.

An onsite wastewater report for the proposed effluent management system consistent with the requirements of *WaterNSW – "Developments in Sydney's Drinking Water Catchment" – Water Quality Information Requirements, 2011* was prepared by Harris Environment Consulting in 2012 in accordance with the requirements of CoA B30. The report is provided in Appendix B. The effluent management system was constructed in 2013 in accordance with this report. Routine maintenance and review of the system is undertaken in accordance with the requirements of the wastewater report.

A biocycle system is currently being investigated to replace the existing AWTS. A wastewater report has been prepared. Tenders are being arranged and Council approval will be sought once the design is confirmed.

5.3.7 Reuse Process Water System

Water for operational purposes is provided by a pump located on a floating gantry at the eastern end of Dam 1. Water is delivered to the site via pipework underbored through the rail line embankment and routed throughout the site. Two separate reticulated water systems for firefighting and process water are in place on site.

Site process water use is summarised in **Table 5.3 and depicted in Figure 5.1.**

Table 5.3: Site Process Water Usage

Area	Operation	Water application	Frequency
In pit	LT160 (mobile crusher)	Water sprays on feeder to suppress dust from feeding and initial crushing of materials.	Water sprays are operational when the LT160 is in operation
	Raw material stockpiles	Water cart to wet material if fines and dust are present. Not usually required once "clean rock " is being processed	As required
	Overburden excavation	Water cart used to suppress dust during excavation. Water sourced from nearest available dam.	Usage determined on weather and work
	Vehicle movements	Water cart used to suppress dust during vehicle movements. Water sourced from nearest available dam.	Usage determined on weather and work
Primary	Surge stockpile	Water is applied to materials at the base of CV199 (conveyor) as well as the head of CV199 where rock discharges to the surge stockpile.	Water sprays are operational as required. This is dependent on the "dampness of the material being processed.
Crushing and screening	Crusher	Water is applied to materials as it is discharged from the surge to the conveyors transporting the materials to the crusher. Cool fog misting sprays in place at CV transfer points.	Water sprays are operational as required. This is dependent on the "dampness of the material being processed.
	Screening	A water based dust suppressant (Polo Citrus) is applied to key parts of the screening process.	Polo citrus is applied as required. This is dependent on the "dampness of the material being processed.
	Filler	Water is applied to the filler dust as it is pugged to make the material easy to handle	Operational at all times associated with the discharge of the filler dust
	Wash down	Water is used for cleaning within in the operations.	As required
Train load out	Loading of trains	Application of 3% water to product to maintain moisture during travelling and minimise dust	Every wagon during loading
	Wash down	Water is used for cleaning of spillages	As required
Road and open area dust suppression	Water cart	Water is applied to the roads and open areas.	Managed through the use of Weatherzone forecasting system and as required.
	Conveyor sprays	Sprays located on the underside of conveyors parallel to roads to suppress dust	As required
Vehicle and equipment washing	Car wash	Light vehicle car wash for the use of staff	Main use at change of shift
	Workshop	Wash down bay in place to clean equipment and vehicles prior to maintenance	There is limited use of the wash bay as minimal vehicles used on site. Possibly 3 times a week
	Tray decontamination	Wash out of truck trays is required to	Dependent on need to load train

Area	Operation	Water application	Frequency
		ensure there is no cross contamination of materials when product is moved on the quarry.	manually and stockpile of product
Fire Management system	Processing plant operations	Fire fighting	Minimal – sometimes used for wash down

5.4 SURFACE WATER MANAGEMENT FOR MODIFICATION 5 – SOUTH WESTERN OVERBURDEN EMPLACEMENT

The South Western Overburden Emplacement (SWOE) is located to the south west of the Peppertree quarry as shown in Figure 5.4. The drainage arrangements for the SWOE will follow the same principles applied across the quarry.

The SWOE drains, predominantly in a south-east direction towards the Marulan South Limestone Mine, with the exception of a small area in the extreme north-west adjacent to Marulan South Road, which drains in a westerly direction under the road and into a tributary of Tangarang Creek.

The SWOE comprises three catchments, which will drain to three sediment basins as shown on Figure 5.4. The sediment basins will be emptied as follows:

- N1 will be a new sediment basin in the SWOE and will overflow or be pumped to the Kiln Dam, which is currently and will continued to be used as a water source as part of the Limestone Mine water management system. The kiln dam will also be reconfigured and enlarged during the construction of the SWOE.
- N2 is an existing dam which will be enlarged and will overflow to Tangarang Creek, via the Main Dam (Dam 1) or be pumped to the Kiln Dam.
- N3 will be a new sediment basin adjacent to the southern access to the SWOE and will overflow to the natural drainage line that drains to the Limestone Mine pit. A sediment dam is currently in place at this location.

Interim sediment and erosion controls are being designed for the early stages of the emplacement.

The sediment basins have been sized in accordance with the criteria for fine and dispersive sediments in DECC's (2008) Managing Urban Stormwater: Soils & Construction – Volume 2E: Mines and Quarries to capture the 95th percentile five day rainfall, including a 50% allowance for sediment storage (Table 5.4)

Table 5.4 SWOE sediment basin capacity requirements

Sediment Basin	Catchment	Catchment Area (ha)	Settlement Zone (ML)	Sediment Zone (ML)	Required Volume (ML)
N1	B	25	8.5	4.2	12.7
N2	A	15	6.4	3.2	9.6
N3	C	8	1.7	0.9	2.6

The WOE comprises six catchments, as shown in Figure 5.4, with most of the clean water catchments diverted around the proposed sediment basins. Some remaining clean water and the dirty water will flow into two sediment basins, with one basin (P1) having the ability to pump water to the Quarry pit sump as required and the other basin (P2) draining into Dam 1, via the bioswale.

- Catchment 1 is upslope of the WOE and will be a clean water catchment, with flows diverted to the west to Dam 1.
- Catchment 2 is upslope of the WOE and will be a clean water catchment, with flows directed under the emplacement into a channel to the north which will flow into sediment basin P2.
- Catchment 3 comprises the north-west and western batters of the WOE and will drain into sediment basin P2.
- Catchment 4 comprises the southern batters of the WOE and will drain under the WOE into the channel to the north and then to sediment basin P2.
- Catchment 5 comprises part of the northern batter of the WOE and will drain into the channel to the north and then to sediment basin P2.
- Catchment 6 comprises the eastern batters of the WOE and the proposed shared road sales stockpile area and will drain to sediment basin P1.

Sediment basin P1 has been sized for a 90th percentile five day rainfall event as it drains to the Quarry pit and sediment basin P2 has been sized for a 95th percentile five day rainfall event as it discharges to the 'sensitive' environment of Dam 1 from where environmental flows occur. The sediment basin sizes are summarised in Table 5.5.

Table 5.5 WOE sediment basin capacity requirements

Sediment Basin	Catchment	Catchment Area (ha)	Settlement Zone (ML)	Sediment Zone (ML)	Required Volume (ML)
P1	6	4.1	1.3	0.8	2.1
P2	2,3,4,5,	10.9	4.6	1.2	5.8

The sediment basins designed for the 95th percentile five-day rain fall may overflow one to two times per year and those designed for the 90th percentile rain fall may overflow three to four times per year. During rain fall greater than the design event, sediment basins N1, N3 and P1 will overflow to either the Quarry or Mine water management systems. Sediment basin P2 will overflow to Dam 1 and sediment basin N2 will overflow to a tributary of Tangarang Creek, which will drain to Dam 1.

Therefore, the Project could contribute flows to Tangarang Creek once or twice a year. Dam 1 is located on Tangarang Creek. Dam 1, overflows into Tangarang Creek in extreme rain events only and no flooding or water quality impacts on downstream users are anticipated due to the impacts of heavy rainfall on the entire local receiving environment.

The proposed dams will therefore maintain the current site performance standard with respect to water quality management and is observed to maintain NORB at downstream monitoring points from the quarry.

Detailed drawings of the dams and sediment controls are being prepared prior to the construction of the SWOE. This will ensure the water management system meets the requirements of the design and erosion and sediment controls such as scour protection is identified.

All sediment controls including the dams will be installed prior to the construction of the emplacement materials.

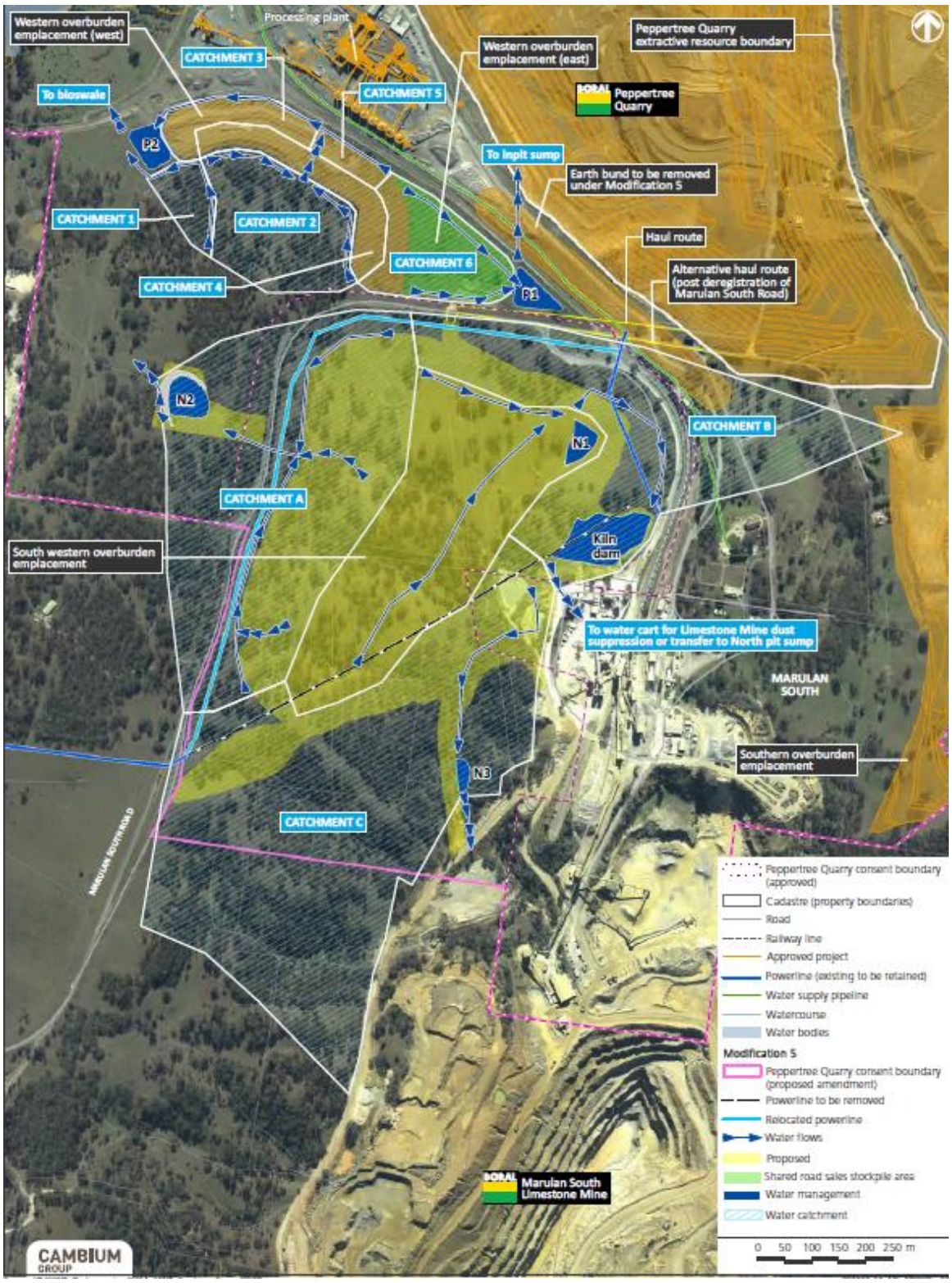


Figure 5.4: South Western Overburden Emplacement Surface Water Management

5.5 SURFACE WATER MANAGEMENT FOR MODIFICATION 6 – DUST EXTRACTION SYSTEM

Approval of Modification 6 allows for the installation and operation of 2 dust extraction units "baghouses" on the main crusher and screen buildings to extract dust from these operations.

The Dust extraction systems are located within the STQ operational plant areas and as such no additional stormwater controls are required.

Stormwater runoff from the STQ plant areas is collected by a perimeter drain to the south west of the site and directs water to Dam K for reuse.

5.6 SITE WATER BALANCE

In accordance with the requirements of CoA B34, a water balance analysis has been carried out for the Quarry based on the operational systems and water use. The water use figures are based predominantly on assessment of usage and knowledge of flow rates of sprays and piping. Water usage is generally not metered or recorded at individual locations. The water balance is based on operational data collected during the 2018 - 2019 period.

Table 5.6 shows typical inflows to the Quarry with Table 5.7 showing demand.

Table 5.6: Quarry Water Availability (2018 - 2019 data)

Water Source	Indicative annual water availability
Dam 1	145 ML
Production Bore	0.296 ML (licence for 15ML but only used 0.296ML due to lack of Flow)
Total water availability per annum	145.296ML

Table 5.7 Quarry Water Demand and Discharge

Area	Operation	Indicative annual water usage
In pit	LT160	Not determined separately
	Raw Material stockpiles	Refer water cart
Primary and Crushing (STQ)	Conveyors & operations	78ML
Train Load out	Product moisture	50ML
Road and open area dust suppression	Water cart	43.8ML
Fire suppression system		
Total water demand per annum		171.8ML

Based on the estimates, the total non-potable annual water demand is estimated as 171.8ML.

Water applied to the product leaving the site demanded approximately 50 ML per annum, with 1.5 to 2% water addition to every loaded train wagon of material.

The water carts are estimated to use approximately 43.8 ML per annum. The carts source water from the sediment and out of pit dams depending on the water volumes available after rain. They do not use water from Dam 1.

The quarry utilised 78 ML in the operations, pumped from Dam 1. More water was applied into the processing of the rock, for the management of occupational health in relation to dust, with more cleaning by hose and water application also taking place.

Due to drought conditions during 2018 – 2019 and no inflow into Dam 1 and sediment ponds for a lengthy period, water was purchased (approximately 46.7 ML) for use in operations and water carts.

An environmental flow to Tangarang Creek, equivalent to 10% of the average daily inflows into the main dam is also required. This flow is directly measured downstream of Dam 1 with a flow meter. This was measured at 24 ML for the 2019 period. (refer Table 7.2)

When water was scarce at the quarry, during the drought, operations ceased, until a supply was available.

In light of this, a review of water supply and operational needs has been undertaken, to ensure a sufficient supply of water for all stages of the project.

Additional smart metering is being installed on the water take from the Main Dam and Dam K to better understand water usage. This data will be reviewed to look at ways to minimise water usage.

A licence for the use of groundwater from the pit has recently been obtained with groundwater modelling confirming volumes available.

The design and operation of the pit is such, that a sump is being installed on a lower bench to where crushing operations are occurring. This sump, due to its location, will be able to retain water and be used as an in pit dam, for the collection of stormwater runoff. The design of having a lower level in pit sump will be included in forward pit planning.

Alternative water sources are being investigated, with discussion being held with Local government as to the use of treated wastewater from nearby facilities.

However, if water becomes scarce operations will be modified. This may include stopping operations until water is available or restricting crushing hours based on available water. Measures have also been implemented to minimise the water usage across the site. The installation of the dust extraction units on the main crushing and screening buildings has reduced the cleaning requirements via hosing. The meteorological forecasting system is used to identify hot dry and windy days such that water application for dust suppression is restricted to the times that are critical and minimising the use of water. Misting and fogging sprays are used within operations to limit the amount of water directly applied to the product.

5.7 EXTREME RAINFALL EVENT MANAGEMENT

An extreme rainfall event procedure, based on a commercially available weather forecasting dashboard, is used to predict meteorological conditions that may generate extreme dust and rain events at the project site. The implementation of the procedures enables Boral to proactively prepare for and manage extreme weather events. Based on the level of an alert, controls and contingencies for stormwater management are effectively and efficiently implemented. Boral has trained staff and developed procedures to take appropriate levels of action based on the dashboard predictions.

The procedure for extreme rainfall event management is contained within a Trigger Action Response Plan (TARP) prepared for the site (refer Appendix C).

6 EROSION AND SEDIMENT CONTROL

Exposed surfaces on emplacement areas, operational areas and haul roads have the potential to undergo erosion and generate sediments during rainfall events that without suitable controls could flow into local waterways.

The steeper slopes of the emplacements areas (compared to the original topography) in particular may lead to increased rates of runoff compared to the existing conditions.

Erosion control, then becomes the first line of defence in managing surface water runoff quality and alleviating pressure on the site sediment dams. The erosion and sediment controls provided in this WMP comply with the requirements of CoA B35 of the Project Approval. Design details for stormwater and sediment control structures for mine and quarry sites are provided in the Sections 5 and 6 of Volume 1 of *Managing Urban Stormwater: Soils and Construction Volume 1*, 4th Edition, March 2004 (Landcom, 2004) (the Blue Book). Additional measures are outlined in *Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries (DECC, 2008).* The design requirements presented in these documents have been adopted for site sediment control structures.

The procedure for selecting erosion and sediment control measures provided in Appendix F of *Volume 2E Mines and Quarries (DECC, 2008)* will be implemented, where possible, for the selection of the techniques to be used during construction and operation of the Quarry. The procedure is reproduced in Appendix D of this WMP. Specific approaches adopted for the site are discussed in the sections below.

6.1 LAND DISTURBANCE

Erosion and sediment control measures will be implemented prior to the disturbance of any land, including the construction of sediment dams, during ongoing operations and expansion of quarry operations. Sediment fencing will be installed downslope of disturbed areas to minimise off site migration of sediment. Sediment fencing will be installed in accordance with the Blue Book sediment fence guideline (SD 6-8).

Prior to land being disturbed, the disturbance area limits will be marked out and personnel will be instructed that works cannot extend outside the boundary of this area. This will ensure that the erosion and sediment control measures set up are able to capture the total area of land being disturbed.

Land disturbance will be minimised by clearing the smallest practical area possible and stabilising non-active operational areas as quickly as possible (e.g. outer bund walls and overburden dumps), where possible.

The erosion control measure selection process documented in Appendix D will be implemented in areas where land is to be disturbed. This selection process is based on the following steps:

- identifying the issue (erosion or sedimentation) to be managed;
- where the issue is erosion, identifying whether it is caused by rainfall impact or concentrated flow;
- where the issue is sedimentation, identifying if sediment is conveyed by sheet or concentrated flow; and
- selecting the appropriate techniques from those presented in Appendix D.

The implementation of the erosion and sediment controls/measures will be staged as appropriate, i.e. construction of site stabilisation works prior to land disturbance works finishing. Consultants will

assess and provide detailed drawings on erosion and sediment controls for infrastructure such as overburden emplacements.

6.2 TOPSOIL MANAGEMENT

Topsoil stripping will be undertaken when the soil is moist to prevent disaggregation of soil structure where possible.

A philosophy of handling soil only once, where possible, will be adopted where possible to minimise the time during which soil may be vulnerable to erosion. This will be achieved by appropriate scheduling of quarrying activities and by having designated permanent areas for topsoil stockpiling. It will also include appropriate scheduling of stripping to develop the bunding around the site without stockpiling the material first.

Stockpiles and bunds will be managed in accordance with the Blue Book SD 4-1 stockpile guideline. Drainage will be provided around stockpiles to prevent ponding on or around the base of the stockpiles. Erosion control systems for overburden stockpiles and bunding will include surface roughening, soil surface mulching and mid slope diversions where possible.

6.3 SEDIMENT DAMS

Sediment basins, on the quarry are designed to moderate an increase in runoff and potentially sediment, by capturing stormwater from emplacement areas before overflowing or being pumped to the quarry pit or Dam 1. This minimises the potential for transport of sediment into downstream waters.

Under normal operating conditions, water from the sediment basins would be transferred to either the Limestone Mine (as outlined in Mod 4 and 5) or Peppertree Quarry's Main dam or pit.

Basins N1, N3 and P1 and areas associated with the Southern Overburden (mod 4) would overflow (during rainfall events greater than the design event) to either the Limestone Mine or Quarry pit. Sediment basin N2 would overflow to a tributary of Tangarang Creek, which discharges to Dam 1. Basin P2 would overflow to Dam 1.

Under Modification 5, N2 would overflow to a tributary of Tangarang Creek in high rainfall events, approximately 1 to 2 times per year. Therefore, during high rainfall events, there may be a slight increase in flows in Tangarang Creek and a slight reduction in runoff to the Limestone Mine compared to existing conditions. However, as Tangarang Creek discharges to Dam 1, which is part of the Quarry water management system, no impacts are likely to be experienced by downstream users. Other sediment basins associated with the SOE, potentially overflow offsite during rainfall events greater than the design event, however pumps in place during such rainfall events minimise any potential for overflows.

Out of pit sediment dams were initially constructed in line with the development of the "borrow pit" for the quarry and the initial noise bund on the northern boundary of the pit.

The capacities of these site sediment dams were designed in accordance with the requirements of CoA B32 of the Project Approval, that is:

- critical structures such as "dirty water" dams are designed, constructed and maintained to accommodate a 1 in 100-year ARI 24-hour event; and
- other dams and water management structures are designed, constructed and maintained to accommodate a 1 in 20-year ARI 24-hour event.

With the exception of 1 sediment dam (Dam W) all initially constructed dams now receive water from rehabilitated areas.

All other out of pit sediment dams have or will be designed in accordance with earth dam requirements presented in Section 6 (SD 6-3) of Volume 1 of the Blue Book, where practicable and possible. A Risk management approach will be applied if a dam cannot be designed or constructed to SD6-3.

Out of pit sediment dams for the WOE, SOE and SWOE have been designed as outlined in Section 5.2 and section 5.3.

In accordance with the requirements of the Blue Book, where possible, sediment dams are designed with a length to width ratio of 3 to 1, where practicable, such that the residence time of water within the dams is suitable for the settlement of sediment prior to discharge to the water reuse system. If this ratio cannot be achieved, baffles will be installed within the dams to artificially create a 3 to 1 ratio.

The sediment dams external to the pit will be constructed within the natural low permeability silt and clay sediments found within the site. If permeable material below the silts and clays is penetrated, exhumed silts and clays will be used to line the dams. A silt/clay layer of approximately 1 m thickness is will be used to line all sediment dams outside of the quarry pit.

Should it be deemed necessary by geotechnical consultant's shotcrete linings are applied to the dams.

Appropriate Scour protection, at the location of each sediment dams spillway, will be in place to ensure the potential for erosion and transport of sediment to downstream waters is minimised.

All sediment dams and associated drainage are constructed prior to any works commencing up gradient of the dams. The dams are constructed in dry conditions to prevent sediment laden water discharging from the site due to runoff occurring during construction.

In-pit sediment dams will not spill water and therefore do not need to be designed to meet Blue Book criteria.

In order to ensure that the pit sumps achieve the desired purpose of capturing all surface runoff from disturbed areas within the pit and preventing the sump from impacting site works, a staged approach to pit sump migration and development has been adopted.

Once vegetation on a basin's contributing catchment has achieved the required surface cover to reduce the erosion rate to negligible, active management of that sediment basin may no longer be required. However, in most cased basins will be retained to harvest and reuse runoff and therefore reduce the water storage demands on Dam 1.

6.4 DRAINAGE SYSTEMS

The drainage network is designed to pre-treat runoff, where possible, prior to discharging to the sediment dams. This is accomplished by installing rock check dams along the drainage pathways to reduce flow energy and promote capture and settling of fine materials.

The permanent areas of the drainage network are designed to minimise in drain erosion and include:

- installation of appropriate liners, including prefabricated liners consisting of concrete, polyethylene, other forms of erosion control blankets or hard armour channels;
- rock check dams located at regular[1] intervals along drainage lines to reduce flow energy; and

[1] The 'Blue Book' recommends that rock check dams should be spaced so that the toe of the upstream dam is level with the spillway of the downstream dam.

- design of drains with grades of less than 1% where possible. Where grades are greater than 1% suitable systems will be developed to prevent erosion of the drainage channels in accordance with the Blue Book, including the use of liner blankets.

Upslope drainage systems are placed around the permanent edges of the quarry pit to prevent erosional surfaces developing around the edge of the pit and to prevent instability. This drainage system then directs water via local structures into the pit base.

In areas of the quarry footprint that are not yet disturbed, surface runoff is diverted around the pit and site operations by clean water diversion drains.

6.5 Road Systems

Roads are constructed to ensure surface drainage is optimised and stabilised, so that erosion of roads is reduced and sedimentation along roadside drains is minimised.

Roads are graded such that runoff flows by the shortest routes to roadside drainage systems that redirect runoff to catchment drainage networks and sediment dams.

Roadways on stockpiles and bunded areas are designed to slope inwards so that runoff is directed back into the pit and contained within the site erosion and sediment control network.

6.6 Long Term Management

Long term site management will include the stabilisation or revegetation of disturbed areas or implementation of suitable drainage facilities around built structures. The revegetation will use, where appropriate, native/indigenous flora that will facilitate rapid stabilisation of disturbed areas. Key areas subject to progressive stabilisation or revegetation will include bund walls and overburden stockpiles. Further details of the site rehabilitation are provided in the site Biodiversity and Rehabilitation Management Plan (refer Section 1.4).

6.7 Maintenance

The pit supervisor and other key staff have the responsibility of undertaking regular inspections to assess the integrity of the sediment and erosion control systems on site in accordance with the checklist provided in Appendix E.

The aim is to undertake this inspection on a quarterly basis in line with the quarterly water monitoring schedule or following large rain events, exceeding 50mm in a 24 hour period.

The pit supervisor undertakes a daily and weekly review of the site and will identify any issues at this time as well. This includes: any potential risk of sheet, rill and gully erosion.

The supervisor will also inspect erosion and sediment control prior to any forecasted heavy rainfall events as per the procedure in the TARP (Appendix C)

The inspection includes assessing permanent structures and those temporarily installed by contractors working in specific areas.

Inspections of permanent structures are also undertaken after rainfall events greater than 50 mm in 24 hours, measured at the site rainfall gauge, to assess how the system has performed. The 50 mm rainfall event used for initiating checks is a trigger criteria only, and actual frequency of inspections is revised if the system is performing effectively under this amount of rainfall.

Inspection of temporary structures around construction areas, overburden stripping areas and unconsolidated stockpiles is undertaken prior to the commencement of works and following rainfall event and on a regular basis thereafter.

Inspections include visual observations to check for erosion of surfaces on site and sedimentation within the water management network. An erosion, sediment control and dam checklist are provided in Appendix E of this WMP.

If any component of the system is identified as not functioning in accordance with the requirements of the WMP, maintenance will be undertaken to reinstate it to the required condition. Additional erosion control measures will be established if required to ensure adequate control and protection.

The areas that require regular inspection under this WMP comprise:

- road and associated drainage systems;
- drainage networks;
- sediment dams;
- bunding and overburden stockpiles;
- temporary stockpiles; and
- overburden stripping areas.

Specific inspection requirements for these structures are presented below.

6.7.1 Roads

Roads are visually inspected for the presence of erosion of the road systems and sedimentation within roadside drainage networks. Where erosion and sedimentation impacts are observed, they are rectified by regrading the road and by clearing sediment accumulation within the drainage network. An assessment is then conducted to identify the potential cause of the erosion and sediment control issues and additional measures are put in place to reduce erosion, as required including:

- installation of mitre drains;
- scour protection of road drainage; and
- regrading of the road surface to reduce gradient.

6.7.2 Drainage Networks

Drainage networks are visually inspected for the presence of erosion of drainage channels and accumulation of sediment in drainage channels. Where erosion and sedimentation has occurred, immediate action is taken to repair the damage and remove excess sediment. Rock check dams are also inspected for sedimentation and cleaned out as required.

Where regular erosion and sedimentation is occurring, an assessment is made of the likely cause of the issue and further protection measures implemented including:

- installation of additional up gradient sediment fences;
- installation of more robust drain liners in accordance with the “Blue Book”;
- installation of additional energy dissipation structures in accordance with the “Blue Book”; and
- reduction of the grade of the drainage network.

6.7.3 Sediment Dams

The sediment dam within the pit (the pit sump) is frequently re-located and does not require regular visual inspection for sedimentation. Other dams are subject to visual inspections on a regular basis to ensure that sedimentation is not resulting in a dam capacity less than the design requirements. These

dams will require emptying on a regular basis for inspection. Dams are periodically re-excavated and regraded to ensure the design capacity is maintained.

Visual inspections are conducted on the clarity of water within the dams prior to discharge and the integrity of the dam structures. This includes checking for cracking of and leakage from the dam walls. Where the integrity of the dam walls appears to be compromised, immediate works will be undertaken to stabilise the structure.

6.7.4 Bunding and Overburden Stockpiles

The overburden stockpiles and bunding are regularly inspected visually to check the condition of existing erosion control structures and for the development of erosion features such as scouring. Where identified, additional measures are put in place to stabilise the stockpiles and reduce erosion including the installation of up-gradient surface water flow capture systems, the installation of erosion control blankets, development of mid-slope terraces or the re-grading of the slopes to reduce gradients.

6.7.5 Temporary Stockpiles and Overburden Stripping Areas

Regular visual inspections of the temporary stockpiles and overburden stripping areas are undertaken to ensure appropriate and effective erosion and sediment controls, such as sediment control fencing and hay bailing, have been implemented and are operating effectively.

6.7.6 Remaining Areas

A general inspection of all other areas onsite is regularly undertaken for signs of erosion and sedimentation. Where identified, an assessment is made of the likely cause of the erosion/ sedimentation and appropriate control measures are installed.

7 WATER MONITORING

7.1 SURFACE WATER QUALITY CRITERIA

7.1.1 Trigger Values

For purposes of assessing the potential impact of Quarry operations on water quality, the **ANZG** default water quality criteria and the targets set out in the Southern Rivers CAP (refer Section 2.2) are relevant considerations. The Southern Rivers CAP recommends that the default water quality criteria specified in the **ANZG** Guidelines be adopted as water quality objectives throughout the Shoalhaven catchment. The relevant **ANZG** default triggers are provided in Table 7.1 below.

As the area around the Quarry drains to the Shoalhaven River, which is part of the Sydney Water Supply catchment, criteria for drinking water quality are also relevant considerations. The *Annual Water Quality Monitoring Report Sydney Catchment Area 2015-16* (WaterNSW) lists a range of water quality benchmarks for catchment streams that have also been considered in assessing appropriate water quality trigger values for Peppertree Quarry. These benchmarks are provided in Table 7.1 below.

The **ANZG** Guidelines move away from setting fixed single number water quality criteria and emphasise water quality criteria that can be determined on a case by case basis, according to local environmental conditions. This is done through the use of local reference data and risk-based decision frameworks. Table 4.3 provides the summary statistics for the water quality monitoring which has been used as the basis for determining triggers specific to the local creeks in the vicinity of Peppertree Quarry.

For physical and chemical stressors for slightly or moderately disturbed ecosystems, such as that surrounding the Peppertree Quarry, the Guidelines recommend the use of the 20th and 80th percentile values of data as the basis for specific trigger values. These statistics have been calculated for the water quality dataset and are summarised in Table 7.1.

The Guidelines specify that two years of monthly sampling (24 samples) is sufficient to provide an indication of the local ecosystem variability and to provide a basis for derivation of 'trigger' values appropriate to conditions in a particular creek system. It is noted that 23 samples have been collected for Barbers Creek, six for Tangarang Creek upstream (U1), 30 for Tangarang Creek downstream (T1), and 22 for Marulan Creek. The low number of samples collected for Tangarang Creek (U1) is due to the ephemeral nature of the creek upstream of the Main Dam and therefore data for this location is not included in Table 7.1. However, it is considered that adequate data is available at the other monitoring locations to derive appropriate trigger values.

It should, however, be noted that Tangarang Creek downstream of the Main Dam (T1) is impacted by discharges from the Quarry to Dam 1 which discharges to T1 as an environmental flow. Barbers Creek is a fifth order creek with a very large catchment area and therefore it is considered that the observed values for Marulan Creek may provide the most appropriate basis for the recommended trigger values as it demonstrates water quality upstream of any possible influence from the Quarry.

Table 7.1 summarises the trigger values based on the various sources which could be considered for the Peppertree WMP.

Table 7.1: Water Quality Criteria

Indicator	ANZG Default Trigger for Ecosystem Protection[1]	WaterNSW Benchmarks for Catchment Streams	Range of Observed Values			Proposed WMP Triggers
			Marulan Ck U&D	Tangarang Ck (T1)	Barbers Ck U&D	
pH	6.5 – 7.5	6.5 – 8.0	7.6 – 8.2	7.7 – 8.0	7.8 - 8.1	**6.5 – 8.5**
EC (µS/cm)	30 – 350		480 – 1,536	356 – 813	414 – 782	**400 - 1,500**
Total nitrogen as N (mg/L)	0.25	<0.25	1.10	0.6	0.6	**1.10**
Total phosphorus as P (mg/L)	0.02	<0.02	0.09	0.03	0.04	**0.09**

[1] Default trigger values for physical and chemical stressors for South-east Australia for slightly disturbed ecosystems (upland river)

The proposed triggers for this WMP are provided in the right-hand column of Table 7.1. They have been arrived at by consideration of the observed data, with more weight given to the data from Marulan Creek, due to the reasons provided above. The pH trigger also includes the range provided by the **ANZG** default trigger.

The proposed trigger values would be applied as follows for ongoing monitoring in Tangarang Creek:

- If the upper bound for pH, EC, total suspended solids or turbidity is exceeded for a period of three consecutive months downstream of the quarry but is not exceeded upstream of the quarry, this would be the trigger to undertake further assessment of potential sources within the quarry.
- If the additional assessment finds that the change in water quality may be induced by quarry operations, then further investigation would be required to identify the source of the water quality impact, and review and revise practices to minimise the impact.

This further assessment would include investigation of the potential pathways for water quality impacts within the quarry area to identify whether the change in water quality is attributable to quarry activities, and the nature of activity that has caused the change.

Investigations would be carried out by an appropriately qualified person to identify the source of the exceedance and to recommend and implement solutions to mitigate any potential impacts. Additional monitoring may be required to identify the source of the impact and to monitor the effectiveness of the remedial solution.

7.1.2 Creek Water Quality Monitoring Regime

The analytical schedule identified in Table 4.2 is completed for both surface and groundwater samples obtained from the site and the surrounding area, except for the out of pit sediment dams. The out of pit sediment dams will be monitored for field chemical and visual parameters, when overflowing, outside of their design capacity. Turbidity and faecal coliforms are measured for surface water only. Visual monitoring of algal blooms within the water supply dam is also undertaken.

All samples are taken in accordance with NSW guidelines for surface and groundwater sampling and by a suitably experienced sampler. All laboratory analysis is completed by a laboratory that is NATA accredited for the analytes presented above. All flow gauging equipment is checked and re-calibrated in accordance with suppliers' recommendations. Monitoring is undertaken by appropriately trained and qualified individuals to ensure quality of monitoring procedures.

Total nutrient concentrations are included in the list of parameters monitored as elevated nutrient levels have historically been identified within existing water quality data for Tangarang Creek, which is typical of agricultural catchments.

Surface water quality monitoring at Tangarang Creek (T1) and the upstream culvert (U1) is undertaken quarterly. Samples for Marulan South Creek will also be taken on a quarterly basis.

Event based sampling is undertaken for T1 and U1 following rainfall events of greater than 50 mm in 24 hours (maximum once per quarter when outflow from the dams is occurring).

Reporting of surface water results is as per Section 10.2.

The locations of the surface water monitoring sites are shown in Figure 4.1.

7.1.3 Dams and Sediment Pond Water Quality Monitoring Regime

In addition to the surface water quality monitoring in the watercourses external to the site, Boral undertakes the following:

- **Dams**: Dam water quality is monitored at the inflow point (pump) in the main water supply dam (Dam1) to ensure that water is of suitable quality for its intended use in quarry operations and for releases to Tangarang Creek. This is undertaken on a quarterly basis. Event based sampling is undertaken at the overflow culverts when large rain events occur.
- **Out of Pit Sediment Dams**: The OB north dam, OB east dam, OB south dam, Farm dam, OB west dam, South OB Dam A, South OB Dam B, South OB Dam C, South OB East Dam, N1SWOE, N2SWOE, N3SWOE, P1West OB and P2 West OB are all located outside the Pit. These dams are inspected during large storm events. Should an overflow event occur, that is outside of the design capacity of the dam, the discharge would be monitored. Dams U, V1, V, W, W1, W2 are no longer monitored as they no receive clean water from rehabilitated area.

7.2 SURFACE WATER ENVIRONMENTAL FLOW

CoA B31 of the Project Approval requires provision of an environmental flow to Tangarang Creek equivalent to 10% of average daily (in)flows. This requirement has been adopted as the assessment criteria used for flows in Tangarang Creek downstream of the Quarry.

The main water storage dam for Peppertree Quarry is the Main Dam (Dam 1), which is located on Tangarang Creek. Environmental flows in Tangarang Creek are managed by slow release of water to Tangarang Creek via seepage from the Main Dam wall. This occurs as during the construction of the dam, crushed glass was placed in the creek bed at the dam wall, allowing water to continually "seep" from the dam.

To ensure that at least 10% of the daily flows in Tangarang Creek are being released back to the catchment, a flow monitoring system is utilised within Dam 1. Dam 1 water levels are recorded daily and used as the basis to calculate daily surface water inflows. Flow in Tangarang Creek downstream of Dam 1 is monitored at the weir downstream of Dam 1. The downstream flows are compared to the upstream flows to confirm that a minimum of 10% of the daily flows into Tangarang Creek are being released. The equipment used to monitor flow is calibrated by external consultants every 2 months.

The environmental flows to Tangarang Creek occur continuously in accordance with inflows and are further supplemented during high flow conditions.

Reporting of surface water environment flow results is as per Section 10.2.

Table 7.2 summarises inflows and outflows for the 2015 - 2020 period and identifies the compliance with CoA B31.

Table 7.2 Tangarang Creek Flows

Month	Total Monthly Inflow to Main Dam	10% of inflow	Total Measured Outflow at Tangarang Creek Gauge	Compliance with CoA B31
	(ML)	(ML)	(ML)	
Jan 2015	7.0	0.7	6.97	Yes
Feb 2015	3.0	0.3	2.3	Yes
March 2015	2.8	0.28	1.29	Yes
April 2015	9.5	0.95	9.93	Yes
May 2015	1.0	0.1	4.64	Yes
June 2015	9.0	0.9	5.49	Yes
July 2015	6.0	0.6	9.54	Yes
Aug 2015	6.0	0.6	1.36	Yes
Sept 2015	2.0	0.2	24.62	Yes
Oct 2015	1.0	0.1	18.44	Yes
Nov 2015	3.0	0.3	5.17	Yes
Dec 2015	1.0	0.1	4.53	Yes
Jan-2016	20.7	2.07	2.38	yes

Month	Total Monthly Inflow to Main Dam	10% of inflow	Total Measured Outflow at Tangarang Creek Gauge	Compliance with CoA B31
	(ML)	(ML)	(ML)	
Feb-2016	3.8	0.38	5.85	yes
Mar-2016	2.3	0.23	10	yes
Apr-2016	0	0	13.46	yes
May-2016	3.1	0.31	5.01	yes
Jun-2016	48.4	4.84	13.1	yes
Jul-2016	5	0.5	18.85	yes
Aug-2016	9.1	0.91	21.27	yes
Sep-2016	5	0.5	18.63	yes
Oct-2016	0.5	0.05	16.83	yes
Nov-2016	5.9	0.59	16.36	yes
Dec-2016	6.4	0.64	33.88	yes
Jan-2017	1.6	0.16	9.05	yes
Feb-2017	11.2	1.12	Gauge error	NA
Mar-2017	30.4	3.4	Gauge error	NA
Apr-2017	1	0.1	Gauge error	NA
May-2017	11	1.1	19.64*	yes
Jun-2017	5.8	0.5	39.48*	yes
Jul-2017	0.9	0.09	1.95	yes
Aug-2017	2	0.2	2.42	yes
Sep-2017	0	0	2.49	yes
Oct-2017	0	0	1.35	yes
Nov-2017	5.4	0.54	1.72	yes
Dec-2017	5.21	0.52	1.14	yes
Jan-2018	0	0	3	yes
Feb-2018	30.9	3.09	0.12	NA gauge obstructed by reeds
Mar-2018	24.2	2.42	0.12	NA gauge obstructed by reeds
Apr-2018	0.9	0.09	1.86	yes
May-2018	0.6	0.06	1.97	yes
Jun-2018	0	0	2.05	yes
Jul-2018	0	0	2.03	yes
Aug-2018	0	0	2.26	yes
Sep-2018	0	0	2.08	yes
Oct-2018	0	0	1.84	yes
Nov-2018	0	0	1.61	yes
Dec-2018	38.4	3.84	3.43	no
Jan-2019	0	0	1.43	yes
Feb-2019	0	0	1.89	yes
Mar-2019	0	0	3.47	yes

Month	Total Monthly Inflow to Main Dam	10% of inflow	Total Measured Outflow at Tangarang Creek Gauge	Compliance with CoA B31
	(ML)	(ML)	(ML)	
Apr-2019	0	0	2.51	yes
May-2019	0	0	2.44	yes
Jun-2019	0	0	2.17	yes
Jul-2019	0	0	1.91	yes
Aug-2019	0	0	1.75	yes
Sep-2019	0	0	2.19	yes
Oct-2019	0	0	1.85	yes
Nov-2019	0	0	1.26	yes
Dec-2019	0	0	0.99	yes
Jan-2020	0	0	0.93	yes
Feb-2020	125	12.5	597*	yes
Mar-2020	2	0.2	36.55*	yes
Apr-2020	2.6	0.26	2.37	yes
May 2020	5.7	0.57	2.88	yes
June 2020	2.2	0.2	2.65	yes
July 2020	12.2	1.22	3.57	yes
August 2020	49.67	4.96	696.78*	yes
September 2020	0	0	3.11	yes
October 2020	32.91	3.29	148.7	yes
November 2020	10	0.1	379.5*	yes
December 2020	17.1	1.7	55.68	yes

Note * potentially false readings due to the flow gauge being flooded.

Table 7.2 shows that monthly total outflow to Tangarang Creek downstream of the Main Dam for the period January 2015 to April 2020 complies with the requirement that environmental flows to Tangarang Creek are equivalent to 10% of average flows upstream of the Main Dam.

7.3 GROUNDWATER

7.3.1 Trigger Values – Ground Water

Trigger values for field and laboratory parameters included in the 2017 WMP have been updated based on the longer-term dataset now available. For parameters where both high and low exceedances may be relevant (e.g. pH) trigger values are based on 5th percentile and 95th percentile data to December 2020. Where only deviations to high concentrations/values are relevant, the 95th percentile only has been used. The long-term data suggests certain groups of wells have similar water quality characteristics, so wells have been grouped based on the available data and separate trigger values applied to each of these groups. Where wells need to be relocated or replaced with different

screening depths (see Section 4.4.1) additional data will need to be collected prior to calculating trigger values.

Assessment of groundwater results will be undertaken following each monitoring round with any trigger levels exceedances being earmarked. Should changes in pH or EC be observed above or below the high and low trigger values, laboratory data should be examined as a confirmatory measure and to infer possible reasons for the changes. For pH, laboratory alkalinity measures should be considered and for changes in EC, laboratory data for total dissolved solids (TDS) and major cations and anions should be considered. If any trigger levels are exceeded in two consecutive rounds of monitoring, further assessment will be undertaken to determine whether the potential anomaly is the result of quarrying activities or due to natural variability.

For nutrients, trigger values from the ANZECC & ARMCANZ 2000 water quality guidelines (referenced in ANZG 2018) are also included. These trigger values are not directly applicable for groundwater where water extraction for beneficial purposes is not occurring, or the groundwater is not supported a groundwater dependent ecosystem. However they are included for comparative purpose, according to the conditions of WMP 2017.

Table 7.3: Trigger Values for Field Parameters

Well ID	EC (uS/cm) 5th%ile	EC (uS/cm) 95th%ile	pH 5th%ile	pH 95th%ile
ANZECC & ARMCANZ 2000 (referred to in ANZG 2018)	30	350	6.5	7.5
PQ01D	2160	4210	8	10
PQ03D, PQ06D	890	4110	11.5	12.7
PQ04D, PQ05D, PQ09D	1140	1810	7.1	9.7
PQ07D	390	1110	7.6	9.4
PQ08D, PQ04S, PQ09S	1880	3830	6.8	8.7

Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems at altitudes > 150 m

Table 7.4: Trigger Values for Nutrients in mg/l

Well ID	TN 95th%ile	NOx 95th%ile	TKN 95th%ile	RP 95th%ile
ANZECC & ARMCANZ 2000 (referred to in ANZG 2018)	0.25	0.015	NA	0.015
PQ01D, PQ09S	8.00	6.80	1.85	0.33
PQ03D, PQ04S, PQ06D, PQ07D	2.22	1.35	2.00	0.33
PQ04D, PQ05D, PQ08D, PQ09D	0.70	0.37	0.60	0.33

Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems at altitudes > 15

All other analytes are assessed against the ANZG 2018 (95% Protection Values).

7.3.2 Ground Water Quality Monitoring Regime

The groundwater monitoring program is currently comprised of a quarterly program of checking groundwater levels using a manual dip meter and collection of groundwater samples for analysis.

7.3.2.1 Sampling Locations

The piezometer network outlined in Figure 4.1 is the key regional groundwater monitoring network established to assess groundwater level and quality impacts from quarrying activities at Peppertree Quarry. In addition, this network is supplemented with the following:

- Sampling of water in the pit sump, where possible.
- Daily water level recording at PQ05D using an automatic pressure transducer.
- Water level monitoring of any nearby private bores, particularly if trigger levels are breached in adjacent piezometers within Peppertree Quarry's monitoring network.

PQ05D is a sentinel well installed within the overburden/bedrock interface aquifer approximately 500 m to the west of the pit void to monitor potential impacts between the site and the nearest abstraction bores. Groundwater elevation changes in this well will trigger mitigation measures to prevent adverse impacts to the nearest abstraction bores. A logger is installed in this well to monitor water elevation.

Water elevations at the base of the pit void and/or the pit sump are recorded and related to groundwater elevations and surrounding surface water features to identify potential seepage impacts. Pit sump water is sampled when water is present during groundwater sampling events.

Figure 7.1 outlines in more detail the location of the piezometer network.

7.3.2.2 Sampling Methodology

The sampling methodology adopted for the monitoring programme involves:

- Manually dipping all piezometers/bores along with downloading any automatic recording pressure transducers.
- All piezometers within the monitoring network with sufficient head of water (approximately ten metres) being sampled using Hydrasleeves, which are ideal for deep, low yielding piezometers. Shallow piezometers are typically sampled with bailer and/or Waterra.
- Collection and testing of field parameters (pH, electrical conductivity, temperature, dissolved oxygen, redox potential) using an appropriately calibrated multiprobe.
- For the pit sump, field parameters will be determined directly from the sump. A rough water level will be estimated from the nearest bench level and water sample bottles being filled straight from the sump (or bucket if access prevents direct access).
- Placement of water samples into laboratory supplied bottles with appropriate preservation and placement upon ice for delivery to the laboratory within 24 hours.

7.3.2.3 Analytical Suite

All piezometers with sufficient head for groundwater to be collected, will be analysed for the following analytical suite:

- Total Dissolved Solids.
- Suspended Solids.
- Turbidity.
- Alkalinity.
- Major cations and anions (Sulfate, Chloride, Calcium, Magnesium, Sodium, Potassium, Fluoride).
- Nutrients (Nitrite + Nitrate, Total Kjeldahl Nitrogen, Total Nitrogen, Total Phosphorus).
- Oil & Grease.
- Polycyclic Aromatic Hydrocarbons.

- Total Recoverable Hydrocarbons.
- Benzene, Toluene, Ethyl Benzene and Xylenes (BTEX).

Reporting of ground water results is as per Section 10.2.

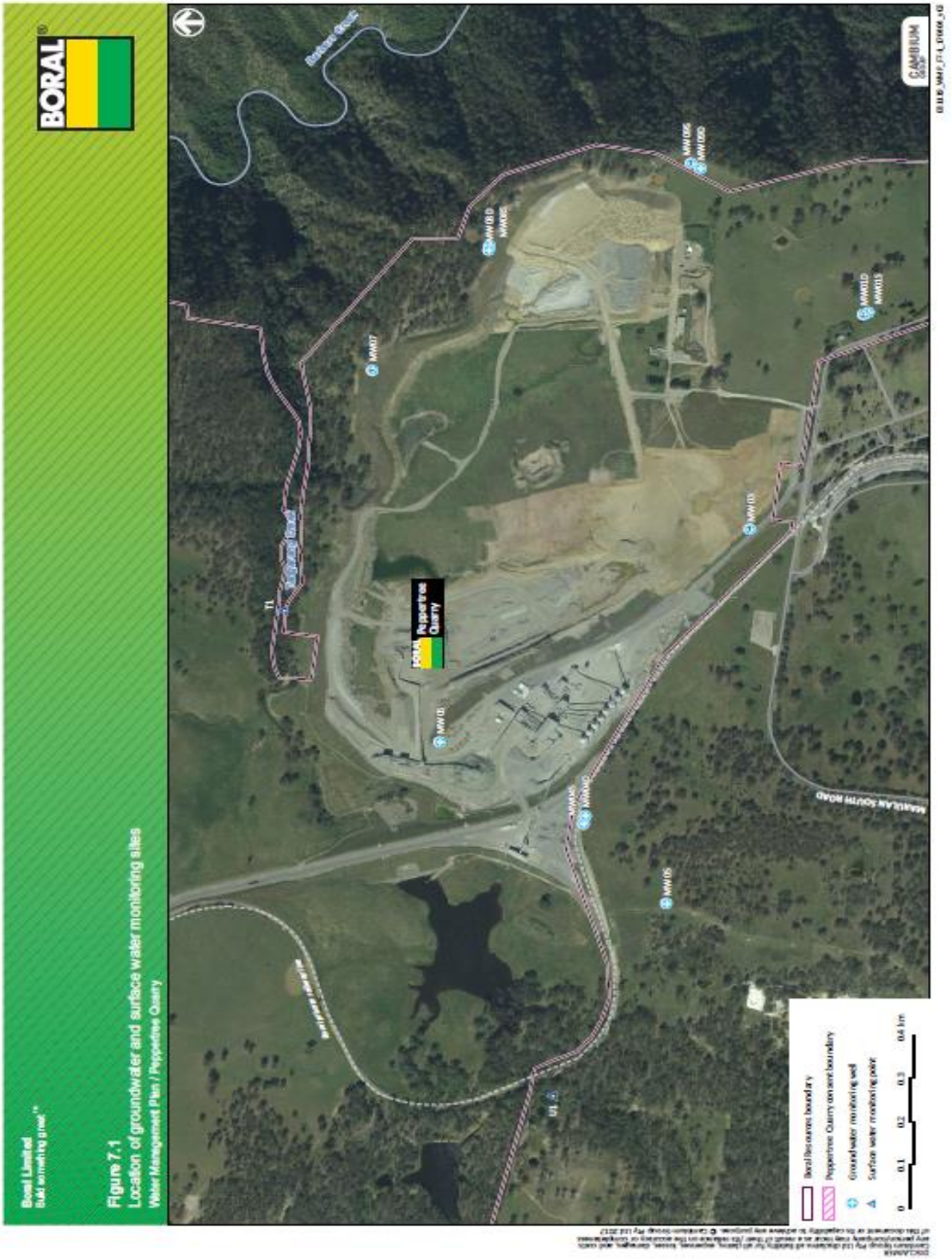


Figure 7.1: Location of Groundwater Monitoring Sites

7.4 SITE WATER USAGE

Rainfall, flow and usage data is recorded and used to manage water supply balances and to manage dust suppression. Water levels in each of the storages are monitored at least monthly to confirm available supply and to alert operations to impending water restrictions. Flow meters monitor the quantity of water being used on-site and to quantify environmental release requirements.

Monthly monitoring of site water usage on the site is undertaken in accordance with Table 7.5. Data is recorded into a database to allow water consumption to be managed.

Table 7.5: Site Water Usage and Monitoring

Area	Operation	Water usage	Monitoring
Dam 1	Reuse water	Recycle to operations	Metered
Dam K	Reuse water pipework to be installed in 2021	Recycle to operations	New meter to be installed
In pit	Pit sump	Pump to dam K for reuse	Metered
	LT160	Water sprays on feeder to suppress dust from feeding and initial crushing of materials.	nil
	Raw material stockpiles	Water cart or sprinklers to wet material if fines and dust are present. Not usually required once "clean rock " is being processed	Estimated based on # of loads per day
	Overburden excavation (when in operation)	Water cart used to suppress dust during excavation. Water sourced from nearest available dam.	Estimated based on # of loads per day
	Vehicle movements	Water cart used to suppress dust during vehicle movements. Water sourced from nearest available dam.	Estimated based on # of loads per day
Primary	Surge stockpile	Water is applied to materials at the at CV 206	No metering. Part of overall process water recycled to the site from Dam 1
Crushing and screening	Crusher	Water is applied to materials as it is discharged from the surge to the conveyors transporting the materials to the crusher	No metering. Part of overall process water recycled to the site from Dam 1
	screening	A water based dust suppressant (Polo Citrus) is applied to key parts of the screening process.	No metering. Part of overall process water recycled to the site from Dam 1
	Filler	Water is applied to the filler dust as it is pugged to make the material easy to handle	No metering. Part of overall process water recycled to the site from Dam 1
	Wash down	Water is used for cleaning within in the operations.	No metering. Part of overall process water recycled to the site from Dam 1
Train load out	Loading of trains	Application of 3% water to product to maintain moisture during travelling and minimise dust	Metered

Area	Operation	Water usage	Monitoring
	Wash down	Water is used for cleaning of spillages	No metering. Part of overall process water recycled to the site from dam 1
Road and open area dust suppression	Water cart	Water is applied to the roads and open areas.	Estimated based on # of loads per day
	Conveyor sprays	Sprays located on the underside of conveyors parallel to roads to suppress dust	No metering. Part of overall process water recycled to the site from dam 1
Vehicle and equipment washing	Car wash	Light vehicle car wash for the use of staff	No metering. Part of overall process water recycled to the site from dam 1
	Workshop	Wash down bay in place to clean equipment and vehicles prior to maintenance	No metering. Part of overall process water recycled to the site from dam 1
	Tray decontamination	Wash out of truck trays is required to ensure there is no cross contamination of materials when product is moved on the quarry.	No metering. Part of overall process water recycled to the site from dam 1
Fire Management system		Fire fighting	Pump operation time and flow rates
Production Bore		Water to operations as required	not in use

7.5 GEOMORPHIC STABILITY

Overburden emplacements are designed and constructed to ensure they remain stable. Compaction, batter slope, drainage and final rehabilitation are tools used during construction and at the completion of the overburden placement to manage erosion and the stability of the emplacements.

A Geomorphic stability monitoring program is in place. It contains 4 key components including:

- Landform stability monitoring
- Ecological development monitoring
- Rapid Visual Assessment
- Drainage and Dam monitoring

The result of the monitoring program will be reported in the Annual review. Water NSW will be informed directly as to the monitoring outcomes and consulted on the geomorphological stability of the SWOE.

7.5.1 Landform Stability Monitoring

The Landform stability monitoring comprises an inspection regime of the emplacement area to monitor the long-term stability. The inspections consist of post rehabilitation and l rapid assessments conducted by an independent specialist on an annual basis.

Onsite, the Pit Supervisor has the responsibility to access “propeller” (3D Drone Mapping and Analytics) and determine changes in the footprint of the emplacements. A number of predetermined points on the emplacements will be identified and measured and reviewed on an annual basis.

Surveys are also taken annually by an independent company. This data will be used to also ascertain any movement in the emplacements or pit walls.

Site inspections are undertaken following heavy rainfall events to assess water flows, damage and erosion.

The aim of the program is to:

- Show that all overburden emplacements and disturbed landforms are vegetated, stable and represent minimal risk of failure and
- Identify any areas of significant active erosion in the quarry site and evaluate the potential for environmental damage and the need for repairs and/or maintenance. Any such areas will be identified as Hazards and captured in the Boral SeQuence safety and environmental electronic management system,
- Determine the requirements for maintenance or remedial treatment of the impacted rehabilitation measures.

7.5.2 Ecological Development monitoring

The Ecological Development monitoring commenced in 2018 with a baseline independent ecological assessment of the rehabilitated areas This assessment is undertaken every 2 years in Spring. This monitoring programs aims to show the following:

- That rehabilitated areas are trending towards providing the biodiversity value outlined in the Biodiversity and rehabilitation Management plan,
- Identify requirements for maintenance activities or remedial actions to ensure rehabilitated areas meet the predetermined completion criteria,
- Show that emplacements are vegetated and stable.

7.5.3 Rapid Visual Assessment

A Rapid Visual Assessment is conducted on an annual basis to assess rehabilitation, weed management and erosion controls. The assessment is based upon visual inspection of nominated and identified areas of the overburden emplacements and rehabilitated areas. This assessment is undertaken by an independent consultant usually over a 2 to 3-day period.

7.5.4 Drainage and Dam Monitoring

The Drainage and Dam monitoring program is conducted on a quarterly basis in line with the surface water sampling programme and following heavy rainfall events. This monitoring is conducted visually to assess each dam and nominated drainage points for actual erosion and / or stability issues. The inspection also identifies any potential risks sheet, rill and gully erosion.

The inspection is managed through a checklist and recorded in the Boral SeQuence safety and environmental electronic Management System.

7.5.5 Completion criteria and remedial actions

Completion criteria, for the geomorphological l stability of the emplacements is outlined in Table 7.6 The criteria, consist of agreed values or standards that indicate if rehabilitated land is resilient and sustainable, and considered suitable for relinquishment sign-off.

Table 7.6: Geomorphological Stability completion criteria

Criteria	Performance indicator	Method	Remedial action
Landform stability	Minimal movement of the identified footprint of the emplacements	Annual survey via "propeller" Annual survey via independent survey	Identify the source of the movement Revise need for earthworks or erosion controls
Rehabilitation	Successful rehabilitation as per the completion criteria of Biodiversity & rehabilitation plan.	Annual rapid visual assessment 2 yearly Ecological assessment	Actions as per the recommendations of the assessments
Erosion	No severe erosion resulting in washouts or slumping of the surfaces	Annual rapid visual assessment Inspection after extreme rain events quarterly drainage and dam inspection	Actions as per the recommendations of the assessments Undertake earthworks and repairs as soon as practical Divert and manage surface water runoff with temporary measures

8 SURFACE WATER AND GROUNDWATER RESPONSE PLANS

8.1 INTRODUCTION

This section provides procedures for responding to impacts identified by the surface water and groundwater quality monitoring programs, the routine monitoring of the erosion and sediment control systems and geomorphic stability. It provides a response plan for taking action in the unlikely event that an unforeseen incident occurs at the site. The Site Environmental Officer is responsible for the implementation of the Response Plans.

The response plans provided below address the requirements of CoA D5 (PART D) of the Project Approval, which requires that Boral:

"assess and manage project-related risks to ensure that there are no exceedances of the criteria and/or performance measures in PART B. Any exceedance of these criteria and/or performance measures constitutes a breach of this approval and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation. Where any exceedance of these criteria and/or performance measures has occurred, the Proponent must, at the earliest opportunity:

a) take all reasonable and feasible measures to ensure that the exceedance ceases and does not re-occur;
b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and
c) implement remediation measures as directed by the Secretary, to the satisfaction of the Secretary

Refer Section 10.2.3 for requirements for incident reporting to the DPE and EPA.

8.2 SURFACE WATER IMPACT RESPONSE PLAN

8.2.1 Exceedance of Surface Water Quality

Surface water quality monitoring exceedances may result due to activities at the quarry or due to the surrounding environmental conditions. Exceedances are notified once water samples have been analysed and supplied by the NATA accredited laboratory.

An exceedance will be determined in relation to the proposed trigger values for Tangarang Creek, whereby

- If the upper bound for pH or EC is exceeded for a period of three consecutive months downstream of the Quarry but is not exceeded upstream of the Quarry, this would be the trigger to undertake further assessment of potential sources within the Quarry.
- If the additional assessment finds that the change in water quality may be induced by Quarry operations, then further investigation would be required to identify the source of the water quality impact, and review and revise practices to minimise the impact.

Note a period of 3 consecutive months has been identified due to the impacts associated with storm events and local pastural influence. It has been recognised that pastural activities, adjacent to the quarry and downstream water way can influence pH and EC. A period of 3 consecutive months allows time to identify that the impact is not weather or other activity related. However, each exceedance will be investigated to determine is source.

The Department of Planning,and Environment (DPIE) and EPA will be notified of the non-compliance / exceedance within seven days of its identification.

An investigation will be undertaken to establish the root cause of the exceedance / non-compliance. This will include checking weather conditions at the time of the exceedance / non-compliance, Peppertree Quarry operations and other possible impacts.

Subject to the findings of the investigation, actions will be taken to repair, replace or change the identified cause of the exceedance / noncompliance. These actions will be completed by appropriately qualified personnel or consultants. These actions will ensure that ongoing impacts will be reduced to levels below relevant impact assessment criteria as quickly as possible.

The identified cause of the incident and the selected response will be formally documented in an exceedance / non-compliance response report.

Training will be undertaken, if changes are required to procedures or operations.

8.2.2 Impacts on Surface Water Flow

Adverse impacts to flows may include reduction in flow below the 10% environmental release requirements, possibly caused by the blocking of the dam outlet pipes, malfunction of the monitoring systems or routine maintenance work. If the flow monitoring system identifies an issue associated with the flows being returned to the catchment the following actions will be taken:

- Immediate action will be taken to augment the flows to the catchment by installing standby pumps a standby release pipeline within the water supply dam.
- The DP&E will be notified of the incident/ impact/ potential impact within seven days of its identification if there is an exceedance or immediately if the incident causes (or threatens to cause) material harm to the environment.
- An investigation will be undertaken to establish the cause of the reduced flows. This will include checking for blockages, assessing the design of the system, checking flow gauging systems and checking pump capacities. Investigations will be undertaken by appropriately qualified personnel or consultants.
- Subject to the findings of the investigation actions will be taken to repair, replace or change the identified cause of the reduced flows. These actions will be completed by appropriately qualified personnel or consultants. These actions will ensure that ongoing impacts will be reduced to levels below relevant impact assessment criteria as quickly as possible
- The identified cause of the impact and the adopted response will be documented in an incident response report.

8.2.3 Impacts on Surface Water Quality

Adverse water quality impacts may occur as a result of:

- inappropriate design of the capture and treatment of the surface water runoff from the site during construction and operation;
- pollutant spills on the site; and
- algal blooms within the water supply dam.

In response to potential impacts on water quality the following actions will be taken:

- If water quality issues associated with discharge from the water supply dam to the down gradient catchment are identified, further treatment will be implemented including:
    - species specific standby treatment systems to remove algae from discharge developed in response to regular monitoring for algae;
    - standby treatment systems (such as flocculation ponds) to reduce sediment loads within the discharge.

- Spill response kits will be readily available throughout the site and will be deployed immediately after a spill occurs to capture and contain a spill. All staff handling potentially contaminating substances or undertaking potentially contaminating activities will be appropriately trained in the use of the spill kits.
- The DPI&E and the EPA will be notified of an incident/ impact/ potential impact immediately if the incident causes (or threatens to cause) material harm to the environment.
- An investigation will be undertaken to identify the source of the water quality impact. Investigations will be undertaken by appropriately qualified personnel or consultants.
- Subject to the findings of the investigation actions will be taken to repair, replace or change the identified cause of the water quality impacts. These actions will be completed by appropriately qualified personnel or consultants. These actions will ensure that ongoing impacts will be reduced to levels below relevant impact assessment criteria as quickly as possible
- The identified cause of the impact and the adopted response will be documented in an incident response report.

8.3 GROUNDWATER IMPACT RESPONSE

8.3.1 Exceedance of Ground Water quality

Groundwater quality monitoring exceedances may result due to activities at the quarry or due to the surrounding environmental conditions. Exceedances are notified once water samples have been analysed and supplied by the NATA accredited laboratory.

An exceedance will be determined in relation to the proposed trigger values for groundwater where trigger levels are exceeded in three consecutive rounds of monitoring. Further assessment will be undertaken to determine whether the potential anomaly is the result of quarrying activities or due to natural variability.

Investigations would be carried out by an appropriately qualified person to identify the source of the exceedance and to recommend and implement solutions to mitigate any potential impacts. Additional monitoring may be required to identify the source of the impact and to monitor the effectiveness of the remedial solution.

Should an exceedance be identified that requires investigation as outlined above the Department of Planning and Environment (DP&E) will be notified of the exceedance within seven days of its identification.

Subject to the findings of the investigation, actions will be taken to minimise any reoccurrence of the exceedance where possible with the identified cause of the impact and the selected response will be formally documented in an incident response report and electronically recorded in the Boral incident management system. These actions will ensure that ongoing impacts will be reduced to levels below relevant impact assessment criteria as quickly as possible

8.3.2 Impacts on Groundwater Quality

Impacts on groundwater quality may be caused by:

- isolated spills seeping directly to underlying groundwater; and/or
- diffuse contamination associated with general quarrying activities, such as chemicals used for rock blasting, seeping into underlying groundwater.

Contaminant spills will be dealt with as described in Section 8.2.3. Additional action will be taken to isolate, remove or remediate contaminated soil that could be a source for groundwater contamination.

Diffuse contamination identified in monitoring wells will be handled as follows:

- As groundwater generally travels slowly, identification of contamination within groundwater wells surrounding the site will provide an early warning sign to initiate investigation, including hydrogeological assessment, fate and transport modelling and an ecological risk assessment to quantify the potential impacts at identified receptors. The investigation will make recommendations on appropriate actions to take to mitigate any potential adverse impacts identified by the investigation.
- Actions will then be implemented to mitigate potential impacts.
- In the case of material harm or an exceedance, appropriate action will be taken to notify the appropriate regulatory authorities and report the incident in accordance with the requirements of the Project Approval (refer Section 10.2.4)

8.3.3 Impacts on Groundwater Elevation Impact Response

If drawdown within the sentinel well MW05 exceeds 5 metres, an investigation will be initiated. This will include initiation of monitoring of groundwater elevations within the nearest registered abstraction well (if permission is provided). The available water column in this well during abstraction will be compared against the expected drawdown associated with the quarry pit void, as previously modelled, to determine if the water supply is likely to be potentially compromised. If there is potential for this to occur, Boral will further quantify the significance of the impact using more sophisticated hydrogeological techniques. If significant impacts are still identified, then options for supplementing the water supply of surrounding abstraction wells will be considered.

As above, appropriate action will be taken to notify the appropriate regulatory authorities and report the incident in accordance with the requirements of the Project Approval In the case of material harm or an exceedance.

8.4 GEOMORPHIC STABILITY RESPONSE

Movement of the overburden emplacements occur due to heavy rainfall, poor drainage or heavy mobile equipment movements. This could result in cracking, undercutting, slips or failures of batters or dam walls.

In response to verified impacts of geomorphic stability (refer Table 7,6), the following actions will be taken:

The identified area will be barricaded to restrict access to the site.

- The area will be assessed, and the appropriate remedial treatment applied. This may include the construction of additional drains, the reconstruction of batters, and the application of mulches and follow up revegetation.
- The DP&E, Water NSW and the EPA will be notified of an incident/ impact/ potential impact immediately if the issue causes (or threatens to cause) material harm to the environment as per the Project Approval (refer section 10.2.4)
- An investigation will be undertaken to identify the source of the instability and / or erosion. Investigations will be undertaken by appropriately qualified personnel or consultants.
- Subject to the findings of the investigation actions will be taken to repair, replace or change the identified cause of the instability. These actions will be completed by appropriately qualified personnel or consultants. These actions will ensure that ongoing impacts will be reduced to levels below relevant impact assessment criteria as quickly as possible
- The identified cause of the instability and the adopted response will be documented in an incident response report.

9 TRAINING

9.1 INDUCTION

All employee and contractors working onsite will be inducted. The Peppertree Quarry induction covers the management of discharges to surface water and the reuse of water across the site.

9.2 SITE SPECIFIC TRAINING

Where identified by management representatives, additional site-specific training will be developed, implemented and delivered to relevant personnel and contractors. Tool box talks will be undertaken with all staff and contractors associated with works outlining the requirements of the relevant Consent and its conditions of consent. They will be made aware that they must comply with the conditions of consent.

10 REPORTING AND REVIEW

10.1 REGULATORY COMPLIANCE

All Boral sites will be aware of regulatory water quality limits to ensure the necessary controls and monitoring is carried out for the purpose of verifying compliance.

Regulatory documents such as the following should be periodically reviewed for site compliance with water management obligations:

- environmental licences
- mining permits
- planning consents
- water licences / supply water approvals

Compliance with relevant surface and groundwater water quality criteria will be managed by appropriate land management, which includes:

- installation and maintenance of sediment and erosion controls
- timely clean-up of any spills and leaks
- maintenance and inspection of chemical storage facilities
- direct monitoring (if required) through regulation or due diligence on sites with high potential for sediment runoff

The applicable licences and regulations will manage the sourcing of water use in operations. Obligations may include:

- sources where water can be obtained i.e. from rivers, creeks, aquifers, bores
- the volume of water that can be obtained
- the requirement for monitoring sources of water i.e. volume or quality
- the requirement to have backflow protection on potable town water supply i.e. town mains.

The performance of the Quarry in relation to Water Management will be judged against:

Compliance with the surface water monitoring criteria

Compliance with the ground water monitoring criteria

Compliance with the 10% environmental flow requirement

Compliance with the completion criteria for geomorphological stability,

The number of incidents, non-compliances, or exceedances.

Condition D5 requires

" *The Applicant must assess and manage development-related risks to ensure that there are no exceedances of the criteria and/or performance measures in PART B. Any exceedance of these criteria and/or performance measures constitutes a breach of this consent and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.*
Where any exceedance of these criteria and/or performance measures has occurred, the Applicant must, at the earliest opportunity:

(a) take all reasonable and feasible measures to ensure that the exceedance ceases and does not re-occur;

(b) consider all reasonable and feasible options for remediation (where relevant) and submit a report to the Department describing those options and any preferred remediation measures or other course of action; and

(c) implement remediation measures as directed by the Planning Secretary, to the satisfaction of the Planning Secretary. "

Peppertree Quarry has in place an Aspects and Impacts Register which is reviewed every two years, by the Environmental and Stakeholder Advisor. This risk register identifies potential sources of risks of pollution of waters and identifies appropriate controls.

Risks to the successful implementation of this plan include:

- Failure of responsible parties to complete required actions;
- Failure to complete adequate reviews of the plan and implement corrective actions;
- Failure to implement and manage water and sediment runoff
- Depletion of water supply

These risks will be managed through a clear definition of roles and responsibilities, adhering to regular reviews of the plan and adaptive management.

Boral have in place a Maintenance Work Order system which schedules, tracks and alerts responsible parties to undertake required works. Once works are complete, evidence is uploaded to the system, so works are closed out as complete.

In the event of an unplanned or unforeseen event (such as, flooding or drought) that has an adverse effect on the operations, management actions may need to be amended to assist in the management of water systems.

A contingency plan detailed in a Trigger Action Response Plan (TARP) for potential storm water risk elements is provided in Appendix C..

10.2 REPORTING

10.2.1 Annual Review

The site environmental officer is responsible for managing the environmental reporting program and arranging specialist consultants to prepare reports, as required. The activities and performance outcomes of the WMP will be presented in the Annual Review (AR).

This will include detailed assessment of monitoring results collected over the course of the WMP, an evaluation of any trends occurring across the site, a summary of any incidents or non-conformances with licences/criteria and recommendations for management actions.

In accordance with the requirements of CoA D11, By the end of March in each year after the commencement of project, or other timeframe agreed by the Secretary, a report must be submitted to the DPIE reviewing the environmental performance of the project, to the satisfaction of the Secretary. This review must:

- (describe the project (including rehabilitation) that were carried out in the previous calendar year, and the project that are proposed to be carried out over the current calendar year.
- include a comprehensive review of the monitoring results and complaints records of the project over the previous calendar year, which includes a comparison of these results against the:
    - relevant statutory requirements, limits or performance measures/criteria.
    - requirements of any plan or program required under this approval.
    - monitoring results of previous years; and
    - relevant predictions in the documents listed condition A2(c).

    .

- identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence.
- evaluate and report on:
- the effectiveness of the noise and air quality management systems; and
- compliance with the performance measures, criteria and operating conditions in this approval.

- identify any trends in the monitoring data over the life of the project.

- identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and

- describe what measures will be implemented over the next calendar year to improve the environmental performance of the project.

- Copies of the Annual Review are submitted to Council and made available to the CCC and any interested person upon request.

  A copy of the Annual Review will also be submitted to the EPA.

10.2.2 EPL Reporting

In accordance with the requirements of EPL 13088, Boral will submit an annual return to the EPA, within 60 days of the licence anniversary date stipulated in the EPL. The annual return includes a Statement of Compliance and a Monitoring and Complaints Summary.

10.2.3 Internal Reporting

In accordance with the Boral HSEQMS and corporate divisional requirements a regular report on environmental compliance and performance is prepared by the site environmental officer which is presented to the site management team for review for provision of additional resources that may be required to mitigate a significant environmental issue. The Boral Group Environmental Advisor is also provided with a regular overview of any significant matters which may be escalated to Board level.

10.2.4 Incident and Non-Compliance Reporting

An incident is defined in the Project Approval, definitions as "An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance"

Initial Incident notification and reporting will be conducted in accordance with Condition D9, Part D, whereby "*The Proponent must immediately notify the Department and any other relevant agencies immediately after it becomes aware of an incident*".
The notification must be in writing to compliance@planning.nsw.gov.au identifying the project (application number and name) along with the location and nature of the incident, along with the location and nature of the incident.

Under the Project Approval, and 'incident' is defined as:

"An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance".

'Material harm' is defined as:

"harm to the environment that:

- *involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial; or*
- *results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000, (such loss includes the reasonable costs and expenses that would be*

incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)

This definition excludes 'harm' that is authorised under either this approval or any other statutory approval"

Incident reporting will also be undertaken in accordance with Condition R2 of the EPA Environment Protection Licence which states "*The licensee or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person becomes aware of the incident in accordance with the requirements of Part 5.7 of the Act."*

Other relevant agencies such as NSW Water and/or NRAR will be notified dependent on the nature of the incident.

In accordance with Appendix 8 of the Approval and Condition R3 of the EPA EPL, a more detailed written incident notification and report must be within 7 days of becoming aware of the incident and the initial immediate notification.

The following requirements will be included as part of the incident notification:

- Identify the project and application number.
- Provide details of the incident (date, time, location, a brief description of what occurred any why it is classified as incident).
- Identify how the incident was detected.
- Identify when the Proponent became aware of the incident.
- Identify any actual or potential non-compliance with conditions of approval.
- Describe what immediate steps were taken in relation to the incident.
- Identify further action(s) that will be taken in relation to the incident.
- Identify a project contact for further communication regarding the incident.

Finally, within 30 days of the date on which the incident occurred (or as otherwise agreed to by the Secretary), Boral will provide the Secretary and any relevant public authorities with a detailed report on the incident, which will include the following requirement:

- Summary of the incident.
- Outcomes of an incident investigation, including identification of the cause of the incident.
- Details of the corrective and preventative actions that have been, or will be, implemented to address the incident and prevent recurrence.
- Details of any communication with other stakeholders regarding the incident

A non-compliance is defined in the Project Approval, Definitions as "An occurrence or set of circumstances or development that is a breach of this approval"

Initial notification of a noncompliance and reporting will be conducted In accordance with Condition D10, Part D, where by "Within seven days of becoming aware of a non-compliance, the Proponent must notify the Department of the non-compliance."

The notification must be in writing to compliance@planning.nsw.gov.au identifying the project (application number and name) along with noncompliance and actions undertaken to address the noncompliance.

10.2.5 Public Reporting

Boral will ensure that the local community is kept informed by way of periodic newsletters, leaflets, local newspaper advertisements and the Quarry web page of the progress of the Quarry, including details of the environmental hotline. A monthly Boral newsletter will be prepared by the Peppertree Quarry Environment and Stakeholder Advisor. This Newsletter will be included in the Discover Marulan local community newspaper. The Boral newsletter provides updates on operations and provides details of the environmental hotline.

A copy of the newsletter is maintained on the Boral Peppertree Quarry website.

Community Consultative Committee meetings are used to inform the committee of the general progress of rehabilitation works. These meetings are held quarterly with community and local government representatives. Minutes of the meetings are provided on the Boral Peppertree Quarry website.

The Boral Peppertree Quarry website is reviewed annually and updated quarterly with minutes, newsletters, and other supporting documents required as per CoA D16.

Community Communication is the responsibility of the Environment and Stakeholder Advisor for Peppertree Quarry.

As per Condition D 16, the following documents are also reported on the Boral websites..

Before the commencement of construction until the completion of all rehabilitation required under this consent, the Applicant must:
(a) make the following information and documents (as they are obtained, approved or as otherwise stipulated within the conditions of this consent) publicly available on its website:

- (i) the document/s listed in condition A2(c);
- (ii) all current statutory approvals for the development;
- (iii) all approved strategies, plans and programs required under the conditions of this consent;
- (iv) minutes of CCC meetings;
- (v) regular reporting on the environmental performance of the development in accordance with the reporting requirements in any plans or programs approved under the conditions of this consent;
- (vi) a comprehensive summary of the monitoring results of the development, reported in accordance with the specifications in any conditions of this consent, or any approved plans and programs;
- (vii) a summary of the current stage and progress of the development;
- (viii) contact details to enquire about the development or to make a complaint;
- (ix) a complaints register, updated monthly;
- (x) the Annual Reviews of the development;
- (xi) audit reports prepared as part of any Independent Environmental Audit of the development and the Applicant's response to the recommendations in any audit report;
- (xii) any other matter required by the Planning Secretary; and

(b) keep such information up to date, to the satisfaction of the Planning Secretary.

10.3 AUDITING

Boral has an established corporate and divisional risk-based audit program that periodically assess operational sites for conformance with HSEQMS requirements.

10.3.1 Independent Environmental Audit

In accordance with the requirements of CoA D13 (Part D), within 3 years of the date of the commencement of construction and every 3 years thereafter, unless the Secretary directs otherwise, Boral will commission and pay the full cost of an Independent Environmental Audit of the project. The adequacy of this WMP will be included in the Environmental Audit. An Independent Audit of the Quarry was conducted in 2015 and 2018 with the next Audit commenced at the end of 2021.

The audit must:

(a) be led by a suitably qualified, experienced and independent auditor whose appointment has been endorsed by the Planning Secretary;

(b) be conducted by a suitably qualified, experienced and independent team of experts (including any expert in field/s specified by the Planning Secretary) whose appointment has been endorsed by the Planning Secretary;

(c) be carried out in consultation with the relevant agencies and the CCC;

(d) assess the environmental performance of the development and whether it is complying with the relevant requirements in this consent, any relevant EPL, water licences and mining leases for the development (including any assessment, strategy, plan or program required under these approvals);

(e) review the adequacy of any approved strategy, plan or program required under the abovementioned approvals and this consent;

(f) recommend appropriate measures or actions to improve the environmental performance of the development and any assessment, strategy, plan or program required under the abovementioned approvals and this consent; and

(g) be conducted and reported to the satisfaction of the Planning Secretary.

Within three months of commencing an Independent Environmental Audit, or within another timeframe agreed by the Planning Secretary, the Applicant must submit a copy of the audit report to the Planning Secretary, and any other NSW agency that requests it, together with its response to any recommendations contained in the audit report, and a timetable for the implementation of the recommendations. The recommendations must be implemented to the satisfaction of the Planning Secretary

10.3.2 Audit of Southern Overburden Construction

In accordance with CoA B41 (Schedule 3), on completion of the construction of the surface water management system for the Southern Overburden Emplacement Area, Boral will commission an audit by a suitably qualified, experienced and independent person, approved by the Secretary of the DP&E, to determine whether the system has been constructed in accordance with the Project Approval. A copy of the audit report and Boral's response to its recommendations will be provided to the Secretary and WaterNSW within 12 weeks of its commissioning. This audit is yet to be conducted as final linings are still to be installed on one dam. Arrangements are being made for an independent consultant to undertake the review.

Condition D 14 also notes…

"*Any condition of this approval that requires the carrying out of monitoring or an environmental audit, whether directly or by way of a plan, strategy or program, is taken to be a condition requiring monitoring or an environmental audit under Division 9.4 of Part 9 of the EP&A Act. This includes conditions in respect of incident notification, reporting and response, non-compliance notification, compliance report and independent audit.".*

This will be recognised and conducted as part of the Independent audit.

10.4 REVIEW OF WMP

This WMP will be reviewed periodically by Boral to determine the efficacy of the WMP and ensure it continues to fulfil its intended purpose. This will allow for and promote adaptive management through progressive stages of future quarry operations. Reviews will be undertaken as a result of any of the following:

- major changes in site conditions or work methods.
- as a result of changes in environmental legislation applicable and relevant to the quarry operations.
- In response to the requirements of CoA D6 (Part D) of the Project Approval which requires a review of the WMP within 3 months of:
    - The submission of an incident report under condition D9
    - The submission of an Annual review under condition D11
    - The submission of an Independent Environmental Audit under condition D13
    - The approval of any modification of the conditions of this approval (unless the conditions require otherwise)
    - Notification of a change in project stage under condition A15 or
    - The issue of a direction of the Secretary under Condition A2(b) which require a review.
- If any of the above reviews result in any revisions of the WMP, the WMP will be provided to the Secretary within 6 weeks for approval, as required by Condition D7.

11 REFERENCES

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ERM (May 2010). *Proposal P17164 – Peppertree Quarry Management Plans*

Landcom (2004). *Managing Urban Stormwater - Soils and Construction Volume 1, 4th Edition; New South Wales Government, Parramatta*.

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ANZECC and ARMCANZ 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, The Guidelines. Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

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NHMRC 2011. Australian Drinking Water Guidelines (2011) – Updated March 2021. National Health and Medical Research Council.

RPS 2021. Technical memorandum: Boral Peppertree Well Assessment. RPS Australia West Pty Ltd. 8 April 2021.

Appendix A:

Consultation

EPA

DOC21/636199

The Proper Officer
Peppertree Quarry
843 Marulan South Road
MARULAN SOUTH 2579
Attention: Sharon Makin

Email: Sharon.makin@boral.com.au

Date: 29 July 2021

Dear Ms Makin

Re: Consultation – Peppertree Quarry Water Management Plan 2021

I refer to your request of 19 July 2021 for the NSW Environment Protection Authority (EPA) to provide any advice or comment on the draft Peppertree Quarry Water Management Plan 2021 (2021 WMP). It is noted that the 2021 WMP is an updated version of the 2017 Peppertree Quarry Water Management Plan, for which the EPA has previously provided comment in February 2017.

The EPA has reviewed the 2021 WMP and notes the changes highlighted. The EPA has no further comment on the content of the document.

If you wish to discuss the EPA's response, Michael Heinze can be contacted on 6229 7002 or at Queanbeyan@epa.nsw.gov.au.

Yours sincerely

CARLIE ARMSTRONG
Unit Head

NSW Water – 17th September 2021

WaterNSW has responded to your request for advice in relation to the Peppertree Quarry Ptree Water Management plan Mod 5 & 6 update . The response is below and/or attached. Record of this consultation has been automatically saved to the portal.

When you are ready, login to your profile to submit the final document to the Department.

Public Authority Response
Thank you for providing WaterNSW with the opportunity to review the Updated Pepper Tree Quarry Water Managemnt Plan. Peppertree Quarry is located within the Shoalhaven River sub-catchment of the Sydney Drinking Water Catchment. Tangarang Creek and Barbers Creek (which reports to the Shoalhaven River) are the primary receiving watercourse for any discharges or runoff from the site.

WaterNSW notes that the 2017 WMP has been updated to incorporate changes/findings associated with:
• Modification 5 (2019) – approved for development of a new overburden emplacement (South-west Overburden Emplacement – SWOE),
• Modification 6 (2020)- approved for the replacement of existing dust extraction units with two baghouses recommendations from the Independent Audit undertaken in November 2018 and actions identified from the 2018 and 2019 Annual Review outlining water management associated with current quarry activities
• Modification 7 (July 2021) – approval pending for the relocation of sediment basin P2 outside of the existing approved footprint, for safety reasons.
• The Independent Audit undertaken in November 2018; and
• Actions identified from the 2018 and 2019 Annual Review outlining water management associated with current quarry activities
WaterNSW notes key changes in the WMP to respond to the above and issues raised by WaterNSW in its submissions to DPIE on each the modification applications include:
• Adequate number of surface water quality monitoring sites with sufficient baseline data available with downstream monitoring sites in Shoalhaven River due to access issues along Barber Creek.
• Implementing new Erosion and Sediment Control structures including additional five sediment dams to be installed as per Modification 5 and three new sediment dams N1, N2 and N3 prior to the construction of the SWOE
• Considered the long-term stability of the SWOE with regard to erosion (sheet, rill and gully) including:
o Implementing a geomorphic stability monitoring program is in place and covers landform stability monitoring, ecological development monitoring, rapid visual assessment and drainage and sediment dam monitoring
o Committed to specific actions to respond to verified impacts of geomorphic instability that include restricting access to area impacted, notifications to regulators and key stakeholders including DPI&E, WaterNSW and the EPA, undertaking investigations using qualified personnel or consultants and documenting and implementing any identified actions from the investigations to repair, replace or change the identified cause of the instability and impacts.

WaterNSW is satisfied that the updated WMP will lead to continued management and of erosion and sediment runoff within the quarry site and ensure there is a neutral or beneficial effect on water quality of receiving waters. WaterNSW would appreciate receiving a copy of the annual review report for the quarry when it becomes available.

DPIE Water – 17th September 2021

DPIE Water has responded to your request for advice in relation to the Peppertree Quarry Ptree Water Management plan Mod 5 & 6 update . The response is below and/or attached. Record of this consultation has been automatically saved to the portal.

When you are ready, login to your profile to submit the final document to the Department.

Public Authority Response
Thank you for providing WaterNSW with the opportunity to review the Updated Pepper Tree Quarry Water Managemnt Plan. Peppertree Quarry is located within the Shoalhaven River sub-catchment of the Sydney Drinking Water Catchment. Tangarang Creek and Barbers Creek (which reports to the Shoalhaven River) are the primary receiving watercourse for any discharges or runoff from the site.

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• Adequate number of surface water quality monitoring sites with sufficient baseline data available with downstream monitoring sites in Shoalhaven River due to access issues along Barber Creek.
• Implementing new Erosion and Sediment Control structures including additional five sediment dams to be installed as per Modification 5 and three new sediment dams N1, N2 and N3 prior to the construction of the SWOE
• Considered the long-term stability of the SWOE with regard to erosion (sheet, rill and gully) including:
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o Committed to specific actions to respond to verified impacts of geomorphic instability that include restricting access to area impacted, notifications to regulators and key stakeholders including DPI&E, WaterNSW and the EPA, undertaking investigations using qualified personnel or consultants and documenting and implementing any identified actions from the investigations to repair, replace or change the identified cause of the instability and impacts.

WaterNSW is satisfied that the updated WMP will lead to continued management and of erosion and sediment runoff within the quarry site and ensure there is a neutral or beneficial effect on water quality of receiving waters. WaterNSW would appreciate receiving a copy of the annual review report for the quarry when it becomes available.

Please contact Ravi Sundaram (0428226152; ravi.sundaram@waternsw.com.au) if you have any queries with regards to the above.

28th October 2021

Heather Dewson <heather.dewson@dpie.nsw.gov.au>
Thu 10/28/2021 9:01 AM
To: Sharon Makin
Cc:Timothy Baker <tim.baker@nrar.nsw.gov.au>

Hi Sharon

It appears that the NRAR portal did indeed have an error. This matter is now registered and a request has been sent to expedite the review.

Kind regards

Heather Dewson | Water Regulation Officer
Natural Resources Access Regulator
Department of Planning, Industry & Environment
6 Stewart Ave Newcastle NSW 2300
E: heather.dewson@dpie.nsw.gov.au
W: www.industry.nsw.gov.au

Appendix B:

On-Site Wastewater Assessment and System Design

ON SITE WASTEWATER ASSESSMENT AND SYSTEM DESIGN
FOR THE PROPOSED OFFICE FOR THE PEPPERTREE QUARRY,
843 MARULAN SOUTH ROAD, MARULAN SOUTH

LGA: GOULBURN MULWAREE COUNCIL

OWNER: BORAL RESOURCES (NSW) PTY LTD

December 2012

Our ref: 838ww

HARRIS ENVIRONMENTAL CONSULTING
ABN 6156 3609 153
PO BOX 70
JAMBEROO 2533
Ph (02) 42360 954
Fx (02) 42361 410
Mobile 0425 335 245
email: sean@harrisenvironmental.com.au
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Harris
environmental consulting

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FIGURES

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TABLES

APPENDICES

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1. ASSESSMENT CRITERIA

Boral Resources (NSW) Pty Ltd have approval to construct an office building within the processing site (under construction) at Peppertree Quarry at 843 Marulan South Road, Marulan South. The property drains to Tangarang Creek, which flows along the northern edge of the site to the deep gorge of Barbers Creek approximately 500 m to the east and into the Shoalhaven River a further 6.5 km to the south. The Shoalhaven River is within the Sydney Water Catchment.

Harris Environmental Consulting was commissioned to undertake this Soil and Site Assessment for On Site Wastewater Management and System Design in accordance with:

- Goulburn Mulwaree Council Development Control Plan (2009)
- Local Government Act 1993
- Australian Standard AS/NZS 3500 Plumbing and Drainage 2003
- Environment and Health Protection Guidelines (1998) On-site Sewage Management for Single Households (Department of Local Government)
- AS/NZ 1547:2012 On-site wastewater management (Standards Australia, 2012)
- Sydney Catchment Authority Neutral or Beneficial Effect on Water Quality Assessment Guideline (2011)
- SCA (2012), Designing and Installing On Site Wastewater Systems. A Sydney Catchment Authority Current Recommended Practice

This report includes three key components.

1. Firstly, the Soil and Site Assessment for On Site Wastewater Management is presented in Sections 3-7 of this report. This is a land capability assessment that follows the requirements of DLG (1998), AS/NZ1547 (2012), SCA (2011) and SCA (2012). This part of the assessment is specific to the type of treatment and disposal system proposed for the site.

2. Secondly, the System Design is included in section 8 of the report. This provides specific details on how the proposed treatment and disposal system will be installed to meet the specific requirements of SCA (2012).

3. Thirdly the Design Producer Statement is included in Appendix I, in which Harris Environmental Consulting warrants the design.

An Aerated Wastewater Treatment System and soil absorption bed is proposed for wastewater treatment.

The location of the property is shown on Figure 1 & 2

Figure 1 Location (Google)

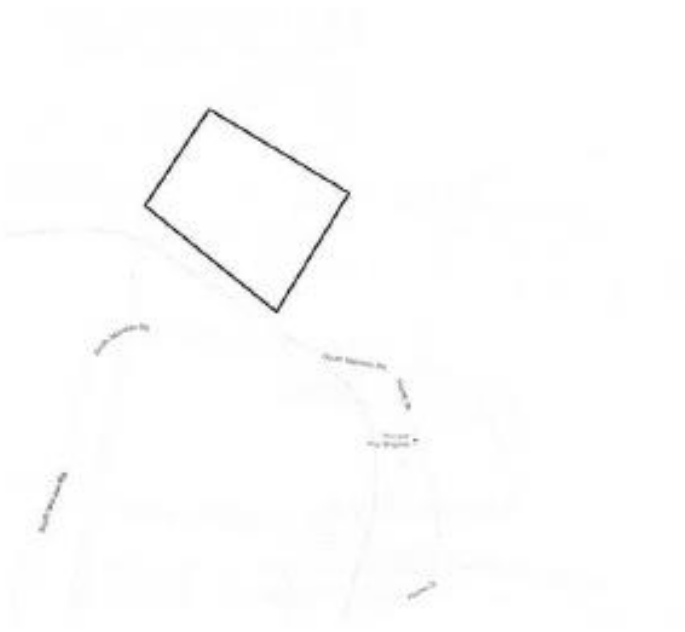
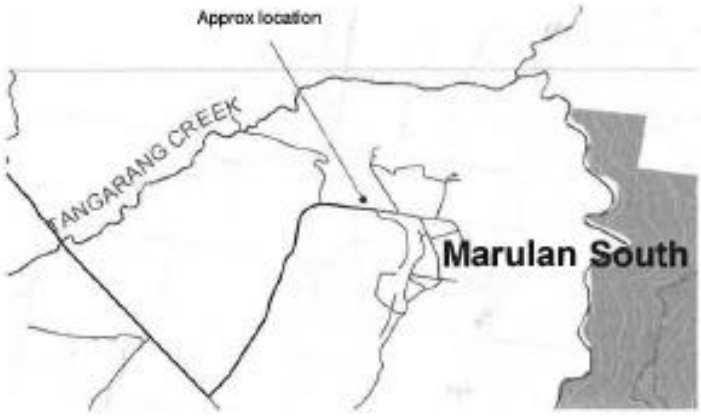


Figure 2 Location (SCA Map of Catchment No. 12)



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2. SITE INFORMATION

Our Ref:	838ww
Owner:	Boral Resources (NSW) Pty Ltd
Project manager:	Mitch Ryan, Project Engineer 9033 5260 0401 893 023
Site address:	843 Marulan South Road, Marulan South
Size of property:	~92+ ha
Local Government Area:	Goulburn
Proposed wastewater treatment:	AWTS
Proposed wastewater disposal	Soil absorption bed
Date site assessed:	6/12/2012
Date report prepared:	13/12/2012
Site assessor:	Msc Env Science (UOW), Grad dip Nat Res (UNE), BscAppSc, Agriculture (HAC) Sean Harris

3. DESIGN WASTEWATER ALLOWANCE

Design wastewater load is estimated for 20 staff, of which 6 are office workers and 14 are operational staff (quarry workforce). The operational staff will work on the site in three x 8 hour shifts.

No other persons or wastewater generating processes will have access to the toilets and associated amenities subject to this assessment.

Table 1 shows the estimated wastewater flows used for the sizing of the Aerated Wastewater Treatment System and soil absorption beds. The design flows are in accordance with ASNZ1547 (2012), as required by SCA (2012). The wastewater generated from quarry workers assume all will have access to toilets and kitchenette, but only 4 of the 14 workers per shift will have a shower.

Table 1 Design wastewater allowance (AS/NZ1547, 2012)

Proposed development	No. Persons	Design flow allowance/person/day	Daily wastewater	Daily wastewater (inc. 3 shifts)
Office workers: Toilets, kitchenette, hand basin and shower	6	43	258	258
Quarry shift worker: Toilet, kitchenette, hand basin	10	27	270	810
Quarry shift worker: Toilet, kitchenette, hand basin and shower	4	45	180	540
Total				1608L/d

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4. SITE ASSESSMENT

Climate - rainfall	Marulan Rainfall Station (median annual 668mm)
Climate - evaporation	Goulburn pan evaporation (median 1699mm)
SCA Evaporation zone	SCA Zone 4
Flood potential	Proposed wastewater treatment system is above 1 in 100 year flood level; minor limitation. Proposed wastewater disposal area above 1 in 20 year flood level; minor limitation.
Frost potential	The site is not known to be subject to severe frosts, minor limitation
Exposure	Northern aspect; minor limitation
Slope	3-4% slope; minor limitation for soil absorption bed
Landform	Simple slope, minor limitation
Run-on	Minor upslope catchment and minor potential for stormwater run-on
Erosion potential	Minor erosion potential
Site drainage	Well drained, permeable soil profile; minor limitation
Evidence of fill	No evidence of fill; minor limitation
Domestic groundwater use	No known groundwater bores are within 200m, minor limitation
Surface rock	No surface rock; minor limitation
Area available for effluent disposal	Area available for effluent disposal within designated Effluent Management Area (EMA), minor limitation

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Photo 1 Office under construction

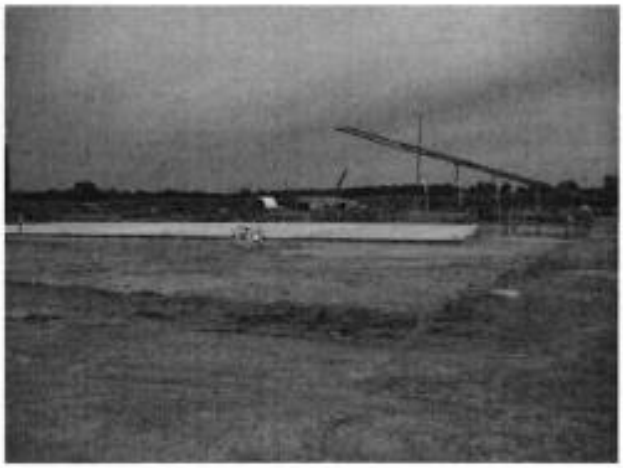

Photo 2 Aerial view of office under construction

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Photo 3 Location of proposed soil absorption beds

Photo 4 Terrain upslope of proposed soil absorption beds

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sean@harrisenvironmental.com.au
www.harrisenvironmental.com.au

5. BUFFERS

Feature	Level of effluent treatment	Effluent application method	Buffer distance	Achievable
Buildings, boundaries, paths and walkways, retaining walls	Primary	Subsoil	2.0 m downslope and where flat, or 4.0m upslope	☐Yes ☐No ☐N/A
	Secondary (disinfected)	Subsurface and surface (including drip or trickle) irrigation	6.0 m	☒Yes ☐No ☐N/A
Premises boundaries, paths and walkways, recreation areas, in ground swimming pools	Primary	Subsoil	3.0 m downslope and where flat, or 6.0 m upslope	☐Yes ☐No ☐N/A
	Secondary (disinfected)	Subsurface irrigation	2.0 m downslope and where flat, or 4.0 m upslope	☒Yes ☐No ☐N/A
		Surface irrigation	6.0 m up- or downslope	☒Yes ☐No ☐N/A
In ground potable water tanks	Primary	Subsoil	15.0 m	☐Yes ☐No ☐N/A
	Secondary (disinfected)	Subsurface and surface irrigation	15.0 m – should not be located upslope of feature	☒Yes ☐No ☐N/A
Permanent and intermittent watercourses	Primary	Subsoil	100 m from the high water level; 150 m to a SCA named river*	☐Yes ☐No ☐N/A
	Secondary (disinfected)	Subsurface and surface irrigation	100 m from the high water level; 150 m to a SCA named river*	☒Yes ☐No ☐N/A
Bore or well used for domestic^ consumption	Primary	Subsoil	100 m from the high water level	☐Yes ☐No ☐N/A
	Secondary (disinfected)	Subsurface and spray irrigation	100 m from the high water level	☒Yes ☐No ☐N/A
Dam and drainage depression	Primary	Subsoil	40 m from the high water level	☐Yes ☐No ☐N/A
	Secondary (disinfected)	Subsurface and surface irrigation	40 m from the high water level	☒Yes ☐No ☐N/A

*SCA named rivers include: Wingecarribee, Nattai, Nepean, Coxs, Wollondilly, Kangaroo, Shoalhaven, Mongarlowe and Tarlo for the full length as defined on the topographical maps, and the Mulwaree River upstream as far as the Braidwood Road Crossing. Reference must be made to the SCA NorBE Assessment Guideline (SCA, 2011).

^If within 100 metres of a bore or well used for domestic consumption, a draw-down analysis done using an appropriate methodology, such as Cromer, Gardner and Beavers, 2001 'An improved viral die-off method to estimate setback distances' is required.

6. SOIL ASSESSMENT

Methods	Shovel			
Saturation depth to impermeable layer	500mm; moderate limitation (note: 500mm soil depth required below base of soil absorption bed, so additional soil depth required)			
Depth to high soil watertable (m)	Groundwater not encountered at a depth of 500mm; minor limitation			
Layer 1		K_{sat} (m/hr)*	K_{sat} (mm/d)*	DLR
depth colour texture coarse fragments soil structure	0 –300mm Dark Brown Sandy loam NA Well structured	20-60	480-1440	NA
Layer 2		K_{sat} (m/hr)*	K_{sat} (mm/d)*	DLR
depth colour texture coarse fragments soil structure	300 –500mm Sandy/cream Sandy loam 10-20%, 20-50mm rock Weakly structured	20-60	480-1440	20mm
Surface rock	No surface rock; minor limitation			
Bulk density	Compacted layer 2-minor limitation.			
Design Irrigation Rate (mm/day)	Design Irrigation Rate: adopted DLR for weakly structured loam receiving secondary treated effluent is 30mm/d.			
pH (soil/water)	pH 5.5-6.0, minor limitation.			
Electrical conduct (1:5) (dS/m)	<4, indicating salinity is not a constraint; minor limitation			
Emerson Aggregate Test (EAT)	3(1) minor limitation			
P sorption	NA for design of soil absorption bed			
Geology Vegetation comm. Soil Landscape	Devonian Granite Woodland grass understorey Marulan variant a			

* Hazelton, P.A and Murphy, B.W ed. (1992)

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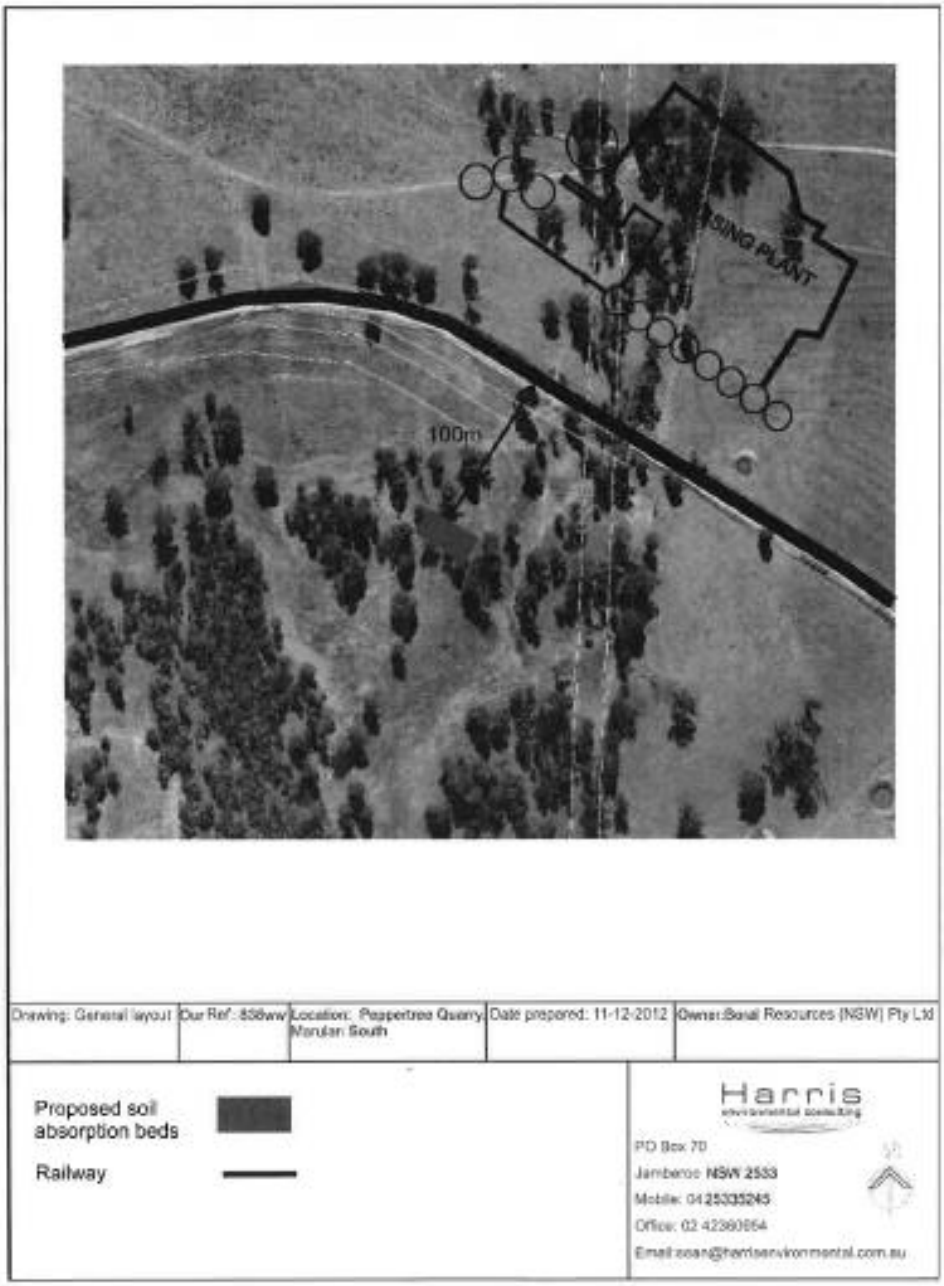
Figure 3 Location of processing plant and soil absorption beds



7. SUMMARY OF SITE AND SOIL INVESTIGATION

A soil absorption bed is proposed for wastewater disposal. The soil depth at the site of the proposed soil absorption bed is approximately 500mm. A soil absorption bed should have 500mm of soil below the base of the bed, and the constructed depth of the soil absorption bed should be 500mm, so the overall soil depth must be 1m. Therefore soil depth at this site is not suitable unless the soil depth is raised. The SCA (2012) describe the proposed method of construction as a *raised soil absorption bed.*

A broad, vegetated drainage depression located on the eastern side of the proposed soil absorption bed requires a 40m buffer.

Photo 5 Broad drainage depression

8. SYSTEM DESIGN

8.1 System Description (general requirements)

An Aerated Wastewater Treatment System will be used for wastewater treatment. The owner is required to provide Council with the AWTS manufacturer's specifications of the proposed treatment system. (Information on proposed AWTS can be obtained from the manufacturer or NSW Heath Register of Accredited Sewage Management Systems at http://www.health.nsw.gov.au/publichealth/environment/water/waste_water.asp).

The AWTS manufacturer will provide the owner/Council with the necessary plans and specifications including NSW Health Accreditation, tank dimensions and capacity, operation and maintenance details, plus Licensed Plumber's name, address, phone number and license number.

The AWTS will be installed and maintained in accordance with Section 5 of the guidelines 'On-site Sewage Management for Single Households' (Department of Local Government, 1998) and AS/NZS 1547-2012 'On-site Domestic Wastewater Management' (Standards Australia, 2000).

Upon approval from Goulburn Council, the owner is to enter into a servicing contract with an approved servicing agent for the life of the system. Copies of the written service reports should be lodged with Goulburn Council following each quarterly service.

The raised soil absorption bed should be constructed in accordance with SCA (2012) Checklist 10.1, included as Appendix VI to the report.

8.2 Location and installation of AWTS

The location of the AWTS should be decided in conjunction by the licensed plumber in consultation with the property owner. The AWTS must be positioned on a stable, level base and be downslope of the building so there is sufficient fall from drainage outlets in the dwelling. AWTS shown on the Site Plan was selected because:

- it is downslope of the buildings from where wastewater is generated;
- at least 2.5m away from the building
- at least 5m from the property boundary
- at least 6m downslope from any in ground water storage tanks.

AWTS installation must comply with the manufacturer's recommendations, AS/NZS 3500.2:2003 Plumbing and Drainage Part 2 Sanitary Plumbing and Drainage' and Council requirements.

The AWTS will be located at a suitable location to allow for drainage. In reference to Table 1, there is sufficient fall to use 100mm sewer pipe.

Table 2 Minimum pipe diameter calculations

Nominal pipe size (DN)	Minimum grade %	Minimum grade ratio
65	2.5	1:40
80	1.65	1:60
100	1.65	1:60
125	1.25	1:80
150	1.00	1:100

Source: 'AS/NZS 3500.2.:2003 Plumbing and Drainage Part 2 Sanitary Plumbing and Drainage' Table 3.2.
NB: pipe grades are expressed as a percentage of vertical to horizontal distances.

The sewer pipe between the office, AWTS and soil absorption beds must be buried at a depth that provides protection against mechanical damage or deformation, in accordance with 'AS/NZS 3500(Set):2003 Plumbing and Drainage Set'. Table 2 outlines the minimum pipe depth for trafficable areas. It is understood that the distribution pipe from the AWTS to the soil absorption bed will be 600mm deep.

Table 3 Minimum pipe depth for trafficable areas

Location	Minimum depth of cover (mm)
Where subject to heavy vehicular traffic	500
Where subject to light vehicular traffic	450
Elsewhere	300

Source:'AS/NZS 3500:2003 Table 3.4 Minimum Cover for Buried Piping'

8.3 Sizing of soil absorption beds

The soil absorption bed can be constructed within the range of widths and depths shown in Table 3 (ASNZ1547, 2012). The bed can be no deeper than 600mm and no wider than 4m. For this site, the proposed base of the bed is 500mm below ground surface (400mm aggregate and 100mm topsoil).

Table 4 Dimensions for constructing soil absorption bed

	Typical dimensions (mm)	Maximum (mm)	Minimum (mm)
Width	1000-4000	4000	1000
Depth of aggregate	300-600	600	300
Depth of topsoil	100-150	150	100
Spacing between adjacent beds (sidewall to sidewall)	-	NA	1000
Source:'AS/NZS 1547:2012 *On-site* domestic wastewater management			

The size of the soil absorption bed is calculated using the formulae in AS/NZ 1547(2012). It is based on design flow rate, design width and Design Loading Rate (DLR), which is the amount of effluent that, over the long-term, be applied each day per area of infiltrative surface without failure of the infiltrative surface.

The DLR adopted for the weakly structured loam subsoil receiving secondary treated effluent is 30 mm/d.

The AS/NZ1547(2012) method for calculating bed size is as follows:

$$L = \frac{Q}{DLR \times W}$$

Where

L = Length in m
Q = Design daily flow in L/day (1608)
W = Width in m
DLR = Design Loading Rate in mm/d (30mm/d)

Based on the above formulae and assumptions described in this report, the soil absorption bed must be **53.6m^2.**

The Linear Loading Rate (LLR), which determines the minimum total system length along the contour, was calculated using the formulae below:

$$L = \frac{Q}{LLR}$$

Where

L = Length of system in m
Q = Design daily flow in L/day (1608)
LLR = Linear Loading Rate in mm/d (45 l/m/d)*

* slope is 3-4%, soil depth >31-60cm and sandy loam topsoils.

Based on the above formulae and assumptions described in this report, the minimum length of the soil absorption bed is 35m i.e., the bed must exceed the minimum length.

Other SCA design requirements taken into account when designing the soil absorption beds for this site:

- Where more than one absorption bed is needed, the bed lengths should be equal and effluent should be distributed evenly via a splitter box or sequencing valve.
- The maximum number of beds for any one design is 10.
- Bed length should be designed to ensure that effluent is evenly distributed and reaches the far end of each bed. Individual beds must be less than 20m for passive systems or 25m for pressure dosed systems.
- Beds must not be added in series (i.e. end on end).

Based on the DLR, LLR and SCA design requirements, **2 x 1.3m wide x 20m long raised soil absorption beds are proposed.**

8.4 Location of soil absorption beds (system layout)

The proposed soil absorption beds are approximately 400m from the office. The soil absorption beds are located on the southern side of the railway, adjacent to the process plant concrete silos No. 1 & 2 and approximately 100m upslope of the railway line.

The proposed location and set back distances of the land application area relevant to the site are to be consistent with the requirements in the Conditions of consent, SCA's 'Development in Sydney's Drinking Water Catchment - Water Quality Information Requirements', and:

- 3m from all downslope (or flat) and 6m from all upslope property boundaries
- 15m and not upslope of in ground pools and potable water tanks
- 40m from any drainage depression, farm dam or waterbody
- 100m from the high water level of any permanent or intermittent watercourse, bore or other potable water source
- 150m from any SCA named river.

8.5 Construction of soil absorption beds

The proposed soil absorption beds are illustrated in the Figure 3 Site Plan - System Design and a description of SCA installation technique follows:

Step 1 Site Preparation

Obtain a copy of the council approved plans and conditions of consent. Accurately locate beds as shown on the site plans and according to the specified and approved design and/or any covenant. Check the location of all constructed beds against the approved site plans. If there is any change in their position from the site plans, a Section 96 application (from the *Environmental Planning and Assessment Act 1979)* must be made to council to alter their position.

Step 2 Positioning

Build the beds along the contours and use laser levelling to ensure that the base is exactly level. If this does not happen, distribution will not be even and one part of the bed will be more heavily loaded. This could cause the most heavily loaded part of the bed to fail prematurely, with further creeping failure as the effluent is forced to more distant parts of the bed.

Always avoid cutting bed through existing weakened ground (eg., through the alignments of former underground pipes, cables or conduits) as they may provide preferential pathways for effluent to escape from the bed. If they cut downslope through the ground occupied by a series of bed, effluent may preferentially flow to the lowest bed causing it to fail or surcharge. Where it is unavoidable to cut into an alignment or it happens accidentally, seal the weaknesses in the bed walls with cement or bentonite grout.

Step 3 Timing

Build beds during fine weather. If it rains before beds are completed, they should be covered to protect them from rain damage.

Once dug, complete the beds promptly to avoid foreign material being washed into the open bed. In particular, avoid puddling, where clay settles out at the bottom of a water filled trench exposed to rain, as clay settling on the base of the bed will reduce bed performance.

Step 4 Excavation

- Carefully excavate the base of any bed and level it with a dumpy or laser level. The bed must be level along and across the line of the bed. If there is a slope across the base of the bed, the effluent will drain to and preferentially load the downslope side of the bed, which may then fail or overflow.
- Where beds are dug along the contour on sloping ground by an excavator that does not have a pivoting bucket, the base of the bed will probably be cut parallel to the ground surface. In this case, the base of the bed will have a fall towards the downslope side. The bed should be further hand dug to level the base and stop excessive effluent accumulating against the downslope wall of the bed.
- Where beds are dug by excavator in clayey soils, any smearing of the bed walls and floor must be fixed by scarifying the surface.

Step 5 Construction

- Do not dig beds in dispersive soils. If the soil appears dispersive after the beds are dug, add gypsum to the bed base at the rate of one kilogram per square metre. Absorption beds should not be built in medium to heavy clay soils, and preferably not in light clay soils.
- Install a self supporting pipe or arch (RelN) that complies with AS/NZS1547:2012.
- Ensure that the sides of beds are not damaged or caused to collapse when the beds are filled with gravel or sand.
- Beds can be filled with gravel (typically 20-40 millimetres or occasionally coarse sand), but it should not be compacted. Appropriate consideration should be given to bed storage capacity where beds are filled with material other than gravel.
- Lay geotextile filter cloth over the gravel or sand in a bed and under the topsoil to ensure that the topsoil does not penetrate and block the bed.
- Test the beds with clean water before filling with gravel (or coarse sand) to ensure effective and even distribution of effluent.

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- Apply 150 to 200 millimetres of topsoil to the top of the bed and leave it slightly mounded above ground level to allow it to settle and to encourage incident rainfall to be shed away from the top of the bed.
- The top of the absorption bed area should be turfed or grass planted to establish vegetation cover promptly after construction. This ensures the best uptake of effluent by evapotranspiration. Ensure that larger deep-rooting plants are not planted close to bed to reduce the chance of root intrusion and clogging of the beds.
- A stormwater diversion berm/ drain should be built on sloping sites upslope of the absorption beds. Standard Drawing No. 10A provides detail about constructing a stormwater diversion drain.

Step 6 Dosing

- **Beds may be gravity-fed or pressure-dosed using pumps or dosing siphons. Raised pressure-dosed absorption beds are a possible alternative where there are shallow limiting layers present (eg bedrock, clay or water table) and not enough separation distance from that layer. The linear loading rate must be addressed in these situations.**
- The annotated Standard Drawing No. 10B describes the installation of gravity-fed beds. Annotated Standard Drawing No. 10C describes the installation of pressure-dosed beds. Annotated Standard Drawing No. 10D describes the installation of raised pressure-dosed absorption beds.
- Checklist 10.1 details matters that should be checked when trenches or beds are installed. Plumbers/ installers and Council inspectors can use this checklist to ensure installation has been completed properly.

8.6 Testing and maintenance

Test trenches and beds with clean water before filling with gravel to ensure even distribution.

Checklist 10.2 details items to be checked during a regular maintenance inspection for an absorption system. See Appendix.

8.7 Distribution

The wastewater should be split between the two beds using a manifold designed at installation.

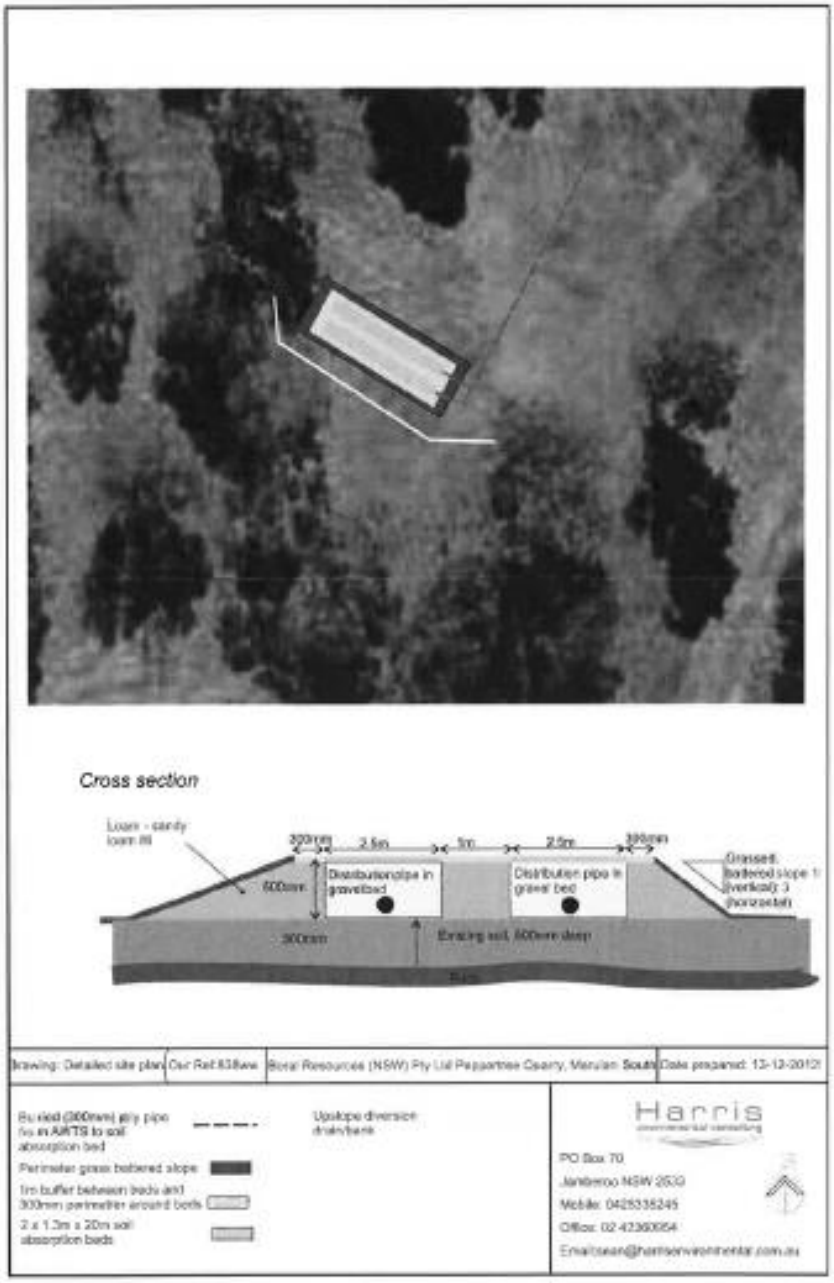
8.8 Stormwater

Run-on stormwater is to be diverted away from the soil absorption bed by means of an earth bank or diversion drain. Figure 3 Site Plan - System Design shows the location of the proposed diversion drain.

8.9 Operation and Management

Upon approval from Goulburn Council, the owner is to enter into a servicing contract with an approved servicing agent for the life of the system. Copies of the written service reports should be lodged with Goulburn Council following each quarterly service.

Figure 4 Soil Absorption Beds - System Design



9. COMPLETION OF WORKS

The last stage of this process involves submitting an Installation Certificate provided by the installer. This is to certify that the system was installed according to the System Design. A copy of the installation certificate must be provided to council and the system designer. A council certifier will make a final inspection before the system is approved for use.

The treatment and application system must be installed by a contractor(s) licensed by NSW Fair Trading. That could be a licensed plumped or a licensed irrigation contractor (or both), each with at least three years experience in effluent disposal.

10. SUMMARY

This assessment recommends the following:

- Install an Aerated Wastewater Treatment System to treat 1608L of wastewater/ day from the office under construction;
- Construct a 53m^2 raised soil absorption bed, in the configuration of **2 x 1.3m wide x 20m long** beds constructed in accordance with SCA (2012) and ASNZ1547(2012); and
- Install upslope stormwater diversion drain.

11. REFERENCES

Department of Local Government (1998) On-site Sewage Management for Single *Households*. NSW Government.

Standards Australia (2012) Australian/New Zealand Standard 1547:2012 *On-site* domestic wastewater management. Standards Australia.

NSW Health Septic Tank Accreditation Guidelines (2001).

Hazelton, P.A and Murphy, B.W ed. (1992) What Do All the Numbers Mean? A Guide for the Interpretation of Soil Test Results. Department of Conservation and Land Management (incorporating the Soil Conservation Service of NSW), Sydney.

Sydney Catchment Authority Neutral or Beneficial Effect on Water Quality Assessment Guideline (2011).

Designing and Installing On Site Wastewater Systems. A Sydney Catchment Authority Current Recommended Practice (May 2012).

Appendix I Designer Producer Statement

DESIGN PRODUCER STATEMENT

On-site Wastewater and/or Effluent Disposal System Design

ISSUED BY:	Harris Environmental Consulting
TO:	Goulburn Council
DA NO:	
TO BE SUPPLIED TO:	Boral Resources (NSW) Pty Ltd
IN RESPECT OF:	On-site wastewater system for Peppertree Quarry, office wastewater treatment and disposal
	Lot/DP: Various lots
	Description: Office domestic wastewater for office
	Address: 843 Marulan South Road, Marulan South

Harris Environmental Consulting has been engaged by **Boral Resources (NSW) Pty Ltd** to provide the technical design details for an on-site wastewater system.

The design has been carried out in accordance with:

- SCA, 2010 'Developments in Sydney's Drinking Water Catchment- Water Quality Information Requirements'.
- DLG, 1998 'Environment and Health Protection Guidelines: On-site Sewage Management for Single Households'
- AS/NZS 1547:2012 'On-site Domestic Wastewater Management'

For details of site assessment and design, refer to the **Wastewater Management Report, Peppertree Quarry, dated 10/12/2012.**

This System Design was prepared with reference to SCA, 2012 'Designing and Installing On-Site Wastewater Systems'

This is an independent design, covered by a current policy of Professional Indemnity Insurance.

DECLARATION:

I believe on reasonable grounds that this design has been carried out in accordance with agency and council requirements, and best practice in on-site wastewater design principles and procedures.

NOTE: This statement does not approve the installed system.

Under certain conditions, **Harris Environmental Consulting** is available to certify the installed system. These conditions include:

- the technology supplier(s) take(s) full responsibility for the stated quality and performance of technologies and other equipment supplied
- the installer(s) take full responsibility for installing the system as specified by all conditions of consent and **Harris Environmental Consulting** design reports unless departure from the station specification(s) is subsequently agreed between the installer and **Harris Environmental Consulting** and approved by the consent authority
- **Harris Environmental Consulting** is to be informed before installation, and engaged, under separate contract, if required to supervise installation of all specified system components.

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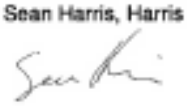
DISCLAIMER:

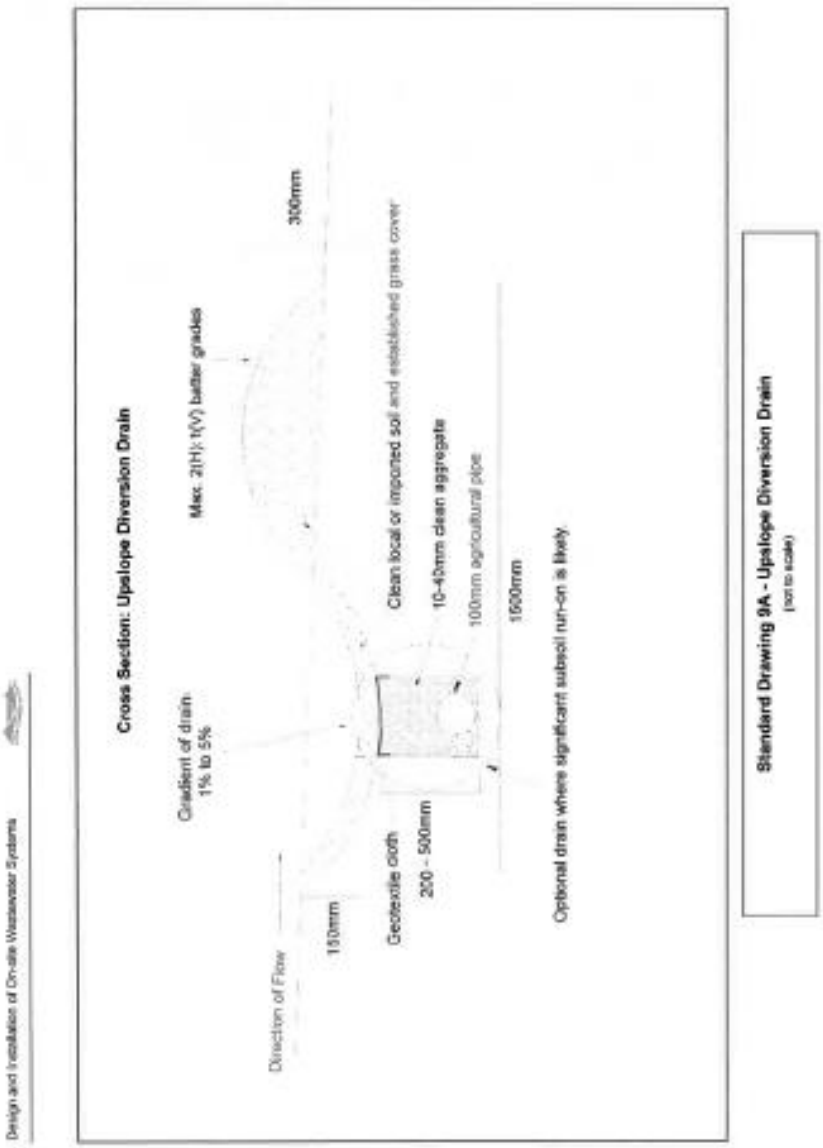
Approval is to be sought from **Harris Environmental Consulting** should variations to the specification and layout in this report/ drawing be considered necessary by the installer before or at the time of installation. Failure to do so **will** invalidate the Design Producer Statement and **Harris Environmental Consulting** will no longer take responsibility for the design.

The client is to make full disclosure of relevant information on existing and/or proposed activities on the site that will influence estimation of likely daily wastewater quantity (based on the number of potential bedrooms and other wastewater producing activities) and quality (in particular any chemicals in the water supply and/or wastewater stream potentially toxic to biological wastewater processes). This design is based on the site assessment carried out by **Harris Environmental Consulting.**

Subsequent changes to the site that might affect the topography and soil profiles are to be notified by the client. Failure, by the Client, to provide this information **will** invalidate this Design Producer Statement.

Name	Sean Harris, Harris Environmental Consulting
Signature	 Msc Env Science (UOW), Grad dip Nat Res (UNE), BscAppSc, Agriculture (HAC)
Title:	Site and Soil Assessment for On-site Wastewater Management on Peppertree Quarry, Marulan South
Date:	10/12/2012

Appendix II Standard Drawing 9A - Upslope Diversion Drain



Appendix III Example of installation certificate

COMPLETION OF WORKS

INSTALLATION CERTIFICATE

On-site Wastewater and/or Effluent Disposal System

(to be prepared and issued by the licensed installer)

ISSUED BY: ***On-Site System Installers Pty Ltd***

TO BE SUPPLIED TO: ***Catchment Council (DA No. XXX/YYYYY)***

IN RESPECT OF: *Mr & Mrs Consumer, On-site wastewater service for 1 Rural Road, Septicville (Catchment Council)*

SITE DETAILS: Lot/DP: *XXX/YYY*
Description: ..... *[insert relevant description]*

DESCRIPTION OF PROJECT:

- *Installation of an on-site wastewater system for a* ..... *[insert relevant proposal eg a four bedroom dwelling].*
- *Treatment system: NSW Health accredited* ..... *[insert relevant system and model number].*
- *Nature of disposal system / Land application:* ..... *[insert relevant land application eg 400 m² subsurface drip irrigation].*

INSTALLED IN ACCORDANCE WITH: *Conditions of consent and Wastewater System Designers Pty Ltd System Design, 1 Rural Road, Septicville, dated DD/MM/YYYY*

DATE OF SITE INSTALLATION INSPECTION: *DD/MM/YYYY*

REPORT: *Variations: None. Installed as indicated on Site Plan in System Design.*

DECLARATION:
I believe on reasonable grounds that all of the wastewater works have been completed in accordance with Council Consent Number 123456 and Wastewater System Designers Pty Ltd System Design dated DD/MM/YYYY.

Name: .....

Title: .....

Signature: .....

For: *On-Site System Installers Pty Ltd*
Date: *DD/MM/YYYY*
cc: *Mr & Mrs Consumer*

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Appendix IV General recomendations to manage water qualiity and quanity

Insinkerator style kitchen garbage disposal units should be avoided as they increase water consumption and raise the nutrient and BOD concentrations of household effluent.

Water conservation can reduce the volume of wastewater that needs to be treated and discharged on site. The development should include appliances that are rated under the Water Efficiency Labelling and Standards (WELS) Scheme that includes:

i. 4 star dual-flush toilets;
ii. 3 star showerheads;
iii. 4 star taps (for all taps other than bath outlets and garden taps);
iv. 3 star urinals; and
v. Water efficient washing machines and dishwashers are to be specified and used wherever possible.

Chemical cleaning compounds and other chemicals that enter the treatment system should be low in phosphate and salt.

Anti bacterial chemical cleaning compounds and other chemicals that enter the treatment system should be avoided. This includes chlorine, disinfectants, bleaches etc.

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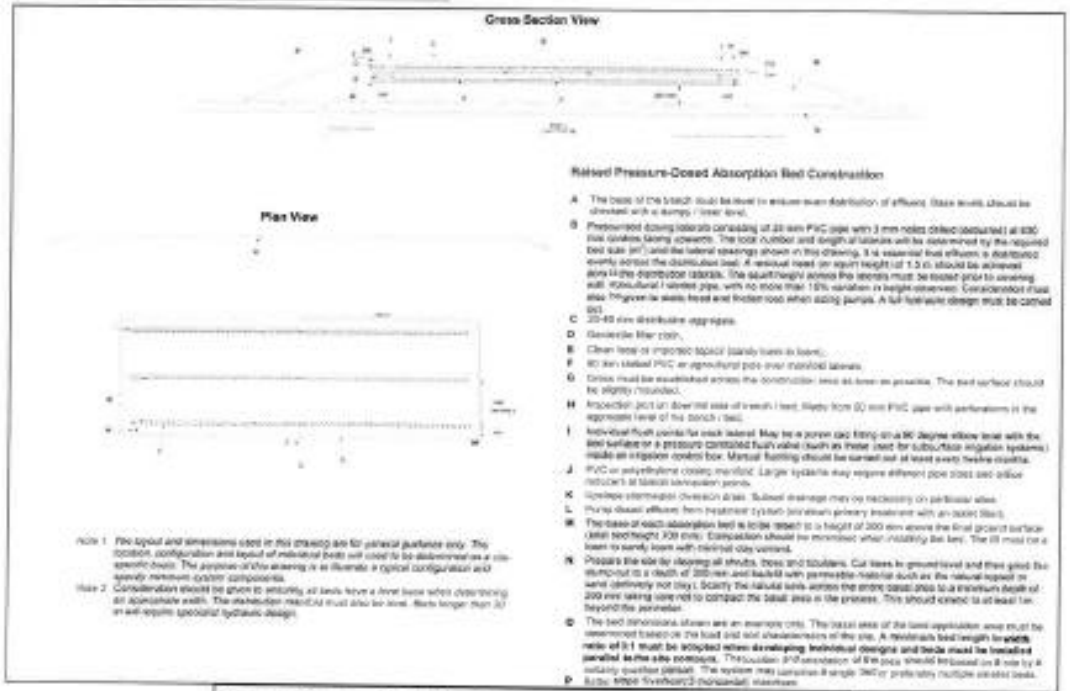
Appendix V SCA Standard Drawing Raised Soil absorption trench/bed



Standard Drawing 10D - Raised Pressure Dosed Absorption Bed Construction

(Not to scale)

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Appendix C: TARP

TARP - Trigger Action Response Plan

TARP Site	Peppertree Quarry (v2)	Date	June 2020
Document ID	TARP_PEP_001	Version	2
Description	TARP Actions Matrix for Peppertree Quarry. Rainfall triggers based on SWMP measurements. This TARP documents the actions required to maintain compliance and stipulates the responsible person for different scenarios.		

			Normal State No rain forecast No rain in preceding week **No discharge from site**	Level 1 Triggers Light scattered showers forecast or received in preceding week (< 30mm rainfall forecast over 5 days) **Unlikely to discharge from site**	Level 2 Triggers Frequent showers forecast ➢ 50mm Rain received in preceding 5 days **Site likely to discharge**	Level 3 Triggers Frequent, moderate to heavy showers forecast Rain greater than 50mm in less than 5 days **Site discharging**
Response Actions/Controls	General Conditions		▪ Reasonably expected dry conditions in day to day operations. ▪ No flows into dams or ponds, low dam levels, no discharge. ▪ No cause for action, routine management activities to be continued.	▪ Forecast rainfall likely to initiate minor flows to Quarry sediment ponds and dams ▪ Rainfall is likely to be fully contained in the sediment ponds and dams, with no offsite discharge ▪ Maximum residence time to settle suspended solids are probable due to minor inflows and low volumes held in dams and ponds.	▪ Residual saturation of ground and road surfaces evident. ▪ Water level in dams is above freeboard markers ▪ Moderate risk of discharge with water quality limits close to Water Management Plan requirements	▪ High likelihood of discharge from sediment basins ▪ High risk of water quality exceeding Water Management Plan limits.
	Quarry Manager	Name/s: Michael Higgins Contact No.: 0401894082	▪ Daily Site inspections.	▪ Ensure site inspections are undertaken ▪ Ensure drainage and sediment controls are in place ▪ Inspection of work area to include update of water management status with rain forecast. ▪	▪ Daily/regular monitoring of real-time water level in dams and ponds ▪ Communicate to Environment Department if site is discharging. ▪ Organise for water samples to be taken if site is discharging ▪ Review weather forecast for rain predicted ▪	▪ Ensure controls and resources are in place and available for relocation of equipment ▪ Consider ceasing activities as necessary ▪ Follow PIRMP if "reportable" discharges or spills occur
	Site Team (Pit Supervisor)	Name/s: Youssef Chaalan Contact No.: 0450740708	▪ Maintenance activities completed as scheduled in the EPP and checklist ▪ Continue use of dam water for dust suppression and water cart	▪ Daily/regular monitoring of free board water level in dams and ponds. ▪ Daily check of sediment and erosion controls and drainage pathways ▪ Monitor use of water cart for dust suppression and roadway cleansing to reduce erosion and sediment tracking ▪ Report any areas of concern ▪ Ensure pumps are available (hire if required). ▪ Ensure pumps fuelled and operable. ▪ Ensure pumps are placed in areas required.	▪ Pre-start and end of shift checks of all sedimentation and erosion controls. ▪ Pumps to be refuelled ▪ Monitor erosion impact on roadways from HME and surface flows. ▪ Monitor existing controls for performance, clean repair where required ▪ Monitor emplacements for erosion or slips ▪ Report any areas of concern ▪ Arrange for dams to be emptied following rain events within 5 days	▪ Pre-start and end of shift checks of all sedimentation and erosion controls. ▪ Consider addition erosion controls in areas of high water flow and/or areas of high erosion ▪ Monitor existing controls for performance, clean repair where required ▪ Consider ceasing/ restricting HME access to high surface flow areas and where vehicle movement has created point source erosion. ▪ Monitor flows in offsite drainage channels pipes for blockages or concerns ▪ Ensure pumps are refuelled and operational ▪ Arrange for de-watering of dams after event has ceased ▪ Arrange clean-up repairs to sediment controls after rain event
	Environment	Name/s: Sharon Makin Contact No.: 0401894185	▪ Inspect Dams and sediment controls during environmental inspections. ▪ Ensure Daily monitoring of weather via WeatherZone Peppertree Dashboard and advise on forecasted rain events	▪ Provide advice to site as required ▪ Meet any reporting requirements	▪ Provide advice to site as required ▪ Meet any Project Approval and EPL reporting requirements ▪ Take water samples as required.	▪ Provide guidance on the control of any water still leaving site. ▪ Meet reporting requirements ▪ Advice/assist in post event clean-up and rectification ▪ Review with QM performance of site and controls post event ▪ Organise for water samples to be taken ▪ Review weather forecast for rain predicted on a regular basis IE 2 hourly

	Role	Name	Contact	Signature
Revised By:	Environment	Sharon Makin	0401894185	
Accepted By:	Production Manager	Kurt Bridges	0401897544	
Accepted By:	Operations Manager	Michael Higgins	0401894082	

Appendix D:

Sediment and Erosion Measures

This approach is adopted in the selection of the most appropriate and effective sediment and control measures.

The steps involve (see Figure C1):

- Identifying the potential for erosion or sediment
- If erosion is of concern, determine whether it will be caused by rainfall or concentrated flows
- If sedimentation is of concern, determine whether it will be caused from sheet or concentrated flow
- Depending on the determined potential cause to either erosion or sedimentation, select the appropriate techniques from Table C1 below.

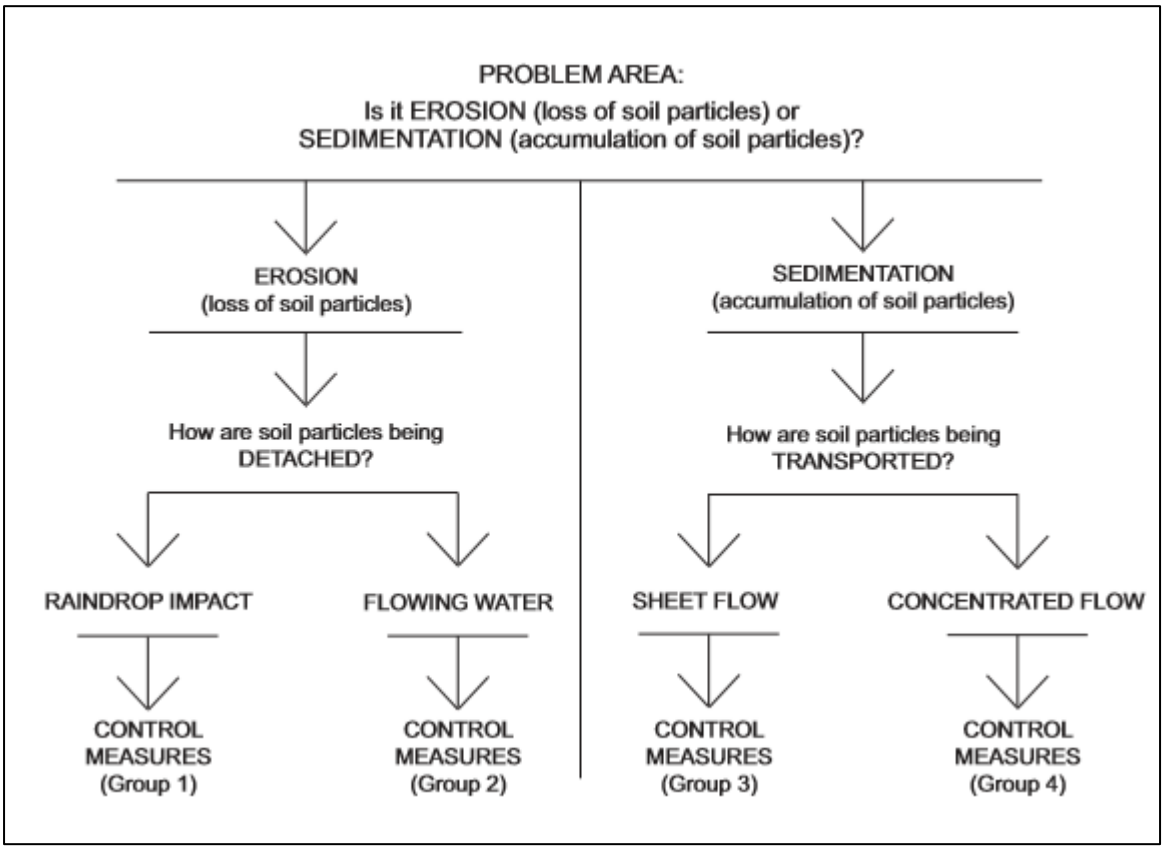

Figure D1: Control Decision Tree
(adopted from Qld Department of Main Roads)

Table D1: Control Techniques (adopted from Qld Department of Main Roads)

GROUP 1: Erosion Control (Rainfall Impact)	
Vegetation • temporary vegetation (cover crop only) • permanent vegetation – introduced (exotic) pasture species or native (endemic) species • refer to **vol. 1**: sections 4.3.2, 7.1 and 7.2; appendices A6 and G	
Batter blankets • vegetation promotion blankets • vegetation suppression blankets • needle-punched geotextile membrane • builder's plastic membrane • refer to **vol. 1**: section 5.4.2; SD5-2; appendices A6 and D	
Soil surface mulching • hydromulch or hydraulic bonded-fibre matrix • blown straw, hay, crop residue, with bitumen tack • tub-ground or chipped organic mulch • brush-matting • rock or gravel mulch • refer to **vol. 1**: section 7.4; figure 7.3; appendices A6 and D	
Geocellular containment systems • Non-woven geotextile type material • Polypropylene material (perforated and non-perforated) • refer to **vol. 1**: section 5.4.2; SD5-3; appendix D	
Surface roughening • roughening parallel to contour • contour ripping or scarifying • 'track walking' • refer to **vol. 1**: section 4.3.2; figures 4.3(a) and (b)	

Geobinders

- organic tackifiers
- co-polymer emulsions
- bitumen emulsion
- cementitious products
- refer to **vol. 1**: section 7.1.2; appendices A6 and D

Group 2: Erosion Control (Concentrated Water Flow)

Up-slope diversions

- excavated channel-type bank
- backpush-type bank or windrow
- catch drains
- shoulder dyke
- refer to **vol. 1**: section 5.4.4; SD5-5 and SD5-6

Mid-slope diversions

- berms and benches
- temporary diversions (at cut/fill line)
- cross banks
- refer to **vol. 1**: section 4.3.1; figure 4.2; appendix A4

Soft armour channels

- trapezoidal or parabolic shape
- consider channel grade and maximum permissible velocity
- establish vegetative ground cover
- standard (un-reinforced) or re-inforced turf
- biodegradable erosion control mat (temporary) or synthetic erosion control mat (permanent)
- refer to **vol. 1**: sections 5.4.3, 7.3; SD5-7; appendix D

Hard armour channels

- loose rock
- rock-filled wire mattresses
- articulating concrete block systems
- grouted rock
- cast in-situ concrete
- builder's plastic lining or geotextile lining
- refer to **vol. 1**: section 5.4.4; table 5.2; figure 5.4; appendix D

In-stream diversions

- temporary coffer dams
- water-filled structures
- temporary lined channel (stream diversion)
- refer to **vol. 1**: section 5.3.5; appendix I

Check dams

- stacked rock
- sandbags and geotextile sausages
- straw bales
- logs
- proprietary products
- refer to **vol. 1**: section 5.4.3; SD5-4; figures 5.3(a) and (b)

Batter drains

- concrete (pre-cast or on-site)
- half 'armco' pipe
- sandbags
- rock-filled wire mattresses
- loose-rock rip rap
- builder's plastic or geotextile lined chutes
- refer to **vol. 1**: section 5.4.4; appendix D

Grade control structures and flumes

- gully pits and field inlets
- sandbag drop structures
- rock-filled wire gabions and mattress structures
- driven sheet piling
- concrete chutes
- inclined pipe spillways
- builder's plastic-lined chutes

Outlet dissipation structures

- loose-rock rip-rap aprons
- rock-filled wire mattresses
- roughness elements
- hydraulic jump-type structures
- impact-type structures
- refer to **vol. 1**: section 5.4.5; figures 5.8, 5.9, 5.10, 5.11 and SC5-8

Revetments and retaining walls
- rip rap
- rock-filled wire gabions and mattresses

Group 3: Sediment Controls (Sheet Flows)

Vegetative buffers
- well established sward with good groundcover
- refer to **vol. 1**: section 6.3.8; table 6.4; SD6-13; appendix G

Sediment barriers/filters
- sediment fences
- vegetation, brush, rock or gravel windrows
- straw bale barriers
- refer to **vol. 1**: section 6.3.7; SD6-7 and SD6-8; figure 6.10; appendix D

Site exit points
- shaker ramps
- rock aprons
- wheel wash systems
- refer to **vol. 1**: section 6.3.9; SD6-14

Group 4: Sediment Controls (Concentrated Flows)

Sediment curtains / turbidity barriers
- floating geotextile
- proprietary polypropylene products
- temporary coffer dams
- water-filled structures
- refer to **vol. 1**: section 6.3.7; SD6-10; appendix D

Sediment traps

- stacked rock/timber with geotextile
- excavated sumps
- straw bale or sand bag structures
- gully pit, field inlet and kerb inlets
- refer to **vol. 1**: section 6.3.6, figure 6.11; SD6-11 and SD6-12

Sediment retention basins

- Type C (riser type) basin
- Type F (extended settling) basins
- Type D (flocculation) basins
- refer to **vol. 1**: sections 6.3.3, 6.3.4 and 6.3.5; SD6-3 and SD6-4; appendices E and J

Appendix E: Erosion and Sediment Control Check Sheet

PEPPERTREE QUARRY EROSION AND SEDIMENT CONTROL CHECK LIST

BORAL

SECTION 1: INSPECTION DETAILS		
MONTHLY INSPECTION		
WHO:	DATE OF INSPECTION:	

SEDIMENT DAM ID	IS THE DAM WORKING WITHIN DESIGN CAPACITY			DOES SEDIMENT NEED TO BE REMOVED			IS THERE EVIDENCE OF CRACKING OR LEAKING FROM THE DAM WALLS			IS THERE ANY EVIDENCE THAT THE DAM HAS OVERFLOWED			COMMENTS / CORRECTIVE ACTIONS	WHO	DUE DATE
	Y	N	NA	Y	N	NA	YES	NO	NA	Y	N	NA			
Dam 1															
Dam K															
OB north dam (X)															
OB east dam															
OB south dam															
Farm Dam															
Ob west dam															
South OB Dam A (shotcrete)															
South OB Dam B (Burtons)															
South OB Dam C (TRN)															
South OB East															
Marulan south drain and ponds															

SEDIMENT DAM ID	IS THE DAM WORKING WITHIN DESIGN CAPACITY			DOES SEDIMENT NEED TO BE REMOVED			IS THERE EVIDENCE OF CRACKING OR LEAKING FROM THE DAM WALLS			IS THERE ANY EVIDENCE THAT THE DAM HAS OVERFLOWED			COMMENTS / CORRECTIVE ACTIONS	WHO	DUE DATE
	Y	N	NA	Y	N	NA	YES	NO	NA	Y	N	NA			
N1 SWOE															
N2 SWOE															
N3 SWOE															
P1 West OB															
P1 West OB															
Dam W1													Pond receives clean water fro completed rehabilitated area		
Dam W2													Pond receives clean water from completed rehabilitated area		
Dam W													Pond receives clean water from completed rehabilitated area		
Dam V													Pond receives clean water from completed rehabilitated area		
Dam V1													Pond receives clean water from completed rehabilitated area		
Dam U													Pond receives clean water from completed rehabilitated area		

INSPECTION TO BE COMPLETED	COMPLIANCE			COMMENTS / CORRECTIVE ACTIONS	WHO	DUE DATE
	YES	NO	NA			
Overburden emplacement and campaign Are work activities and land disturbance being confined to the minimum area practicable and are sensitive areas being avoided / protected *(use barrier fence where required to control access and limit extent of disturbance)*						
Overburden emplacement / scalps						

INSPECTION TO BE COMPLETED	COMPLIANCE			COMMENTS / CORRECTIVE ACTIONS	WHO	DUE DATE
stockpile / noise bund Is there evidence of problematic site erosion such as gullies, rilling, land slips, subsidence and stream bank instability? *(if yes Implement decision tree for the selection of erosion control devices)*						
Overburden emplacement Are drainage channels on the emplacement lined with scour protection and working –ie no signs of erosion *(if yes Implement decision tree for the selection of erosion control devices)*						
Traffic Is there any sign that vehicles are not staying on delineated roads *(use barrier fence where required to control access and limit extent of disturbance)*						
Roads Is there evidence of erosion on haul roads or road side drainage networks						
General site Are appropriate site erosion control measures (barrier fencing, stormwater diversions, mulch, surface stabilisation) in place where required and properly maintained?						
Does an erosion hazard exist that requires installation of new erosion and sediment controls *(if yes Implement decision tree for the selection of erosion control devices)*						

INSPECTION TO BE COMPLETED	COMPLIANCE			COMMENTS / CORRECTIVE ACTIONS	WHO	DUE DATE
diversion drains Is upstream "run on" storm water being successfully diverted around active quarry areas to minimise dirty water run off						
Internal drains Is there an accumulation of sediment in drainage networks or check dams						
is the biofilter at the Main dam clear of sediment						
Train load out Are drainage channels at the rear of the TLO working –ie no signs of erosion or overflow *(if yes Implement decision tree for the selection of erosion control devices)*						
Are all completed work areas being successfully stabilised (by vegetation or other means)						