

Water Management Plan

for the

New Berrima Clay/Shale Quarry

PA 08_0212

FOR APPROVAL

Prepared by:

**Strategic Environmental & Engineering
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in Conjunction with:



R.W. CORKERY & CO. PTY. LIMITED

September 2022

Approved by
the Secretary's nominee, xxxxxxxxx,
on xxx



ABN: 52 000 005 550

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for the

New Berrima Clay/Shale Quarry

PA 08_0212

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CONTENTS

	Page
COMMONLY USED ACRONYMS	VI
1. INTRODUCTION.....	1
2. APPROVED ACTIVITIES AND STAGED OPERATIONS	3
2.1 APPROVED ACTIVITIES.....	3
2.2 STAGED OPERATIONS	3
3. LEGAL AND OTHER REQUIREMENTS	6
3.1 PROJECT APPROVAL 08_0212	6
3.2 OTHER APPROVALS, LEASES AND LICENCES	9
4. ROLES AND RESPONSIBILITIES.....	11
5. COMPETENCE TRAINING AND AWARENESS	12
6. DRAINAGE, CATCHMENTS AND DAMS	13
6.1 CATCHMENTS AND DRAINAGE.....	13
6.2 PRE-COMMENCEMENT DAMS.....	13
6.3 BASELINE WATER QUALITY	15
6.4 AQUATIC HABITAT	16
6.5 WATERFRONT LANDS.....	18
7. SITE WATER BALANCE	19
7.1 INTRODUCTION.....	19
7.2 WATER USES AND DEMAND	19
7.2.1 On-site Water Demand	19
7.2.2 Amenities and Ablutions Supply	19
7.2.3 Dust Suppression.....	19
7.2.4 Washdown	20
7.3 SOURCES AND SECURITY OF WATER SUPPLY	20
7.3.1 Water Supply.....	20
7.3.2 Water Security.....	20
7.4 WATER MANAGEMENT	21
7.4.1 Pollution Risks	21
7.4.2 Storage	21
7.4.3 Dirty Water	25
7.4.4 Clean Water	31
7.4.5 Discharges	32
7.4.6 Contaminated Water	34
7.4.7 Water Use Minimisation Program	34
8. EROSION AND SEDIMENT CONTROL PLAN	35
8.1 SOURCES OF EROSION, SEDIMENTATION AND POLLUTION.....	35
8.1.1 Sources of Erosion and Sedimentation	35
8.1.2 Sources of Pollution and Water Contamination	35

CONTENTS

	Page
8.2 EROSION AND SEDIMENT CONTROL MANAGEMENT	35
8.2.1 Implementation Strategy	35
8.2.2 Erosion and Sediment Control Monitoring	37
8.2.3 ESCP Review.....	38
9. SURFACE WATER MONITORING PROGRAM	39
9.1 INTRODUCTION	39
9.2 SURFACE WATER IMPACT ASSESSMENT CRITERIA	39
9.3 SURFACE WATER MONITORING PROGRAM	39
9.3.1 Monitoring Parameters, Frequency and Location	39
9.4 SURFACE WATER TRIGGERS	41
9.5 STRATEGY MONITORING AND AMENDMENT	41
10. GROUNDWATER MANAGEMENT	42
10.1 EXISTING GROUNDWATER ENVIRONMENT	42
10.2 GROUNDWATER MONITORING PROGRAM	42
10.2.1 Monitoring Locations and Piezometer Details.....	42
10.2.2 Assessment Criteria	43
10.2.3 Baseline Groundwater Monitoring Data	43
10.2.5 Ongoing Groundwater Monitoring Parameters and Frequency	45
10.3 GROUNDWATER TRIGGER ACTION RESPONSE PLAN.....	47
11. MITIGATION MEASURES	49
11.1 SURFACE WATER	49
11.2 GROUNDWATER.....	49
12. EVALUATION OF COMPLIANCE	50
13. COMPLAINTS HANDLING AND RESPONSE.....	51
14. CORRECTIVE AND PREVENTATIVE ACTIONS	52
15. INCIDENT REPORTING	54
16. PUBLICATION OF MONITORING INFORMATION	55
17. PLAN REVIEW.....	56
18. REFERENCES	57
APPENDICES	
Appendix A Consultation and Response	58
Appendix B Erosion and Sediment Control Plan	60
CHARTS	
Chart 1 Baseline pH (2017 to October 2020)	16
Chart 2 Baseline EC (2017 to October 2020)	16
Chart 3 Baseline TSS & Turbidity (2017 to October 2020).....	17

CONTENTS

	Page
FIGURES	
Figure 1	Locality Plan..... 2
Figure 2	Approved Layout – New Berrima Clay/Shale Quarry 4
Figure 3	Extraction Stages..... 5
Figure 4	Project Site Major Catchments and Water Sample Locations 14
Figure 5	Water Management: Stages 1-4 Establishment 26
Figure 6	Water Management Stages 1 – 4; Operations 27
Figure 7	Water Management: Stages 5-7 Establishment 28
Figure 8	Water Management: Stages 5-7 Operation 29
Figure 9	Final Landform 30
Figure 10	Piezometer Construction Details 44
TABLES	
Table 1	Hours of Operation..... 3
Table 2	Project Approval Requirements Relating to Water Management 6
Table 3	Statement of Commitments Relating to Water Management 9
Table 4	EPL 20377 Requirements Relating to Water Management..... 10
Table 5	Roles and Responsibilities..... 11
Table 6	Pre-Commencement Dam Sizes 13
Table 7	Results of Water Quality Testing (2017 to October 2020) 17
Table 8	Water Management Structures 22
Table 9	Harvestable Rights Water Management Dams 25
Table 10	Sediment Basin Conditional Discharge Water Quality Targets* 33
Table 11	Water Quality Parameters for all Water Quality Monitoring Locations 40
Table 12	Key Baseline Groundwater Quality Parameters 46
Table 13	Groundwater Tigger Action Response Plan 47
Table 14	Example Corrective Actions / Contingency Measures..... 52

COMMONLY USED ACRONYMS

AHD	Australian Height Datum
AS	Australian Standard
DECC	NSW Department of Environment and Climate Change
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry and Environment
DPE-Water	NSW Department of Planning and Environment - Water
EC	Electric Conductivity
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ESCPs	Erosion and Sediment Control Plans
NATA	National Association of Testing Authorities
NTU	Nephelometric Turbidity Units
PA	Project Approval
SEEC	Strategic Environmental Engineering Consulting Pty Limited
SEPP	State Environmental Planning Policy
TSS	Total suspended solids
WMP	Water Management Plan

1. INTRODUCTION

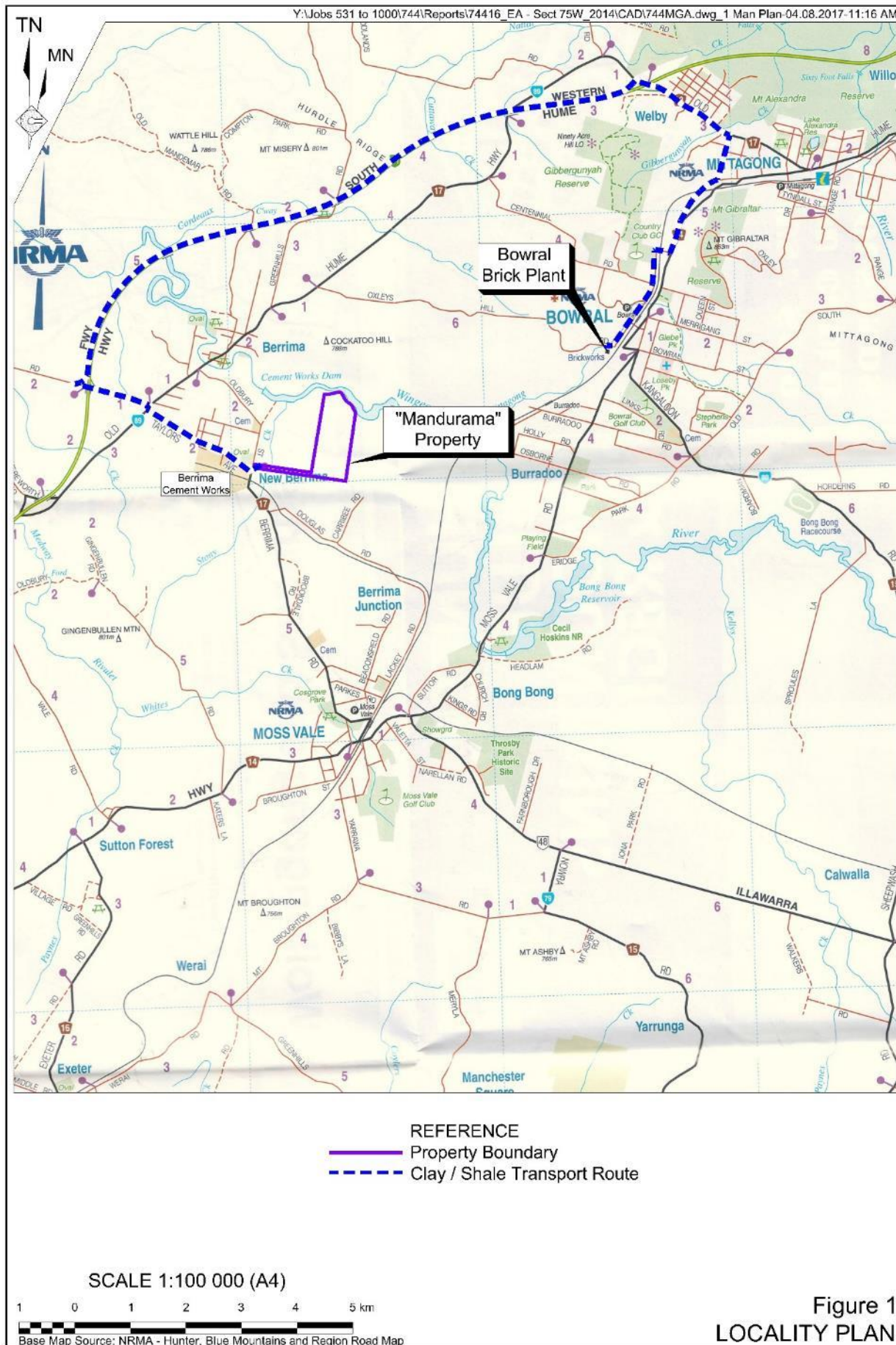
This Water Management Plan (WMP) has been prepared by Strategic Environmental and Engineering Consulting (SEEC) Pty Ltd in conjunction with R.W. Corkery & Co. Pty Limited on behalf of The Austral Brick Company Pty Limited (Austral) for the New Berrima Clay/Shale Quarry (the Quarry). The Quarry is located within the “Mandurama” property approximately 1.5km east of New Berrima in the Southern Highlands of NSW (**Figure 1**). For the purposes of this document, the area of the approved Quarry is referred to as “the Quarry Site”.

This WMP has been prepared in satisfaction of Project Approval (PA) 08_0212 *PA Conditions 3(13) to 3(15), 3(18) and 5(3)*¹. The Environment Protection Agency (EPA), Department of Primary Industries – Water (now Department of Planning and Environment - Water) and Water NSW have been / previously been consulted. Further consultation has also been sought from these agencies (see **Appendix A**). Strategic Environmental & Engineering Consulting (SEEC) were also previously approved by Department of Planning and Environment (DPE) as being suitably qualified and experienced for preparation of this WMP.

In addition to this WMP, a range of other management plans have also been prepared to guide operations within the Quarry. These include the following.

- Environmental Management Strategy
- Noise Management Plan
- Transport Management Plan
- Landscape Management Plan
- Air Quality Management Plan
- Aboriginal Heritage Management Plan

¹ All conditions in Project Approval 08_0212 are referenced as the schedule number followed by the condition number in brackets, e.g. *PA Condition 3(13)*.



2. APPROVED ACTIVITIES AND STAGED OPERATIONS

2.1 APPROVED ACTIVITIES

The principal activities approved at the Quarry (**Figure 2**) comprise the following.

- Construction of visibility barriers to provide visual screening for the quarry operations.
- Extraction and stockpiling of clay/shale from the extraction area using standard ripping, pushing and loading techniques.
- Transportation of up to 150,000t per year of quarry products via Berrima Road using articulated and rigid trucks not exceeding 19m in length.

The relevant limitations upon the approved activities nominated in Conditions within Project Approval 08_0212 are as follows.

- “The Proponent must not carry out any development in the extraction area below a level of 640m AHD” *PA Condition 2(6)*.
- “The Proponent must not extract more than 150,000 tonnes of extractive materials from the site in any calendar year” *PA Condition 2(7)*.
- “The Proponent must not transport more than:
 - a) 150,000 tonnes of product from the site in any calendar year;
 - b) 68 laden trucks from the site in a day; and
 - c) 8 laden trucks from the site in an hour.

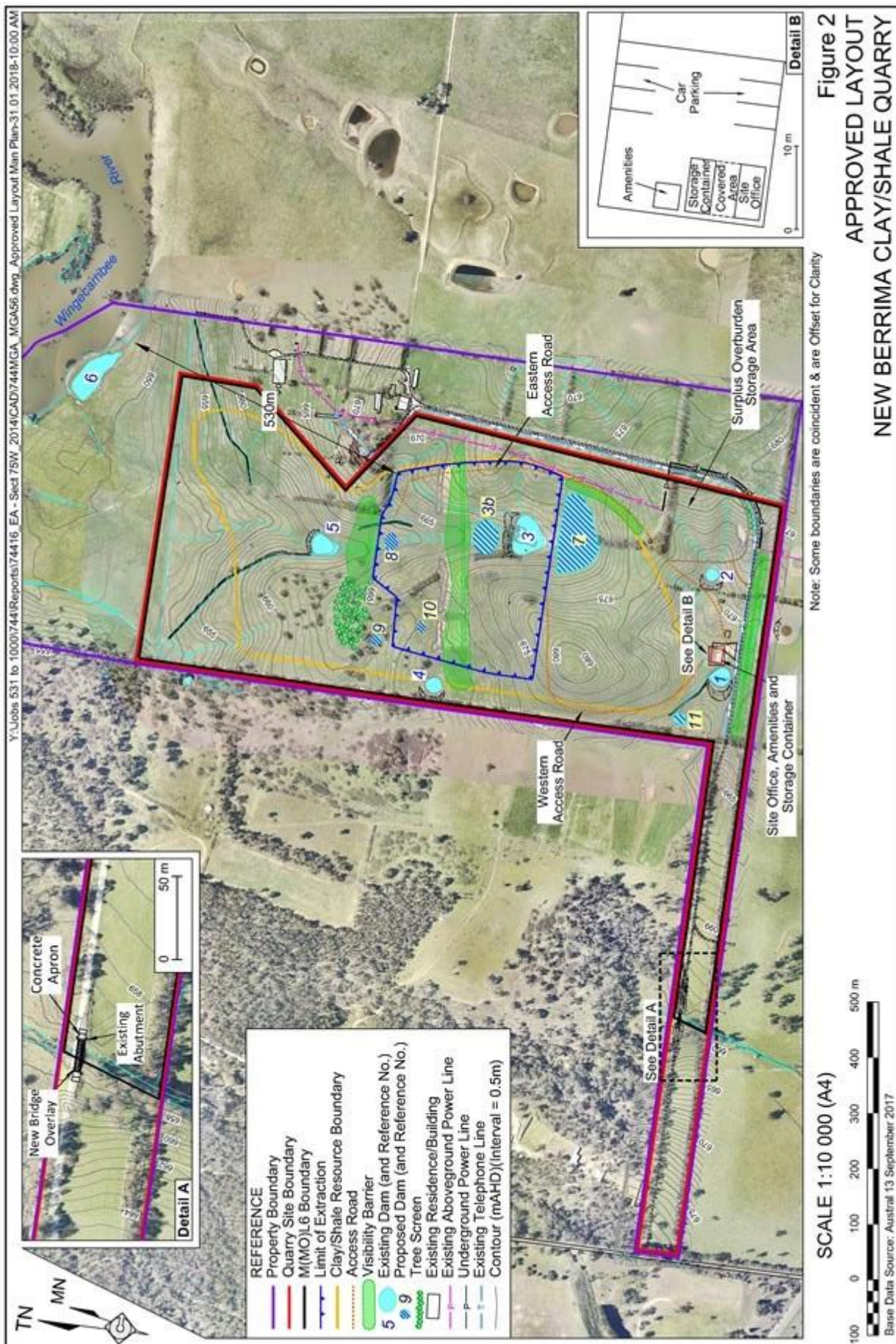
The approved quarry life is until 31 December 2045 and the approved hours of operation are outlined in **Table 1**.

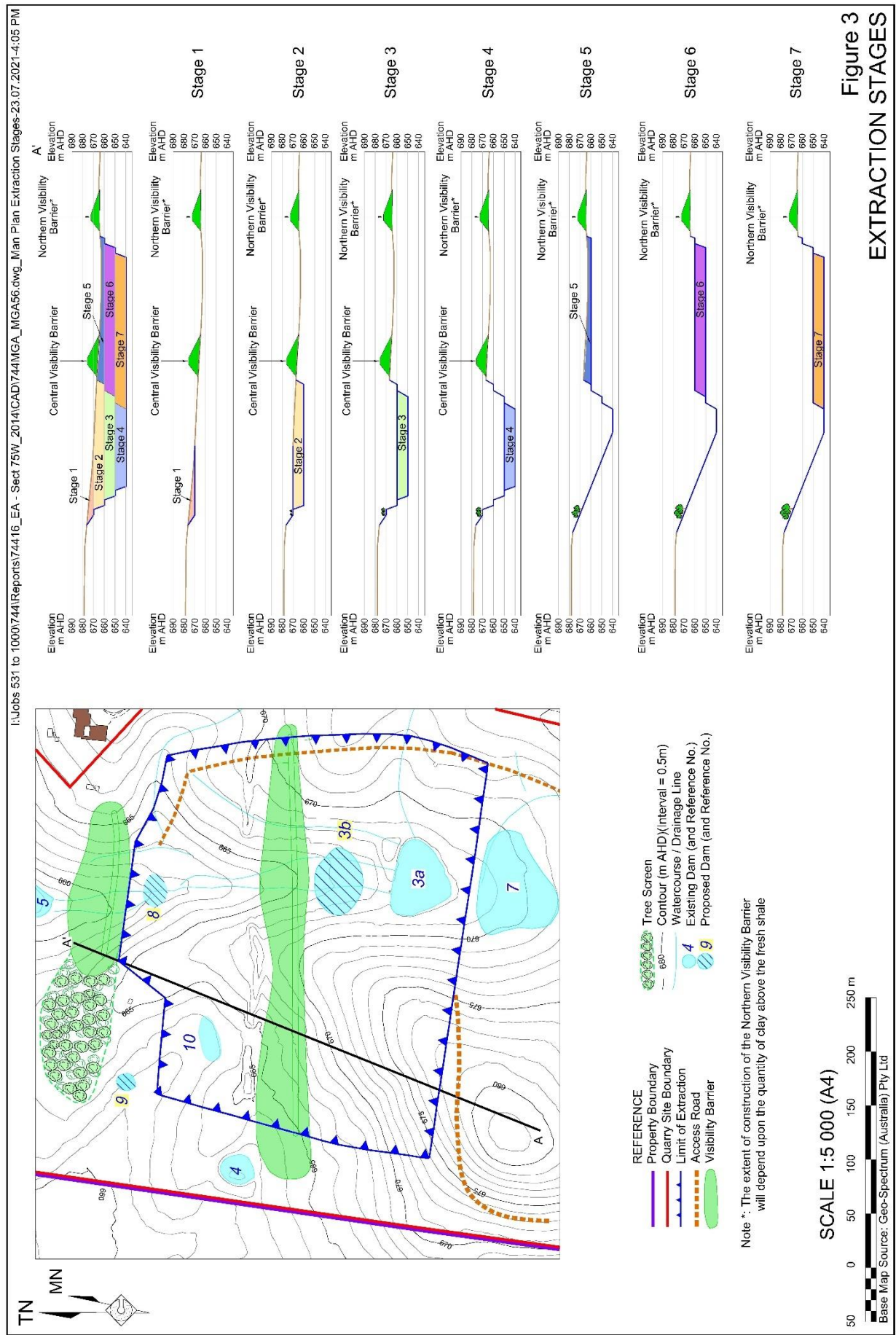
Table 1
Hours of Operation

Day	Construction and Extraction Operations	Clay/Shale Transportation
Monday – Friday	7:00am to 5:00pm	7:00am to 4:00pm
Saturday	8:00am to 1:00pm	8:00am to 1:00pm
Sundays and Public Holidays	None	None

2.2 STAGED OPERATIONS

Figure 3 displays the staging sequence throughout the life of the Quarry. The southern section would be extracted in four stages, namely Stages 1 to 4. Once extraction ceases in the southern section, extraction would commence in the northern section with extraction undertaken in three stages, namely Stages 5 to 7. It is noted that, whilst the stages will progress sequentially, the actual timing for each stage will be largely dependent on the raw material requirements at the Bowral Brick Plant.





3. LEGAL AND OTHER REQUIREMENTS

3.1 PROJECT APPROVAL 08_0212

Austral was granted PA 08_0212 by the (then) Director-General of Planning and Infrastructure on 7 July 2012 pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Modification 1 of PA 08_0212 was issued on 15 December 2015 to incorporate modifications to the Quarry associated with an alternate extraction area boundary. Modification 2 of PA 08_0212 was approved on 6 July 2017 to incorporate modifications to the Quarry associated with the construction of a new bridge over Stony Creek, the realignment of the western access road, the repositioning of the site office, amenities and storage container, and the installation of underground power and removal of a section of overhead power line. PA 08_0212 includes the conditions that Austral needs to comply with and sets out the matters that need to be addressed within this WMP.

Relevant water-related conditions in PA 08_0212 are reproduced in **Tables 2** and **3** with a reference provided to the section(s) this document where each condition is addressed.

Table 2
Project Approval Requirements Relating to Water Management

Page 1 of 3

Cond No.	Requirement	Plan Section
3	(Soil & Water - Note) The Proponent is required to obtain the necessary water licences for the project under the <i>Water Act 1912</i> and/or <i>Water Management Act 2000</i> .	12.3
3(13)	The Proponent must maintain a minimum buffer distance of 515m (measured from the top of bank) between extraction area and Wingecarribee River.	Figure 2
3(14)	The Proponent must ensure that all surface water discharges from the site comply with section 120 of the POEO Act or, if an EPL has been issued regulating water discharges from the site, the discharge limits (both volume and quality) set for the project in the EPL.	7.4.4.3 9.2
3(15)	The Proponent must ensure it has sufficient water for all stages of the project, and if necessary, adjust the scale of quarrying operations on site to match its available supply.	7.3
3(16)	The Proponent must manage on-site sewage to the satisfaction of Council and EPA.	11.1
3(17)	The Proponent must ensure all chemicals and/or petroleum products on site are stored in accordance with Australian Standard AS1940-2004, <i>The Storage and Handling of Flammable and Combustible Liquids</i> , and in appropriately bunded areas with impervious flooring and of sufficient capacity to contain 110% of the largest container stored within the bund. The flooring and bund(s) must be designed in accordance with: - the requirements of relevant Australian Standards; and - DECC's <i>Storing and Handling Liquids: Environmental Protection – Participants Manual</i>.	11.1, 11.2
3(18)	The Proponent must prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must be prepared in consultation with the EPA, Water NSW and DPI – Water by suitably qualified and experienced persons whose appointment has been approved by the Secretary, and be submitted to the Secretary for approval prior to the construction [of] the visibility barriers on site.	This Document
	In addition to the standard requirements for management plans (see condition 3 of schedule 5), this plan must include a:	7
	(a) Site Water Balance that includes details of: sources and security of water supply, including contingency planning for future reporting periods;	7.3
	- water use on site; - water management on site;	7.2 7.4

Table 2 (Cont'd)
Project Approval Requirements Relating to Water Management

Page 2 of 3

Cond No.	Requirement	Plan Section
3(18) (Cont'd)	reporting procedures, including comparisons of the site water balance each calendar year; and	7.3.2
	describes the measures that will be implemented to minimise clean water use on site;	7.4.7
	(b) Surface Water Management Plan, that includes:	6.3
	detailed baseline data on surface water flows and quality in the water-bodies that could be affected by the project;	9.3.1.1
	- a detailed description of the surface water management system on site, including the: - clean water diversion systems; - erosion and sediment controls; and - water storages;	Appendix B and 7.4
	a plan for identifying, extracting, handling, and the long-term storage of potentially acid forming material on site;	Not Applicable
	- detailed plans, including design objectives and performance criteria, for: - the water storage dams; - reinstatement of drainage lines on the rehabilitated areas of the site; - control of water pollution from rehabilitated areas of the site;	Appendix B and 7.4
	- performance criteria for the following, including trigger levels for investigating any potentially adverse impacts, for the following: - the water management system; - surface water quality of local water ways; and - ecosystem health of local water ways;	9.2, 9.4
	performance criteria for surface water quality attributes relevant to water quality impacts on biological diversity and aquatic ecological integrity, including salinity, heavy metals, sediment load, pH, hardness and biological oxygen demand;	9.2, 9.4
	- a program to monitor - the effectiveness of the water management system; - surface water flows and quality in local water ways; and - ecosystem health of local water ways;	9, Appendix B
	a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project; and	12, 14, 15
	(c) Groundwater Management Plan, which includes:	
	detailed baseline data on groundwater levels, yield and quality in the area, that could be affected by the project;	10.1
	groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;	10.2, 10.3
	- a program to monitor: - groundwater inflows to the quarrying operations; - the impacts of the project on: - local alluvial aquifers; - any groundwater bores on privately-owned land that could be affected by the project; - the seepage/leachate from water storages or backfilled voids on site; and - groundwater dependent ecosystems;	10.2
	a plan to respond to any exceedances of the groundwater assessment criteria;	10.3

Table 2 (Cont'd)
Project Approval Requirements Relating to Water Management

Page 3 of 3

Cond No.	Requirement	Plan Section
4(1)	As soon as practicable after obtaining monitoring results showing an: (a) exceedance of any relevant criteria in schedule 3, the Proponent must notify affected landowners in writing of the exceedance, and provide regular monitoring results to each of affected landowner until the project is again complying with the relevant criteria.	10.3
5(3)	The Proponent must ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include: (a) detailed baseline data;	6.3
	(b) a description of: - the relevant statutory requirements (including any relevant approval, licence or lease conditions); - any relevant limits or performance measures/criteria; and - 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;	3
	(c) a description of the measures that will be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	11
	(d) a program to monitor and report on the: - impacts and environmental performance of the project; and - effectiveness of any management measures (see (c) above);	9.3 12
	(e) a contingency plan to manage any unpredicted impacts and their consequences;	14, 15
	(f) a program to investigate and implement ways to improve the environmental performance of the project over time;	8.2.3, 12, 17
	(g) a protocol for managing and reporting any: - incidents; - complaints; - non-compliances with statutory requirements; and - exceedances of the impact assessment criteria and/or performance criteria; and	12, 13, 14, 15
	(h) a protocol for periodic review of the plan. Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans.	17
5(7)	The Proponent must notify, at the earliest opportunity, the Secretary and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment. For any other incident associated with the project, the Proponent must notify the Secretary and any other relevant agencies as soon as practicable after the Proponent becomes aware of the incident. Within 7 days of the date of the incident, the Proponent must provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.	15
5(8)	The Proponent must provide regular reporting on the environmental performance of the project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval.	16

Table 3
Statement of Commitments Relating to Water Management

Commitment			Plan Section
Desired Outcome	Action	Timing	
Minimisation of potential impacts on surface water quality and supply of the local watercourse system, particularly the Wingecarribee River.	4.1 Ensure early and progressive revegetation of amenity bunds and rehabilitation of completed extraction areas.	Ongoing	8.2.1.1
	4.2 Use of any water sourced from the sedimentation basins for dust suppression within the upslope catchment of a sedimentation basin.	As required	Not Applicable
	4.3 Install sediment control fencing around the amenity bunds under construction and other areas of exposed soil until vegetation has been established.	As required	Appendix B
	4.4 Construct and operate various surface water management controls such as diversion structures and sedimentation basins in accordance with the Water Management Plan.	During the construction periods	Appendix B
	4.5 Armour potential scour points (e.g. channel inlets / outlets and bends) with rock.	During the construction periods	8.2.1.2
	4.6 Inspect diversion structures monthly and within 24 hours following any rain event that generates flow in the drains to identify areas of erosion, scour or damage. Repair any problem areas and/or take appropriate stabilising action.	Ongoing	8.2.2

3.2 OTHER APPROVALS, LEASES AND LICENCES

Other approvals and licences relevant to the site include Mining (Mineral Owners) Mining Lease 6 which was granted by the Department of Planning and Environment, Division of Resources and Geoscience on 27 June 2017 for the area displayed on **Figure 2** and Environment Protection Licence (EPL) 20377 issued by the Environment Protection Authority on 1 August 2016 and last varied 29 January 2021.

Mining (Mineral Owners) Mining Lease 6 does not contain any specific requirements relevant to this WMP. EPL 20377 contains a range of requirements relevant to this WMP which are summarised in **Table 4** with a reference to the section(s) in this document where the requirement is addressed.

Table 4
EPL 20377 Requirements Relating to Water Management

Cond No.	Requirement			Plan Section	
P1.3	The following points referred to in the table are identified in this licence for the purposes of the monitoring and/or the setting of limits for discharges of pollutants to water from the point.			9.3	
	Water and Land				
	EPA No.	Type of Monitoring and Discharge Point	Location Description		
	4	Water Quality Monitoring Discharge to waters	South west of the quarry void and labelled WS4 on map titled "EPL Monitoring Locations" dated August 2019 (DOC19/862266)		
	5	Water Quality Monitoring Discharge to waters	North of the quarry void and labelled WS5b on map titled "EPL Monitoring Locations" dated August 2019 (DOC19/862266).		
L1.1	Except as provided in any other condition of this licence, the licensee must comply with section 120 of the <i>Protection of the Environment Operations Act 1997</i> .			9.2, 9.4	
L2.4	Water and/or Land Concentration Limits (Points 4,5)			7.4.5	
	Pollutant	Units of Measure	100 th percentile concentration limit		
	Oil and Grease	Visible	Nil visible		
	pH	pH	6.5-8.5		
	Total Suspended Solids	Milligrams per litre	50		
L2.5	Exceeding the limits specified in Condition L2.4 of this licence for pH and total suspended solids (TSS) for discharges from the sediment basins identified by Condition P1.3 is only permitted when the discharge occurs solely as a result of rainfall measured at the premises. The rainfall must exceed the 5 day rainfall depth value for the corresponding discharge point in the table below over a consecutive 5 day period for discharge to be considered to occur solely as a result of rainfall.			7.4.5.2	
	EPA Identification No.	Classification of Basin	Design 5 Day Rainfall Event (mm)		
	4, 5	85 th	36.2mm		
L2.6	If the licensee uses turbidity (NTU) in place of total suspended solids (TSS), the licensee must develop a relationship between NTU and TSS for water quality in the sediment basins in order to determine the NTU equivalent of 50 mg/L TSS. The licensee must develop and implement a method to enable the ongoing verification of the relationship between NTU and TSS.			7.4.5	
L2.7	The licensee must provide the EPA with a copy of the statistical correlation assessment methodology and results before using NTU in place of TSS.			9.2	
L2.8	The licensee must develop and implement a method to enable the ongoing verification of the relationship between NTU and TSS.			9.2	
M2.3	Water and/or Land Monitoring Requirements (Points 4,5)			9.3	
	Pollutant	Units of Measure	Frequency		Sampling Method
	Oil and Grease	Visible	Daily During any Discharge		Inspection
	pH	pH			Probe
	Total Suspended Solids	Milligrams per litre			Grab sample
	Turbidity	Nephelometric turbidity units			Probe

4. ROLES AND RESPONSIBILITIES

Table 5 presents the roles and responsibilities for the implementation of this WMP.

Table 5
Roles and Responsibilities

Roles*	Responsibilities
NSW Manufacturing Manager	Ensure adequate resources are available to enable implementation of the WMP.
Raw Materials and Mining Manager	Accountable for the overall environmental performance of the Quarry operations, including implementation of all water management controls outlined in Section 8.
Environment Manager (also referred to as the Site Environmental Manager in Appendix B)	Manage the implementation of the following components of this WMP. • Inspection, monitoring and maintenance of all erosion and sediment controls as outlined in Sections 9 and 10. • Evaluation of compliance as outlined in Section 12 and related follow-up actions. • Complaints handling and response as outlined in Section 13. • Incident reporting as outlined in Section 15. • Coordinate Environmental Monitoring and publishing of data as outlined in Section 16. • Review of this WMP as outlined in Section 17. • Conduct environmental component of site induction for all employees and contractors – see Section 5.
All personnel	• Ensure training and awareness induction has been undertaken. • Compliance with this WMP.
* Or equivalent position delegated these responsibilities.	

5. COMPETENCE TRAINING AND AWARENESS

All Company personnel and contractors and their employees will undergo Company and site-specific inductions, incorporating basic information in relation to the operation of this WMP as a component of the site induction program. The Environment Manager or delegate will be responsible for ensuring that all relevant employees are appropriately inducted prior to undertaking any ground-disturbing works and are re-inducted on at least a 2-yearly basis.

6. DRAINAGE, CATCHMENTS AND DAMS

6.1 CATCHMENTS AND DRAINAGE

The extraction area occupies the northern extent of a hillcrest position with radial drainage primarily towards the north and east. Although all surface runoff from the Quarry Site ultimately reaches the Wingecarribee River, the Quarry Site can be divided into two main catchments, the northern and southern catchment (see **Figure 4**). The northern catchment drains directly to the Wingecarribee River whilst the southern catchment drains to Stony Creek.

Both of these catchments receive run-on from external lands west and south of the Quarry Site. Adjoining lands include agricultural activities with potential for sediment laden run off. Although there are first and second order streams marked on the topographic map all drainage lines are in fact open grassy depressions with no bed or banks.

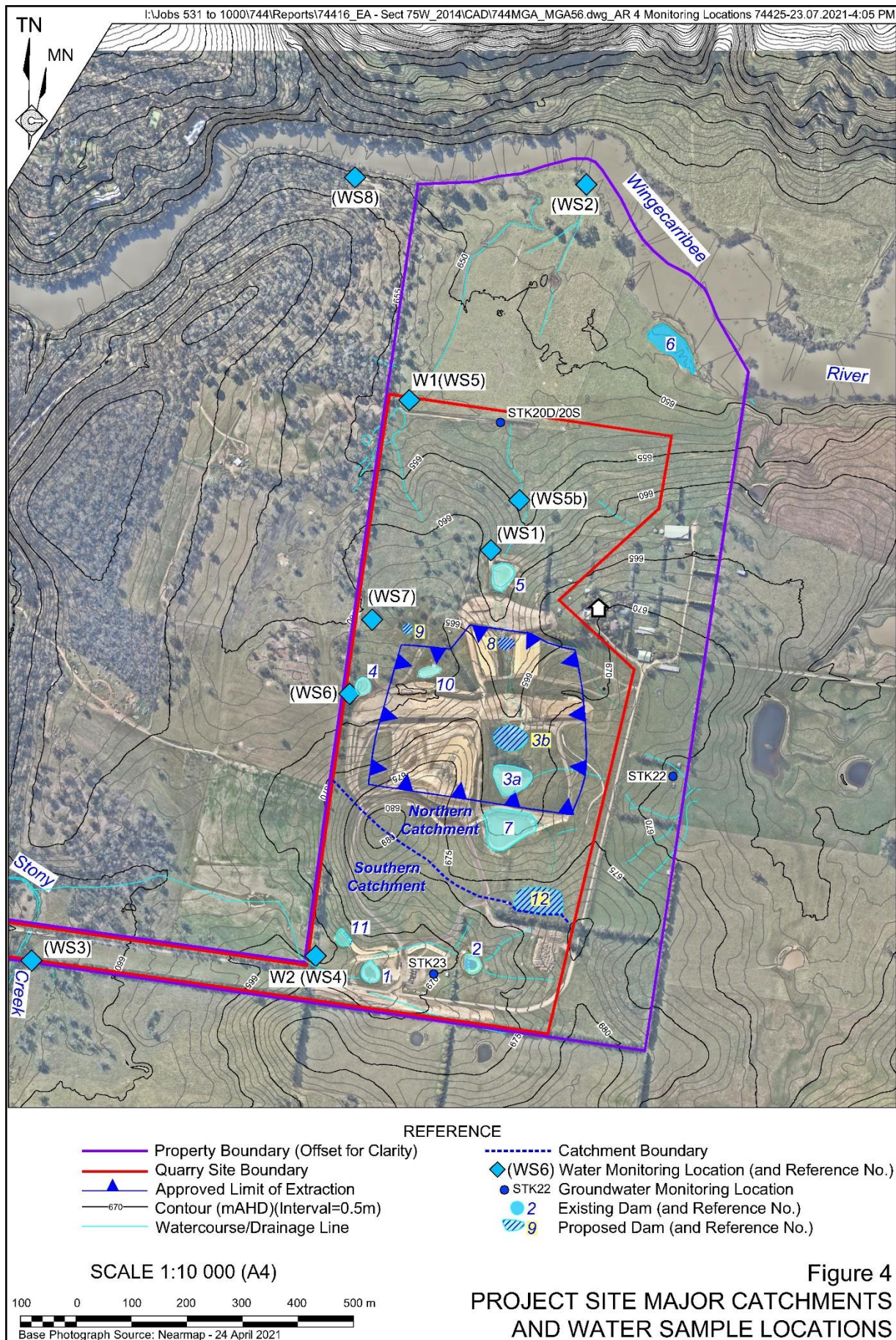
6.2 PRE-COMMENCEMENT DAMS

Prior to commencement of operations there were five existing farm dams within the Quarry Site and one off-site dam on the northern boundary of the property (Dam 6). All appear to be structurally sound and capable of holding water. The existing farm dams are numbered on **Figure 4** and their estimated capacities are shown in **Table 6**.

Table 6
Pre-Commencement Dam Sizes

Structure Number	Approximate Surface Area (m ²)	Assumed Capacity (ML)
1	950	1.4
2*	460	0.7
3	2,960	4.4
4*	670	1.0
5	1,570	2.4
6	3,000	2.5
Total	9,610	12.4
*These dams have now been upgraded as outlined within this WMP.		

The combined capacity of these existing dams is estimated to be 12.4ML which exceeds the Harvestable Right Capacity of 8.5ML. However, they were all built before 1999 and have been used for stock purposes and so they do not require a licence. Nevertheless, these dams were included in the assessment to build additional dams (see Section 7.4.1.2).



6.3 BASELINE WATER QUALITY

Water samples were collected on 22 August 2008 at WS1, WS2 and WS3 prior to the preparation of the 2010 *Environmental Assessment*. Since May 2017, a regular water monitoring program has been commenced and samples are collected monthly (when water is present) at all monitoring sites (WS1 to WS8). The location of these sites is shown in **Figure 4** and summarised below.

- WS2 represents the upstream Wingecarribee River monitoring location and WS8 represents the downstream location,
- WS1, WS5, WS6 and WS7 represent monitoring locations within ephemeral drainage lines within the Quarry Site which ultimately report to the Wingecarribee River. WS5 is also located on the confluence with drainage lines from the property west of the Quarry Site. As a result, monitoring since November 2018 has been undertaken at monitoring location WS5b, which is located upstream of this confluence and will not be affected by water runoff from the adjacent property.
- WS4 is located within an ephemeral drainage line in the southern part of the Quarry Site which reports to Stony Creek.
- WS3 is located within Stony Creek upstream of any Quarry activities.

Monitoring up to and including October 2020 are considered baseline water quality results (with site establishment commencing November 2020). The results of laboratory testing for baseline monitoring are summarised in **Table 7** and key parameters are graphed in **Charts 1 to 3**. General conclusions that can be drawn from the baseline water quality monitoring are as follows.

- Water was not present at WS4, WS5b, WS6 and WS7 during any monitoring events and was not present at WS1 since the August 2008 sampling event. Water was also only present at WS5 on two occasions. As these are ephemeral drainage lines located in well vegetated catchments, run off events will be limited to short periods following adequate rainfall.
- At WS2 (Wingecarribee River upstream) and WS8 (Wingecarribee River downstream), water has been present during all monitoring events. As would be expected, the results for most parameters are very similar between these locations with near neutral pH ranging from 6.2 to 7.8 and low electrical conductivities ranging from 102µS/cm to 390µS/cm. Whilst generally low, total suspended solids (TSS) and turbidity at WS2 (upstream) range from 3mg/L to 77mg/L with a median of 15mg/L and 5.3NTU to 75NTU with a median of 18NTU respectively. At WS8 (downstream) TSS and turbidity has ranged from 4mg/L to 250mg/L with a median of 11mg/L and 3.5NTU to 70NTU with a median of 16NTU respectively. It is noted that the higher maximum TSS at WS8 (downstream) may be related to agricultural activities on the landholding west of the Quarry Site with monitoring location WS5 previously relocated to WS5b due to runoff from the adjoining property confounding results.
- At WS3 (Stony Creek upstream), water has also been present during all monitoring events and, similar to Wingecarribee River, has near neutral pH ranging from 6.6 to 8.1. However, the electrical conductivity, TSS and turbidity are higher, ranging from 215µS/cm to 970µS/cm, 2mg/L to 380mg/L and 0.6NTU to 180NTU and is likely reflective of agricultural and industrial activities further upstream.

- At WS5, sufficient water was present in June and July 2017 to collect samples for analysis. The pH was also near neutral at 6.4 and 6.7 and electrical conductivity was low at 120 μ S/cm and 135 μ S/cm. Similar to WS3, TSS and turbidity were elevated, at 61mg/L and 290mg/L and 80NTU and 180NTU respectively.

6.4 AQUATIC HABITAT

There is no aquatic habitat within the Quarry Site nor any groundwater dependent ecosystems within the “Mandurama” property.

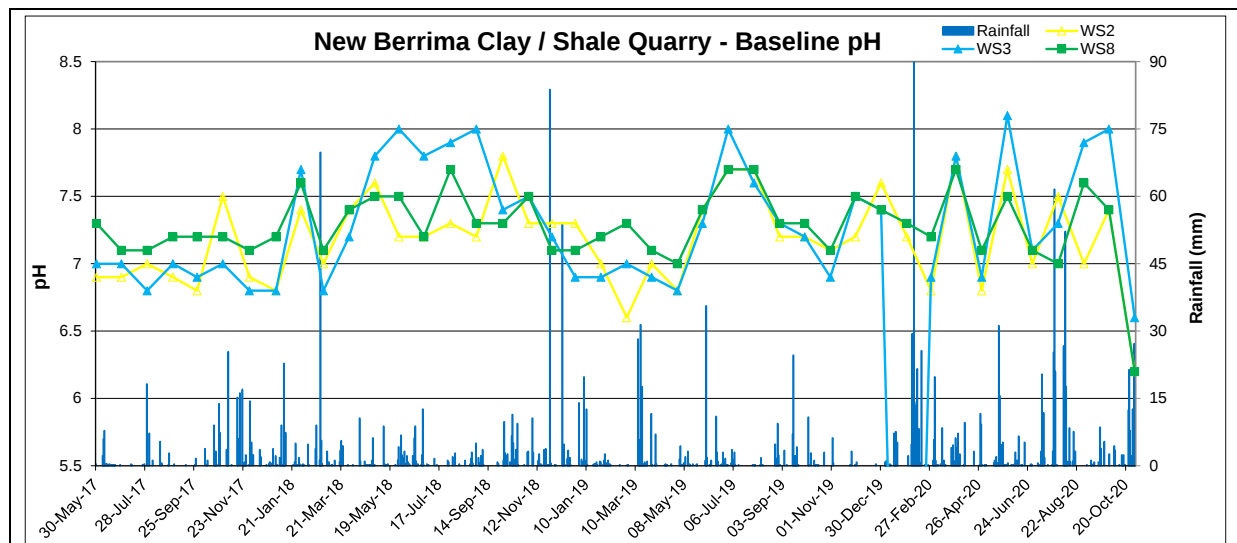


Chart 1
Baseline pH (2017 to October 2020)

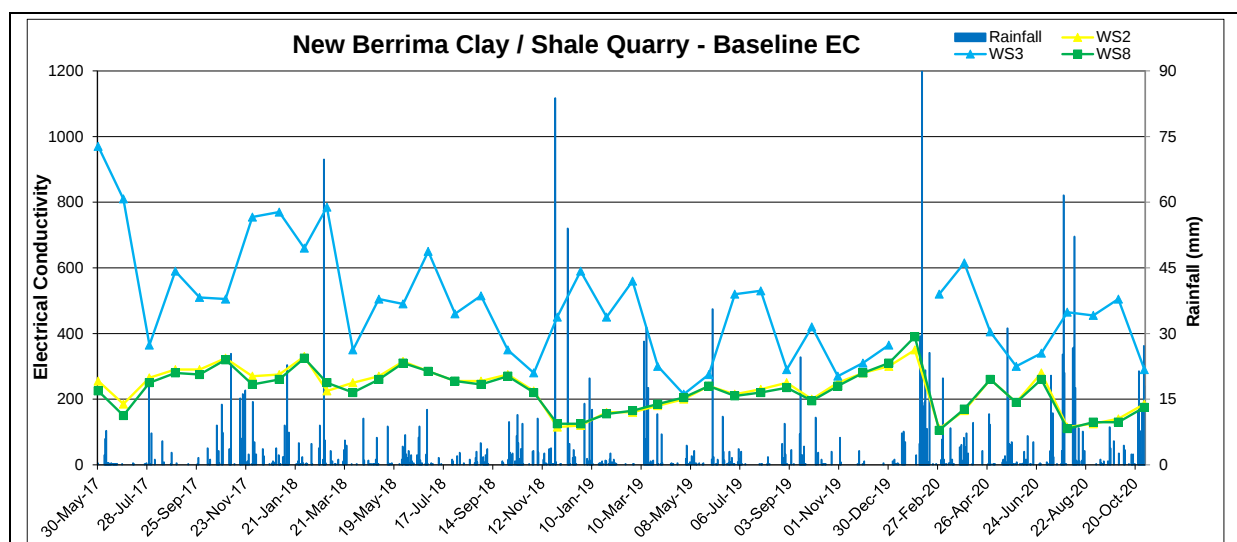


Chart 2
Baseline EC (2017 to October 2020)

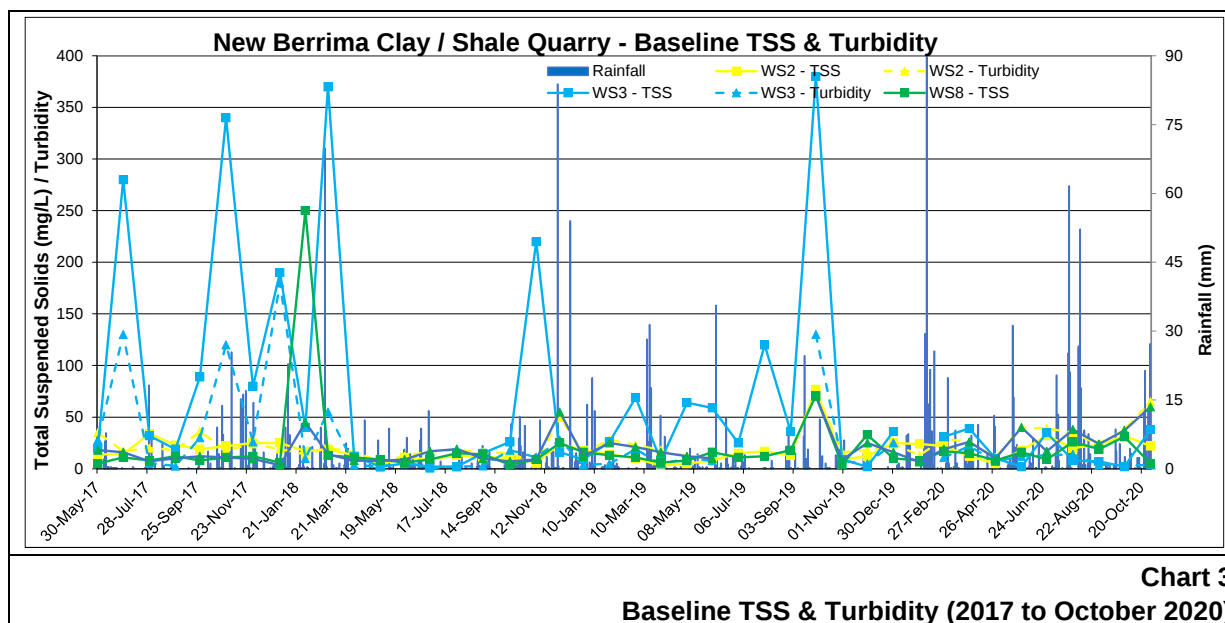


Table 7
Results of Water Quality Testing (2017 to October 2020)

Parameter	Units	WS1		WS2		WS3		WS4		WS5		WS5b		WS6		WS7		WS8	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
pH		7.7	7.7	6.2	7.8	6.6	8.1	NS	NS	6.4	6.7	NS	NS	NS	NS	NS	NS	6.2	7.7
EC	µS/cm	7.7		7.2		7.2				6.6								7.3	
		393	393	102	350	215	970			120	135							105	390
		393.0		250.0		462.5				127.5								237.5	
Sodium	mg/L	26.9	26.9	8.2	44.0	10.0	80.0			17.0	18.0							8.0	45.0
		26.9		23.0		27.0				17.5								22.0	
Potassium	mg/L	27.1	27.1	1.2	10.0	1.8	26.0			2.1	4.8							2.1	13.0
		27.1		5.1		6.9				3.5								5.0	
Calcium	mg/L	13.6	13.6	3.6	23.0	24.0	92.0			3.9	4.6							5.0	26.0
		13.6		14.0		58.5				4.3								15.0	
Magnesium	mg/L	7.9	7.9	2.3	11.0	5.7	28.0			2.3	2.8							2.6	9.4
		7.9		6.1		9.6				2.6								6.0	
Chloride	mg/L	60	60	15	53	19	195			35	37							18	53
		60.0		33.0		50.5				36.0								32.5	
Sulfate	mg/L	2	2	2	82	3	285			2	2							4	83
		2.0		24.0		27.0				2.0								31.0	
Bicarbonate	mg/L	NT	NT	29	82	17	315			12	21							8	79
		NT		51.5		180.0				16.5								48.5	
Phosphate	mg/L	NT	NT	0.1	0.3	0.1	1.3			0.1	0.1							0.1	0.3
		NT		0.1		0.1				0.1								0.1	
Fluoride	mg/L	NT	NT	0.1	1.7	0.1	0.3			0.1	0.1							0.1	0.4
		NT		0.1		0.2				0.1								0.1	
Nitrate	mg/L	NT	NT	0.1	4.6	0.1	4.7			0.1	0.1							0.1	4.4
		NT		1.2		0.1				0.1								1.2	
Total Ammonia	mg/L	NT	NT	0.0	1.6	0.1	3.3			0.1	0.3							0.1	0.3
		NT		0.1		0.1				0.2								0.1	
TKN	mg/L	7.3	7.3	0.1	3.8	0.1	17.0			1.5	1.7							0.1	2.4
		7.3		1.1		1.2				1.6								1.2	
Total Phosphorus	mg/L	0.2	0.2	0.0	2.0	0.0	2.5			0.2	0.8							0.0	0.2
		0.2		0.1		0.4				0.5								0.1	
TSS	mg/L	32	32	3	77	2	380			61	290							4	250
		32.0		15.0		26.0				175.5								11.0	
Turbidity	NTU	NT	NT	5.3	75.0	0.6	180.0			80.0	180.0							3.5	70.0
		NT		18.0		10.0				130.0								16.0	

NS = No Sample

NT = Not Tested

6.5 WATERFRONT LANDS

There are no Quarry-related works proposed within 40m of the Wingecaribee River and, although there are first and second order streams marked on the topographic map, all drainage lines at the site are in fact open grassy depressions with no bed or banks. Therefore, these are considered not to be classified as waterfront land.

Whilst not related to the Quarry operations or approvals, it is noted that, Austral Bricks in conjunction with Greening Australia, have fenced ~400m frontage along Wingecaribee River excluding further cattle grazing and planted out native species to enhance both the riparian habitat and water quality.

7. SITE WATER BALANCE

7.1 INTRODUCTION

The following site water balance provides an overall description of where all water is sourced, where it is used, how much of it is used and where it ultimately ends up. It identifies the proposed storages and their volumes and whether they are used for dirty water (e.g. sediment basins, pumping dams, sumps) or for clean, useable, water (either as part of the works or for agricultural purposes).

7.2 WATER USES AND DEMAND

7.2.1 On-site Water Demand

There are three demands for water, namely:

- staff requirements and ablutions;
- dust suppression; and
- machinery washdown.

7.2.2 Amenities and Ablutions Supply

The site office and ablutions will be supplied by potable water imported by tanker or 20L bottles, i.e. no water collected on site will be used. Note: toilets are portable pump-out toilets.

7.2.3 Dust Suppression

Based on the distance of the unsealed access road between the edge of the extraction area and the Stony Creek bridge, allowing for an average width of 4m, approximately 4,800m² of internal roads will need dust suppression. On dry days, the required water application rates are expected to be 1L/m²/application with time between applications of 2 hours (watering up to 5 occasions per day) resulting in a daily water demand of 24kL. Dust suppression will only be required when extraction and haulage activities are underway, which is estimated to be approximately 90 days spread over a year (assuming haulage intensity occurs at ~80% of the maximum approved truck movements), equating to a water usage of 2.16ML per year. Alternatively, road sealing options may be investigated to reduce or remove the need for application of water during haulage.

However, haulage may occur at a greater intensity but over fewer days or a lower intensity over more days. In the first instance, the rate of water application would increase but would be required over fewer days. In the second instance, the rate of water application would decrease but occur over more days. As a result, a water cart will be kept on site at all times during extraction or haulage operations to enable watering of sections of the Site Access Road on an as required basis. To allow for fluctuations in dust suppression requirements, an extra allowance of 1ML per year is provided for this purpose so the annual total volume for dust suppression will be 3.16ML during operations.

Given that Austral will now seal the access road from Berrima Road to the Extraction Area (above and beyond conditional requirements), the above estimates demonstrate the volume of water that will be saved annually over the life of the Quarry.

7.2.4 Washdown

The requirement for washdown water (for machinery washdown) will be minimal but, if required, an additional 2,000L might be required each day that the Quarry is operational, i.e. 90 days per year. This equates to 0.18ML per year.

7.3 SOURCES AND SECURITY OF WATER SUPPLY

7.3.1 Water Supply

Water for dust suppression and washdown will be preferential sourced from ‘dirty’ water dams, primarily from the Quarry sumps (Dam 3b during Stages 1 to 4 and Dam 8 during Stages 5 to 7) (see **Figure 4**). If necessary in dry periods, or for operational / water management purposes, water will also be supplied from one or more of the other dams.

7.3.2 Water Security

Section 4.6.3 of the 2015 *Environmental Assessment* (RWC, 2015) provides an assessment of the water supply confidence based upon a water balance spreadsheet developed by Strategic and Environmental Engineering Consulting (SEEC) Pty. Ltd. The spreadsheet was calibrated using 99.33 years of daily rainfall data from the Bureau of Meteorology’s Moss Vale rainfall station. The spreadsheet took into account inherent system losses (e.g. surface wetting) and used a 20% volumetric runoff coefficient for a 2.5ha vegetated catchment to Dam 7. These calculations determined that the Quarry water demand would, on average, be met by Dam 7 for 99% of the time.

However, following a review of the water management system during preparation of the 2018 WMP and, given the location of Dam 7 above the highwall, once extraction commences north of Dam 7 it is considered preferable to maintain Dam 7 as empty as practicable by pumping water captured in it around the extraction area. As a result, utilisation of Dam 7 as a water storage is now not proposed.

Therefore, water for dust suppression will principally be obtained from the Quarry sumps (Dams 3a/3b and 8), which will provide a beneficial use of ‘dirty’ water. The Quarry sumps both have catchments larger than 2.5ha and their disturbed catchments would have a runoff coefficient higher than that previously assumed for the vegetated Dam 7 catchment. Notwithstanding, if necessary, water could also be sourced from one or more of the sediment basins (Section 7.4.2). The Quarry does not require make-up water.

Volumes of water used on site will be logged with their date and purpose and reported in the Quarry’s *Annual Review*. The volumes will be compared each year to gauge their consistency or variability.

7.4 WATER MANAGEMENT

7.4.1 Pollution Risks

As noted within the 2010 Environmental Assessment and subsequent documentation, the greatest risk to water quality attributable to the Quarry is the flow of sediment-laden runoff to the Wingecarribee River. Additional sources of potential impacts on surface water quality include the potential for hydrocarbon spills such as fuels, oils and hydraulic fluids.

It is noted that there is no evidence of pyritic material or acid generation issues within the Ashfield Shale. As such, water quality issues associated with acid generation, such as generation of heavy metals, are considered to be very low risk. Notwithstanding, monitoring of pH will occur to demonstrate that acid generation is not occurring.

Therefore, in order to protect water quality, biological diversity and ecosystem integrity, the principal matters to be managed and monitored include sediments, pH and hydrocarbons.

7.4.2 Storage

7.4.2.1 Introduction

There will be thirteen water storages at the Quarry Site, although not all will be active at the same time. The storages are summarised in **Table 8**. The use of an individual storage can change depending on the stage of works and so sometimes a storage might be used as a sediment basin while at other times it might be a clean water storage. When storages are used as sediment basins, captured dirty water will either be pumped to the Quarry Sump or Dam 12 (once constructed) and utilised for Quarry operations (i.e. dust suppression and wash down, refer to Section 7.2) or treated, if necessary, and discharged. Direct treatment and discharge from the sediment basins may also be undertaken if required to ensure compliance with EPL conditions. When storages are considered ‘clean’ (i.e. no impact on water quality from Quarry activities, or water has been managed to achieve the required EPL conditions) they may be used for either Quarry or farm uses.

7.4.2.2 Harvestable Right

NSW harvestable right legislation permits landholders to build a certain volume of dams without requiring a licence. The total volume is called the harvestable right and there are two factors that determine it for a parcel of land, namely:

- the property’s geographical location; and
- the area of the property (ha).

Table 8
Water Management Structures

No.	Est Stages 1-4	Ops Stages 1-4	Est Stages 5-7	Ops Stages 5-7	Final Landform	Current Capacity	Revised Minimum Sediment Basin Volume [^]	Management
1	Dirty	Clean	Clean	Clean	Clean	Existing ~1.4ML	0.44ML	Sediment Basin during Stage 1 establishment. No management when clean.
2	Dirty	Dirty	Dirty	Dirty	Clean	Increased to 1.8ML	1.8ML	Sediment basin throughout all operations (unless catchment area suitably stabilised).
3a	Dirty	NA (removed)	NA (removed)	NA (removed)	NA (removed)	Existing ~4.4ML	No longer required	Sediment basin during Stage 1 initial establishment then decommissioned and replaced with 3b as extraction continues.
3b	NA	Dirty	Dirty	Dirty	NA (removed)	Not yet constructed	No minimum – within the Quarry extraction area	Quarry Sump for Stages 2-4.
4	Dirty	Clean	Dirty	Clean	Clean	Increased to 1.4ML	1.06ML	Sediment basin during both establishment stages. No management when clean.
5	Dirty 3.73ML	Dirty* 2.1ML	Dirty 2.1ML	Dirty* 0.5ML	NA (removed)	Increased to 4.0ML	Variable Minimum Sizing	Sediment basin throughout all operations (*unless catchment area suitably stabilised / dirty water does not report to the basin).
6	Clean	Clean	Clean	Clean	Clean	2.5ML	NA	Not related to Quarry Site operations.
7	Dirty*	Clean	NA (removed)	NA (removed)	NA (removed)	Constructed to 8.65ML	NA	Dam 7 will capture clean water that cannot be passively diverted around the extraction area. It will be pumped around the extraction area and released as clean water.
8	NA	NA	NA	Dirty	Clean	Not yet constructed	No minimum – within the Quarry extraction area	Quarry Sump for Stages 5-7. Farm dam in final landform.
9	NA	NA	Dirty	NA (removed)	NA	Not yet constructed	0.53ML	Sediment basin during Stage 5-7 establishment then decommissioned.
10	Dirty	NA (removed)	NA	NA	NA	Constructed to 0.23ML	0.15ML	Sediment basin during Stage 1-4 establishment then decommissioned.
11	Dirty	Clean	Clean	NA (removed)	NA	Constructed to 0.26ML	0.26ML	Sediment basin during Stage 1-4 establishment. As access road will be sealed the dam will be retained as a precaution but will be functionally managed as a clean water dam. Removed following establishment of eastern access during Stages 5 to 7.
12	Dirty	Dirty	Dirty	Dirty	NA (removed)	Not yet constructed	12ML [#]	Dirty water storage and treatment dam throughout life of Quarry. Receives dirty water pumped from other sediment basins. Turkeys nest construction. Removed in final landform.

Est – Establishment, Ops = Operations

* Dam 7 will include a period during which minor sediment laden water may report to it until disturbances are stabilised (see Section 7.4.2)

[^] Dam sizing for sediment basins is the minimum required in accordance with Landcom (2004) and DECCW 2008) and is only required for those stages where the sediment basin catchment is classified as “dirty”.

[#] Dam 12 is not a formal sediment basin. Rather a nominal maximum size is provided based on the storage of twice the settlement zone of all other sediment basins.

The 100.2ha property was assessed using the harvestable right dam calculator at <http://www.water.nsw.gov.au/Water-Licensing/Basic-water-rights/Harvesting-runoff/Calculator/default.aspx> on 13 March 2015. The calculator shows the Property has a harvestable right of 8.5ML. This was exceeded by the existing dams but dams used for pollution control purposes (i.e. sediment dams and clean water dams used to prevent water entering ‘dirty’ catchment areas) are exempt from the harvestable right calculation. In summary:

- Dam 1 (1.4ML) will, at one time during the life of the Quarry, be a sediment basin for the purpose of maintaining water quality. However, at other times it will remain for agricultural purposes so its volume is included in the harvestable right calculation. Dam 1 will remain in the final landform.
- Dam 2 is adjacent the Surplus Overburden Storage Area and has been enlarged to 1.8ML. It will collect sediment-laden runoff from the Surplus Overburden Storage Area. Water from Dam 2 may either be treated (if necessary) and discharged or pumped to Dam 12 for storage and treatment. Because its use is to prevent sediment-laden water leaving the site, Dam 2 is exempt from the harvestable right calculation during the Quarry’s life. However, Dam 2 will remain in the final landform.
- Dam 3a will, for a short time, collect dirty water during establishment of Stages 1-4 and will overflow to Dam 5 and, as a result, is exempt from the harvestable right calculation during the Quarry’s life. Dam 3a will quickly be removed and replaced with Dam 3b / Quarry sump as extraction commences.
- Dam 4 will, at times during the life of the Quarry, be a sediment basin for the purpose of maintaining water quality. During those periods water trapped in it will be pumped to either Dam 12 or Dam 5 for treatment. However, at other times it will remain for agricultural purposes and so its volume is included in the harvestable right calculation. The capacity of Dam 4 has been increased to at least 1.4ML. It will also remain in the final landform.
- Once the extraction area becomes internally-draining, Storages 3b and 8 will be sumps in the operational extraction area with water gravitating to them. Dam 3b will be removed following operations but Dam 8 will be retained as a clean water dam as part of the final landform. At that time, Dam 8 will be part of the harvestable right calculation.
- Dams 9 and 10 will be constructed for the purposes of maintaining water quality (i.e. they will be sediment basins) and so they are exempt from the harvestable right calculation. Both are temporary and neither will remain in the final landform.
- Dam 11 will also be constructed as a sediment basin whilst the western access road is stabilised. However, Dam 11 will be retained as a clean water dam receiving runoff from the sloped section of the western access road until the road is decommissioned (during Stages 5 to 7). As such, the volume of Dam 11 has been included in the harvestable right calculation for the operational period.

- Dam 7 is located above the southern boundary of the extraction area and will capture clean water runoff that cannot be diverted around the extraction area due to the existing topography. Without Dam 7, the clean water would flow over the highwall into the extraction area and become dirty water. Therefore Dam 7 is considered a pollution control dam and is exempt from the harvestable right calculation during the Quarry life. Given the location of the dam above the highwall, for operational safety purposes has been sized to capture the 100 year, 24 hour, rainfall intensity which is 9.62mm/hr (233mm/day). Assuming a runoff coefficient (C_{10}) of 0.7 and a catchment of 5.3ha its required volume is calculated as 8.65ML. Once an extraction highwall is formed adjacent Dam 7, water captured in Dam 7 would be pumped around the extraction area and released to receiving waters. Dam 7 will not remain as part of the final landform.
- Dam 5 will be utilised throughout Quarry operations as a sediment basin. During the early establishment stages it will have a maximum catchment of about 18.5ha, most of which would be undisturbed. The catchment area reporting to Dam 5 decreases significantly as the quarry excavation progresses, because the excavation area becomes internally draining. Because its use is to prevent sediment-laden water leaving the site, Dam 5 is exempt from the harvestable right calculation during the Quarry's life. As such, the volume in Dam 5 (up to 4.0ML) is not included as part of the harvestable right calculation. Dam 5 will not remain as part of the final landform.
- Dam 6 (off the Quarry Site but on the Property (**Figure 4**)) will be unaltered and will continue to be used for agricultural purposes. Therefore, its volume (2.5ML) is part of the harvestable right calculation. Dam 6 will remain as part of the final landform.
- Dam 12 is a turkeys nest dam (i.e. has no catchment and only receives water from skyfall and via pumping from other dams). If required for operational efficiencies, Dam 12 will be constructed to provide a single point for dirty water treatment. Dam 12 will only receive dirty water pumped from other sediment basins and the Quarry sump. It will be removed in the final landform. Dam 12 is not included in the harvestable right calculation.

In summary, the Water Management Dams and their capacities that are included within the harvestable right calculation are outlined in **Table 9**. As discussed above, Dams 3a, 5, 7, 9, 10 and 12 do not form part of the operational or final landform harvestable right calculations.

In total, the combined capacity of the water management dams during the operational stages which are not utilised for pollution control equates to 5.56ML, whilst the capacity of dams retained as part of the final landform will equal 8.5ML. These capacities are less than or equal to the permissible harvestable right volume. How the dams are used throughout the Quarry life is discussed in more detail in the following sections.

Table 9
Harvestable Rights Water Management Dams

Identifier	Operational Phases (ML)	Final Landform (ML)*
Dam 1	1.4	1.4
Dam 2	0.0^	1.8
Dam 4	1.4	1.0
Dam 6	2.5	2.5
Dam 8	0.0^	1.8
Dam 11	0.26	0.0
Total Volume	5.56	8.5
^ Dam 2 and Dam 8 will remain as sediment basins during all operational phases and are therefore excluded from the harvestable right. * Should any dam volumes be increased during operations for sediment management, their storage capacity will be reduced to this volume for the final landform.		

7.4.3 Dirty Water

7.4.3.1 Sediment Basins

Where and when applicable, all the existing dams (excluding Dam 6) will be used as sediment basins at least once. However, depending on the stage of works, they will be supplemented by a number of other temporary sediment basins. The following four primary stages of work are identified.

- Establishment of Stages 1 – 4 (site access roads, southern part of the extraction area and construction of the visibility barriers).
- Operation of Stages 1 – 4.
- Establishment of Stages 5 – 7 (northern part of the extraction area).
- Operation of Stages 5 – 7.

Table 8 and **Figures 5 to 8** identify which dams and storages will be actively used as sediment basins during the above four stages of works. **Figure 9** shows which dams will remain in the final landform. When an existing dam is no longer required as a sediment basin, it will remain but be classified as a clean water dam. Dam 11 will also remain until the western access road is decommissioned (during Stages 5 to 7). The other temporary basins (Dams 9, 10 and 12) will also be removed during or at the completion of operations. **Table 8** details the current capacities of the dams, the minimum size when in use as a sediment basin, and when during the various stages they will be considered clean water or dirty water dams.

Except Dams 2, 12 and the Quarry sumps, all sediment basins are sized to capture the 5-day, 85th percentile rainfall depth (36.2 mm) (DECC, 2008 and Landcom, 2004). Dam 2 will be operational for more than three years and so it is designed for the 95th percentile 5-Day rainfall depth (75.2mm). Although Dam 5 would be operational for more than three years, it will not have its maximum catchment for that period of time; the excavations upstream would provide their own storage as they develop and, once the Quarry Sump is established to sufficient capacity Dam 5 would become a clean water dam. Overflows from Dam 2 will be monitored through monitoring point WS4.

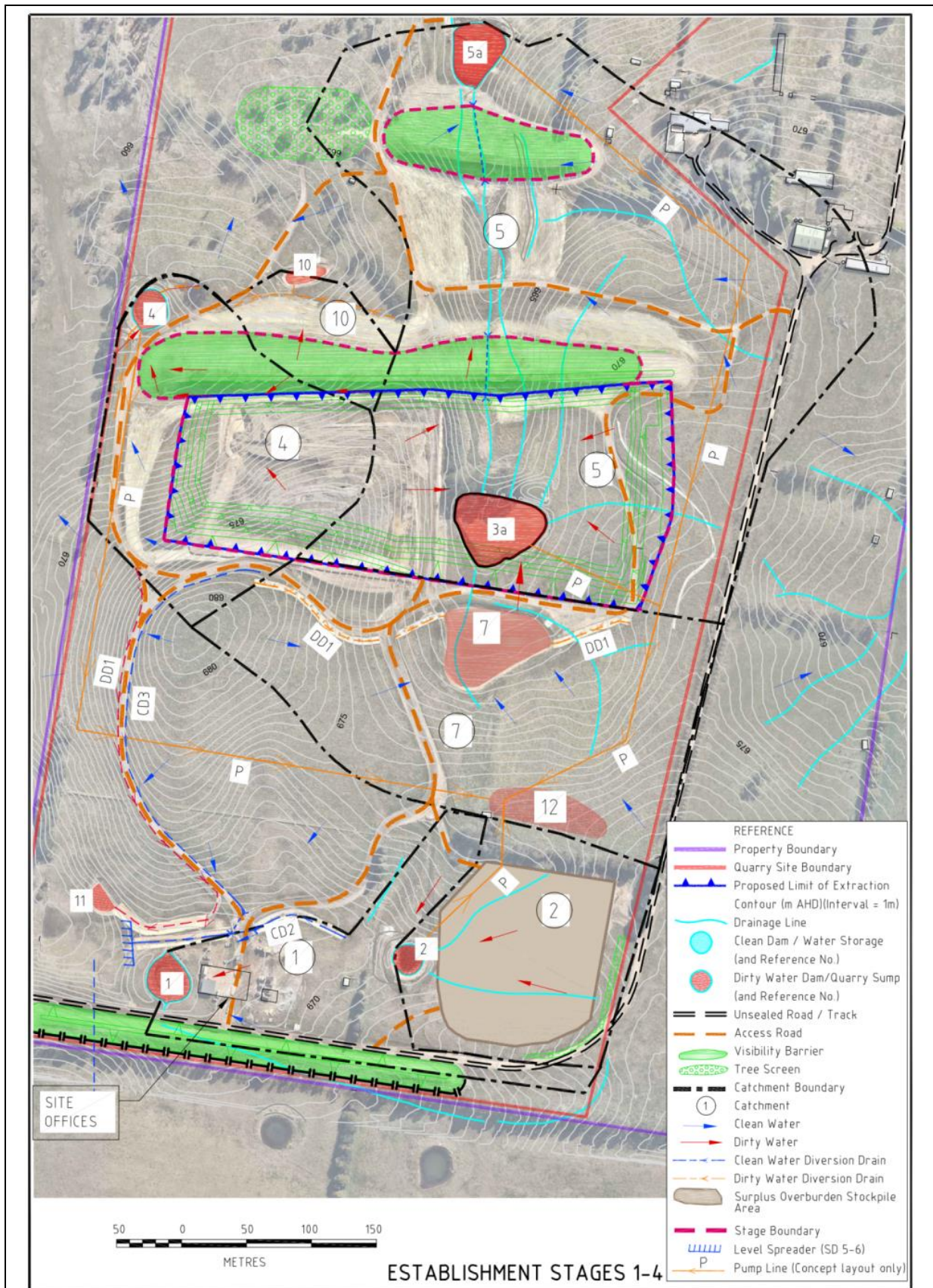


Figure 5
Water Management: Stages 1-4 Establishment

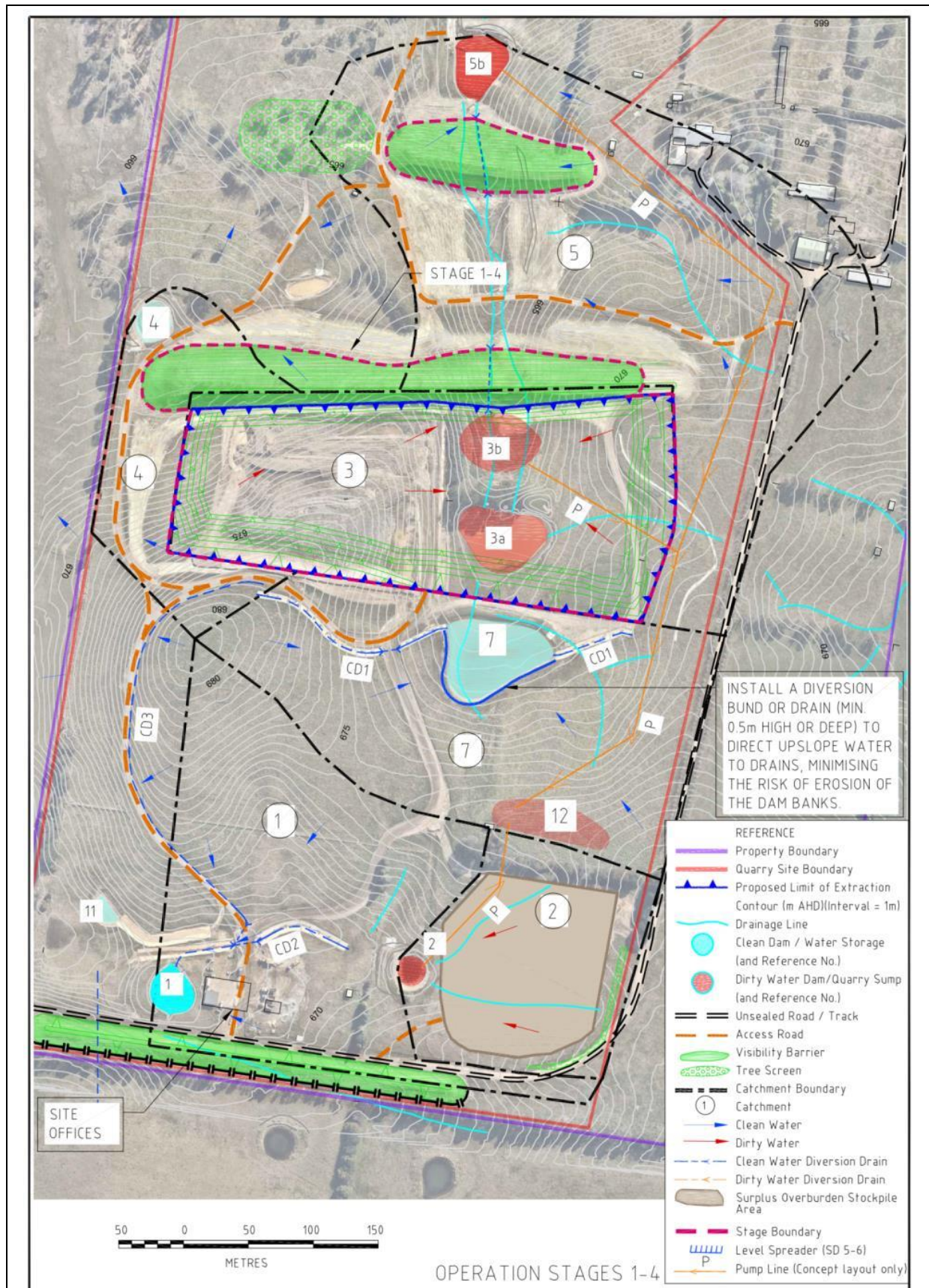
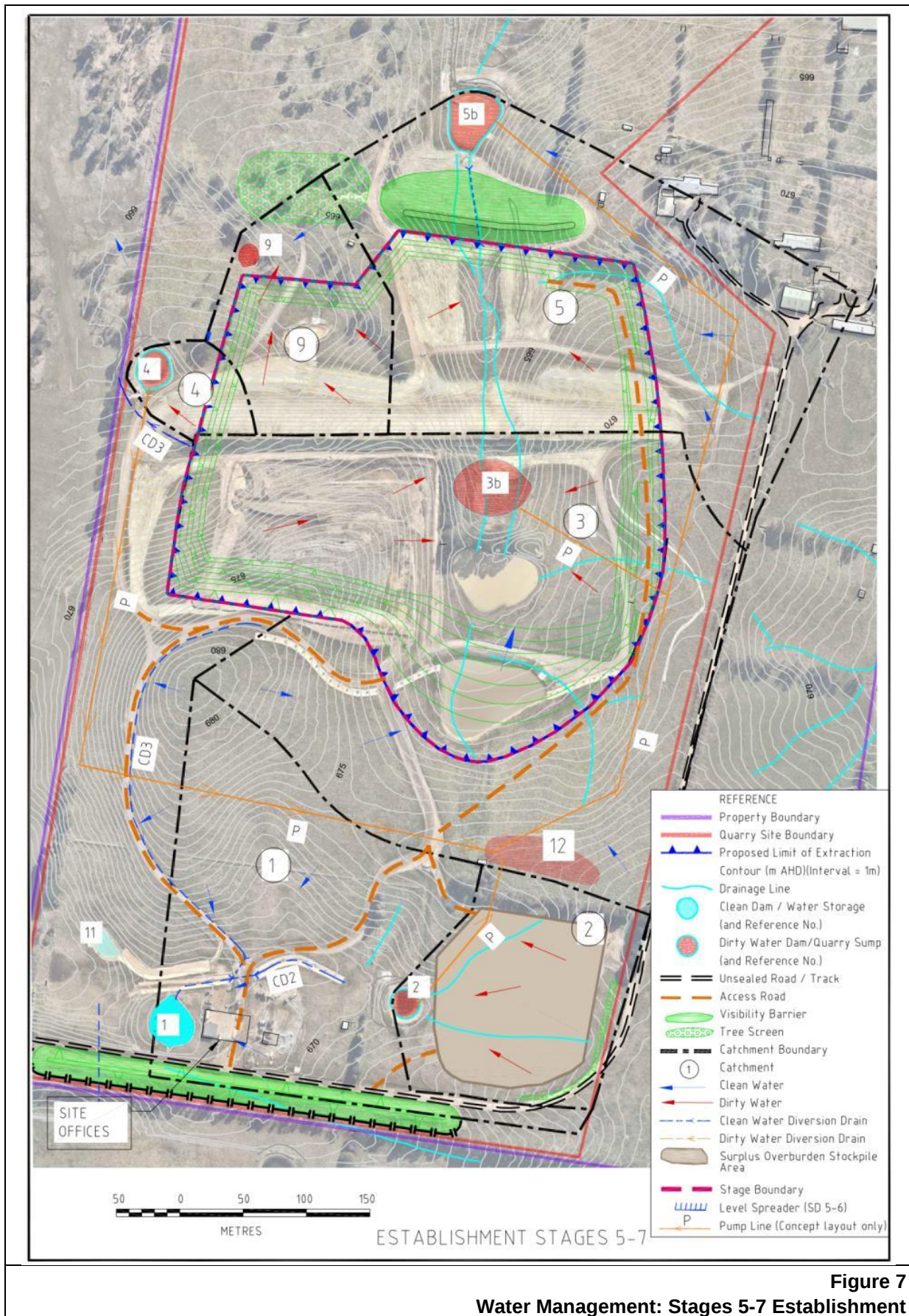


Figure 6
Water Management Stages 1 – 4; Operations



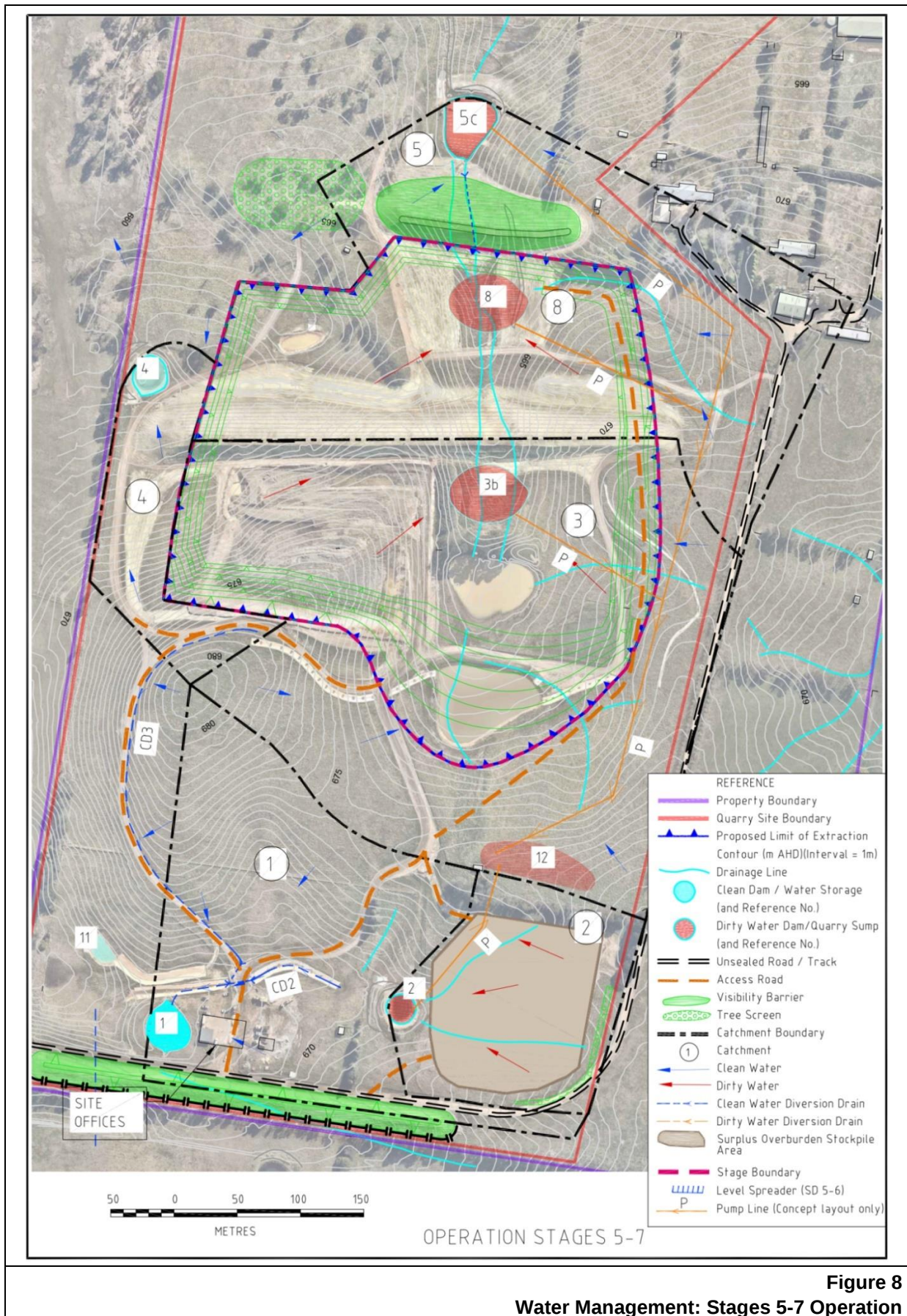
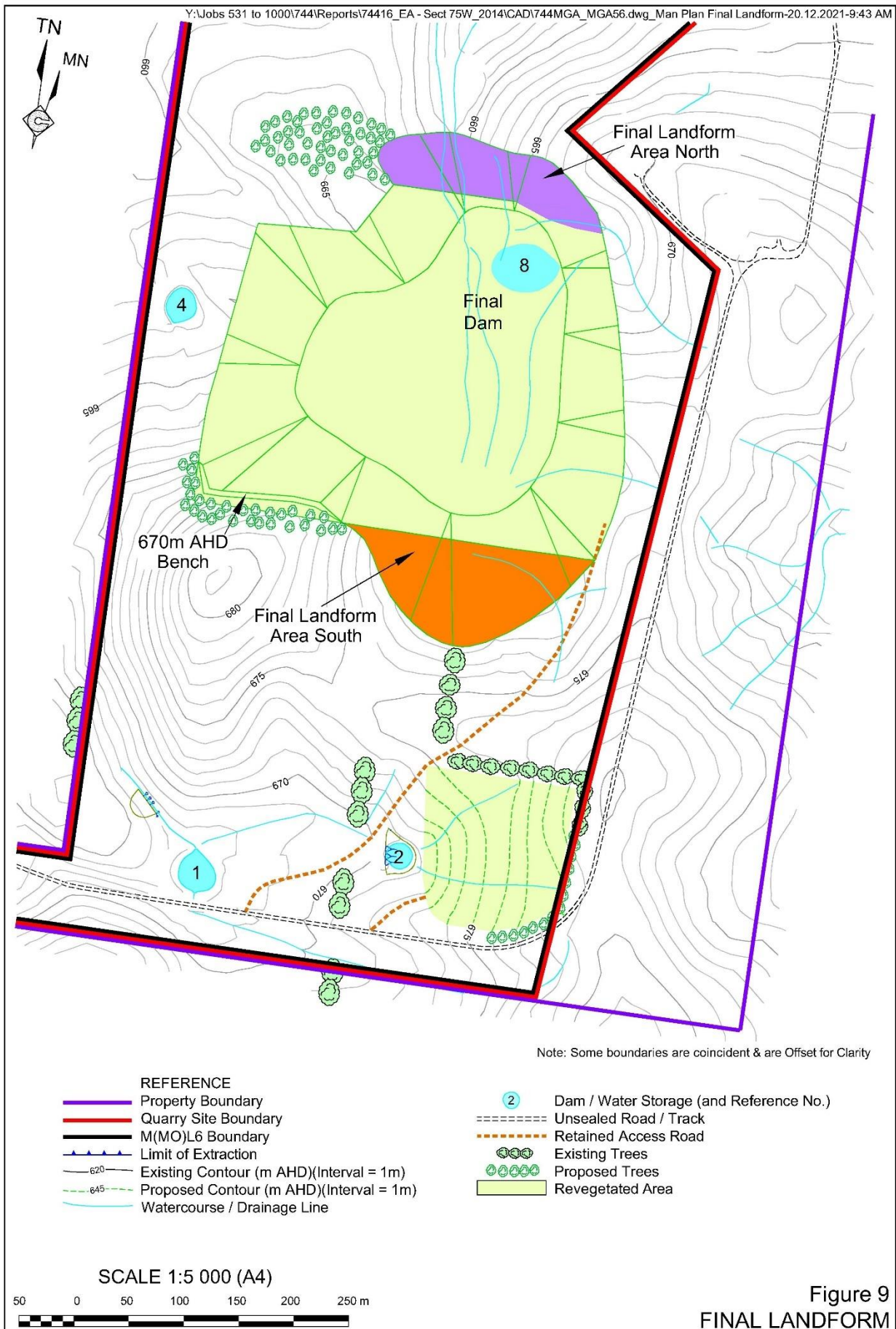


Figure 8
Water Management: Stages 5-7 Operation



Dams 4, 9 and 10 would be utilised as sediment basins for short periods of time during the site establishment phases for Stages 1 to 4 and 5 to 7. Controlled discharges may be undertaken directly from these dams or water may be piped into the Quarry Sump, Dam 5 or Dam 12. Controlled discharges will be flocculated if necessary to meet water quality criteria (see Section 7.4.5).

Dams 1, 11 and 7 will also be utilised as sediment basins for a short period of time during initial establishment for Stages 1 to 4, whilst the site access roads and site office area is established and the initial overburden material is transported to the surplus overburden stockpile area. Should any discharges be required from these dams during that time, they will also be flocculated, if necessary, to meet water quality criteria. It is noted that Dam 7 has not specifically been denoted as a sediment basin given that the use of the temporary haul route would be utilised for a short period and not involve any vegetation clearing or stripping.

A nominal maximum sizing of Dam 12 has been calculated to provide the capacity to receive twice the volume of dirty water from the settlement zones of all other sediment basins. Controlled discharges will be undertaken through a pipe to monitoring point WS5b. As Dam 12 will be a turkeys nest with no catchment and used for the purpose of storage and treatment, the rainfall depth and percentile requirements do not apply. If required for operational efficiencies, Dam 12 may be constructed and operated as a centralised water storage and treatment dam to provide more efficient management of dam clean out and maintenance.

Note: The total volume of a sediment basin comprises a sediment retention zone and a water (settling) zone, both sized in accordance with Landcom (2004) and DECC (2008). Details of the minimum sediment basin sizing is provided in **Appendix B**.

7.4.3.2 Extraction Area Sumps

Internal runoff from the extraction area will be collected in Dams 3b and 8 which are sumps within the extraction area. These will also collect any groundwater seepage that might enter the excavation. If necessary, water will be treated and discharged directly from the sumps or pumped into Dam 5 or 12 for treatment and controlled discharge. It is noted that, due to the significant storage within the excavation, the sumps do not have a defined minimum capacity and are managed for operational purposes not as sediment basins. As such the catchment area reporting to the sumps is not included within the catchment areas for downstream sediment basins.

7.4.4 Clean Water

Clean water derived from upslope will be diverted by clean water diversion drains as shown in **Figures 6 to 9**. Clean water diversions will outlet via a level spreader.

As disturbed lands are stabilised (**Appendix B**) the associated sediment basins will be removed or converted to clean water storage (**Table 8**).

7.4.5 Discharges

7.4.5.1 Discharge Locations

Figure 4 displays the existing catchments within the Quarry Site and the ephemeral watercourses on site.

Runoff from disturbed areas within the Quarry Site would discharge at two main locations, i.e. at monitoring locations WS4 (W2) and WS5b.

Monitoring location WS4 is located in the southern catchment near the southwestern corner of the Quarry Site and will discharge runoff from the internal access road and the surplus overburden storage area, i.e. only after the runoff has passed through Dams 11 and 2 respectively (see **Figure 4**). It is noted that culverts will be provided beneath the western and eastern access roads to enable outflows from Dam 2 without entraining additional sediments from the surface of the access roads.

Monitoring location WS5b is located within the northern catchment, downstream of Dam 5, i.e. north of the northern most water management infrastructure for the Quarry.

Monitoring locations WS6 and WS7 are located near the western boundary of the Quarry Site (see **Figure 4**). These locations are both located in the northern catchment and drain extremely localised areas, including Dams 4, 9 and 10. Whilst these dams are being operated as sediment basins, controlled discharges may occur directly from these dams or by piping the water into the Quarry sump, catchment of Dam 5, or Dam 12.

It is noteworthy that the location of monitoring location WS5b has been selected taking into account that runoff from the property west of the Quarry Site enters the Quarry Site immediately upstream of the former monitoring location WS5, therefore confounding monitoring results at WS5.

7.4.5.2 Wet Weather Discharges from Sediment Basins

Most sediment basins within the Quarry Site are designed for a 5-day, 85th percentile rainfall depth which is 36.2mm. A rainfall event greater than that will cause a basin to overtop, unless it is built larger than required. Such events are referred to as “wet weather discharges”. On average, such discharges can be expected to occur four to six times a year (based on the design principals of DECC (2008)). Their occurrence and duration will be logged and reported in the Site’s *Annual Review*. Discharges from Dam 2 can be expected to occur, on average, once or twice a year (based on the design principals of DECC (2008)). Condition L2.5 of EPL 20377 provides for such wet-weather discharges.

It is noted that water that is retained within sediment basins following a wet weather basin will be flocculated (if required) and discharged as a conditional discharge (see Section 7.4.5.3). However, in the event that further rainfall occurs within the five-day treatment period (whether that be due to a wet weather or normal rain event) and causes a further discharge, this further discharge will also be classified as wet weather.

Basin water quality monitoring will be discontinued when the function of the basin is no longer for pollution control.

7.4.5.3 Quality Criteria for Conditional Discharges from Sediment Basins

Following a rain event when water has accumulated in sediment basins above the settlement zone, the settlement zone capacity of those sediment basins will be restored within five days of the conclusion of the rain event³ through sediment basin de-watering. Water collected in a sediment basin will be flocculated (if required to meet water quality criteria), settled and discharged within five days of the conclusion of a rain event². These are referred to as “Conditional Discharges” and they will be logged and reported in the Quarry’s *Annual Review*. As outlined in Section 7.4.5.2, in the event that further rainfall occurs within the five-day treatment period and results in an overflow, the overflow will be classified as a wet weather discharge and the five day treatment period will recommence.

Alternatively, water will be transferred to the Quarry Sump or Dam 12 for storage. In this case, water would be pumped from the sediment basins so as to reinstate the settlement zone within the five day treatment period. Pending site water requirements, treatment (if required) and conditional discharge of water will also be undertaken from the Quarry Sump or Dam 12 to WS5b. As Dam 12 will be a turkeys nest dam (with no catchment), the five day treatment period does not apply.

Before a conditional discharge occurs, the water will be tested to ensure it meets the target water quality parameters given in **Table 10**. If required, flocculation will be undertaken to achieve these targets. This will be undertaken by either manual methods or use of automatic flocculators, however, no automatic discharging will occur.

Basin water quality monitoring will be discontinued when the function of the basin is no longer pollution control.

Table 10
Sediment Basin Conditional Discharge Water Quality Targets*

Parameter	Target
pH	Between 6.5 and 8.5
Total Suspended Solids (TSS)^	Less than or equal to 50 mg/L
Oil and grease	Non-visible
* As specified by EPL 20377.	
^ In the event that an appropriate relationship between TSS and NTU is established, a variation to EPL 20377 may be sought to replace TSS limits with an approved NTU limit.	

7.4.5.4 Volumes of Discharge

The volumes of conditional discharges will be equal to, or less than, the associated sediment basin volume. The volumes of unconditional discharges will depend on the rainfall events that cause them. If necessary for operational purposes, conditional discharges will also be undertaken for water stored within Dams 3b and 8. The estimated volumes of conditional discharges will be recorded.

² A rainfall event is considered to have concluded 24hours following the cessation of rain in order to provide for the cessation of inflows to the basins (as inflows prevent effective flocculation). It is noted that should further rainfall be received within the 5-day treatment period the treatment period will recommence at the conclusion of the further rain event.

7.4.6 Contaminated Water

There is no anticipated need for management of contaminated water.

7.4.7 Water Use Minimisation Program

Water use will be minimised as much as practicable and be limited to dust suppression, machinery washdown and ablutions.

8. EROSION AND SEDIMENT CONTROL PLAN

8.1 SOURCES OF EROSION, SEDIMENTATION AND POLLUTION

8.1.1 Sources of Erosion and Sedimentation

8.1.1.1 Establishment Stages

During the establishment stages soils will be exposed to erosion when building the following.

- The visibility barriers
- The access and haul road(s)
- The temporary haul route
- The sediment basins
- The extraction area
- Clean and dirty water diversion drains (e.g. CD1, CD2)

8.1.1.2 Operational Stages

During the operational stages soils will be exposed to erosion in:

- the Surplus Overburden Stockpile Area; and
- the Extraction Area.

8.1.2 Sources of Pollution and Water Contamination

There will be no sources of pollution and contamination other than sediment-laden water.

It is noted that the Ashfield Shale typically has very low concentrations of pyrite and therefore generation of acid is not expected to occur. Further, the Quarry is in excess of 600m above the elevation at which acid sulphate soils are formed. Hence, generation of acid from this source is not possible.

8.2 EROSION AND SEDIMENT CONTROL MANAGEMENT

8.2.1 Implementation Strategy

Erosion and sediment loss will be mitigated by implementing a series of staged Erosion and Sediment Control Plans (ESCPs) – see **Appendix B**. They are designed to the requirements of Landcom (2004) and DECC (2008). A summary of the implementation strategies is given in the following sections.

8.2.1.1 Erosion Control

Rapid rehabilitation of disturbed areas is the most effective form of erosion control (Landcom, 2004). As such, the following apply.

- Bare soil will be stabilised using soil binders/hydromulch or similar with a target of achieving a C-factor (ground cover factor) of 0.15 (equivalent to about 50% soil coverage) within 20 days of final shaping and a C-factor of 0.05 (equivalent to about 70% soil coverage) within a further 40 days. If this target is not reached in these timeframes, supplementary stabilisation will be undertaken. Note that these C-factors can be achieved using vegetation or alternative erosion control methods such as mulch, binders, hydromulches, compost blankets or organic fibre matting.
- Stockpiles of overburden material will be progressively stabilised following final shaping. Stabilisation will be done with the aim of achieving a C-factor of 0.15. It is noted that, as the stockpile will be regularly accessed and reshaped, limited areas will be available for final shaping and stabilisation until the majority of the stockpile is formed. This approach is acceptable given that the surplus overburden stockpile area will drain to Dam 2 and that the overburden material is not required as a growth medium.
- Clay and shale material awaiting transport will be stockpiled on the floor of the extraction area. This ensures that any erosion of this material is confined within the extraction area with no further erosion controls required.
- Diversion drains will be stabilised against scour using vegetation. Rock rip-rap will also be utilised in any areas that are not successfully stabilised using vegetation.

8.2.1.2 Sediment Control

The primary measure for sediment control will be the Sediment Basins. Most are designed to capture the 85th percentile rainfall, 5-day rainfall depth which is 36.2mm. Dam 2 is designed for the 5-day, 95th percentile rainfall depth which is 75.2mm. It is noted that this is the minimum design to meet the requirements of Landcom (2004) and DECCW (2008). The sediment basins will be subject to the following design, monitoring and maintenance requirements.

- The design of the sediment basins will include an emergency spillway designed to safely convey the 100-year ARI flow (DECC, 2008).
- Waters will be discharged from a basin (after treatment if required) or transferred to the Quarry Sump or Dam 12 within five days after the conclusion of inflow from a rain event if that the inflow results in the basin water level encroaching into the required settling zone³
- Markers will be installed in each sediment basin showing the Storage Zone (i.e. the lower zone) and the Settling Zone (i.e. the upper zone) in the basin.

³ An automated water level system may be utilised to determine this.

- After discharging treated water from any sediment basin, the level of retained sediment will be inspected. If retained sediment exceeds the marked level of the Storage Zone, sediment will be removed and placed within the Extraction Area or Surplus Overburden Stockpile Area.
- Any damaged components of the sediment basins will be repaired as soon as practicable.

Other sediment control measures e.g. rock filter dams, sediment fencing, mulch bunds etc. might be adopted throughout the site at the discretion of the Raw Materials & Mining Manager or Environment Manager. However, should any erosion or sedimentation occur outside of the dirty water management system, this will be stabilised as soon as possible.

8.2.1.3 Flocculation / Coagulation

If adequate settling of suspended solids is not achieved in the sediment basins or within the water storage and treatment dam (Dam 12) or Quarry Sump (where controlled discharge is planned), flocculation will be required. Flocculation may be achieved using gypsum or another EPA endorsed / approved flocculent / coagulant. All flocculants / coagulants will be used at their recommended dilution rates and applied evenly to the water to ensure adequate settling. Automatic flocculation / coagulation is an option that may be implemented.

8.2.2 Erosion and Sediment Control Monitoring

The performance of the erosion and sediment control measures will be measured by regular site inspections utilising a formal erosion and sediment control inspection checklist. In summary:

- The sediment basins and erosion and sediment controls will be inspected:
 - On a quarterly basis irrespective of rainfall; and
 - following a rainfall event that causes inflow to a sediment basin that encroaches into the settling zone⁴; and
 - Inspect the integrity of any sediment-control measures, including sediment basins, sediment traps, etc.;
 - Look for any signs of erosion, particularly in areas that do not drain to a sediment basin or other sediment capture measure;
 - Inspect any areas subject to stabilisation to ensure they are establishing an adequate cover of vegetation in a timely manner; and
 - Complete treatment and discharge in accordance with Section 7.4.5.
- Necessary repairs to sediment basins or erosion and sediment controls would be undertaken as soon as practicable.
- The management procedures for the sedimentation basins will be regularly reviewed to ensure ongoing efficient operation and protection of downstream water quality.
- Before a conditional discharge the water quality will be tested, treated if necessary and re-tested if necessary to meet the targets given in **Table 10**.

⁴ This may be measured automatically using water level sensors.

8.2.3 ESCP Review

The ESCPs submitted in **Appendix B** will be reviewed shortly before each establishment or set of operational stages (i.e. prior to operations for Stages 1 to 4 and prior to operations for Stages 5 to 7). At the discretion of the Raw Materials and Mining Manager or Environment Manager, and in consultation with a Certified Professional in Erosion and Sediment Control, the plans will be revised if necessary. The ESCPs will also be revised during works if conditions, work practices or water quality monitoring dictate.

9. SURFACE WATER MONITORING PROGRAM

9.1 INTRODUCTION

This sub-section provides a description of the surface water monitoring that will be undertaken throughout and following the life of the Quarry. It is noted that the results of the previous water quality monitoring is discussed in Section 6.3 of this document. The approach to monitoring, both in terms of parameters analysed and frequency of sampling, reflects a realistic risk-based approach for the Quarry and not a generic approach.

9.2 SURFACE WATER IMPACT ASSESSMENT CRITERIA

The aim of the erosion and sediment control plan is to ensure that water leaving the site (other than wet-weather discharges) has a water quality no worse than:

- the water quality in the Wingecarribee River (the receiving water) (WS2); or
- the water quality within Stony Creek (WS3).

This criteria or objectives are drawn from State Environmental Planning Policy (SEPP) Sydney Drinking Water Catchment (2011).

Standard criteria imposed through Environment Protection Licences are as follows.

- pH = 6.5 to 8.5
- Total Suspended Solids = <50mg/L⁵
- Oil and Grease = not visible

These criteria are considered to be the key parameters required to assess ecosystem health.

9.3 SURFACE WATER MONITORING PROGRAM

9.3.1 Monitoring Parameters, Frequency and Location

9.3.1.1 Baseline Monitoring

As site establishment activities have commenced, the baseline monitoring period concluded in October 2020. A summary of the baseline monitoring results is provided in Section 6.3.

9.3.1.2 During Establishment Stages

During the establishment stages, water quality will be measured:

- at all sediment basins (following their construction) or Dam 12 / the Quarry Sump prior to any required conditional discharge and within 24 hours (if safe access is achievable) of any wet weather discharge (see Section 7.4.5 and **Table 10**); and

⁵ Or equivalent turbidity (NTU) as agreed with the NSW EPA and determined in accordance with an approved methodology.

- opportunistically at the locations identified on **Figure 4** at least four times a year (if water is present) and surveillance testing completed for the additional analytes listed in **Table 11**.

It is noted that WS2 represents an upstream sample location within the Wingecarribee River and a further sampling location (WS8) has been established downstream of the Quarry Site (see **Figure 4**). However, as noted in Section 6.3, results at WS8 can be influenced by activities on the adjoining landholding. As such, monitoring location WS5b, which represents the discharge point for the northern catchment area, has been located in order to avoid confounding results.

It is noted that the parameters to be tested are in excess of those considered relevant to the nature of the clay/shale in which there is limited opportunities for the clay/shale to influence water quality. As such, these parameters will be reviewed over time and, when sufficient data is available, a modification sought to reduce the monitoring parameters to the most appropriate suite.

Table 11
Water Quality Parameters for all Water Quality Monitoring Locations

- Physical Parameters - pH - Electrical Conductivity - Total suspended solids - Turbidity (NTU)	
- Major cations - Sodium - Calcium - Magnesium - Potassium	- Major anions - Hardness - Dissolved Oxygen - Oil and grease (visual) - Chloride - Sulfate - Bicarbonate (hardness)
- Metals - Aluminium - Arsenic - Cadmium - Cobalt - Chromium	- Copper - Iron - Lead - Manganese - Zinc
- Nutrients - Total phosphorus - Total nitrogen	

9.3.1.3 During Operational Stages

During operational stages, water quality will continue be monitored:

- at all sediment basins (following their construction) or Dam 12 / the Quarry Sump⁶ prior to any required conditional discharge and within 24 hours (if safe access is achievable) of any wet weather discharge (see Section 7.4.5 and **Table 10**); and

⁶ Basin water quality monitoring will be discontinued when the function of the basin is no longer for pollution control.

- opportunistically at the monitoring locations identified on **Figure 4** as well as the active Quarry sump on at least on an annual basis and surveillance testing completed for the parameters as specified in **Table 11**.

9.4 SURFACE WATER TRIGGERS

If water quality monitoring results at WS4, WS5b, WS6 or WS7 (on-site monitoring locations downstream of Quarry disturbance areas) exceed the water quality criteria in **Table 10**, this will trigger an investigation and incident reporting in accordance with Sections 14 and 15 of this WMP. However, it will not be considered a water quality trigger if this occurs during a wet weather event (see Section 7.4.5.2).

In the event that water quality monitoring at the Wingecarribee downstream monitoring site (WS8) exceeds the water quality criteria in **Table 10** and also exceeds the upstream monitoring site (WS2) for 3 consecutive monitoring events, this will trigger an investigation and incident reporting in accordance with Sections 14 and 15 of this WMP. To determine if the Quarry is having an adverse impact, the investigation will include review of water quality results against baseline data, review of any discharge monitoring data, erosion and sediment control inspection records and any activities observed on adjacent properties which may affect water quality.

9.5 STRATEGY MONITORING AND AMENDMENT

The results of the water quality monitoring will be collated and summarised within the Quarry's *Annual Review* (Section 16), with a copy also provided to Council, Water NSW, DPE-Water, and any other relevant government agency, if requested.

The Water Management Plan for the Quarry will be independently audited in accordance with the independent audit schedule of PA 08_0212 with upgrades or amendments made as required to ensure ongoing compliance with relevant environmental protection instruments.

10. GROUNDWATER MANAGEMENT

10.1 EXISTING GROUNDWATER ENVIRONMENT

The Quarry Site is located within the Sydney Basin Nepean Groundwater Source as defined by the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011*. The geology of this groundwater source consists of sedimentary sandstone amid siltstone formations with intervening coal seams.

Previous drilling within the Quarry Site confirms the area is underlain by a sequence of shales and laminites belonging to the Ashfield Shale, a Triassic rock unit often outcropping in the Southern Highlands. The Ashfield Shale is the target resource for the Quarry. The Ashfield Shale is underlain by Hawkesbury Sandstone. Extraction will not extend into the Hawkesbury Sandstone.

Ashfield Shale is typically of very low permeability, although higher yields can occur where fractures are encountered. Austral's experience at the Bowral Quarry has shown that groundwater inflows from the Ashfield Shale are negligible and are typically limited to short-term seeps following rainfall. There are no groundwater bores recovering any groundwater supplies from within the Ashfield Shale in the Southern Highlands. Surrounding registered groundwater bores source water from the Hawkesbury Sandstone with reported yields ranging from 1.3L/S to 9.1L/S.

The extraction area also comprises a clay regolith profile that ranges from 2m to 10m in thickness. This profile will act to inhibit local groundwater recharge, thereby minimising the potential for significant or ephemeral perched aquifers to develop within the regolith profile.

Locally, the water table to the north of the extraction area is expected to be in equilibrium with the Wingecarribee River at approximately 648m AHD, with a shallow hydraulic gradient anticipated beneath the Quarry to the north towards the river. It is likely that the water table beneath the extraction area will be of the order of 1m or 2m above the level of the Wingecarribee River at approximately 650m AHD.

Due to the low permeability of the Ashfield Shale, the Quarry is considered to pose a very low risk to local or regional groundwater or to other groundwater users.

10.2 GROUNDWATER MONITORING PROGRAM

10.2.1 Monitoring Locations and Piezometer Details

PA Condition 18A nominates "*The Proponent must install 3 pairs of nested piezometers prior to the quarry pit floor reaching 660m AHD in consultation with DPI-Water and to the satisfaction of the Secretary.*". Whilst extraction has not yet commenced, the following piezometers (see **Figure 4**) were proactively installed during July 2019 following advice from Jacobs hydrogeologist Greg Sheppard and in consultation with NRAR.

- STK20D – Forms the deep bore of a nested piezometer north of the extraction area and adjacent Wingecarribee River. Water bearing zone 640.9m AHD to 637.8m AHD (hole termination).

- STK20S – Forms the shallow bore of a nested piezometer north of the extraction area and adjacent Wingecarribee River. Water bearing zone 639.9m AHD to 626.3m AHD (hole termination).
- STK22 – Single piezometer east of the extraction area. Water bearing zone 656.8m AHD to 633.5m AHD (hole termination).
- STK23 – Single piezometer south of the extraction area. Water bearing zone 650.4m AHD to 635.3m AHD (hole termination).

Piezometer construction details are presented in **Figure 10**.

10.2.2 Assessment Criteria

Insufficient data has been collected to provide specific assessment criteria. The minimal impact considerations from the NSW Aquifer Interference Policy (2012) do not provide specific water quality criteria. Rather, the Policy requires that, for minimal impact, any activity should not lower the beneficial use category of the groundwater source.

As additional baseline water quality monitoring is undertaken the beneficial use category of the groundwater source will be defined and specific criteria developed. The early and proactive installation of groundwater monitoring bores prior to commencement of extraction will provide for collection of baseline data and definition of appropriate criteria well before the potential interception of groundwater.

Final impact assessment criteria will be defined and the WMP updated following extraction reaching a depth of 660m AHD (i.e. the depth at which groundwater monitoring bores were required to be installed). Notwithstanding, a Trigger Action Response Plan (TARP) is included as Section 10.3 and initial groundwater monitoring data is provided in Section 10.2.3.

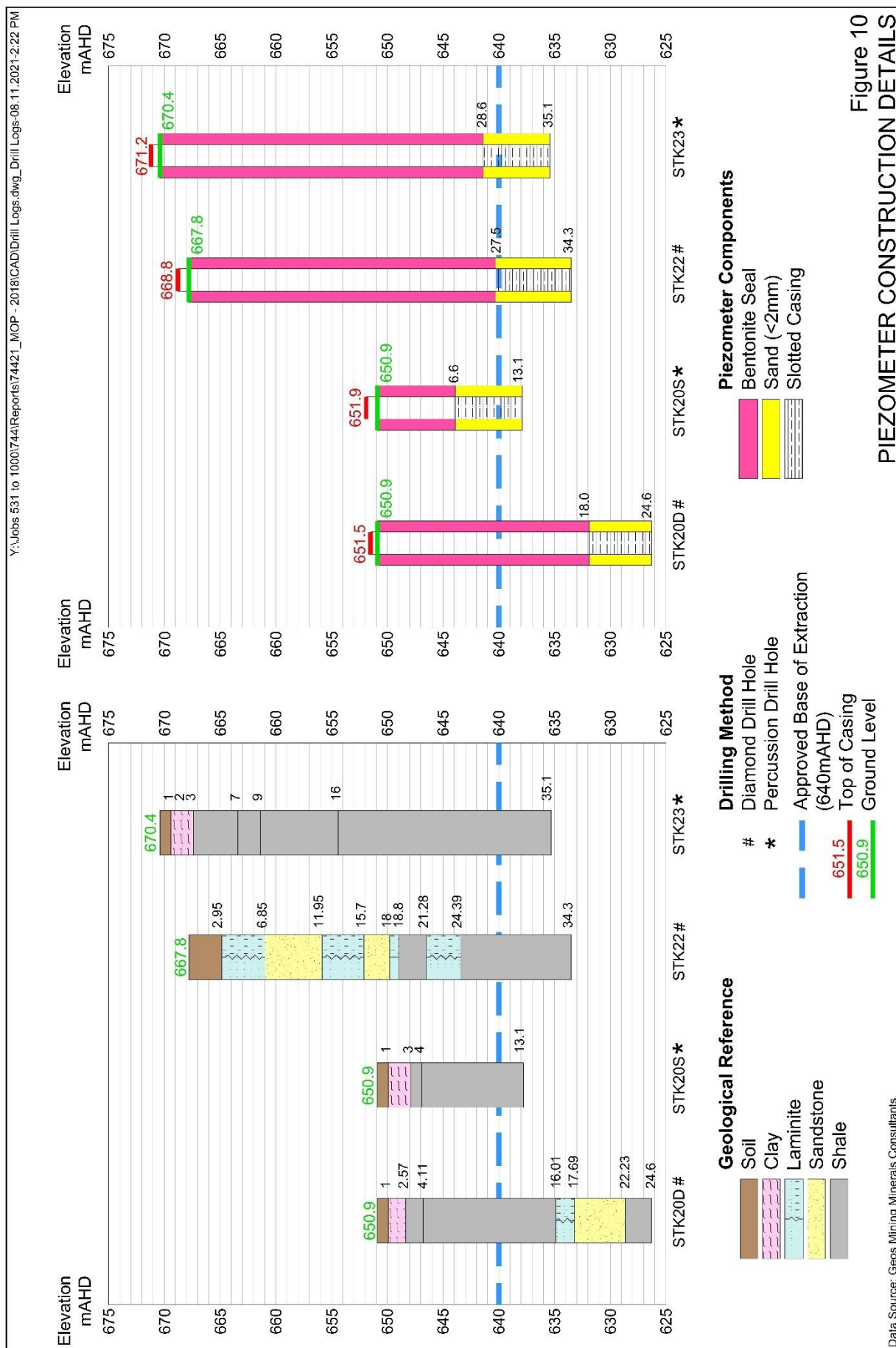
10.2.3 Baseline Groundwater Monitoring Data

Since installation of the bores four rounds of monitoring has been completed, the results of which are summarised in **Table 12**. Ongoing baseline monitoring will be undertaken and included within future revisions of the WMP.

Initial monitoring indicates the groundwater is slightly brackish to brackish with an acidic to slightly alkaline pH. Nitrogen and phosphorous levels are slightly elevated but are generally consistent with concentrations recorded within surface water. To date, slightly elevated levels of aluminium and iron have been recorded during some monitoring events at some locations.

Groundwater levels have increased between 2m and 4m across all sites since monitoring commenced, with increases occurring during 2020/2021. This is a reflection of the multiple significant rainfall events that have occurred during this period.

Further monitoring is required to provide an adequate description of baseline water quality and levels.



10.2.4 Ongoing Groundwater Monitoring Parameters and Frequency

The following analytes and parameters will continue to be monitored within the four monitoring bores.

- Standing Water Level (m AHD)
- pH
- Electrical Conductivity
- Major Cations
 - Sodium
 - Calcium
 - Magnesium
 - Potassium
- Major Anions
 - Chloride
 - Sulfate
 - Bicarbonate
- Iron
- Aluminium
- Total Phosphorous
- Total Nitrogen

Prior to the extraction reaching a depth of 660m AHD, monitoring will be undertaken six-monthly. Following extraction reaching a depth of 660m AHD, monitoring will be undertaken on a quarterly basis.

Table 12
Key Baseline Groundwater Quality Parameters

Parameter	Units	STK20S		STK20D		STK22		STK23	
		Min	Max	Min	Max	Min	Max	Min	Max
		Median		Median		Median		Median	
Physical Parameters									
Standing Water Level	m AHD	643.03	647.12	641.01	645.24	663.05	665.70	665.80	668.18
		645.24		642.98		664.83		666.74	
pH		6.1	7.0	5.9	7.3	4.9	7.4	7.2	7.8
		6.7		6.4		7.0		7.6	
EC	µS/cm	3280	3660	768	1420	896	1010	4560	5180
		3455		908		908		4760	
Major Anions and Cations									
Sodium	mg/L	197	253	60	68	97	113	236	296
		225		64		101		256	
Potassium	mg/L	6	8	5	16	17	19	17	35
		6		13		17		18	
Calcium	mg/L	96	129	21	60	28	38	278	316
		105		31		34		296	
Magnesium	mg/L	178	215	26	63	24	26	232	263
		205		39		25		248	
Chloride	mg/L	810	1160	154	402	137	152	1060	1420
		912		202		146		1215	
Sulfate	mg/L	20	199	1	4	2	14	33	122
		162		4		8		57	
Bicarbonate	mg/L	72	973	109	409	103	254	482	1690
		142		131		212		536	
Fluoride	mg/L	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.2
		0.2		0.1		0.2		0.1	
Nutrients									
Nitrate	mg/L	0.24	0.61	0.06	0.07	0.01	0.06	0.01	0.26
		0.30		0.07		0.04		0.09	
Total Ammonia	mg/L	0.13	0.58	0.48	1.30	0.20	1.64	0.05	0.33
		0.15		1.21		0.50		0.23	
TKN	mg/L	0.40	2.10	0.70	9.30	11.70	17.50	0.10	0.90
		0.70		3.55		13.40		0.30	
Total Phosphorus	mg/L	0.10	4.43	0.05	0.96	0.22	2.68	0.01	0.19
		0.36		0.07		0.38		0.02	
Reactive Phosphorus	mg/L	0.00	0.00	0.03	0.03	0.03	0.18	0.00	0.00
		below LOR		0.03		0.11		below LOR	
Metals									
Aluminium	mg/L	0.000	0.000	0.160	0.520	0.560	1.260	0.010	0.020
		below LOR		0.250		0.940		0.015	
Iron	NTU	0.7	58.4	21.2	31.4	6.9	19.6	0.1	6.9
		13.6		24.4		13.9		3.5	

In addition to monitoring within the groundwater bores, once extraction reaches a depth of 660m AHD, Austral will routinely monitor (at least quarterly) and record groundwater inflows from the walls or floor of the extraction area. This would be achieved through visual observations of the Quarry faces for seeping water and comparison of the estimated volume contained within the Quarry sump vs the rainfall and water usage for dust suppression as calculated on a quarterly basis.

The frequency of monitoring and parameters monitored will be reviewed annually as part of the Annual Review process and revised if necessary to ensure meaningful data is being collected.

10.3 GROUNDWATER TRIGGER ACTION RESPONSE PLAN

Whilst specific groundwater quality impact assessment criteria have not yet been developed, the principal potential for impacts upon groundwater quality would arise due to impacts upon groundwater levels. Therefore, the following TARP (see **Table 13**) has been developed focusing upon groundwater levels and inflows. Notwithstanding, provision is made for responding to any reports from adjoining landholders claiming impacts to groundwater quality. The groundwater quality triggers will be refined as baseline groundwater quality monitoring data is collected and assessment criteria developed.

It is noted that the triggers for groundwater levels have been derived through consideration of the minimal impact considerations from the *NSW Aquifer Interference Policy* (2012) for less productive porous and fractured rock water sources.

Table 13
Groundwater Trigger Action Response Plan

Page 1 of 2

Trigger Level	Alert Level	Action	Response
Groundwater Levels			
Groundwater levels remain within 1m of recorded levels over the past 6 months.	Green	No action required.	Nil.
Groundwater level trends indicate a continuing decline in drawdown levels exceeding 1m over a 6 month period (or shorter).	Amber	Conduct investigation: Review and assess monitoring results and relevant activities within and surrounding the Quarry.	- Review records of any groundwater inflows and confirm calculated sump water volumes and rainfall records to confirm whether undetected inflows may have occurred. - Review trends in water levels over time and determine if there is likely a causal link to Quarry-related activities or any other known surrounding activities. - Establish links (if any) between water levels and climatic conditions (e.g. rainfall). - Determine the need for an additional 'non-routine' groundwater level monitoring.
Adjoining property owner reports impact upon their groundwater supply.	Amber	As above, plus consult with adjoining property owner and provide copy of monitoring data.	As above plus: - Assess need for off-site groundwater monitoring and, if recommended, seek landholder's approval. - Notify the landholder of their right to request a dispute resolution (in accordance with the Dispute Resolution Process within the Environmental Management Strategy).
Groundwater level trends indicate a continuing decline in drawdown levels exceeding 2m over a 6 month period (or shorter).	Red	Report as an incident and submit formal report to DPE and relevant agencies in accordance with the incident response process outlined within the Environmental Management Strategy.	In addition to the responses outlined within the amber alert undertake the following. - Seek a review of the monitoring data by a suitably qualified consultant. - Review the need to temporarily increase the monitoring frequency. - Review the need for further groundwater assessment and modelling. - Update this GWMP as applicable.

Table 13 (Cont'd)
Groundwater Tigger Action Response Plan

Page 2 of 2

Trigger Level	Alert Level	Action	Response
Groundwater Inflows			
No groundwater inflows.	Green	No action required	Nil.
Minor groundwater inflows recorded (<2ML/year).	Amber	Conduct investigation: Review and assess monitoring results and current hydrogeological information.	- Review inflow observations and calculations to ensure correct methodology. - Review inflow rate compared to depth of extraction and available hydrogeological information. - Engage hydrogeological expert, if required, to prepare a conceptual hydrogeological model and further assess likely future groundwater inflows. - Seek necessary water licencing.
Moderate or greater inflows recorded (>2ML/year) WITHOUT appropriate water licencing being held.	Red	Report as an incident and submit formal report to DPE and DPE-Water and in accordance with the incident response process outlined within the Environmental Management Strategy.	- Cease extraction below the depth of the current floor of extraction. - Engage hydrogeological expert to undertake review and any necessary modelling. - Obtain required water licencing.
Groundwater Quality			
Adjoining property owner reports water quality impacts upon their groundwater supply.	Amber	Consult with adjoining property owner and provide copy of monitoring data. Conduct investigation: Review and assess monitoring results and relevant activities within and surrounding the Quarry.	- Undertake groundwater levels investigation as per Amber response for groundwater levels. - Review records of groundwater quality within the Quarry groundwater monitoring network to establish any links. - Assess need for off-site groundwater monitoring and, if recommended, seek landholder's approval. - Notify the landholder of their right to request a dispute resolution (in accordance with the Dispute Resolution Process within the Environmental Management Strategy).

11. MITIGATION MEASURES

11.1 SURFACE WATER

In order to meet the water quality targets (see Section 9.4), statutory requirements (see Section 3) and to minimise the impact of quarry operations on surface water, mitigation measures principally relate to:

- i) the avoidance or control of sediment-laden runoff; and
- ii) the management of hydrocarbons and sewage.

As discussed in Section 8.1.2, there are no acid sulfate soils within the Quarry Site and the Ashfield Shale has very low concentrations of pyrite and therefore acid generation is not expected to occur. As a result, no specific management measures are required. Notwithstanding, contingency measures have been specified in Section 14 in the event low pH is recorded in water on site.

The management of sediment-laden runoff has been comprehensively addressed in Section 7 and **Appendix B**.

The potential for hydrocarbon spillages will be minimal given Austral will not be storing any fuel on site. All diesel used on site will be delivered to site on the day of use. Only small quantities of oils and greases will be stored on a bunded pallet inside a container. Any storage of hydrocarbons will be in accordance with *AS1940 The Storage and Handling of Flammable and Combustible Liquids*.

The potential for contamination of surface water by sewage will be negligible given all sewage will be collected in a pump-out waste water system (such as portaloos) and removed off site in accordance with relevant Council and EPA requirements. This will principally be achieved through the use of a licenced contractor to manage the collection and maintenance of the waste water system.

11.2 GROUNDWATER

Mitigation measures required to protect the expected groundwater resources in the underlying Hawkesbury Sandstone formation will be comparable with those relevant to surface water, i.e. with respect to contamination from hydrocarbons and/or sewage.

12. EVALUATION OF COMPLIANCE

Following commencement of extraction, surface water monitoring results will be entered into the water monitoring spread sheet within 7 days of the receipt of laboratory results relating to any discharge event. During entry to the spread sheet, the monitoring results will be assessed against the relevant criteria.

All monitoring results will be reviewed by the Environment Manager and a summary provided within each *Annual Review*.

In the event that monitoring identifies an exceedance of the triggers outlined in Sections 9.4 or 10.3 of this document, Austral will initiate appropriate corrective and preventative actions as discussed in Sections 10.3 and 14 and, if applicable, incident reporting as discussed in Section 15.

A copy of the investigation report and regular updates on the status of the identified corrective and/or preventative actions will be provided to DPE and EPA and, if required, the complainant, in accordance with the procedures identified in Section 14. In addition, a summary of the report will be included in the subsequent *Annual Review*.

13. COMPLAINTS HANDLING AND RESPONSE

In the event that a complaint related to water or sediment / erosion is received, this would be managed in accordance with the complaints management procedure as outlined within the Environmental Management Strategy for the Quarry (prepared in accordance with *PA Condition 5(1)*). Furthermore, should any complaints be received alleging impacts to surrounding groundwater bore levels or quality, this would be investigated in accordance with the TARP specified in Section 10.3.

14. CORRECTIVE AND PREVENTATIVE ACTIONS

In the event that water monitoring identifies an exceedance of the relevant criteria, the exceedance will be reviewed to determine the likely cause(s). The review will seek to determine:

- whether the exceedance of the criteria was directly related to a source associated with the Quarry or if environmental factors contributed to the exceedance;
- the primary cause of the exceedance;
- any contributing factors which led to the exceedance;
- whether appropriate controls were implemented to prevent the exceedance; and
- corrective and preventative measures that may be implemented to prevent a recurrence of the exceedance.

Follow up water quality sampling will include the full suite of baseline monitoring parameters as per Section 9.3.1.1 until water quality parameters return to below criteria or the additional parameters are determined to be irrelevant to the investigation.

Corrective and/or preventative actions / contingency measures will be assigned to relevant personnel of either Austral or its contractor. Actions will be communicated internally, such as through planning meetings and toolbox talks, and outstanding actions will be monitored for their effectiveness upon completion.

Example actions / contingency measures that could be adopted in response to an exceedance of water quality criteria are provided in **Table 14**. If the corrective actions / contingency measures are not effective, specialist advice will be sought.

Table 14
Example Corrective Actions / Contingency Measures

Page 1 of 2

Water Quality Trigger	Potential Cause	Corrective Action / Contingency Measures
Total Suspended Solids or Turbidity Exceeds Trigger Level (see Section 9.4.2)	Insufficient residence time in sediment basins to settle clay particles.	Pump water back to Quarry sump or alternate on-site water storage (if holding capacity is available).
		Treatment with appropriate flocculants or coagulants to settle fine particles prior to discharge.
	Erosion / entrainment at discharge point / water released at too high velocity.	Release discharge waters at a lower velocity.
		Install additional stabilisation at discharge point – e.g. level spreader, rock armouring / check dam.
	Excessive erosion or sediment generation within disturbance areas.	Review erosion and sediment control measures to confirm consistency with the Erosion and Sediment Control Plan.
		Implement additional stabilisation / sediment reduction measures such as supplementary seeding of stabilising cover, hydromulching, addition of soil binder, additional sediment fencing, rock armouring, check dams, etc.

Table 14 (Cont'd)
Example Corrective Actions / Contingency Measures

Page 2 of 2

Water Quality Trigger	Potential Cause	Corrective Action / Contingency Measures
The pH of water to be discharged is below 6.5.	Application of flocculants or coagulants to reduced sediment levels has caused a reduction in pH.	Addition of suitable alkaline amendments prior to discharge of water.
		Review flocculant / coagulant used and determine if suitable alternatives are available.
	A pocket of pyritic material is exposed within the extraction area ¹ .	Inspection of the exposed extraction faces and floor by a geologist or suitably qualified person for evidence of pyritic material and acid generation.
		Define the extent of pyritic material and determine appropriate actions, e.g. remove from site, treat on-site with alkaline amendments or re-cover with clay material to prevent further oxidation.
Hydrocarbons detected in discharge water or sediment basins.	Hydrocarbon leak from mobile equipment.	Stand down equipment item until repairs are completed and clean-up of contaminated materials.
	Hydrocarbon spill during refuelling or equipment maintenance.	Suspend refuelling or maintenance activity and clean up contaminated materials. Review operating procedure for refuelling or maintenance and implement additional controls as applicable to prevent reoccurrence.
Note 1: There is no evidence of pyritic material or acid generation issues within the Ashfield Shale. This contingency has been included for completeness.		

15. INCIDENT REPORTING

In the event that routine water quality monitoring establishes that an exceedance of an environmental criterion was directly attributed to activities associated with the Quarry, the exceedance will be reported in accordance with the Incident Reporting Procedure outlined within the Environmental Management Strategy for the Quarry (prepared in accordance with *PA Condition 5(1)*).

16. PUBLICATION OF MONITORING INFORMATION

Austral will place a summary of all water monitoring results reports on Austral's website, which will be updated at least quarterly.

In addition, Austral will include a summary of all water monitoring data within each *Annual Review* for the period ending 31 December each year and address the relevant requirements of *PA Condition 5(4)*. That document, once approved by the relevant government agency, will also be published on Austral's website.

17. PLAN REVIEW

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

- the submission of an *Annual Review* under *PA Condition 5(4)*;
- the submission of an incident report under *PA Condition 5(7)*;
- the submission of an independent environmental audit report under *PA Condition 5(9)*; and
- any modification to the conditions of PA08_0212.

Any non-administrative updates to this WMP will be undertaken in consultation with Water NSW and the DPE - Water and submitted to the DPE – Planning and Assessment for endorsement. Any administrative updates will be submitted directly to DPE – Planning and Assessment for endorsement.

18. REFERENCES

DECC (2008). *Managing Urban Stormwater. Soils and Construction.* Volume 2e Mines and Quarries. NSW Department of Environment and Climate Change, Sydney.

Landcom (2004). *Managing Urban Stormwater. Soils and Construction.* Volume 1.

R.W. Corkery & Co. (2015). *Environmental Assessment to Support a Section 75W Modification of PA08_0212 for the New Berrima Clay/Shale Quarry.*

SEPP (2011). *State Environmental Planning Policy. Sydney Drinking Water Catchment.*

Appendix A

Consultation and Response

Copies of consultation correspondence are provided as follows with a summary of how the consultation comments have been addressed provided in **Table A1**.

Table A1
Coverage of Consultation Comments – WMP

Agency	Comment	Coverage
Water NSW 4/08/22	Water NSW requests that the WMP and the Soil and Erosion Control Plan be reviewed again considering the extremely wet weather conditions since late 2021 which are expected to continue at least until early 2023. This may change the site conditions including erosion and sediment runoff into receiving water especially from the overlying first and second order drainage lines.	The current WMP was reviewed in June 2022 in light of the significant rainfall events that occurred during 2021 and 2022. As reported in the Annual Reviews the water management systems have performed extremely well and beyond the design standards. No further changes to the WMP are considered necessary in light of the continued wet weather conditions.
Department of Planning and Environment - Water 28 July 2022	Install at least one more piezometer (nested recommended) between the quarry and the river, preferably halfway through from the north-eastern edge of the quarry.	Consultation was undertaken with NRAR prior to the installation of the monitoring bores with the planned installation outlined in correspondence to NRAR dated 20 April 2019. Email correspondence from NRAR dated 27 May 2019 confirmed acceptance of the piezometers. At this stage, no additional piezometers are planned. However, the need for any additional monitoring will be considered over the life of the Quarry (noting that the southern half of the extraction area will be extracted over the next ~15 years prior to extraction commencing in the northern half).
	That the proponent determine baseline groundwater level and quality by analysing 3 years of monitoring data which is understood to be available by November 2022. This is requested to be completed and provided to the department for review by end of January 2023.	It is noted that the requirement for installation of the groundwater bores was prior to extraction reaching a depth of 660m AHD. The bores have been installed well in advance with no extraction having reached 660m AHD (i.e. groundwater monitoring is not yet a requirement with all data collected to date being additional due diligence information).
	That the proponent establish final Trigger Action Response Plan (TARP) parameters and provide to the department for review by end of January 2023.	Monitoring data will continue to be reviewed and summarised on an annual basis within the Annual Review which is provided annually to all relevant agencies by 28 February. This review and reporting process is considered appropriate with additional reporting considered superfluous. Whilst the WMP will continue to be reviewed on an annual basis following each Annual Review, the preparation of “final” TARP parameters will be undertaken once extraction exceeds 660m AHD. The TARP parameters will then continue to be reviewed annually. Given the above, setting of TARP parameters beyond those currently specified within Section 10.3 is considered premature.

Appendix B

Erosion and Sediment Control Plan

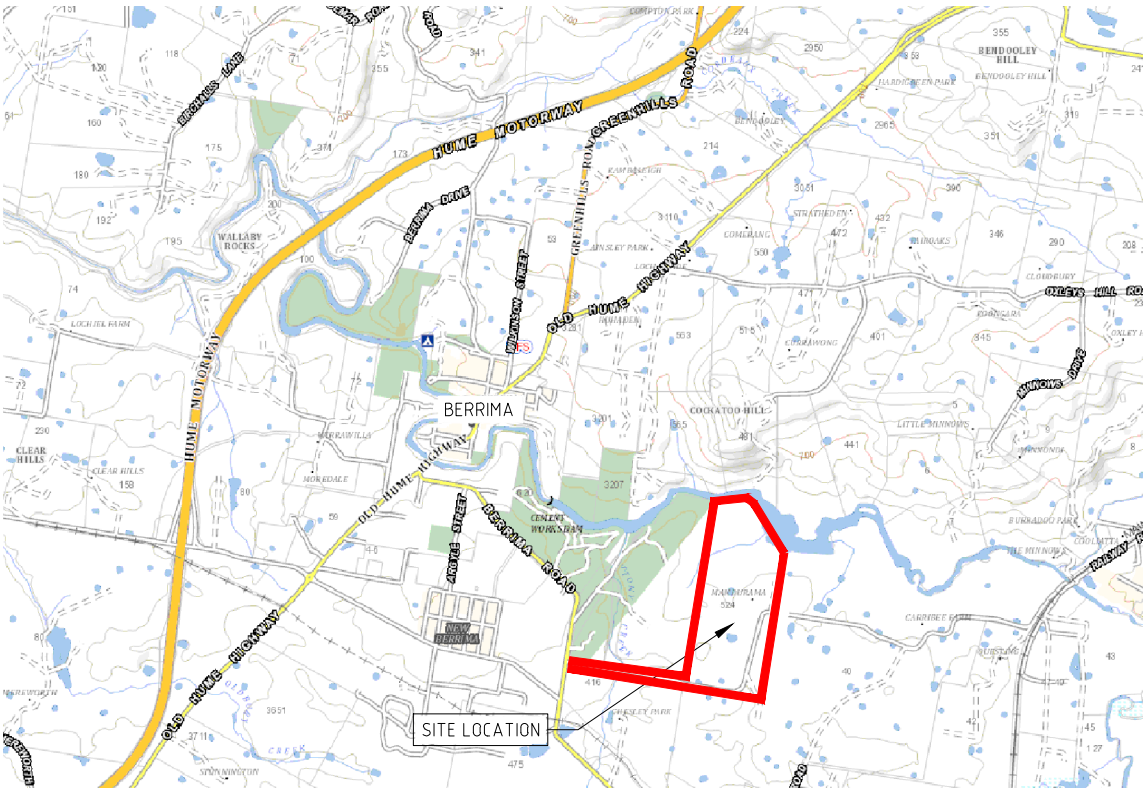
Contents:

- ESCP000 – Cover sheet, Locality Plan and Drawing Schedule
- ESCP001 – General Notes – Sheet 1 of 2
- ESCP002 – General Notes – Sheet 2 of 2
- ESCP003 – Sediment Basin Schedule, Background Data and Calculations
- ESCP004 – Informative Tables
- ESCP005 – Standard Drawings
- ESCP006 – Standard Drawings Continued
- ESCP007 – Establishment Stages 1 – 4
- ESCP008 – Establishment Stages 5 – 7

EROSION AND SEDIMENT CONTROL PLANS

DECEMBER 2021

DRAWING NUMBER	DRAWING TITLE
14.000289_P01_ESCP000	ESCP - COVER SHEET, LOCALITY PLAN AND DRAWING SCHEDULE
14.000289_P01_ESCP001	ESCP - GENERAL NOTES - SHEET 1 OF 2
14.000289_P01_ESCP002	ESCP - GENERAL NOTES - SHEET 2 OF 2
14.000289_P01_ESCP003	ESCP - SEDIMENT BASIN SCHEDULE, BACKGROUND DATA & CALCULATIONS
14.000289_P01_ESCP004	ESCP - INFORMATIVE TABLES
14.000289_P01_ESCP005	ESCP - STANDARD DRAWINGS
14.000289_P01_ESCP006	ESCP - STANDARD DRAWINGS CONTINUED
14.000289_P01_ESCP007	ESCP - ESTABLISHMENT STAGES 1-4
14.000289_P01_ESCP008	ESCP - ESTABLISHMENT STAGES 5-7



LOCALITY PLAN
N.T.S.

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS	DRAWING STATUS		North	CLIENT	 P.O.Box 1098, Bowral, NSW. 2576 Suites 7 & 8, 68-70 Station Street Bowral NSW 2576. (t) 02 4862 1633 (f) 02 4862 3088 email: reception@seec.com.au WWW.SEEC.COM.AU	PROJECT TITLE	DRAWING TITLE			
06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING	DESIGN BY	M.P.	AUSTRAL BRICKS	NEW BERRIMA SHALE QUARRY		ESCP				
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	DRAWN BY	M.R.				COVER SHEET, LOCALITY PLAN				
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	FINAL APPROVAL	M.P.				AND DRAWING SCHEDULE				
03	01/02/18	M.P.	M.N.	M.P.	AMENDED TO CLIENTS COMMENTS	SCALE:	N.A.				PROJECT NO.				
02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE	(on A3 Original)					SUB-PR NO.				
01	14/11/17	M.P.	L.O.	M.P.	FINAL ISSUE						DRAWING NO.				
00	6/04/16	M.P.	N.L.	M.P.	FINAL ISSUE						REV				
A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION	FINAL					14000289				
											P01	ESCP000	06		

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GENERAL REQUIREMENTS

EROSION AND SEDIMENT CONTROL DESIGN

The details shown on this drawing are primarily for site establishment stage erosion and sediment control requirements (Site Establishment Stages 1 to 4, and Site Establishment Stages 5 to 7). This Erosion and Sediment Control Plan (ESCP) has been prepared in accordance with Blue Book Volume 1 (Landcom, 2004) and Volume 2E – Mines and Quarries and project approval conditions.

An erosion hazard assessment has been completed for the proposed works. The predicted soil loss has been determined in accordance with the following:

$$A = R \times K \times LS \times C \times P$$

Where

A = Annual soil loss due to erosion (t/ha/yr)
R = Rainfall erosivity factor
K = Soil erodibility factor
LS = Topographic factor derived from slope length (SL) and slope gradient (S)
C = Cover and management factor
P = Erosion control practice factor

The following values have been used:

K	: 2580
S	: 0.064
LS	: Varies (200m MAX.)
S	: Varies (Typically 5 - 15% for general surfaces, up to 40% on bunds)
LS	: Varies (Typically 1.19 to 5.96 for general surfaces up to 6.92 on bunds)
C	: 1.0 (Construction stage - i.e. no soil surface protection or ground cover applied)
P	: 1.3 (for general construction areas)

Based on the above data, the potential soil loss rate varies from 25t - 1656 t/ha/yr depending on the works.

DESIGN ASSUMPTIONS AND BACKGROUND INFORMATION

- Volumetric runoff coefficient (CV) = 0.64 (assuming hydrologic group D runoff coefficient - low infiltration, high runoff)
- Basins are designed for the 5-day, 85th %ile rainfall depth = 36.2mm,
- Dam 2 is designed for the 5-day, 95th %ile rainfall depth = 75.2mm.
- Runoff coefficient (C10) = 0.6 for pervious areas, 0.9 for disturbed areas.

EROSION AND SEDIMENT CONTROL INSTRUCTIONS – SITE ESTABLISHMENT STAGES

Before commencement of site establishment works involving clearing, grubbing, topsoil stripping and earthworks in each area/section of works, the site is to be secured and the following erosion and sediment control measures installed as required throughout all stages of works. Clearing, grubbing, stripping and earthworks necessary to install the erosion and sediment controls are permitted but must be kept to an absolute minimum.

1. Barrier flagging (or alternative measures) should be in place around the edge of the construction boundary to restrict access and in any additional locations as required to minimise unnecessary disturbance. Refer to the 'Access Control' notes.
2. Construct defined site access roads.
3. Ensure sediment fencing is in place downslope of stockpile areas and following Standard Drawing SD 6-8 (Refer to the 'Sediment Fencing' notes below).
4. Clean water diversions are to be constructed and stabilised. Refer to plans for details.
5. Sediment basins including the inlet and outlet dissipation structures are to be installed in the locations shown – refer to the 'Sediment Basin' notes and Tables 2 and 3 on ESCP003 for minimum sizing requirements.
6. Onsite (dirty) water diversions (where applicable) are to be constructed and stabilised/lined – refer to plans for details and Table 4 on ESCP003 for sizing and lining requirements. These might not be required depending on the exact locations of the basins.
7. Stockpile areas are to be established in the surplus overburden stockpile area and in accordance with the 'Stockpiling' notes below.
8. Once all of the above measures are complete and stable, construction works can proceed in accordance with the engineering plans. Topsoil should be managed in accordance with the 'Topsoil Stripping, Soil Management and Stockpiling' notes.
9. Slope lengths across disturbed lands are to be maintained at the required intervals during all rainfall events (Refer to the 'Slope Lengths' notes).
10. Dust suppression to be carried out when required (Refer to the 'Dust Suppression' notes).
11. Temporary stabilisation of some lands prior to rainfall is to be undertaken in accordance with the 'Stabilisation' notes and the 'Rainfall Preparation Procedure'.
12. Treatment of dirty water is to be carried out as necessary in accordance with the 'Dirty Water Treatment and Discharge Requirements' notes.
13. Monitoring, maintenance and inspections are to be carried out regularly as required, in accordance with the 'Site Inspection and Monitoring and Maintenance' notes.
14. Undertake progressive stabilisation of lands as final earthworks are complete in each area (rather

than waiting until the completion of works).

15. Final stabilisation is to be completed in accordance with the 'Stabilisation' notes.

ACCESS CONTROL - (For works outside of the approved extraction area, the following access controls will be implemented as appropriate).

- Install barrier fences or suitable administrative controls to define the project works and clearing limits.
- Barrier fencing can simply be made from tape wound around star pickets or stakes. Alternatively, sediment fence, site fence or chain wire fences can be used for this purpose if so desired. Existing fences and/or site flagging can also be used where they are present in the relevant locations.
- Barrier and sediment fencing are to be used to ensure that all vehicles leaving the site pass over a stable access point to minimise bogginess in these areas and minimise sediment tracking onto public roads.
- Barrier fencing is to be used at the discretion of the site manager to delineate all 'no go' areas.
- The soil erosion hazard on the site will be kept as low as practicable by minimising land disturbance and staqing works. Some ways of doing this are outlined in Table 1.

TOPSOIL STRIPPING, SOIL MANAGEMENT AND STOCKPILING

During all stages of site establishment and operation, soils are to be stripped and managed in accordance with the following:

- Prior to topsoil stripping gypsum is to be spread over the ground surface at a rate of 1 tonne per hectare. The gypsum will be stripped up and premixed with the topsoil.
- As much as possible topsoils are to be stripped when moist (not wet or dry).
- Topsoils are to be stripped separately from the underlying subsoils. Topsoil depths may vary across the project site and care should be taken to avoid stripping underlying soil horizons (subsoils) with the topsoil layer.
- As much as possible subsoils are not to be worked when wet.

Stockpiles are to be established within the surplus overburden stockpile area or the approved extraction area. If additional or alternative locations for stockpiling are required they should be subject to approval prior to establishment. All stockpiles should incorporate clearly defined access controls and comply with the regulations outlined below.

All stockpiles must be constructed and maintained in accordance with Standard Drawing SD 4-1 and the following:

- Prior to stabilisation, all soil stockpiles must have sediment fencing or equivalent installed around their bases as per Standard Drawing SD 4-1.
- Mulched vegetation, topsoil and subsoil are to be stockpiled separately wherever possible.
- Stockpiles of overburden material will be progressively stabilised to achieve a C-factor of 0.5 (i.e. - 50% vegetative cover). This approach is considered acceptable given that the surplus overburden stockpile are will drain to Dam 2 and that the overburden material is not required as a growth medium.
- Topsoil stockpiles should be constructed to no more than 2 meters in height.
- Stockpiles should be battered at a maximum slope of 2H:1V wherever possible.

STABILISATION

- Undertake progressive stabilisation of disturbed ground surfaces outside of the approved extraction area as they are completed rather than at the end of the works program.
- Bare soil will be stabilised using soil binders/hydromulch or similar with a target of achieving:
 - A C-factor (ground cover factor) of 0.15 (i.e. – equivalent to about 50% soil coverage) within 20 days of final shaping; and
 - A C-factor of 0.05 (i.e. – equivalent to about 70% soil coverage) within a further 40 days.
- If the above targets are not reached in these timeframes, supplementary stabilisation will be undertaken.
- Note that these C-factors can be achieved using vegetation or alternative erosion control methods such as mulch, binders, hydromulches, compost blankets or organic fibre matting.
- During site establishment (i.e. formation of the visibility barriers and access/haul roads), disturbed lands that are not finished and will not be re-worked within 20 days will be stabilised using a soil binder to achieve a C-factor of 0.15 (i.e. – equivalent to about 50% soil coverage).
- Areas to be revegetated are to be topsoiled first using the gypsum treated topsoil stripped during the initial stages of works (refer to the Topsoil Stripping, Soil Management and Stockpiling notes). Refer to Standard Drawing (SD 4-2) for instructions regarding topsoil replacement.
- Appropriate seedbed preparation should be carried out when revegetating lands (See Standard Drawing (SD 7-1)).
- Soils may require treatment with a slow release fertiliser to improve fertility. Fertiliser specifications and application rates are to be determined prior to final rehabilitation.
- Wherever possible, re-use cleared/mulched vegetation for either temporary or permanent stabilisation of disturbed areas. If mulch is not available or appropriate then the use of jute mesh, erosion control matting (ECM), soil stabilisers (e.g. Vital P47/Stonewall), hydromulching, or an appropriate approved alternative should be considered for provision of groundcover until

vegetation has established.

- Diversion drains and table drains are to be stabilised using the lining requirements in Tables 4 and 5 on ESCP003. Subsoil surfaces for all permanent drainage lines and concentrated flow areas are to have gypsum applied at a rate of 5 tonnes per hectare prior to lining. Refer to the Table 4 for specific sizing and lining details for clean water drain stabilisation. Also refer to Standard Drawings (SD 5-6 and SD 5-7).
- Refer to the 'Stockpiling' notes for stabilisation requirements on stockpiles. Also refer to Standard Drawing (SD 4-1).
- Sediment basin overflows and culvert inlets / outlets are to be stabilised in accordance with Table 3 on ESCP003.
- As surfaces are stabilised (at least 90% of any finished area has at least 70% ground cover) and permanent drainage measures are installed, temporary erosion and sediment control structures and water management structures can be removed (e.g. sediment fence and diversion drains).
- Prior to forecast high rainfall or site shutdown (> 3 days) and in accordance with the 'Rainfall Preparation Procedure', exposed soil areas will be 'locked down' using temporary ground covers such as biodegradable matting, geotextile matting, hydromulch, soil binders (e.g. Vital P47/stonewall) or similar. Refer to the 'Rainfall Preparation Procedure' for details.
- Highly trafficked areas (i.e. site access/haul roads, site compounds) will be stabilised where feasible with suitable trafficable materials such as DGB, roadbase, gravel or dustex to minimise erosion and provide stability to vehicle movements.

SEDIMENT FENCING

- During site establishment, install sediment fences in the locations shown in ESCP007 and ESCP008
- Install all sediment fencing in accordance with Standard Drawing SD 6-8.
- Sediment fences must be firmly trenched into the ground for their entire length.
- Sediment fences must include small 'returns' at maximum 20m intervals (see Standard Drawing 6-8) to minimise the risk of water flowing along them.

SEDIMENT BASINS

- The required sediment basin sizes and details are shown on Table 6-.
- The sediment basin/s have been sized (volumes determined) for the maximum area of disturbance (the worst case scenario) considering all stages.
- Sediment basin footprints shown on the plans are indicative only. A detailed survey analysis is to be undertaken prior to construction to ensure the required volumes can be achieved. If the required sediment basin volumes cannot be provided due to space or topographical restrictions additional basins/sumps are to be provided to supplement the basin volume and/or enhanced erosion control measures are to be carried out. This is to be undertaken by onsite survey in consultation with SEEC or an appropriately qualified soil conservationist (CPESC) prior to any land disturbance taking place once the workforce has mobilised to site. If full sized sediment basin volumes cannot be provided as shown on these ESCPs the plans are to be updated prior to commencing works.
- Sediment basins are to be constructed in accordance with engineering detail to ensure appropriate stability and compaction is achieved. Also refer to SD 6-4.
- The sediment basin/s are to be built to incorporate a primary outlet (weir overflow/spillway) sized to have a capacity to pass the 100 year peak flow - Refer to Table 3.
- An energy dissipater of equivalent width and lining to the spillway is to be constructed at each spillway outlet. Dissipater to extend onto stable, vegetated lands to ensure sheet flow.
- Gypsum is to be shallow ripped into the basin internal walls, spillway base and walls and dissipater ground surface during construction at a rate of 5t/ha.
- Safety controls are to be implemented around the sediment basins as required.
- Water will be discharged from a basin (after treatment if required) or transferred to Dam 12 within 5-days after the conclusion of a rain event if that inflow results in the basin water level encroaching into the required settling zone.
- Dam 12 will have a capability to receive dirty water from all active sediment basins and, being a turkeys nest dam, will have the ability to store the dirty water without impinging upon the maintenance of settlement zones in the sediment basins.
- Any release of water from sediment basins will need to be tested to comply with the water quality requirements prior to being discharged from site (Refer to the 'Dirty Water Treatment and Discharge Requirements' below for further details).
- Note if water is pumped into a tanker truck for later use, it cannot be discharged offsite without first being tested and if required, treated.
- Water in sediment basins (excluding Dam 12) must be effectively flocculated (if required), settled, tested to comply with the discharge requirements and discharged within 5-days or less following a rainfall event.
- Sediment basins inlets may be preloaded with gypsum (spread out over the inlet flow surface area) prior to rainfall. This will help to treat (flocculate) site water.
- An automatic flocculation system at the sediment basin/s inlet may be necessary if water treatment is not being successfully achieved via manual methods.
- A sediment marker is to be installed within sediment basins indicating the sediment volume level.
- Sediment basins are to be desilted prior to reaching the indicated sediment volume levels.

(GENERAL REQUIREMENTS ARE CONTINUED ON THE FOLLOWING PAGE)

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS	DRAWING STATUS	North	CLIENT	PROJECT TITLE	DRAWING TITLE		
06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING	DESIGN BY	M.P.	 P.O.Box 1098, Bowral, NSW. 2576 Suites 7 & 8, 68-70 Station Street Bowral NSW 2576. (t) 02 4862 1633 (f) 02 4862 3088 email: reception@seec.com.au WWW.SEEC.COM.AU	NEW BERRIMA SHALE QUARRY	ESCP GENERAL NOTES SHEET 1 OF 2		
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	DRAWN BY	M.R.					
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	FINAL APPROVAL	M.P.					
03	01/02/18	M.P.	M.N.	M.P.	AMENDED TO CLIENTS COMMENTS	SCALE:	N.A.					
02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE	(on A3 Original)						
01	14/11/17	M.P.	L.O.	M.P.	FINAL ISSUE							
00	6/04/16	M.P.	N.L.	M.P.	FINAL ISSUE	FINAL			PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION				14000289	P01	ESCP001	06

Plot Date: Monday, 20 December 2021 8:13:18 AM

CAD File Name: J:\14000289 New Berrima Shale Quarry\Drawings\14000289_P01_ESCP000_REV 06.dwg

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GENERAL REQUIREMENTS CONTINUED

DUST SUPPRESSION

- Dust suppression should be carried out whenever necessary to minimise sediment becoming air borne due to wind erosion.
- An appropriate water source for dust suppression and/or dust suppressant management system (e.g. dustex, dustguard or equivalent) must be identified prior to starting construction works.
- Temporary stabilisers (e.g. Vital Bon-Matt P47), geotextile, jute matting or equivalent can be used in non-trafficcked areas to assist with dust control.
- Wherever possible access track running surfaces to be stabilised with crushed rock, aggregate, roadbase, a trafficable soil stabiliser or equivalent to assist with dust control on these surfaces.

DIRTY WATER TREATMENT AND DISCHARGE REQUIREMENTS

- Any active / controlled discharge of water from the project (i.e. where water is moved offsite via direct action such as pumping rather than flowing off the project as a result of heavy rainfall) is to achieve:
 - 50mg/L or less TSS (Total Suspended Sediment) or equivalent NTU based on approved correlation; and
 - pH 6.5 to 8.5; and
 - no visible trace of oil and grease.
- Flocculation might be achieved by using gypsum at a rate of approximately 30 kg/100 m3 of stormwater. Alternative flocculating agents can only be used if approval by EPA has been granted. Refer to manufacturers guidelines for dosage details.
- Ensure the flocculant/coagulant is thoroughly mixed/diluted with water prior to spreading evenly over the entire pond surface or circulated using a pump system for proper treatment of water. Dirty water from the basins can be used for mixing the flocculant/coagulant.

SLOPE LENGTHS

- Ideally slope lengths should be restricted to maximum 80m intervals across all disturbed lands (excluding the extraction area) during rainfall unless otherwise stabilised. This will reduce the amount of sediment reaching a basin and so extend the de-silting period.
- Diversion bunds/drains, low flow earth banks (Standard Drawing SD 5-5) or sandbags/equivalent can be installed prior to rainfall event to achieve this.

RAINFALL PREPARATION PROCEDURE DURING SITE ESTABLISHMENT

- The weather forecast is to be monitored regularly (at least daily and hourly when rainfall is imminent) by the site environmental manager (or their representative).
- At least 48 hours prior to forecast rainfall (> 60% chance of 12mm or more over 24 hours), the site environment manager (or their representative) is to inspect (and record the condition of, and any action required) the condition of all erosion and sediment controls and undertake any works necessary to establish/maintain them.

SITE INSPECTION, MONITORING AND MAINTENANCE DURING SITE ESTABLISHMENT

- Regular site inspections are to be conducted by the site environment manager (or their representative). Inspections are to be undertaken:
 - At least weekly during construction hours; and
 - Prior to forecast significant (>12mm) rainfall (see above); and
 - Daily during rain events (if safe to do so); and
 - Within 24 hours of the cessation of a rain event that causes runoff (if safe to do so).
- Additional erosion and sediment controls will be installed as necessary to ensure satisfactory outcomes in keeping with the project conditions and best-practice Blue Book guidelines.
- Sediment or rocks tracked from the site will be removed from public roads as soon as possible (e.g. with street sweepers).
- After rainfall, sediment accumulated in trapping devices (e.g. filter dams, sediment fence) will be removed to a secure location where it can't wash or blow offsite (preferably to an active stockpile).
- Weather conditions will be monitored onsite and daily rainfall will be recorded at the site's weather station (AB02).
- Safe storage areas for wastes, fuels, excess concrete and other potential contaminants are to be delineated by the site manager in accordance with the project requirements.
- Adequate supplies of erosion control measures (e.g. geofabric rolls, jute matting, polymer soil binders) are to be maintained in the site compound for rapid deployment as required.
- Adequate supplies of flocculant (and flocculating equipment) are to be available as required.
- Dust suppression is to be undertaken as required to minimise the risk of offsite dust impacts. Refer to the Dust Suppression notes for details.

SITE INSPECTION, MONITORING AND MAINTENANCE DURING OPERATIONS

- The site will be operated on a campaign basis so staff will not be on site full-time.
- However, the site will be inspected after it receives rainfall sufficient to cause inflow that encroaches into the settling zone of a sediment basin. This may be measured automatically.
- Sediment basins will be managed per the 'Sediment Basin' notes to re-gain the required settling volumes.

ORDER OF WORKS

- Other water management measures (e.g. diversion drains, spillways, etc.) will be inspected.
- Areas of rehabilitation will be inspected.
- Erosion and sediment control measures will be maintained as necessary.

STAGES 1 TO 4 ESTABLISHMENT

Install the following measures.

- Construct site office and stabilised access from Berrima Road.
- Construct clean water diversion drains CD2 and CD3 and stabilise and then their outlets.
- Pump out Dam 1 (which will initially be used as a sediment basin). Check its capacity and adjust if necessary. Construct a new spillway (if necessary); stabilise any disturbed lands.
- Build SB11.
- Construct dirty water drains to ensure all disturbed areas within Catchments 1 and 11 drain to SB1 and SB11.
- Pump out Dam 5 which will be used as a sediment basin. Check its capacity and adjust if necessary. Construct its spillway and stabilise any disturbed lands.
- Pump out and enlarge Dam 2. Construct the spillway and stabilise any disturbed lands.
- If necessary construct dirty water drains to ensure all disturbed areas within Catchment 2 drain to Dam 2.
- Install clean water diversion drain CD1 and stabilise it.
- Delineate lands south of the extraction area that will require ground disturbance with barrier fences to restrict access – refer to Table 1 and to the Barrier Fence Notes.
- Strip the topsoil from these locations and stockpile it to the requirements of the Stockpiling Notes.
- Construct the haul road to provide access to the sites of the central and northern visibility barriers and the extraction area. Stabilise any disturbed lands.
- Construct Dam 10 which will be a sediment basin; stabilise any disturbed lands.
- If necessary construct dirty water drains to ensure all disturbed areas within Catchment 10 drains to SB10.
- Pump out Dam 4 (which will initially be used as a sediment basin) and construct a new spillway (if necessary); stabilise the disturbed lands.
- If necessary construct dirty water drains to ensure all disturbed areas within Catchment 4 drain to SB4.
- When all sediment basins and their associated drains and spillways are complete, general earthworks may begin. Ensure all dirty water drains to a sediment basin.
- Delineate the extent of all works with barrier fences to restrict access – refer to Table 1 and to the Barrier Fence Notes.
- Strip the topsoil from the work areas and the extraction area. Stockpile it to the requirements of the Stockpiling Notes.
- Construct Dam 7.
- Build the central and northern visibility barriers.
- Build the southern visibility barrier. This barrier requires special treatment as the southern face and the western part of the northern face will not be able to drain to SB1. In this location soil binder will be kept on hand and will be applied to all disturbed surfaces that don't drain to SB1 if rain is forecast (more than 60% chance of more than 12mm in 24 hours). Alternatively soil binder may be pre-emptively applied to completed surfaces.
- Ensure all dirty water drains to a sediment basin. For small areas (<2,500 m²) that can't, drain to a sediment capture device e.g. sediment fence, rock filter dam, sediment sump.
- Progressively stabilise all disturbed surfaces to the requirements of the 'Stabilisation' notes on ESCP001.
- Manage the sediment basins to the requirements of the 'Sediment Basin' and 'Dirty Water Treatment and Discharge Requirements' Notes.
- Once the disturbed lands are stabilised, SB1 and SB4 will be converted to clean water storages and CD2 can be removed if required.
- Once the disturbed lands are stabilised, SB10 and any associated catch drains can be removed and the lands stabilised. Alternatively, SB10 may be retained as a clean water dam until Stages 5 to 7 Site Establishment.
- Begin extraction.

- Remove SB11 and DD1 when Western Access Road is stable. Alternatively, SB11 may be retained as a clean water dam during operations.

STAGES 1 TO 4 OPERATION

- The only dirty water storages in this stage are SB2, SB5 and SB12. However, it is noted that, when the catchments for SB2 and SB5 are stabilised they may be regarded as clean water.
- Manage them per the Sediment Basin notes.
- During this period ensure diversion drains are stable and that any areas of rehabilitation are adequately stabilised in accordance with the 'Stabilisation' notes on ESCP001.
- Pump-out Dam 7 (clean water) as necessary.

STAGES 5 TO 7 ESTABLISHMENT

- This stage involves the expansion of the extraction area north. As part of the works the central visibility barrier will be removed.
- Install clean water diversion CD3 at Dam 4 which will become a sediment basin while works occur.
- Pump out Storage 4 to SB5 or SB12 as required.
- Install SB9; stabilise the lands.
- Strip the topsoil in the Extraction Area footprint and stockpile it according to the stockpiling notes.
- Water trapped in SB9 will be pumped to SB5 or SB12 for treatment.
- When the extraction area is internally draining SB4 may revert to a clean water storage and SB9 may be removed; stabilise any disturbed lands.
- Progressively stabilise all disturbed surfaces outside of the extraction area to the requirements of the 'Stabilisation' notes on ESCP001.
- Manage SB5 to the requirements of the 'Sediment Basin' Notes.
- Dam 7 will be removed as part of the creation of the terminal batters on the southern boundary of the construction site.

STAGES 5 TO 7 OPERATION

- The only dirty water storages in this stage are SB2, SB5 and SB12. However, it is noted that, when the catchments for SB2 and SB5 are stabilised they may be regarded as clean water.
- Manage them according to the requirements of the 'Sediment Basin' notes.
- During this period ensure diversion drains are stable and that any areas of rehabilitation are adequately stabilised in accordance with the 'Stabilisation' notes on ESCP001.

POST QUARRY

- Post Quarry works will be to:
 - Remove the Surplus Overburden Stockpile by transferring the material to the former Extraction Area.
 - Rehabilitate the former Surplus Overburden Stockpile area.
 - Remove the northern visibility barrier and stabilise the land there.
 - Rehabilitate the Extraction Area, although it will remain internally-draining to Dam 8.
- No new Sediment basins or water storages will be required, however:
 - SB2 will be used in the same manner as it was during operation until its catchment is stabilised. At that time it will be converted back to a clean water dam.
 - SB5 will be managed as a sediment basin during the removal and stabilisation of the northern visibility barrier. It will be pumped dry before works begin. Once its catchment is stabilised it will become a clean water dam.
 - SB12 will be managed as a Turkeys Nest sediment basin. Dirty water from SB2, SB5 and SB8 will be pumped to SB12 for treatment and provide additional volume within basins.
- Progressively stabilise all disturbed surfaces to the requirements of the 'Stabilisation' notes on ESCP001.
- Manage the sediment basins to the requirements of the 'Sediment Basin'

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06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING	DESIGN BY	M.P.	AUSTRAL BRICKS	NEW BERRIMA SHALE QUARRY		ESCP GENERAL NOTES SHEET 2 OF 2											
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	DRAWN BY	M.R.															
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02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE	FINAL																
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A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION							PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV							
											14000289	P01	ESCP002	06								

TABLE 1 LIMITATIONS TO ACCESS DURING CONSTRUCTION		
LAND USE	LIMITATION	REMARKS
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans	All site workers should clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope) or similar materials.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones on site. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries
Remaining lands, including revegetation areas	Entry prohibited except for essential management works	Thinning of growth might be necessary, for example, for fire reduction or weed removal. All thinning activities additional to the agreed scope must be approved by RMS prior to commencement.

NOTE - Table 1 does not apply to internally draining excavation areas

TABLE 4 – CLEAN WATER DIVERSIONS

Drain Number	Base Width (m)	Depth (m)	Grade (%)	Lining
CD1	0.5	0.6	4	Grass or Geofabric
CD2	0.5	0.75	1.5-2	Grass or Geofabric
CD3	0.5	0.6	4	Grass or Geofabric

all side slopes at 1V:3H.

TABLE 5 – DIRTY WATER DIVERSIONS

Drain Number	Base Width (m)	Depth (m)	Grade (%)	Lining
All Dirty Water Drains	0.5	0.6	Varies	Jute Mesh & Bitumen or Geofabric

all side slopes at 1V:3H.

TABLE 2 – SEDIMENT BASIN SIZING TABLE

Sediment Basin Number	Total Catchment (ha)	Storage (soil) Volume (m³)	Settling (water) Volume (m³)	Total Basin Volume (m³)
1	3.3	49	394	1,400 (existing)
2	2.74	174	1,628	1,802
4	3.8	467	592	1,059
5a	18.5	781	2,947	3,728
5b	8.08	426	1,638	2,064
5c	2.1	74	426	500
9	2.1	149	380	529
10	0.75	57	94	151
11	1	25	232	257

Note: 5a sizing is based on Establishment Stages 1-4
5b sizing is based on Operational Stages 1-4 and Establishment Stages 5-7
5c sizing is based on Operational Stages 5-7

TABLE 3 - SPILLWAY SIZINGS**

Sediment Basin Number	Base Width (m)	Slope %	Lining
1	3	5	100 mm rock over geotextile for first 5 m thence grass
2	4	5	100 mm rock over geotextile for first 5 m thence grass
4	5	5	100 mm rock over geotextile for first 5 m thence grass
5	10	5	100 mm rock over geotextile for first 5 m thence grass
9	3.5	5	100 mm rock over geotextile for first 5 m thence grass
10	2	5	100 mm rock over geotextile for first 5 m thence grass
11	2	5	100 mm rock over geotextile for first 5 m thence grass

**Note: minimum embankment height above spillway must be 1.2 m

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06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING	DESIGN BY	M.P.					NEW BERRIMA SHALE QUARRY	ESCP SEDIMENT BASIN SCHEDULE, BACKGROUND DATA AND CALCS			
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	DRAWN BY	M.R.									
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	FINAL APPROVAL	M.P.									
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A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION											

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REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS
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A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	M.P.
DRAWN BY	M.R.
FINAL APPROVAL	M.P.
SCALE: (on A3 Original)	N.A.
FINAL	

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NEW BERRIMA SHALE QUARRY

DRAWING TITLE			
ESCP INFORMATIVE TABLES			
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
14000289	P01	ESCP004	06

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TABLE A3 FROM LANDCOM (2004) "THE BLUE BOOK"

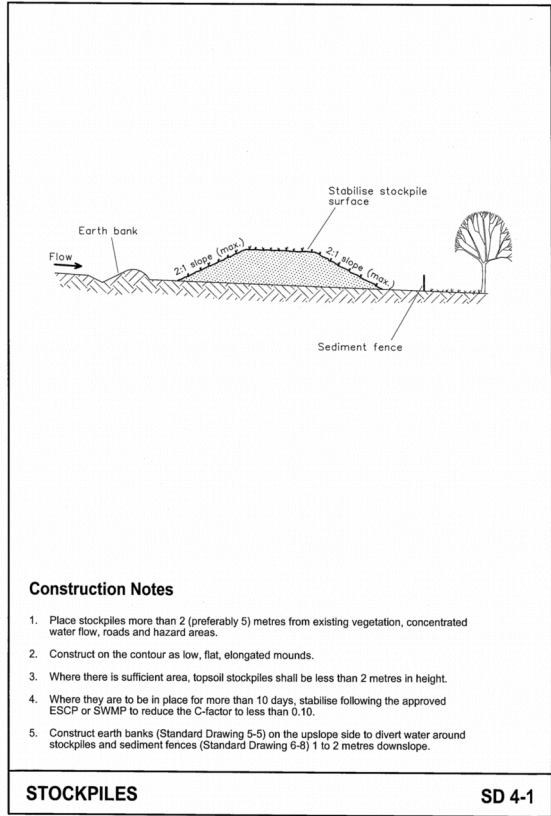
Table A3 Soil Stabilisation Control Matrix (adapted from various sources, including Meyer and Ports (1976), Israelson et al. (1980), Goldman et al. (1980), URS Greiner Woodward Clyde (1999) and the North American Green website)

Class	Type	Vegetation Type ⁽¹⁾	Design Life (months)	Use in Concentrated Flow ⁽²⁾	Availability (days) ⁽³⁾	Relative Cost Bracket ⁽⁴⁾	Residual Impact ⁽⁵⁾	C-factor <33%, <6m	C-factor <33%, 6-15m	C-factor 33-50%, <6m	C-factor 33-50%, 6-15m	C-factor 33-50%, >15m	Notes
BIODEGRADABLE MULCHES ⁽⁶⁾													1 Whether vegetation is required and its type if so, will affect the technique used. Biodegradable mulches, RECPs and hydraulic soil stabilisers can all be used on their own to provide short term protection. However, their effectiveness is less when used in isolation than when used with vegetative growth. Most techniques are used to help establish vegetative growth using sown grasses. Should the client specify shrubs primarily planted as tuberoses), then thicker mulches, RECPs or biodegradable mulches should be used. Non biodegradable RECP's are used to reinforce grasses (turf) permanently. They are not suitable for use with individual shrubs. They can work synergistically with the established grass to increase its resistance to shear stress and, therefore, increase its resistance to erosion by concentrated flow.
Straw (anchored)	4.5 tonnes per hectare	Grass	1 to 6	No	< 5days	Low	Moderate	0.17	0.47	0.20	0.20	0.20	2 Products might or might not be suitable for use in areas of concentrated flow. All products are suitable for steep flow conditions, although some would be over designed in such cases.
Wood Chip	15 tonnes per hectare	Grass/Shrubs	1 to 6	No	< 5days	Low	Moderate	0.08	0.08	0.08	No data	No data	3 Whether or not a product is readily available is critical to the selection process. Many RECP and hydraulic soil stabilisers techniques use products that might be off the shelf and available from several suppliers. Biodegradable mulches can be affected by seasonal variation, although they might also be available on site after initial clearing and grubbing. Temporary seeding might also be seasonal.
Wood Chip	27 tonnes per hectare	Shrubs	1 to 6	No	< 5days	Low	Moderate	0.05	0.05	0.05	No data	No data	4 For any given technique, cost can vary greatly depending on geographic location, size of project and installation requirements. In addition, costs can vary over time. Because of these factors, giving accurate installed costs is not possible. However, if a product is relatively inexpensive to purchase and install close to its point of manufacture, it will still be relatively inexpensive to purchase and install remote from it.
Wood Chip	56 tonnes per hectare	Shrubs	1 to 6	No	< 5days	Low	Moderate	0.02	0.02	0.02	0.02	0.02	5 This criterion relates to the impact that a particular practice might have on construction activities once they are resumed on an area that was temporarily stabilised.
Hydrumulching	1.5 tonnes mulch + 300 litres binder per hectare	Grass	1 to 3	No	< 5days	Low	Low	0.00	0.03	0.07	0.03	0.05	6 The performance of an erosion control technique is quantified by assigning it with a C-factor (Appendix A). The C-factor will vary from close to zero for full cover, to 1.0 for no cover on highly disturbed soils. The C-factor strongly affects the soil loss calculation (RUSLE) and users need to be careful in specifying its value, particularly when values <0.1 are quoted. Note that the C-factor does not apply to concentrated flow.
Bonded Fibre	5 tonnes fibre per hectare	Grass	1 to 6	No	< 5days	Low	Moderate	0.00	0.03	0.07	0.03	0.05	Values for the C-factor are given for various slopes gradients and lengths and show that it can change dramatically with them. The values given are compiled from existing data and from inference between products of a similar nature. They are given as a guide only and do not profess to be accurate in all respects. Overall, accurate C-factors are only available for manufactured products, primarily from the USA (RECP's in particular) where extensive independent testing has been undertaken. Unfortunately, very little data is available for the "lower cost" options such as biodegradable mulches, jute mesh and hydraulic soil stabilisers. Wherever possible, the manufacturers should be contacted for their latest data on acceptable C-factors.
Brown compost, bonded	Minimum 50 mm blanket	Grass/Shrubs	6 to 18	No	< 5days	Medium	Low	0.00	0.03	0.07	0.03	0.05	For the RECP's in particular, the C-factors given here are for the product as installed with no vegetation. Note however that lower C-factors can be expected if vegetation is promoted with many RECP's. Indeed, non biodegradable RECP's are designed to work synergistically with turf and must be used with it.
ROLLED EROSION CONTROL PRODUCTS (RECP's) ⁽⁷⁾													7 For information on trade names and suppliers of these products, please phone the office of Australasian Chapter of the International Erosion Control Association on 1800 354 322 or (+61 2) 4677 0901.
Biodegradable	Jute mesh	Grass	6 to 12	Yes	< 5days	Low	Moderate	0.10	0.20	0.40	0.20	0.40	
	Coconut fibre mesh (~400 gsm)	Grass	24	Yes	< 5days	Low	Moderate	0.10	0.20	0.40	0.20	0.40	
	Coconut fibre mesh (~700 gsm or more)	Grass	48	Yes	< 5days	Medium	Moderate	0.10	0.10	0.20	0.10	0.15	
	Curled wood fibre	Grass	6 to 12	Yes	< 5days	Medium	Moderate	0.01	0.05	0.10	0.10	0.15	
	Jute matting (~350 gsm)	Grass	6 to 18	Yes	< 5days	Medium	Moderate	0.00	0.03	0.07	0.03	0.05	
	Jute matting (~400 gsm)	Shrubs	12 to 24	Yes	< 5days	Medium	Moderate	0.00	0.03	0.07	0.03	0.05	
	Coconut fibre matting (~450 gsm)	Grass	18 to 24	Yes	< 5days	Medium	Moderate	0.00	0.03	0.07	0.03	0.05	
	Coconut fibre matting (~500 gsm)	Shrubs	> 48	Yes	< 5days	High	High	0.00	0.05	0.10	0.03	0.05	
Photodegradable	Mesh (< 5 mm openings)	Grass	> 12	Yes	< 5days	High	High	0.00	0.03	0.07	0.03	0.05	
Non Biodegradable	Plastic fibres with netting	Grass	> 48	Yes	< 5days	High	High	0.00	0.05	0.10	0.03	0.05	
TRMs, all categories,	Composite with biodegradable	Grass/Shrubs	> 12	Yes	< 5days	High	High	0.00	0.03	0.07	0.03	0.05	
HYDRAULIC SOIL STABILISERS ⁽⁸⁾													
	Polymer/Polyacrylamide (rate depends on type)	Grass	1 to 6	No	< 5days	Low	Low	0.01	0.05	0.10	0.10	No data	
	Bitumen emulsion (12,000 l/ha)	Grass	1 to 6	No	< 5days	Low	Low	0.01	0.05	0.10	0.10	No data	
TEMPORARY SEEDING													
	Annual	NA	6 to 12	No	< 5days	Low	Low	0.05	0.05	0.10	0.10	No data	
	Perennial	NA	> 12	No	< 5days	Low	Low to moderate	0.05	0.05	0.10	0.10	No data	
INSTANT TURF ⁽⁹⁾													
	Kikuyu	Grass	> 12	Yes	< 5days	Medium	Low	<0.01	<0.01	<0.01	<0.01	<0.01	
	Reinforced turf (pregrown)	Grass	> 12	Yes	5 - 15 days	High	High	<0.01	<0.01	<0.01	<0.01	<0.01	

Table D1 Erosion Control Products for Stabilising Disturbed Lands

* (note that this table has been updated from Table D1 in Landcom (2004)).

Erosion control practice (generic type) [1]	Type	Effect on vegetation				Controlling erosion and pollution				Structural Performance					Constraints	
		enhances germination of grass seeds	controls weeds	enhances growth of turfstock	reinforces root-holding ability	protects soil surfaces	reduces runoff	filters or traps sediment	slope seepage	retains waves	stable in low moderate channel flows	stable in high (5-7 m/sec) channel flows	stabilises pavements			
ORGANIC PRODUCTS (can be recycled)																
Composted Coarse Mulch	18 tonnes per hectare	1	1	1	0	3	3	2	0	0	0	0	0	Might need anchoring		
Composted Coarse Mulch	27 tonnes per hectare	0	2	3	0	3	3	3	0	0	0	0	0			
Composted Coarse Mulch	56 tonnes per hectare	0	3	3	0	3	3	3	0	0	0	0	0			
Composted soil conditioner	100 L per m ² (max)	3	1	3	2	1	1	0	0	0	0	0	0			
Manufactured soils	150 L per m ² (max)	3	1	3	2	1	1	0	0	0	0	0	0			
SPRAY ON PRODUCTS																
Hydrumulching	2.0 tonnes mulch + 300 litres binder per hectare	3	0	0	0	3	1	1	0	0	0	0	0			
Bonded Fibre	5 tonnes fibre per hectare	3	1	1	0	3	2	1	0	0	0	0	0			
Bonded, Brown Compost	Min 50 mm cover	2	3	3	2	3	3	3	0	0	0	0	0			
ROLLED EROSION CONTROL PRODUCTS (RECP's)																
Biodegradable ECP's	Jute mesh	2	1	0	1	2	1	0	0	0	1	0	0			
	Coconut fibre mesh (400gsm)	2	1	0	1	2	1	1	0	0	1	0	0			
	Coconut fibre mesh (700gsm)	2	1	1	1	2	1	1	0	0	2	2	0			
	Curled wood fibre in plastic mesh	3	1	1	1	3	2	1	0	0	1	0	0			
	Jute matting (~350 gsm)	3	1	1	1	3	2	1	0	0	2	1	0			
	Jute matting (~400 gsm)	3	1	1	1	3	2	1	0	0	2	1	0			
	Coconut fibre matting (~450 gsm)	3	1	1	1	3	2	1	0	0	2	1	0			
	Coconut fibre matting (~500 gsm)	3	1	1	1	3	2	1	0	0	2	1	0			
Photodegradable ECP's	Mesh (< 5 mm openings)	2	0	0	1	2	1	0	0	0	1	0	0			
	Super light weight nonwoven (~30gsm)	2	0	0	1	2	1	0	0	0	1	0	0			
Non Biodegradable TRM's	Plastic fibres with netting	2	1	0	3	3	2	1	0	0	3	3	0			
	Light performance 3D welded fibres	2	1	0	3	3	2	1	0	0	3	2	0			
	Medium performance 3D welded or woven fibres	2	1	0	3	3	2	1	0	0	3	3	0			
	High performance 3D woven fibre	2	1	0	3	3	2	1	0	0	3	3	1			
	Med. perform. composite with degradable material	2	1	0	3	3	2	1	0	0	3	3	0			
HYDRAULIC SOIL STABILISERS																
	Polymer/Polyacrylamide (rate depends on type)	0	0	0	0	2	0	0	0	0	1	0	0			
	Bitumen emulsion (12,000 l/ha)	0	0	0	0	2	0	0	0	0	1	0	0			
TEMPORARY SEEDING																
	Annual	0	1	0	0	3	2	2	0	0	1	0	0			
	Perennial	0	2	0	0	3	2	2	0	0	1	0	0			
INSTANT TURF																
	Kikuyu	0	1	0	0	3	2	2	0	1	1	2	0			
	Reinforced turf (pregrown)	0	1	0	3	3	2	2	0	1	2	2	0			
OTHER PRODUCTS																
	Straw (anchored)	3	1	1	0	3	3	2	0	0	0	0	0			
	Wheat mat	0	3	1	0	3	0	0	0	0	0	0	0			
	Geotextile	0	1	1	1	2	0	2	0	2	1	0	0			
	Sediment fences	0	0	0	0	0	1	2	0	0	0	0	0			
	Earth-filled geotextile tubes	0	0	0	0	0	0	3	0	0	0	0	0			
	Floating sediment barriers	0	0	0	0	0	0	3	0	0	0	0	0			
	Grout injected mats	0	1	0	0	3	0	0	1	0	0	0	0			
	Gabion Mattresses	0	0	0	0	3	0	0	0	2	3	3	0			
	Artificial concrete mats	0	0	0	0	3	0	0	0	0	3	3	1			
	Reinforced armouring systems	0	0	0	0	3	0	0	0	0	3	2	0			
	Cellular soil confinement (synthetic)	2	0	0	0	3	1	0	0	2	2	2	0			
	Wind barrier fencing	0	0	0	0	2	0	1	0	0	0	0	0			
	Flexible waterproof membranes	0	0	0	0	0	0	3	0	0	0	0	0			
	Vertical soil moisture barriers	0	0	0	0	0	0	3	0	0	0	0	0			
	Geosynthetic clay liners	0	0	0	0	0	0	3	0	0	0	0	0			
	Prefabricated subsurface drainage	1	0	1	0	1	1	0	3	2	0	0	2			
	Pipe filter sediment barriers	0	0	0	0	0	0	3	0	0	0	0	0			
	Matting and logs	0	0	0	0	2	1	2	0	0	1	0	0			
Needs staking																

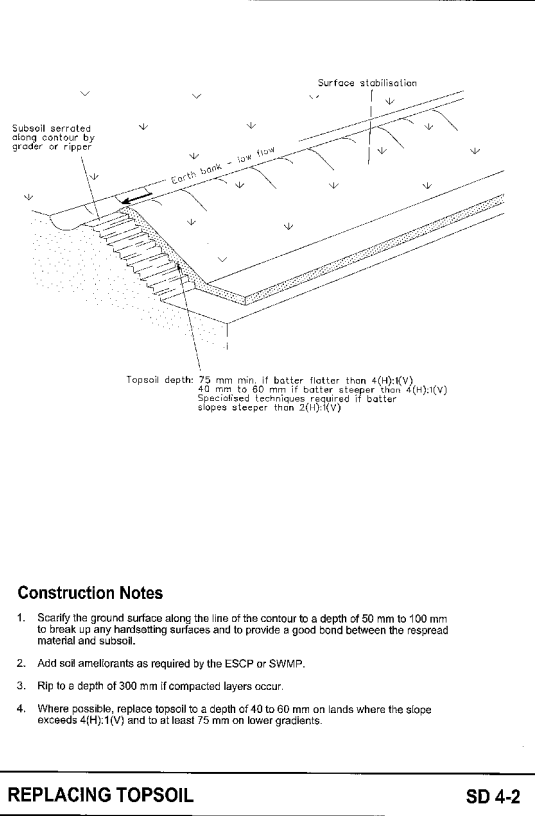


Construction Notes

- Place stockpiles more than 2 (preferably 5) metres from existing vegetation, concentrated water flow, roads and hazard areas.
- Construct on the contour as low, flat, elongated mounds.
- Where there is sufficient area, topsoil stockpiles shall be less than 2 metres in height.
- Where they are to be in place for more than 10 days, stabilise following the approved ESCP or SWMP to reduce the C-factor to less than 0.10.
- Construct earth banks (Standard Drawing 5-5) on the upslope side to divert water around stockpiles and sediment fences (Standard Drawing 6-8) 1 to 2 metres downslope.

STOCKPILES

SD 4-1

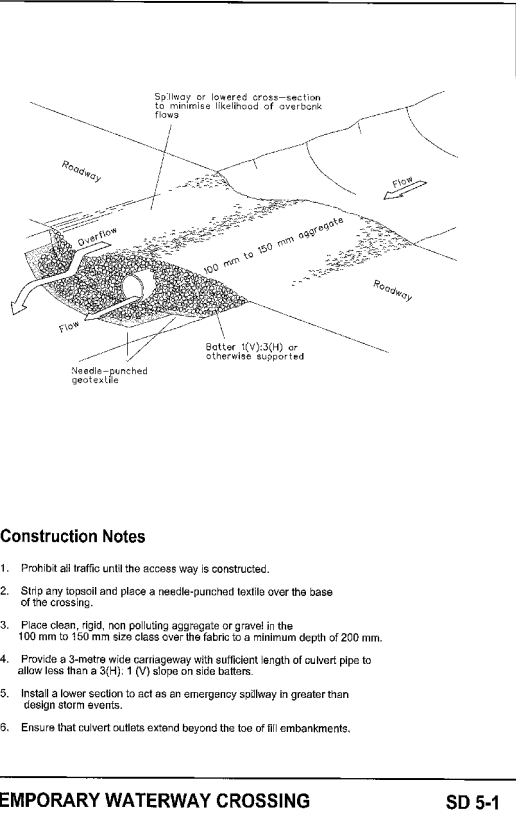


Construction Notes

- Scarify the ground surface along the line of the contour to a depth of 50 mm to 100 mm to break up any handfasting surfaces and to provide a good bond between the respread material and subsoil.
- Add soil ameliorants as required by the ESCP or SWMP.
- Rip to a depth of 300 mm if compacted layers occur.
- Where possible, replace topsoil to a depth of 40 to 60 mm on lands where the slope exceeds 4(H):1(V) and to at least 75 mm on lower gradients.

REPLACING TOPSOIL

SD 4-2

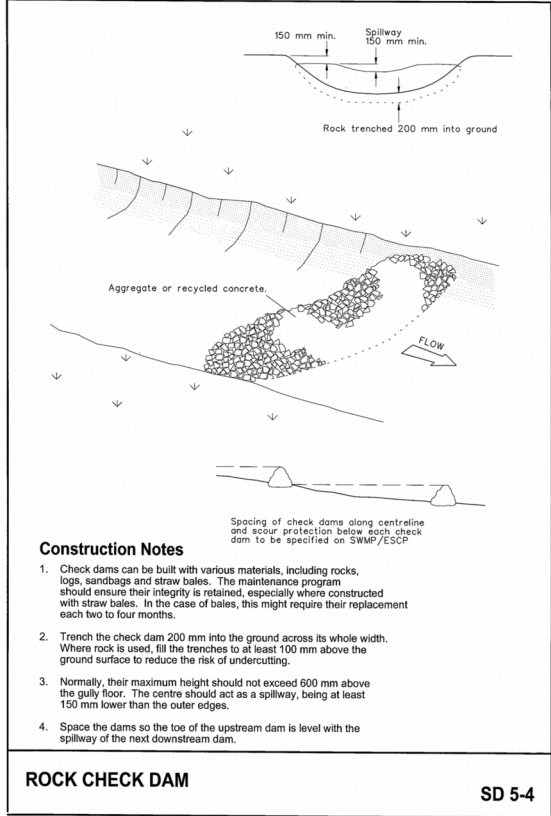


Construction Notes

- Prohibit all traffic until the access way is constructed.
- Strip any topsoil and place a needle-punched textile over the base of the crossing.
- Place clean, rigid, non polluting aggregate or gravel in the 100 mm to 150 mm size class over the fabric to a minimum depth of 200 mm.
- Provide a 3-metre wide carriageway with sufficient length of culvert pipe to allow less than a 5(H):1 (V) slope on side batters.
- Install a lower section to act as an emergency spillway in greater than design storm events.
- Ensure that culvert outlets extend beyond the toe of fill embankments.

TEMPORARY WATERWAY CROSSING

SD 5-1

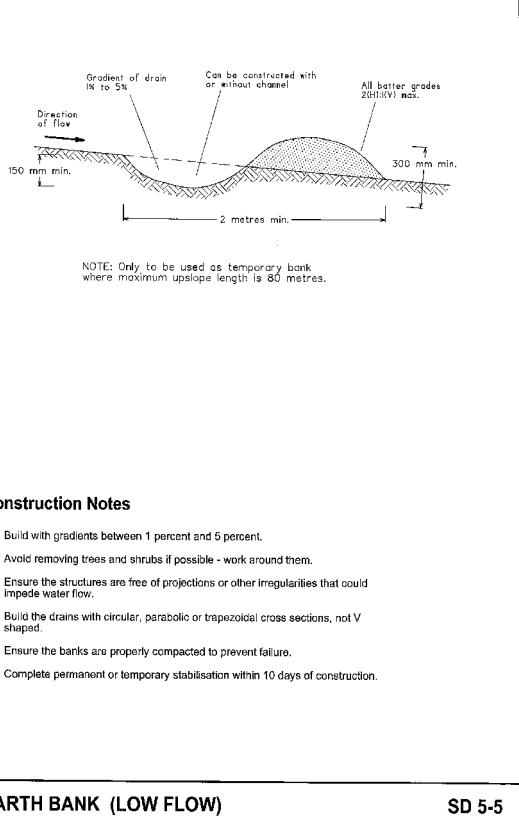


Construction Notes

- Check dams can be built with various materials, including rocks, logs, sandbags and straw bales. The maintenance program should ensure their integrity is retained, especially where constructed with straw bales. In the case of bales, this might require their replacement each two to four months.
- Trench the check dam 200 mm into the ground across its whole width. Where rock is used, fill the trenches to at least 100 mm above the ground surface to reduce the risk of undercutting.
- Normally, their maximum height should not exceed 600 mm above the gully floor. The centre should act as a spillway, being at least 150 mm lower than the outer edges.
- Space the dams so the toe of the upstream dam is level with the spillway of the next downstream dam.

ROCK CHECK DAM

SD 5-4

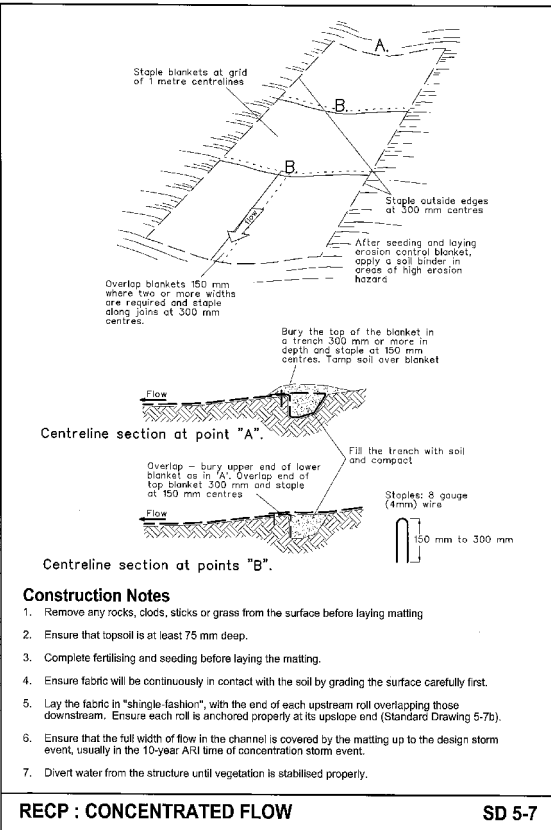


Construction Notes

- Build with gradients between 1 percent and 5 percent.
- Avoid removing trees and shrubs if possible - work around them.
- Ensure the structures are free of projections or other irregularities that could impede water flow.
- Build the drains with circular, parabolic or trapezoidal cross sections, not V shaped.
- Ensure the banks are properly compacted to prevent failure.
- Complete permanent or temporary stabilisation within 10 days of construction.

EARTH BANK (LOW FLOW)

SD 5-5

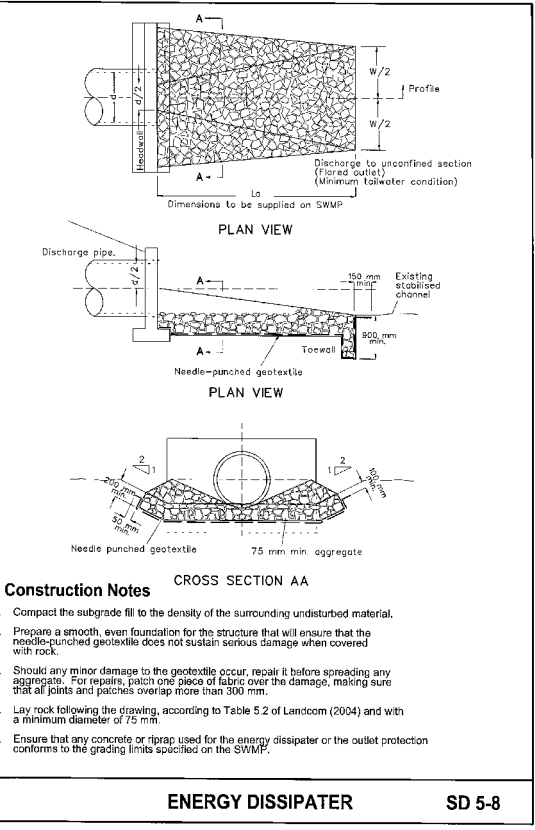


Construction Notes

- Remove any rocks, clods, sticks or grass from the surface before laying matting
- Ensure that topsoil is at least 75 mm deep.
- Complete fertilising and seeding before laying the matting.
- Ensure fabric will be continuously in contact with the soil by grading the surface carefully first.
- Lay the fabric in "shingle-fashion", with the end of each upstream roll overlapping those downstream. Ensure each roll is anchored properly at its upslope end (Standard Drawing 5-7b).
- Ensure that the full width of flow in the channel is covered by the matting up to the design storm event, usually in the 10-year ARI time of concentration storm event.
- Divert water from the structure until vegetation is stabilised properly.

RECP : CONCENTRATED FLOW

SD 5-7

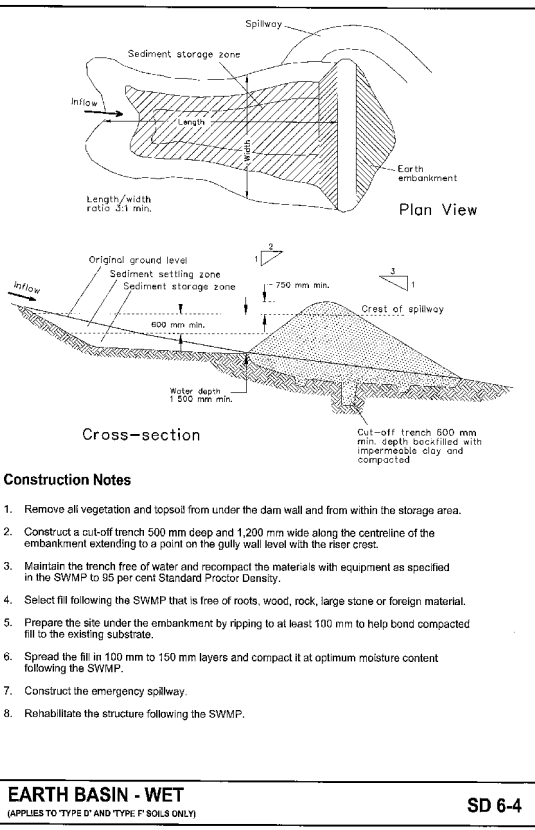


Construction Notes

- Compact the subgrade fill to the density of the surrounding undisturbed material.
- Prepare a smooth, even foundation for the structure that will ensure that the needle-punched geotextile does not sustain serious damage when covered with rock.
- Should any minor damage to the geotextile occur, repair it before spreading any aggregate. For repairs, patch one piece of fabric over the damage, making sure that all joints and patches overlap more than 300 mm.
- Lay rock following the drawing, according to Table 5.2 of Landcom (2004) and with a minimum diameter of 75 mm.
- Ensure that any concrete or riprap used for the energy dissipater or the outlet protection conforms to the grading limits specified on the SWMP.

ENERGY DISSIPATER

SD 5-8

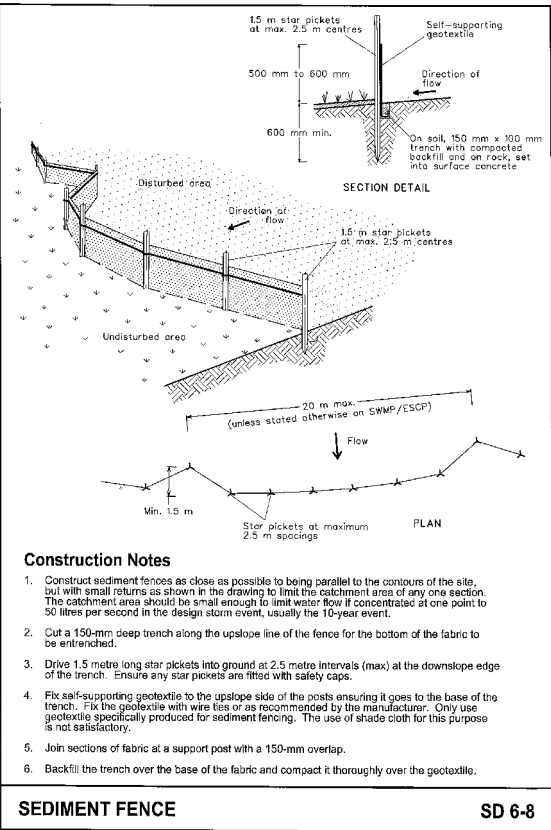


Construction Notes

- Remove all vegetation and topsoil from under the dam wall and from within the storage area.
- Construct a cut-off trench 500 mm deep and 1200 mm wide along the centreline of the embankment extending to a point on the gully wall level with the riser crest.
- Maintain the trench free of water and recompact the materials with equipment as specified in the SWMP to 95 per cent Standard Proctor Density.
- Select fill following the SWMP that is free of roots, wood, rock, large stone or foreign material.
- Prepare the site under the embankment by ripping to at least 100 mm to help bond compacted fill to the existing substrate.
- Spread the fill in 100 mm to 150 mm layers and compact it at optimum moisture content following the SWMP.
- Construct the emergency spillway.
- Rehabilitate the structure following the SWMP.

EARTH BASIN - WET
(APPLIES TO TYPE 'D' AND TYPE 'F' SOILS ONLY)

SD 6-4

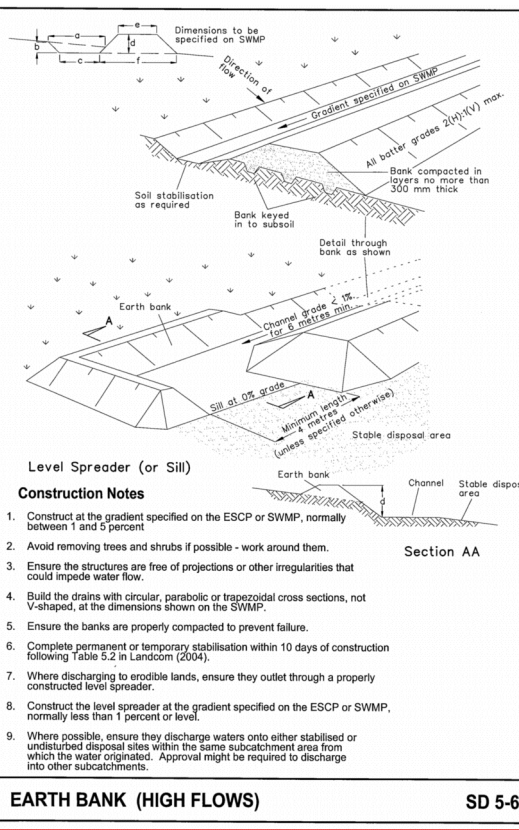


Construction Notes

- Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
- Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entangled.
- Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
- Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
- Join sections of fabric at a support post with a 150-mm overlap.
- Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE

SD 6-8



Construction Notes

- Construct at the gradient specified on the ESCP or SWMP, normally between 1 and 5 percent
- Avoid removing trees and shrubs if possible - work around them.
- Ensure the structures are free of projections or other irregularities that could impede water flow.
- Build the drains with circular, parabolic or trapezoidal cross sections, not V-shaped, at the dimensions shown on the SWMP.
- Ensure the banks are properly compacted to prevent failure.
- Complete permanent or temporary stabilisation within 10 days of construction following Table 5.2 in Landcom (2004).
- Where discharging to erodible lands, ensure they outlet through a properly constructed level spreader.
- Construct the level spreader at the gradient specified on the ESCP or SWMP, normally less than 1 percent or level.
- Where possible, ensure they discharge waters onto either stabilised or undisturbed disposal sites within the same subcatchment area from which the water originated. Approval might be required to discharge into other subcatchments.

EARTH BANK (HIGH FLOWS)

SD 5-6

REV	DATE	DES.	DRN.	APP.	REVISION DETAILS	DRAWING STATUS	
06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING	DESIGN BY	M.P.
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	DRAWN BY	M.R.
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS	FINAL APPROVAL	M.P.
03	01/02/18	M.P.	M.N.	M.P.	AMENDED TO CLIENTS COMMENTS	SCALE: (on A3 Original)	N.A.
02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE	FINAL	
01	14/11/17	M.P.	L.O.	M.P.	FINAL ISSUE		
00	6/04/16	M.P.	N.L.	M.P.	FINAL ISSUE		
A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION		

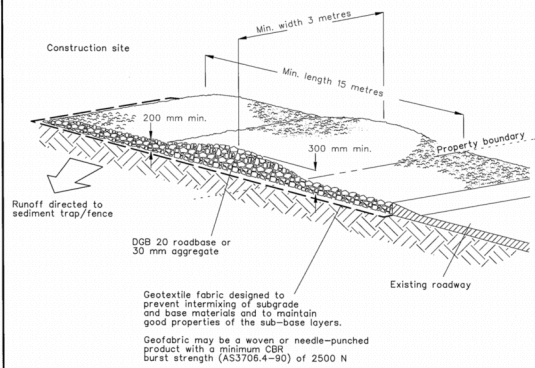
AUSTRAL BRICKS



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NEW BERRIMA SHALE QUARRY

DRAWING TITLE			
ESCP STANDARD DRAWINGS			
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
14000289	P01	ESCP005	06

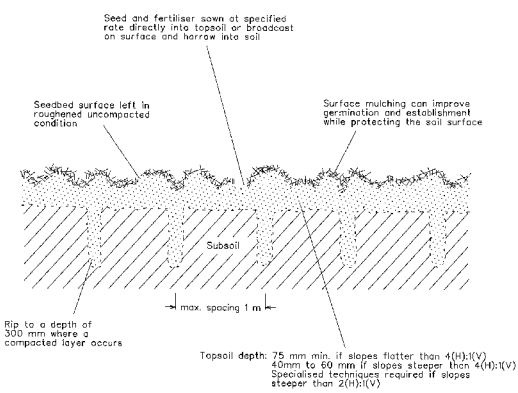


Construction Notes

- Strip the topsoil, level the site and compact the subgrade.
- Cover the area with needle-punched geotextile.
- Construct a 200-mm thick pad over the geotextile using road base or 30-mm aggregate.
- Ensure the structure is at least 15 metres long or to building alignment and at least 3 metres wide.
- Where a sediment fence joins onto the stabilised access, construct a hump in the stabilised access to divert water to the sediment fence

STABILISED SITE ACCESS

SD 6-14



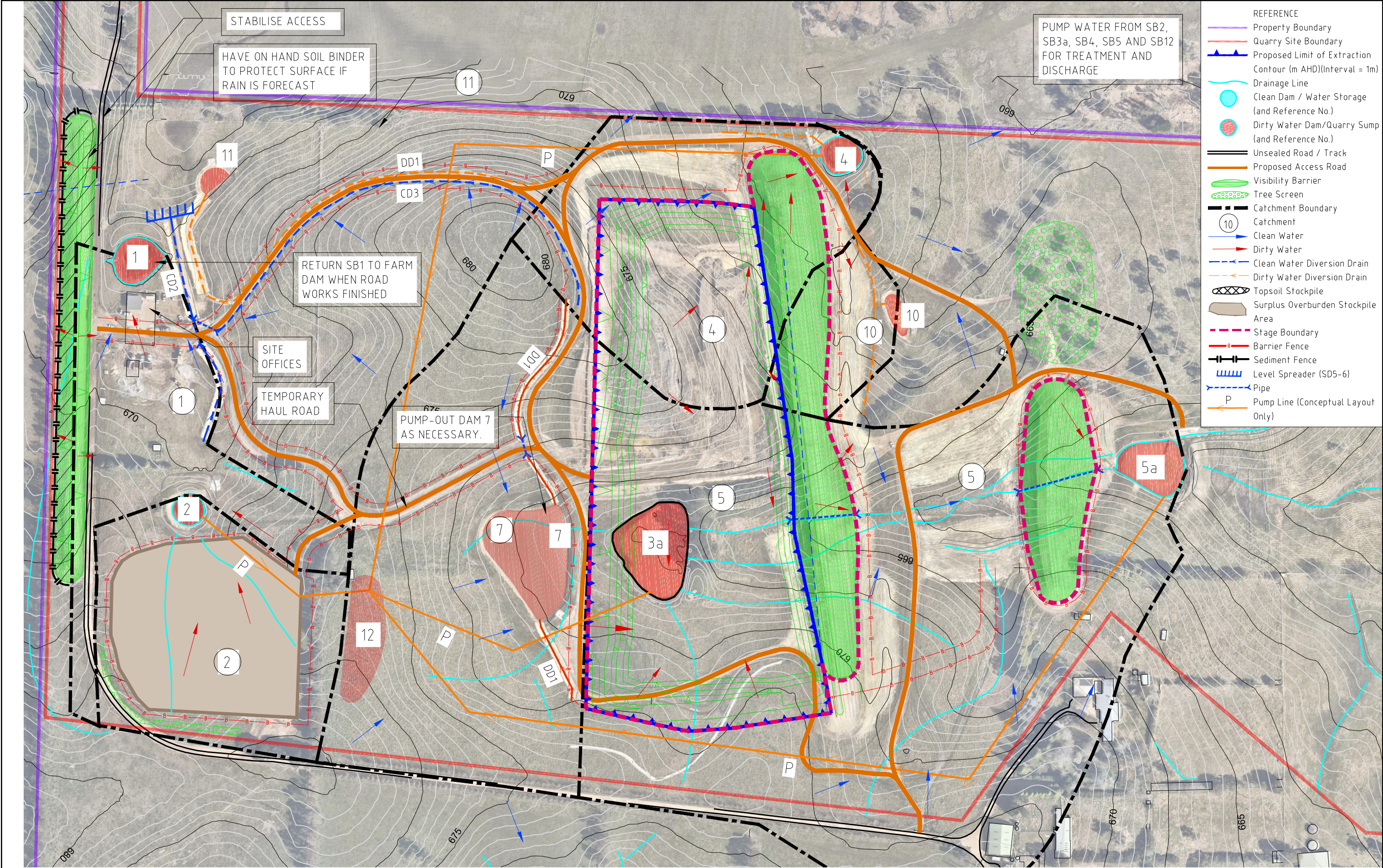
Construction Notes

- Loosen compacted soil before sowing any seed. If necessary, rip the soil to a depth of 300 mm. Avoid rotary hoe cultivation.
- Work the ground only as much as necessary to achieve the desired tilth and prepare a good seedbed.
- Avoid cultivation in very wet or very dry conditions.
- Cultivate on or close to the contour where possible, not up and down the slope.

SEEDBED PREPARATION

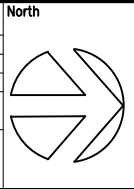
SD 7-1

REV	DATE	DES.	DRN.	APP.	REVISION	DETAILS	DRAWING STATUS		North	CLIENT	SEEC PO.Box 1098, Bowral, NSW. 2576 Suites 7 & 8, 68-70 Station Street Bowral NSW 2576. (t) 02 4862 1633 (f) 02 4862 3088 email: reception@seec.com.au WWW.SEEC.COM.AU	PROJECT TITLE		DRAWING TITLE								
06	20/12/21	M.P.	L.O.	A.M.	UPDATED	SEDIMENT BASIN SIZING	DESIGN BY	M.P.				AUSTRAL BRICKS		NEW BERRIMA SHALE QUARRY				ESCP STANDARD DRAWINGS CONTINUED				
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS	AS PER CLIENT COMMENTS	DRAWN BY	M.R.														
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS	AS PER CLIENT COMMENTS	FINAL APPROVAL	M.P.														
03	01/02/18	M.P.	M.N.	M.P.	AMENDED TO	CLIENTS COMMENTS	SCALE: (on A3 Original)															N.A.
02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE	FINAL																
01	14/11/17	M.P.	L.O.	M.P.	FINAL ISSUE																	
00	6/04/16	M.P.	N.L.	M.P.	FINAL ISSUE																	
A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE – FOR CONSULTATION																	
														PROJECT NO. 14000289		SUB-PR NO. P01		DRAWING NO. ESCP006		REV 06		



REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS
03	01/02/18	M.P.	M.N.	M.P.	AMENDED TO CLIENTS COMMENTS
02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE
01	14/11/17	M.P.	L.O.	M.P.	FINAL ISSUE
00	6/04/16	M.P.	N.L.	M.P.	FINAL ISSUE
A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	M.P.
DRAWN BY	M.R.
FINAL APPROVAL	M.P.
SCALE:	NTS
(on A3 Original)	
FINAL	



CLIENT

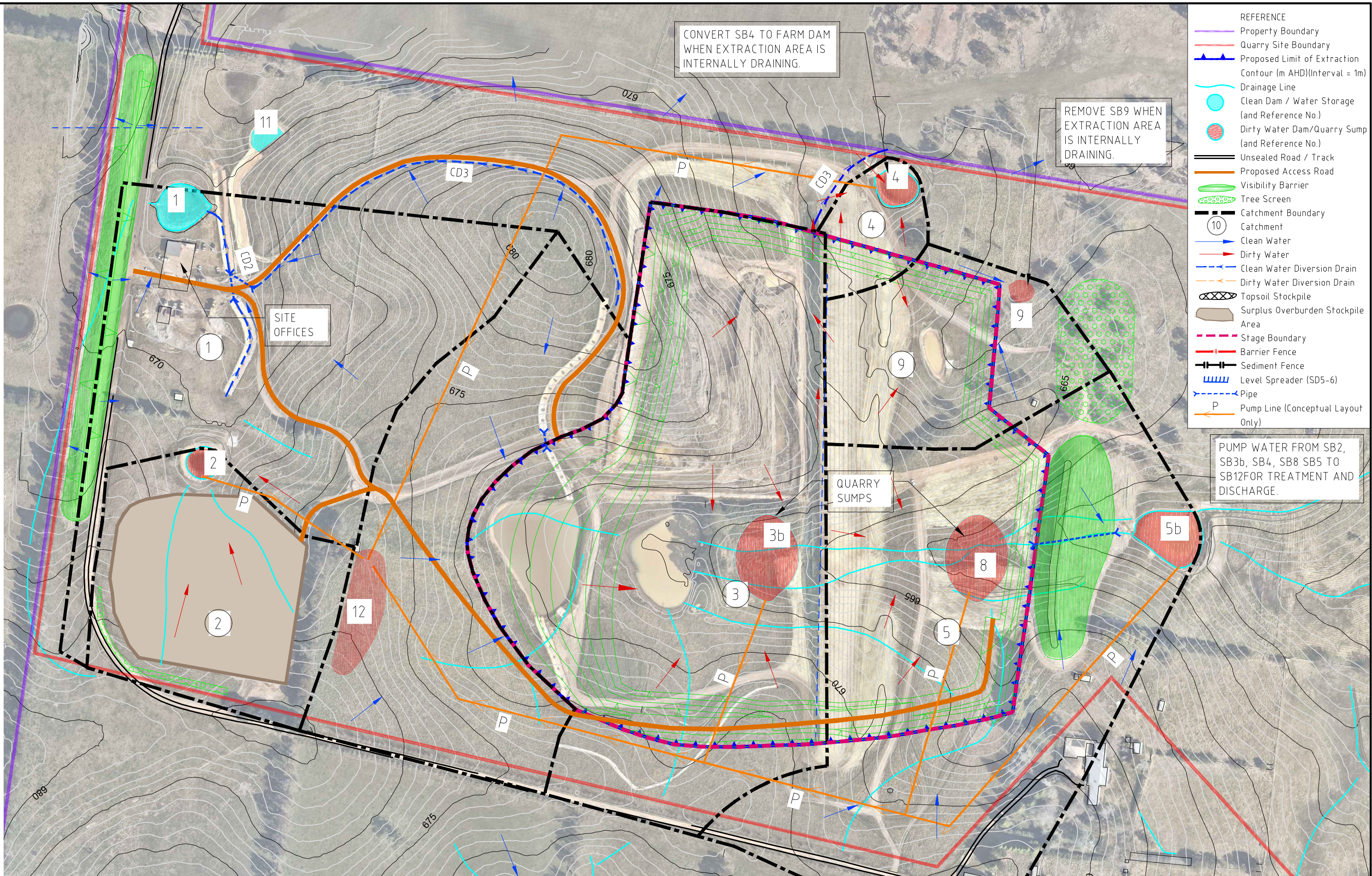
AUSTRAL BRICKS



PROJECT TITLE

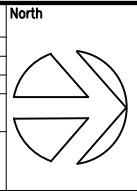
NEW BERRIMA SHALE QUARRY

DRAWING TITLE			
ESCP ESTABLISHMENT STAGES 1-4			
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
14000289	P01	ESCP007	06



REV	DATE	DES.	DRN.	APP.	REVISION DETAILS
06	20/12/21	M.P.	L.O.	A.M.	UPDATED SEDIMENT BASIN SIZING
05	03/12/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS
04	28/09/21	M.P.	L.O.	A.M.	AMENDMENTS AS PER CLIENT COMMENTS
03	01/02/18	M.P.	M.N.	M.P.	AMENDED TO CLIENTS COMMENTS
02	14/12/17	M.P.	L.O.	M.P.	FINAL ISSUE
01	14/11/17	M.P.	L.O.	M.P.	FINAL ISSUE
00	6/04/16	M.P.	N.L.	M.P.	FINAL ISSUE
A	11/12/15	M.P.	M.R.	M.P.	DRAFT ISSUE - FOR CONSULTATION

DRAWING STATUS	
DESIGN BY	M.P.
DRAWN BY	M.R.
FINAL APPROVAL	M.P.
SCALE:	NTS
(on A3 Original)	
FINAL	



CLIENT

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PROJECT TITLE

NEW BERRIMA SHALE QUARRY

DRAWING TITLE			
ESCP ESTABLISHMENT STAGES 5-7			
PROJECT NO.	SUB-PR NO.	DRAWING NO.	REV
14000289	P01	ESCP008	06