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Friday, 27 November 2015

Resource Assessments
Department of Planning and Environment
GPO Box 39
SYDNEY NSW 2001
ATTN: Ms Swati Sharma

RE: HB Maroota Sand Quarry DA 267-11-99 Mod 2 Response

Dear Ms Sharma,

I refer you to the correspondence submitted to your Department in October 2015 by the Department of Primary Industries (DPI) reference OUT15/30074, regarding their responses to the exhibition of the EIS for items related to **Water Licences and Water Balance** Modelling and the **Transfer of Water Offsite**.

We have reviewed the comments and offer an amended Revised Soil and Water Management Plan (SWMP) report no 1557_HMA_SWMP_R5 to address the issues raised.

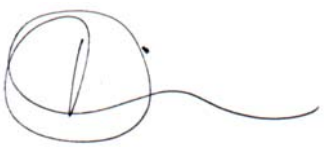
Primarily the comments relate to disparity over the status of bores on the site listed on the NOW Register, which was summarised in *Table 1,* and the actual status of the bores. The table has been amended and comments added to describe the history and current status of the bores. Information was obtained from both the NSW Office of Water (NOW) online register and HB Records. *Figure 2* has been amended to include locations of the bores on the site. Records of all bore construction has been included in the Appendices as requested.

A copy of the status of all the Water Access Licences is included in the Appendices. The Water Access Licences (26163 & 24157) for the two bores, PT84PB1 & 2 are current and *Table 1* erroneously listed PT84PB1 as destroyed. It appears some of the confusion arises from the NOW Register listing the bore at that location as cancelled however it is evident, according to historical documents, bore logs and per coms from Mr Martin Hodgson that this bore is operational and is the one referred to in the current WAL. The dam licence for irrigation (10CA104888) is current and has also been included in the Appendices.

Correspondence relating to this bore and other bores on the site has also been included in the Appendices for clarification. Since both the WAL bores listed are functional an alternative water supply source **is not required.**

The Transfer of Water Offsite relates to the water from Dam 1 and the report has been amended to reflect this.

Yours Sincerely



Tara O'Brien

VGT Pty Ltd

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Hodgson Quarry Products Pty Ltd

Soil and Water Management Plan
Maroota Quarry
Via Maroota

Prepared by:

VGT Pty Ltd

for:

Hodgson Quarry ProductsPty Ltd

Report No: 1557_HMA_SWMP_R5

Hodgson Quarry Products Pty Ltd

Soil and Water Management Plan
Maroota Quarry
Via Maroota

Prepared by:	
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Report Date:	27/11/2015	
Report Number:	1557_HMA_SWMP_R5	
Copy Number:		
Report Authorised by:	Martin Hodgson	Date: 27/11/2015
	Tara O'Brien	Date: 27/11/2015

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Table of Contents

Figures

Appendices

Section 1. Executive Summary

This document has been prepared to discuss the proposed Soil and Water Management system within the Maroota Quarry, located at Maroota.

The water management of the site has been developed to comply with Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries. Sediment basins are designed for a 95th percentile, 5 day rainfall event whilst catch drains and diversions are designed for a 10 year Average Recurrence Interval.

Clean water is currently diverted around the disturbed area via diversion bunds where possible and the natural topography assists. A portion of clean water from the undisturbed areas and properties adjacent to the quarry on Roberts Road does enter the main quarry area. Dirty water is collected in the disturbed areas into one of several dams to allow for settling to occur.

Retained water is reused on site for dust suppression and material processing. For this reason water is generally retained as far as possible on site. No water is released off-site.

If required Dams will only be discharged when quality limits are met.

The proponent will undertake a regular monitoring and maintenance program to ensure water management goals are met.

Section 2. Introduction

2.1. Glossary

Term	Meaning
Acid Sulphate Soils (ASS)	Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen, and may produce acidic leachate and run-off which can pollute receiving waters and liberate toxins. ASS are classified as materials which are above the groundwater, are undergoing oxidation and have a pH of less than 4.0.
Alluvial Soil	Juvenile soils formed by deposition from still or moving water. Little pedological development beyond some accumulation of organic matter at the surface.
Arboreal	To live in, or be connected with, trees.
AHD – Australian Height Datum	A height of zero was assigned to the mean sea level determination at 30 tide gauges around the Australian Mainland coastline, measured over a three year period from 1966 to 1968. (G.C. Luton and G.M Johnson 2001)
Amenity	The degree of pleasantness of an area or place.
ANZECC	Australian and New Zealand Environment and Conservation Council
Artefact	An object, normally portable, made or modified by human hands.
Aquifer	A soil or rock layer or group of layers that is sufficiently saturated and permeable to yield significant quantities of water.
Average recurrence interval (ARI)	Average or expected period between exceedance of a flood.
Bed Rock	The unweathered rock that lies below loose surface deposits of soil and alluvium.
Biological Diversity	The variety of all life forms, comprising genetic diversity (within species), species diversity and ecosystem diversity.
Cumulative Impact	The sum effect on the environment resulting from the successive effects of several different impacts.
Catchment	A valley defined naturally by the watershed line along the tops of the ridges that separate it from a neighbouring catchment. The area within this watershed line is the catchment area from which rainfall flows into a river or reservoir.
Culvert	One or more adjacent, enclosed channels for conveying a stream below road formation level.
Cumulative impact	The sum effect on the environment resulting from the successive effects of several different impacts.
Earthworks	The process of extracting, moving and depositing earth during construction.
DRE	Department of Trade and Investment- Resources and Energy
Ecologically sustainable development	Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.
Ecosystem	A functional unit of energy transfer and nutrient cycling in a given place such as a forest or estuary; it includes all the relationships within the biotic community and between the biotic components of the system.
Embankment	A mound or bank of earth or stone formed to support a roadway, serve as a protective barrier, or the like.
Endangered Ecological Community (EEC)	An ecological community specified in Part 3 of the *NSW Threatened Species Conservation Act 1995*. An ecological community is listed as endangered if, in the opinion of the Scientific Committee: it is likely to become extinct in

Term	Meaning
	nature in NSW unless the circumstances and factor threatening its survival cease top operate, or it might already be extinct.
EPA	Environmental Protection Authority
Erosion	The natural process where wind or water detaches a soil particle and provides energy to move the particle.
Excavation	The act or process of digging out earth during construction.
Fauna	The animal population
Flora	Plants that make up the vegetation of the site
Floodplain	Large flat area of alluvium adjacent to a watercourse, characterised by frequent active erosion and aggregation by channelled and overbank stream flow.
Greenhouse Effect/ Global Warming	The heating of the atmosphere by the absorption of infrared energy remitted by the Earth as it receives energy from the Sun.
Groundwater	All waters occurring below the land surface. The upper surface of the soils saturated by groundwater in any particular area is called the water table.
Habitat	The place where an organism lives; habitats are measurable and can be described by their flora and physical components.
Hydrology	The study of rainfall and surface water runoff processes.
Introduced species	Plants and animals not native to Australia and known or thought to have been brought in by humans.
Inversion	Is a deviation from the normal change of an atmospheric property with altitude. It almost always refers to a temperature inversion, i.e., an increase in temperature with height, or to the layer (inversion layer) within which such an increase occurs.
LEP	Local Environmental Plan (prepared under the *Environmental Planning and Assessment Act 1979*)
Licence (EPA)	A Pollution Control Licence is issued pursuant to section 17D of the Pollution Control Act 1970 on premises scheduled or prescribed by the legislation. Licensing remains the main instrument for implementing point source pollution control, reduction and remediation programs. A licence is renewable annually and is subject to a fee calculated on the basis of the nature and size of the operation
Local road	A road or street used primarily for access to abutting properties
OEH	Office of Environment and Heritage
pH	A measure of the degree of acidity or alkalinity expressed on a logarithmic scale of 1-14, on which 1 is most acid, 7 is neutral and 14 is most basic.
Pollution Reduction Program – PRP	PRP's can be required as a condition of the EPA licence or, possibly, as a condition of other works approval. Plans can define the capital works to be installed, new pollution control equipment, process changes, site rehabilitation or other measures to be introduced within the period of the plan to correct nominated environmental problems.
REP	Regional Environmental Plan (prepared under the *Environmental Planning and Assessment Act 1979*)
Rainfall Erosivity	Ability of rainfall to cause erosion.
Rehabilitation	The restoration of a landscape and especially the vegetation following its disturbance.
Remnant vegetation	Native vegetation remaining after widespread clearing has taken place.
Revised Universal Soil Loss Equation (RUSLE)	Is designed to predict the long term, average, annual soil loss from sheet and rill flow at nominated sites under specified management conditions.
Runoff Coefficient	The coefficient of runoff is the ratio of how much water is likely to runoff a site against how much rain falls in any particular storm event.

Term	Meaning
Sediment	Material of varying sizes that has been or is being moved from its site of origin by the action of wind, water or gravity.
Sedimentation basin	An area where run-off is ponded to allow sediment to be deposited. The longer the period that run-off is held, the smaller the size of the sediment deposited. Such basins have to be cleaned regularly.
Slope length/gradient Factor	The slope length–gradient factor, LS, describes the combined effect of slope length and slope gradient on soil loss. It is the ratio of soil loss per unit area at any particular site to the corresponding loss from a specific experimental plot of known length and gradient.
Soil	That part of the upper weathered layer of the earth's crust that can support plant growth. Any naturally occurring loose or soft deposit forming part of the earth's crust and resulting from weathering or breakdown of rock formation or from the decay of vegetation.
Soil Erodibility (K)	Soil erodibility factor (K-factor) – In the Revised Universal Soil Loss Equation, the soil erodibility factor, K, is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff.
Soil Hydrological Group	Four Soil Hydrologic Groups (USDA, 1993) are derived from a consideration of their infiltration and permeability characteristics. The four Groups are: Group A – very low runoff potential, Group B – low to moderate runoff potential, Group C – moderate to high runoff potential and Group D – very high runoff potential.
Soil Texture Group	An important attribute of soils that affects the effectiveness of sediment retention structures is the proportion of particles finer than 0.02 mm. Particles that are finer than 0.02 mm are relatively difficult to trap in simple sediment retention basins, while those that are coarser are not.
Stone Artefact	Fragment of a stone (used by Aborigines) which generally possesses one or more of the following characteristics: positive or negative ring crack, distinct positive or negative bulb of force, definite eraillure scar in a position beneath a platform or definite remnants of flake scars
Stormwater	Rainwater which runs off urban and agricultural catchments, following rain events. This untreated water is carried in stormwater channels and discharges into creeks, rivers, lakes, harbours and oceans.
Study Area	The area to which technical investigations or assessments have been undertaken. Includes areas adjoining or proximal to the site.
Swale	A natural depression or wide shallow ditch used to temporarily convey, store, or filter runoff.
T – Tonnes	Weight measurement being 1000 kilograms.
Waste	Includes any matter (whether liquid, solid, gaseous or radioactive) that is discharged, emitted or deposited in the environment in such volume, constituency, or manner as to cause an alteration to the environment.
Water body	The collective name for all forms of static and active water features (rivers, creeks, streams, lakes and estuaries).
Wetland	Land either permanently or temporarily covered by water. These areas are usually characterised by vegetation or a moist soil or aquatic type.
Water pollution	Placing in or on, or otherwise introducing into or onto, waters (whether through an act or omission) any matter, whether solid, liquid or gaseous, so that the physical, chemical or biological condition of the waters is changed. (POEO Act 1997)
1 in 100 year flood level	Refers to the flood which occurs, on average, once every 100 years. Also known as the 100 year Average Recurrence Interval of a flood. These events are of a random nature. It is possible for there to be two 100 year floods in successive years; similarly to 100 year flood may not occur for 200 years and the 100 year flood may not be the largest flood in the last 100 years.

2.2. Introduction

HB Maroota Quarry is located on Roberts Road near Old Northern Road, Maroota. Maroota is approximately 50 kilometres north west of Sydney see *Figure One*. The site was formerly known as Sun-A-Rise Quarry, where construction of a water supply dam commenced around 1970. Consent was granted for extraction and processing of sand, clay and pebble material in 2000. HB Maroota Pty Ltd took over operations on the site in 2004.

A Soil and Water Management Plan (SWMP) was developed by Morse McVey and Associates Pty Ltd for the site in 1999 and was submitted with the EIS in the same year.

A new Environmental Assessment (EA) was submitted in May 2015 to extend the life of the quarry to the Department of Planning and Environment. Thus this report seeks to update the original SWMP.

2.3. Regulatory Requirements

2.3.1. Planning and Environment- Planning Services

Development approval, with conditions of consent was issued by the then Department of Urban Affairs and Planning (S98/00772) on the 31st of May 2000 (see *Appendix B).* This consent expires on the 31st of May 2015.

Modification to S98/00772 was issued on the 29th of November 2000 (also see *Appendix B).*

As stated above a Modification to Consent was submitted to the Department in May 2015 and is currently under consideration.

Conditions in the consent that relate to soil and water management are reproduced below.

DEPTH OF EXTRACTION

Baulkham Hills Shire Council Development Control Plan for Extractive Industries (DCP 500) requires that the depth of extraction incorporate a 2m freeboard above the wet weather high groundwater level. To meet the objectives of this policy, the Applicant shall ensure that the depth of extraction is consistent with the depth as shown in the extraction plan in the EIS and follow the procedures in Condition 40 if groundwater is encountered during extraction.

WATER QUALITY

Soil and Water Management Plan

38. The Applicant shall prepare and implement a Soil and Water Management Plan as part of the EMP. This plan shall be updated on an annual basis, to the satisfaction of DLWC and in consultation with DLWC. This Plan shall have particular regard to the most recent editions of the Department of Housing's publications Managing Urban Stormwater Soils and Construction (1990), and the requirements of Council's Development Control Plan 500 Extractive Industries.

The Soil and Water Management Plan shall contain, but not be limited to:

> *c) management of the impacts of all phases of the development on the quality and quantity of surface and groundwater, including water in storage, sedimentation dams and flooding impacts;*

d) details of measures to be employed to minimise soil erosion and the discharge of sediment to land and/or waters;

e) management of the impacts of the development on nearby creeks and waterbodies, in particular, the Hawkesbury River;

f) a strategy for the decommissioning of water management structures, including storage, sedimentation and leachate dams once extraction is complete;

g) identification of all potential sources of water pollution and a detailed description of the remedial action to be taken or management systems to be implemented to minimise emissions of those pollutants from all sources within the subject site;

h) description of monitoring methodologies and standards that will be adhered to;

i) identification of the locations where monitoring will be carried out;

j) detailed description of the monitoring cycle and the duration of each monitoring cycle;

k) details of actions to ameliorate impacts if they exceed the relevant criteria;

l) detail any exceedances and the mitigative actions used; and

m) *emergency contingency plans for implementation in the event that the* groundwater is encountered during excavation (see Condition 40).

Water Monitoring

39. Groundwater monitoring shall be undertaken on a regularly scheduled basis to provide data suitable for the determination of the wet weather high groundwater level, to the satisfaction of DLWC. A network of monitoring bores shall be installed at appropriate locations across the site to accommodate these objectives.[5]

Groundwater Management

40. The Applicant shall immediately notify DLWC in the event of groundwater being encountered during excavation. The location and elevation of such intersections is to be reported to allow determination by DLWC whether the water table occurs within a perched aquifer or if it is at a regional level, In the event of breaching of the groundwater table, operations are to cease and DLWC consulted immediately to determine the basis upon which extraction may recommence.6 If no response is received from DLWC within 24 hours, the Applicant shall implement the emergency contingency plans as described in the Soil and Water Management Plan (Condition 38). The Applicant shall advise the Director-General of the results of any such incidents under this Condition.

41. Site works and excavations are to be backfilled or infilled only with earth and rock materials sourced as a result of extraction operations in the Maroota area. This condition does not apply to the construction of the perimeter bund wall.

Licensable Groundwater Works

All groundwater investigation/monitoring and groundwater supply works are required to be licensed with the DLWC under the provisions of the Water Act 1912 A licence under Part 5 of the Wafer Act 1912 is required to authorise a water supply bore (10BL157594) for industrial (Sand Washing) purposes and stock.

Surface Water Management

The applicant shall not allow any tailwater drainage to discharge into or onto:

- *any adjoining public or Crown road;*
- *any other persons land;*
- *any Crown land;*

- *any river, creek or watercourse;*
- *any groundwater aquifer;*
- *any native vegetation as described under the Native Vegetation Conservation Act 1997;*
- *any wetlands of environmental significance6*

44, Surface stormwater runoff from the disturbed areas on the site must be directed to the sedimentation dam(s).

Dam Licencing

45. A license will be required for any new dams under Part 2 of the Water Act 1912. The Applicant shall submit design plans/ survey of the structures as required by DLWC.

2.3.2. EPA Licence

Environmental Protection Licence 6535 (see *Appendix C)* has been issued under the *Protection of the Environmental Operations Act, 1997* for Crushing, Grinding or Separating Works and Dredging Works. It is renewed annually on the 12th of March.

There are no specific monitoring requirements in the licence.

2.3.3. National Office of Water (NOW)

The site holds a number of licences issued under the *Water Management Act 2000*, for the operation of groundwater bores as well as dams. Location of these bores and dams can be found in *Figure Two.*

According to the NOW groundwater maps available on the NOW Register, there are a total of eleven bores registered on the site, two of which were installed by the then Department of Water Resources in 1997. It is difficult to correlate the bores listed with the Register with the remaining bores on the site as many bores that have been destroyed are still listed as current and the most recent ones do not appear as yet. There are four older bores that are not listed by NOW that had been installed on the site, PT84MW1 (1970's), 'Nursery Bore' (1970's?), 'House Bore' (1981) and Roberts Road Bore (1970's). PT84MW1 is still in use and is regularly sampled. The 'House Bore' and 'Nursery Bore' have been destroyed and the Roberts Road Bore was capped in the 1970's. PT84MW6 is licenced but does not appear on the records yet due to it having been installed recently.

'Nursery Bore', 'House Bore', 'Roberts Road Bore' and 'Excavation Bore' were granted licences under an amnesty by the then Department of Water Resources in 1999 (see *Appendix F* for correspondence). It appears that the bores granted under the amnesty were not allocated bore numbers and do not appear on the Register with the exception of the 'Excavation Bore'.

A number of the monitoring bores are listed on the Register as still being active but have in fact been destroyed due to the progression of mining (see *Figure Two.).* PT84MW2 was replaced by PT84MW5 due to blockage of the bore and PT84MW4 was destroyed by mining and replaced by PT84MW6. PT84MW1 to PT84MW3 were licenced under 10BL158808 according to correspondence from Fabio Carosone of URS Australia Pty Ltd to Ralph Betts of HB (see Appendix F). The bore number for PT84MW1, which has been in continuous use, however cannot be found in the online NOW Register and original documentation of the licence provided by NOW does not include the bore number.

Some of the original licences have been converted to Water Access Licences (WAL in 2011), PT84PB1 and PT84PB2. The licence for the Nursey Dam of 264mL per years appears to have been incorporated into the WAL approval for PT84PB2, the irrigation bore. PT84PB2 appears on the NOW Register as GW102451 and 'cancelled' however the WAL is current until February 2016.

Table 1. Groundwater Bore Summary

Water Access Licence Number (WAL)	Water Approval No'/ Reference Number	Licence	NOW Bore No	Identification	Purpose	Allocation	Expiry	Bore Status	Comments
24163	10WA114817/ 10AL114816	Was 10BL159748, 10PT901430 (converted to WAL 2011)	GW105835	PT84PB1	Extraction	45.0 ML per year	14/06/2025	Converted to WAL	Located on lot 1 DP228308. Can extract at a rate of 3L/sec.
24157	10CA114819/ 10AL114818	Was 10BL157595 10PT901431 (converted to WAL 2011)	GW102451	PT84PB2	Irrigation	6.0ML per year	16/02/2016	Current. Converted to WAL	Located on Lot 2/228308 Installed 1999. Located adjacent to Dam 4. Possible that the location has been mistaken to be the Nursery Bore in the NOW Register under licence 10BL159150 and is listed as cancelled.
-	10CA104888/ 10AL104887	10SL045324 (converted to WAL 2011)	-	Nursery Dam	Irrigation	264ML per year	17/02/2016	-	Located on Lot 2/228308.
-	-	10BL15978	GW102450	Excavation Bore	Test Bore	-	-	Cancelled. Destroyed.	Installed 1999. Licence granted under amnesty in 1999.
		-	Not listed on NOW groundwater data base.	Nursery Bore	Test Bore	-	perpetuity	Destroyed.	Located on Lot 2/228308 Installed 1970's? Located between nursery and Dam 4.
-	-	-	Not listed on NOW groundwater data base.	House Bore	Test Bore	-	perpetuity		Installed 1981. Located adjacent to House on Lot 2 DP312327.

Water Access Licence Number (WAL)	Water Approval No'/ Reference Number	Licence	NOW Bore No	Identification	Purpose	Allocation	Expiry	Bore Status	Comments
-	-	-	Not listed on NOW groundwater data base.	Roberts Road Bore	Test Bore	-	perpetuity	Cancelled. Capped in 1970's.	Located on Lot 1/228308 Licence granted under amnesty in 1999. Located near trees adjacent to Roberts Road and site entrance.
-	-	10BL158808	Not listed on NOW groundwater data base	PT84MW1	Monitoring	-	perpetuity	In use for water sampling	Installed 20/10/1998. Located near nursery.
-	-	10BL158808	-	PT84MW2	Monitoring	-	perpetuity	Bore Destroyed. Replaced by MW5	Installed 20/10/1998 Not converted to WAL
-	-	10BL158808	Not listed on NOW groundwater data base	PT84MW3	Monitoring	-	perpetuity	Bore Destroyed	Installed 21/10/1998.
-	-	10BL158808	GW114209	PT84MW4	Monitoring	-	perpetuity	Bore Destroyed	Installed 2009. Replaced by PT84MW6.
-	-	10BL158808	GW114208	PT84MW5	Monitoring	-	perpetuity	New bore	Installed March 2013. Bore replaced PT84MW2 and application for licence under 10BL158808 was made.
-	-	10BL605696	GW114972	PT84MW-6	Monitoring		perpetuity	In use for water sampling	Installed January 2015. To replace PT84MW4
-	-	-	GW075003	-	Monitoring	-	-	Not in use	Installed 1997. NOW owned.
-	-	-	GW075004	-	Monitoring	-	-	Not in use	Installed 1997. NOW owned.

2.4. Objectives

The principle objectives of the SWMP are set out below.

- To ensure the segregation of ‘dirty’ water from ‘clean’ water and maximise the retention of time of ‘dirty’ water such that any discharge from the project site meets the relevant water-quality limits, including limits contained in the relevant guidelines and any limits imposed by specific project approvals. ‘Dirty’ water is defined as surface runoff from disturbed catchments. ‘Clean’ water is defined as surface runoff from catchments that are undisturbed or rehabilitated catchments.
- To minimise the volume of water discharged from the project site but, should the discharge of water prove necessary, ensure sufficient settlement time is provided prior to discharge or employ other means such as flocculants to ensure the water meets the objectives identified in the point above.
- To ensure water used in the processing of materials (sand) is contained within the closed system on the site.
- To monitor the effectiveness of surface water and sediment controls and to ensure all relevant surface water quality criteria are met.

Section 3. Existing Site

3.1. Geology

From the EIS (1999):

'The Maroota area is known for the production of sand, which represents a valuable resource to the building industry. The sand is obtained from two main sources, the Maroota Sand and the weathered profiles of the Hawkesbury Sandstone. ….

…..The Maroota Sand comprises a sequence of interbedded and poorly sorted sands, gravels, clayey gravels, gravelly sands, clayey/silty sands and clay which range from compacted to partly consolidate materials. The bulk of these sediments, however, consists of sand sized material. Ferricrete bands are common and occur at a number of levels within the Maroota Sand……

…..The Hawkesbury Sandstone is a widespread formation occupying a large portion of the Sydney Basin. It comprises a thick sequence of sub-horizontal, massive, cemented quartz sandstone, with well-developed cross-bedding and intercalations of shale and siltstone beds. Grain size is generally in the range of fine to medium sand, but sorting is generally poor with some silt and pebble grains. Shale layers and bands and occasional carbonaceous beds are also common within the Hawkesbury Sandstone. Shale beds have been identified at various locations between the Maroota Sand and the underlying Hawkesbury Sandstone bedrock.

3.2. Topography

The areas landscape is formed on a Hawkesbury Sandstone plateau surrounded by steep valleys and massive cliff faces. The relief ranges from 170m AHD, south of the project area to 240.7m AHD at the Maroota trig Station. Within the site elevations range from 226m at the south-western end along Old Northern Road to 178m AHD at the base of the dam excavation.

The original drainage pattern of the area was in a northerly direction to eventually join a tributary of Coopers Creek approximately 2km to the north, however, runoff along this line is captured by a number of dams, two of which are located inside the property boundaries. Those dams provide a water supply to the existing nursery operations on the site. The rest of the site is internally draining, with all runoff directed towards the central dam construction operation.

3.3. Site Features

A number of site features are discussed below.

- An office building, car shed/workshop and amenities building are located at the entrance of the site. The office consist of a permanent building whilst the sheds are of corrugated iron and colour bond construction.
- Adjacent to the office is the weighbridge.
- A processing plant is located centrally in the quarry is also of colour bond construction. Smaller office buildings and general storage are located in this area.
- Mobile plant is located within the quarry. Internal haul roads link the quarry to the weighbridge and the access road to the quarry.

The site surface is covered in dams, material stockpiles, grass and vegetation. Roads are constructed of gravel.

3.3.1. Contaminated Sites Register/ Dangerous Goods

A search of the NSW EPA Contaminated Land Register shows that the site has not been notified. The proponent advises that there are no dangerous goods held on site.

3.3.2. Site History Summary and Contaminants of Potential Concern

Based on a review of the available historical information, the site began operations in 1990's when construction of a water supply dam began. Previous land uses were agricultural. The proponents took over operations on the site in 2004 as an established quarry.

Table 2. Site Use Summary and Associate Potential Contaminants

Site Use/ Contaminate Source	Potential Contaminants
Weed and pest spraying	Pesticides (OCP's and OPP's) in surface water
Fuel Storage	Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl benzene, Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAHs)
Emplacement of mulch for rehabilitation	Alkalinity, ammonia, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate, OCP/OPP, Total phenolics, potassium, sodium, sulphate, total organic carbon and BOD

3.4. Existing Water Management

3.4.1. Drainage Patterns

The quarry forms a bowl like structure capturing surface water and directing it to a number of dams located within the site as shown in *Figure Three*. The portions of the site adjacent to Old Northern Road comprise mainly of clean water catchments whilst the disturbed areas extend from the central area to the north and east. The lowest point of the site is Dam 1 with the highest adjacent to Old Northern Road. Surface water collected over properties to the east of Roberts Road enter the site via a road culvert just north of the site entrance. This catchment comprising of approximately 10 Ha is considered clean, and is diverted into Dam 1.

The original creek line runs north of the property from Dam 1. No discharge to the creek has occurred due the water needs of the processing plant.

3.4.2. Process Water Dam

The extraction of sand on the site relies on an adequate supply of water for washing and screening of material. After processing, residue clay/silt is delivered to designated drying areas and liberated water is drained into a holding dam to settle sediment entrained in the process. Water from the holding dam is then pumped back into the process dam for re-use.

For ease of discussion the dam has been divided into three areas;

- Area 1, current pond;
- Area 2, dam works stage one;
- Area 3, current dried wet fines stockpile area, approximately 43,000 cubic metres, overlying insitu sandstone reserves

3.4.2.1. Background

The creation of a large water storage dam in one campaign is not practical because the amount of material to be removed is approximately 230,000 cubic metres and the sand plant processes approximately 80,000 cubic metre per annum, thus there is four years of supply in the dam area. This large scale mining will sterilise the water supply needed to operate the processing plant.

Hodgson Quarry and Plant has resolved to undertake a staged dam construction to provide the sand plant with access to a continuous supply of water so it can continue to operate.

The construction of the dams in the base of the quarry requires excavation works to RL 178 or a firm base. The firm base is an essential component in the dam construction. Compaction of a clay liner on unconsolidated sands or silts will cause the liner to crack and fail. Backfilling will occur to RL 179.4 and then covering with a 600 millimetre compacted clay liner, to RL 180.0. The clay liner used on site is a blend of the dry reject material from the plant and the reclaimed dried wet reject found in the east portions of the site.

Delays in completing the dam works have been due to a number of reasons which include:

- Wet weather flooding the quarry floor; and
- Frequent rain events making the dried reject material unworkable.

3.4.2.2. Proposed Program

Hodgson Quarry and Plant intend to initially complete a temporary dam wall between Areas 1 and 2. Excavation will continue in Area 2, to RL 178 metres or a firm base. The current level in the northern portion of Area 2 has reached the proposed base RL and excavation is continuing in the southern portion. Once completed the dam will be formalised, backfilled and clay-lined. .

Area 1 will then be pumped into Area 2, allowing Area 1 to be dried and prepared for filling and lining. The important element of this staged process is to allow the sand plant access to a continuous supply of water.

3.4.2.3. Wet Weather Operation

Under normal conditions water is pumped from the process dam to the plant. After processing, residue clay/silt is delivered to designated drying areas and liberated water is drained into a holding dam to settle sediment entrained in the process. Water from the holding dam is then pumped back into the process dam for re-use.

The operation of the plant is not affected by wet weather conditions. Water will still be drawn from the process dam and recycled back to it via the holding dam. The dams have more than sufficient capacity to contain the design storm event and the processing plant is located well above the water levels. Emergency pumping of water off-site would not be necessary to continue the plant operations. However, if required the surplus water would be tested and treated prior to release off-site as described in *Section 5.4*.

Surface water drainage is sufficient for the design storm event and as discussed in *Section 5, Table 8*, it is not possible for the dams to overtop and release uncontrolled discharge from the site for the design storm event. Access to the processing plant is not limited by wet weather.

3.4.3. Water Balance

A water balance has been conducted based on historical daily rainfall, evaporation data, and production usage and runoff capacities from the Blue Book. The plant requires 160L per second to process the sand which equates to approximately 13,800 cubic metres per day. It is essential that there is sufficient capacity in the dams onsite to provide this processing water.

3.4.3.1. Dam Volumes

The volumes of the dams on the site are estimated in the table below.

Table 3. Dam Volumes

Dam Identification/ Catchment	Dam Area (m^2)	Estimated Average Depth (m)	Estimated Volume (m^3)
Dam 1	18,890	2	37,780
Dam 2	4,380	2	8,760
Dam 3	7,494	2	14,988
Dam 4	14,480	2	28,860
Total Volume held			90,388

Note: volumes and areas have been calculated using SURPAC software.

The approximate water storage capacity of the current excavation is approximately 136,000 metres cubed, well above the design event of a 1% AEP storm event (of approximately 11,000 metres cubed) based on the 'Blue Book'.

3.4.3.2. Production Losses

On average 10 cubic metres per day is used for dust suppression.

An average of 400 trucks are loaded per month with material estimated to be at 4% moisture. Assuming each truck is 30 tonnes that equates to 480 cubic metres of water leaving the site each month.

Stockpiled sand and clay material have approximately 5% and 35% moisture content (by mass) respectively. Assuming production rate of 1675 tonnes of material per day of which approximately 70% is sand and 30% is clay material the monthly water losses have been calculated to be approximately 1760 cubic metres and 4520 cubic metres respectively.

3.4.3.3. Rainfall and Evaporation Rates

Rainfall data was gathered from the Glenorie (Old Northern Road) (BOM site 67010). Evaporation rates were obtained from the nearest available comparative site which was the Peats Ridge (Waratah Road) (BOM site 61351). and tabulated to obtain the net rainfall data. A run-off co-efficient of 0.57 (from the *Blue Book*) has also been used to estimate the actual runoff from the mean monthly rainfall. Other assumptions are as follows.

- A nominal total dam surface area of 45,254m^2.
- Vertical perimeter embankment walls.
- A maximum storage depth of 4 m.
- A pan evaporation factor of 0.75 for the water storage (to convert recorded pan evaporation to pond surface evaporation).
- No losses for seepage are taken into account.

3.4.3.4. Water Balance Calculation

Using the above data the water balance has been tabulated below.

Table 4. Water Balance Calculation

Month	Mean Monthly Rainfall for years 1914 to 2015 (mm)	Mean Monthly Rainfall for years 1914 to 2015 reduced for run-off co-efficient (m)	Mean Daily Evaporation for years 1981 to 2012 (mm)	Mean Monthly Evaporation for years 1974 to 2014 (mm)	Mean Monthly Evaporation for years 1974 to 2014 With Pan Evaporation Factor (mm)	Evaporation Loss from the Dams (m^3)	Loss per month due to processing for sand (m^3)	Loss per month due to processing for clay (m^3)	Loss per month due to trucks (m^3)	Loss per month due to dust suppression (m^3)	Nett Water Remaining (m^3)	Cumulative Volume (m^3)
January	99.2	0.0565	4.6	138	103.5	4684	1759	4523	480	300	10,590	10,590
February	112.6	0.0642	3.4	102	76.5	3462	1759	4523	480	300	14,815	25,405
March	104.4	0.0595	2.6	78	58.5	2647	1759	4523	480	300	13,796	39,201
April	85.3	0.0486	1.8	54	40.5	1833	1759	4523	480	300	10,360	49,561
May	78.2	0.0446	1.6	48	36	1629	1759	4523	480	300	9,004	58,565
June	95.3	0.0543	1.7	51	38.25	1731	1759	4523	480	300	12,685	71,250
July	52.0	0.0296	2.4	72	54	2444	1759	4523	480	300	2,339	73,589
August	60.8	0.0347	3.4	102	76.5	3462	1759	4523	480	300	3,310	76,898
September	51.5	0.0294	4.0	120	90	4073	1759	4523	480	300	632	77,530
October	70.8	0.0404	4.3	129	96.75	4378	1759	4523	480	300	4,616	82,147
November	79.8	0.0455	4.7	141	105.75	4786	1759	4523	480	300	6,198	88,345
December	77.1	0.0439	3.2	96	72	3258	1759	4523	480	300	7,101	95,446

As can be seen above under average conditions there is a surplus of water (95,500 cubic metres per year) collected on the site.

3.4.4. Projected Future Water Usage

The water balance is affected primarily by the rainfall and the production losses suffered through the processing of the sand. In order to maintain the currency of the water balance the following items will be recorded and /or reviewed if the production rates or rainfall received alter significantly from the expected rates. The water balance would be recalculated using the most current data.

- Rainfall data is currently collected on the site using the meteorological station and is reported monthly along with other meteorological data. Site data will be used in the water balance calculation if required.
- Spot moisture checks would be conducted on stockpiles to determine losses.
- Volumes of water used through the plant will be estimated and/or recorded if there is a change in process or equipment. Data will be used to recalculate the water balance as required.
- Water levels within the dam will be recorded annually. To assist with this, a marker post will be installed in each dam with current levels shown. Any annual change in the level will be measured and the volume of water gained or lost from the dams will be calculated and recorded in the water balance.

Should any significant changes to the water balance be apparent, the water management system will be reviewed and changed if required.

3.4.5. Surface Water Quality

There are no surface monitoring requirements in the EPA licence or consent conditions and no discharge off-site has occurred recently. As such no surface water quality monitoring has been undertaken.

Should discharge be required sampling would be undertaken and water quality would be compared to the ANZECC (2000) Australian and New Zealand Guidlines for Fresh and Marine Quality triggger values as appropriate.

Samples would be analysed by NATA accrediated laboratories using EPA approved methods and APHA or Australian Standards.

3.5. Soil Types

Important site physical characteristics are identified in the table below.

Table 5. Constraints and Characteristics

Constraint/Opportunity	Value
Rainfall Erosivity	Moderate (R-factor= 2,290)
Rainfall Zone	1
Slope Gradients	Variable (average up to 14%)
Potential Erosion Hazard	Generally high depending on the slopes
Soil Erodiblity	Moderate to high
Calculated Soil Loss	Up to 2,400 tonnes/ha/yr depending on particular quarry slopes.
Soil Loss Class	1 to 7
Soil Texture Group	Type F
Soil Hydrological Group	B
Percent Dispersible (subsoil)	Significant
Runoff Coefficient	0.57 low to moderate (Soil Hydrological Group B)
Disturbed Site Area	28 ha approximately

The Soil Hydrological Group for the soil materials is assumed to be B, low to moderate run-off potential. Water moves into and through these soils at a moderate rate when thoroughly wetted. They shed run-off only infrequently.

Sediment retention basins are designed using the Type F Soils calculations. This includes the sediment storage zone calculation using the estimated soil loss for the site over two months.

The likely soil loss is calculated with the Revised Universal Soil Loss Equation (RUSLE). The values of the other RUSLE factors are: P of 1.3, and the C is assumed to be 1.0 for bare soil.

Section 4. Site Works

4.1. Extraction Techniques

4.1.1. Quarry Staging and Methods

Site works involve the extraction of sand, clay and gravel material from approximately 28 hectares of the site to an average depth of 20-25 metres, depending on the underlying groundwater level. Maximum extraction depth will be approximately 35 metres, towards Old Northern Road. Extraction operations will continue as before with the sand and sandstone materials providing raw material to the processing plant. Staging of the extraction will follow the areas outlined in the accompanying figures.

4.1.2. Materials Processing and Storage

The material is loaded into a belt feeder which introduces the sand into a mixing tank. An electric pump at the water storage dam and pumps water to the mixing tank via a pipeline. The sand slurry is drawn out of the mixing tank by a slurry pump and pumped to the processing plant.

The processing plant washes and screens material, using water primarily from the existing water supply dam adjacent to the northern boundary (Dam 1).

After washing and screening, material is stockpiled adjacent to the plant area prior to transportation off-site by truck. Trucks are loaded using a front-end-loader.

Washing and screening forms a residual clay/silt slurry which is piped to designated drying areas in a previously extracted cell where it will be spread in thin layers to dry. Liberated water will be drained to the water dam for re-use in the processing plant.

Section 5. Proposed Water Management

The current water management strategy is to divert clean water as appropriate but retaining as much surface water as possible to meet the needs of the processing plant.

5.1. Clean Water Management

Clean water is diverted around the site via series of earthen bunds where possible or utilising the natural ridgeline topography and bunds (see *Figure Three*). This system has shown to be satisfactory and no changes are proposed.

5.2. Dirty Water Management

All surface water captured over the disturbed areas of the quarry is considered dirty and is collected in on site dams. No water is discharged off site.

The site is above the 1 in 100 year flood level and quarrying at the site will have no adverse impact on flooding in the area.

In general there will be no major changes to the dirty water management system. The site is divided into 4 major catchments consisting of clean and dirty water catchments as discussed below.

5.2.1. Catchment 1

Catchment 1 is the largest catchment on the site and comprises both clean and dirty water sub-catchments. Dam 1, used as a source of processing water, is located centrally in this catchment at the lowest point. As the quarry progresses the size of the catchments will alter and thus the required capacity of the dam will change in order to meet the design storm event criteria.

The total catchment area is approximately 26 Hectares however it has been divided into two sub-catchments for ease of calculation when designing sediment basins and drains based on slopes and slope lengths.

Catchment 1A comprises Dam 1 in the north east of the site. It is approximately 1.9Ha in area with average slopes of approximately 0-1%. The size of this catchment will not change appreciably over the extraction stages.

Catchment 1B comprises the east and west flanks of Dam 1 and is approximately 5.0Ha in area with slopes averaging 8%. The size of this catchment will not change appreciably over the extraction stages.

Catchment 1C comprises the western portion of Catchment 1 and is approximately 2.1Ha in area with slopes averaging 5%. The size of this catchment will not change appreciably over the extraction stages.

Catchment 1D is considered clean water and comprises the south eastern portion and the eastern boundary of Catchment 1. It is approximately 6.0Ha in area with slopes averaging 9%. By Stage One the catchment will reduce to 2.5 Ha as water is diverted into Catchment 2.

Catchment 1E is also considered clean water and comprises the properties to the east of Roberts Road. It is approximately 11Ha in area with slopes averaging 9%. The size of this catchment will not change over the extraction stages.

The following table summarises the Catchment 1 volumes required by the Blue Book calculations in *Appendix D.*

Table 6. Existing Catchment 1 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
1A	1.89	4	748	752
1B	5.00	631	1,978	2,609
1C	2.13	123	843	966
1D	5.97	-	2,362	2,362
1E	10.84	-	4,288	4,288
Total	**25.83**	**758**	**10,219**	**10,977**

Note: volumes and areas have been calculated using SURPAC software.

Table 7. Stage One to Six Catchment 1 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
1A	1.89	4	748	752
1B	5.00	631	1,978	2,609
1C	2.13	123	843	966
1D	2.54	-	1,005	1,005
1E	10.84	-	4,288	4,288
Total	**22.40**	**758**	**8,862**	**9,620**

Note: volumes and areas have been calculated using SURPAC software.

The following table outlines the current estimated volume held in Dam 1. It also shows the potential volume of water that could be held in this catchment before it would overtop at the lowest point of the quarry wall (calculated using survey data).

Table 8. Dam 1 Volume

Dam Identification/ Catchment	Dam Area (m^2)	Estimated Depth (m)	Estimated Volume (m^3)	Potential Volume that could be held (m^3)
Dam 1	18,890	2	37,780	136,000

Note: volumes and areas have been calculated using SURPAC software.

As can be seen from the tables above, the volume of water that could be held by the Dam 1 is more than sufficient to capture the design storm event.

5.2.2. Catchment 2

Catchment 2 is the area of current extraction and surrounding slopes and comprises of dirty water sub-catchments. Dam 2 is located centrally in this catchment at the lowest point. As the quarry progresses the size of the catchments will alter and thus the required capacity of the dam will change in order to meet the design storm event criteria.

The total existing catchment area is approximately 5.3 Hectares however it has been divided into two sub-catchments for ease of calculation when designing sediment basins and drains based on slopes and slope lengths.

Catchment 2A comprises Dam 2 and is approximately 3.4Ha in area with average slopes of approximately 14%. The size of this catchment will not change appreciably over the extraction stages.

Catchment 2B comprises the west flanks of Dam 2 and undisturbed slopes further west. It is approximately 5.0Ha in area with slopes averaging 8%. The size of this catchment will change over the extraction stages to a maximum extent of approximately 16Ha. It has been assumed that the average slope of the staged quarry extensions will be about 14%.

The following table summarises the Catchment 2 volumes required by the Blue Book calculations in *Appendix D.*

Table 9. Existing Catchment 2 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
2A	3.43	971	1,357	2,328
2B	1.90	235	752	987
Total	**5.33**	**1,206**	**2,109**	**3,315**

Note: volumes and areas have been calculated using SURPAC software.

Table 10. Stage One to Two Catchment 2 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
2A	9.77	1,390	3,865	5,255
2B	3.59	-	1,420	1,420
Total	**13.36**	**1,390**	**5,285**	**6,675**

Note: volumes and areas have been calculated using SURPAC software.

Table 11. Stage Three Catchment 2 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
2A	10.52	2,409	4,162	6,571
2B	3.59	-	1,420	1,420
Total	**13.36**	**2,409**	**5,582**	**7,991**

Note: volumes and areas have been calculated using SURPAC software.

Table 12. Stage Four Catchment 2 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
2A	11.90	4,334	4,707	9,041
2B	2.78	-	1,101	1,101
Total	**14.68**	**4,334**	**5,808**	**10,142**

Note: volumes and areas have been calculated using SURPAC software.

Table 13. Stage Five to Six Catchment 2 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
2	15.77	6,214	6,238	12,452

Note: volumes and areas have been calculated using SURPAC software.

The following table outlines the current estimated volume held in Dam 2. It also shows the potential volume of water that could be held in this catchment before it would overtop at the lowest point of the quarry wall (calculated using survey data).

Table 14. Dam 2 Volume

Dam Identification/ Catchment	Dam Area (m^2)	Estimated Depth (m)	Estimated Volume (m^3)	Potential Volume that could be held (m^3)
Dam 2	4,380	2	8,760	

Note: volumes and areas have been calculated using SURPAC software.

As can be seen from the tables above, the volume of water that could be held by the Dam 2 is more than sufficient to capture the design storm event.

5.2.3. Catchment 3

Catchment 3 is in the north west corner of the site and comprises of clean water. Dam 3 is located centrally in this catchment at the lowest point. As the quarry progresses the size of the catchment will reduce and thus the required capacity of the dam will change in order to meet the design storm event criteria. Eventually the dam will be de-watered by pumping to either Dam 1 or Dam 2 and excavated. The surface water captured over this catchment will be treated as dirty water as extraction progresses.

Catchment 3 comprises Dam 3 and is approximately 3.4Ha in area with average slopes of approximately 5%. The size of this catchment will reduce over the extraction stages as dirty water is directed to catchment 2.

The following table summarises the Catchment 3 volumes required by the Blue Book calculations in *Appendix D.*

Table 15. Existing Catchment 3 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
3	3.73	-	1,476	1,476

Note: volumes and areas have been calculated using SURPAC software.

Table 16. Stage One to Three Catchment 3 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
3	3.59	-	1,420	1,420

Note: volumes and areas have been calculated using SURPAC software.

Table 17. Stage Four to Five Catchment 3 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
3	2.78	-	1,101	1,101

Note: volumes and areas have been calculated using SURPAC software.

The following table outlines the current estimated volume held in Dam 3 and its potential capacity assuming a freeboard of approximately 1m.

Table 18. Dam 3 Volume

Dam Identification/ Catchment	Dam Area (m^2)	Estimated Depth (m)	Estimated Volume (m^3)	Potential Volume that could be held (m^3)
Dam 3	7,494	2	14,988	22,482

Note: volumes and areas have been calculated using SURPAC software.

As can be seen from the tables above, the volume of water that could be held by the Dam 3 is more than sufficient to capture the design storm event. At this stage the dam is passively managed.

5.2.4. Catchment 4

Catchment 4 is in the north west corner of the site and comprises of clean water. The Dam is located to the north of this catchment at the lowest point. As the quarry progresses the size of the catchment will reduce and thus the required capacity of the dam will change in order to meet the design storm event criteria. Eventually the dam will be de-watered by pumping to Dam 2 and excavated. The surface water captured over this catchment will be treated as dirty water as extraction progresses.

Catchment 4 comprises Dam 4 and is approximately 4.2Ha in area with average slopes of approximately 5%. The size of this catchment will reduce over the extraction stages as dirty water is directed to catchment 2.

The following table summarises the Catchment 4 volumes required by the Blue Book calculations in *Appendix D.*

Table 19. Existing Catchment 4 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
4	4.21	-	1,665	1,665

Note: volumes and areas have been calculated using SURPAC software.

Table 20. Stage One to Two Catchment 3 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
3	4.13	-	1,634	1,634

Note: volumes and areas have been calculated using SURPAC software.

Table 21. Stage Three Catchment 3 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
3	2.83	-	1,119	1,119

Note: volumes and areas have been calculated using SURPAC software.

Table 22. Stage Four Catchment 3 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)
3	2.15	-	850	850

Note: volumes and areas have been calculated using SURPAC software.

The following table outlines the current estimated volume held in Dam 4 and its potential capacity assuming a freeboard of approximately 1m.

Table 23. Dam 1 Volume

Dam Identification/ Catchment	Dam Area (m^2)	Estimated Depth (m)	Estimated Volume (m^3)	Potential Volume that could be held (m^3)
Dam 4	14,480	2	28,960	43,440

Note: volumes and areas have been calculated using SURPAC software.

As can be seen from the tables above, the volume of water that could be held by the Dam 3 is more than sufficient to capture the design storm event. At this stage the dam is passively managed.

5.2.5. Final Stage Catchment

By the final excavation stages the total catchment area will be directed to a dam located in the north east. The final catchment will be approximately 38Ha, including the rural/residential catchment east of Roberts Road. Extraction will have proceeded to 185m AHD and a spillway will be designed to overtop at 192m AHD. At this height the potential volume of the final dam would be approximately 945,300 cubic metres (assuming an average depth of 7m).

Site Catchment is approximately 28 Ha in area with average slopes of approximately 9%. It has been assumed that the entire site has been rehabilitated in this calculation and negligible sediment entrainment occurs.

Rural/Residential Catchment to the east is approximately 10.8 Ha with average slopes of 9%.

The following table summarises the catchment volumes required by the Blue Book calculations in *Appendix D.*

Table 24. Existing Catchment 4 Volumes

Catchment	Catchment Area (Ha)	Sediment Basin Storage (soil) volume (m^3)	Sediment Basin Storage (water) volume (m^3)	Dam Volume Required for 95th percentile, 5 day rainfall event (m^3)	Estimation of Final Dam capacity (m^3)
Site Catchment	28	-	11,076	11,076	945,300
Rural/Residential Catchment	11	-	4,288	4,288	
Total	39	-	15,364	15,364	

Note: volumes and areas have been calculated using SURPAC software.

As can be seen from the tables above, the volume of water that could be held by the Dam in the final landform is more than sufficient to capture the design storm event.

5.3. Final Landform

The final landform according to the EIS is to slope gently (between 1:3 and 1:4) from the native trees screens along Old Northern Road and from the planted bunds along Roberts Road to the dam in the north-western corner. A permanent dam will be retained in the north east corner of the site as described above.

5.4. Transfer of Water Offsite

The following management procedures will be followed when excess surface water from Dam 1 is to be transferred to neighbouring land owned by Mr Tony Portelli.

- Under an agreement signed by Mr Tony Portelli and Mr Martin Hodgson of the Maroota Quarry water will only be transferred when mutually agreeable to both parties thus Mr Portelli will be contacted prior to any transfer occurring.
- Water transferred to the neighbouring land owned by Mr Toni Portelli will be tested for relevant pollutants prior to pumping.
- Only water that meets the described criteria will be released.
- Records of all water testing will be held on site.
- Records of dates and volumes of transfer of water will be held on site.
- Pumping of the water will be supervised by HB Maroota staff to ensure that overtopping of the receiving dam does not occur.

Pumping will cease immediately if contamination of the water to be transferred is suspected

5.4.1. Risk Assessment

The water transferred to Mr Portelli's property is intended to be used for stock water and irrigation. In this respect a basic risk assessment for water to be used for that purpose is outlined below.

Table 25. Risk Assessment

Analyte	Guideline (ANZECC 2000- Primary Industries)	Comment	Activity/Process Assessment	Risk
pH	6.0 – 9.0 for surface water	Soil and animal health will not generally be affected by water with pH in the range of 4–9. Corrosion potential of pumping, irrigation and stock watering systems increases as pH drops below 6.	Ground water used in the area for stock watering ranges from a pH as low as 4 to 7. Surface waters are generally around pH 7. pH will be tested prior to transfer and adjusted if required.	Moderate
Biological Parameters	various	Presence may be harmful to stock health.	The quarry process does not involve processing of biological waste or products such as effluent that could potentially contaminate the water to be transferred. No potential nutrients are used in the process that could contribute to algal growth.	Low
Calcium	<1000mg/L	Palatability of water affected. Potential health effects to stock in higher concentrations.	Groundwater in the area is low in calcium. The quarry activities do not involve processes that could contribute to high levels of calcium. Lime may be used to adjust the pH level of transfer water however which may increase calcium levels.	Low
Magnesium	<2000mg/L	Potential health effects to stock in higher concentrations.	Groundwater in the area is low in magnesium. The quarry activities do not involve processes that could contribute to high levels of magnesium.	Low
Nitrate	<400mg/L	Potential health effects to stock in higher concentrations.	The quarry activities do not involve processes that could contribute to high levels of nitrate. Fertilisation of rehabilitation areas may contribute to the nitrate load.	Low
Nitrite	<30mg/L	Potential health effects to stock in	The quarry activities do not involve processes that could contribute to high levels of nitrite. Fertilisation of	Low

Analyte	Guideline (ANZECC 2000- Primary Industries)	Comment	Activity/Process Assessment	Risk
		higher concentrations.	rehabilitation areas may contribute to the nitrite load.	
Sulphate	<1000mg/L	Potential health effects to stock in higher concentrations.	The quarry activities do not involve processes that could contribute to high levels of Sulphate.	Low
Total Dissolved Solids (TDS)	<4000mg/L	Potential health effects to stock in higher concentrations.	Groundwater in the area is low in TDS. The quarry activities do not involve processes that could contribute to high levels of TDS except perhaps evaporation.	Low
Metals	Various	Potential health effects to stock.	The quarry activities do not involve processes that could contribute to high levels of metals.	Low
Pesticides	Various	Potential health effects to stock.	The quarry activities do not involve processes that could contribute to high levels of Pesticides.	Low
Hydrocarbons	Various	Potential health effects to stock.	The quarry plant and machinery use diesel fuels and oils to operate. There is a potential risk of hydrocarbon contamination	Moderate
Total Suspended Solids	No Guideline, however recommended <50mg/L for aquatic ecosystems	Generally not harmful to stock. May affect aquatic ecosystems.	There is the potential for suspended solids to be entrained in the transfer water although the risk to stock in minimal.	Moderate

5.4.2. Water Testing

It is proposed that water testing parameters include:

- pH
- Electrical Conductivity
- Total Suspended Solids
- Visual inspection for Oil and Grease and test if presence observed to confirm
- Visual inspection for algal blooms

Should the conductivity be observed to be of a level of concern >2000µS/cm, pumping will cease and further testing will be conducted as listed below to determine the best course of action.

- Calcium
- Magnesium
- Sodium (to estimate TDS)
- Potassium (to estimate TDS)
- Chloride (to estimate TDS)
- Nitrate
- Nitrite
- Sulphate

5.4.3. General Procedures

- In the event of offsite discharge being required, prior to discharge via spillway from northern dam, water will be analysed to determine whether EPA criteria of 50 mg/L total suspended solids is met. If not met, chemical flocculation will occur prior to discharge.
- No discharge of water off-site has occurred and all water retained on site has been utilised in the processing of extracted material.
- Sediment laden water pumped into the holding dam is allowed settle prior to pumping back into the process dam. This ensures that no sediment escapes the site and maintains water quality in the process dam.
- All hydrocarbon (fuel/oil) spills will be contained and prevented from entering the surface or groundwater systems.
- All water quality control structures will be designed to ensure zero net impact on receiving waters up to the 1% AEP storm event for suspended solids, total phosphorus, and total nitrogen

5.5. Contaminated Water

One of the main sources of potential water contamination, aside from sediment from the quarry, is hydrocarbons from fuels and oils used by the plant on the site. The risk of hydrocarbons entering the water system is minimised by restricting all plant and vehicle repair and maintenance to the designated workshop area. All contractors are required to carry a spill kit and to notify the Site Manager immediately a spill occurs.

Waste and contaminated material is removed off site by a licenced waste contractor.

5.6. Recycling of Water

The quarry currently endeavours to recycle as much water on site as possible. Water collected in the sediment dams is used for dust suppression, rehabilitation works and for processing operations as described in *Section 3.4.3.* These practices will be continued and reduces the requirement to discharge.

5.7. Diversion Drains

If new diversion drains are required they will be designed with a sufficient capacity to convey runoff from a 1 in 10 year storm. They will be trapezoidal in shape and have side batters of 1 in 3 to enable maintenance of the structures (see *Appendix E).*

Where steep grades are required which result in flow velocities that may cause scour, the drains shall be lined with appropriate scour protection, e.g. rock, jute mesh, rip rap etc.

5.8. Decommissioning of Water Management Structures

Water management structures, including storage and sedimentation dams are to be decommissioned after use. Temporary sediment traps, ponds and channels are to be removed and graded towards the active extraction area. Fines remaining within the sediment device will be removed by front end loader and place within cells to be rehabilitated. Temporary sediment controls such as filter fencing and diversion banks will be used until the area has stabilised as part of site rehabilitation.

The main water process dam will remain in place in the final landform. The sedimentation basin and spillway lading into this dam will only be removed once all extraction has ceased on the site and rehabilitation has occurred sufficiently to reduce sediment load entering the dam.

Section 6. Soil Management

6.1. General Instructions

The control of erosion and sedimentation at Maroota focusses on source reduction measures. In general these measures include:

- Read the SWMP with the engineering plans and any other plans or written instructions issued in relation to development at the subject site.
- Ensure contractors undertake all soil and water management works as instructed in this specification and constructed following the guidelines stated in Department of Housing (2008) (the "Blue Book").
- Inform all subcontractors of their responsibilities in minimising the potential for soil erosion and pollution to downslope areas.

6.2. Works Sequence

- All works are to be undertaken following the engineering plans
- Topsoil will be stripped and stockpiled in the rehabilitated previous active cell.
- Construct earth banks (Stormwater Collection Drains) to divert as much clean water as possible and capture the dirty water.
- Rehabilitate lands previously used to stockpile topsoil with clay residue materials and previously stockpiled topsoil.
- Install barrier fencing to limit access to rehabilitated areas.
- Ensure management practices are carried out to minimise areas being affected by wind and water erosion.

6.3. Erosion Control

- The soil erosion hazard on the site will be kept as low as practicable by minimising disturbance. Some ways of doing this are outlined in *Table 26.*
- Extraction will take place within a defined work area and materials will be transported only within the site for processing.
- Entry to land not involved directly in the extraction process will be prohibited and will be managed as natural grassland.
- Limit vehicular access to the site to that essential for construction work.

Table 26. Limitations to Access

Landuse	Access Limitations	Comments
Extraction	Land disturbances beyond five (preferably two) metres from the edge of the operations are prohibited.	All site workers should clearly recognise these areas and they should be clearly marked — suitable materials include barrier mesh, sediment fencing, etc. The project manager will determine their actual location on site. They can vary in position to conserve existing vegetation best while being considerate of the needs of efficient works activities.
Access Roads	Roads and tracks are limited to a width that are the minimum necessary to allow safe operation of heavy equipment	
Remaining Lands	Land disturbances are prohibited except for essential management works.	

Here, rehabilitation means achieving a C-factor (Revised Universal Soil Loss Equation) of less than 0.1 and set in motion a program that should ensure it will drop permanently, by reducing the risk of erosion by vegetation, paving, armouring, etc. as soon as practicable after extraction activities cease.

NOTE: The cover factor, C, is the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from continuously tilled, bare soil. A C-factor of 1.0 corresponds to that of bare soil.

While C-factors are likely to rise to 1.0 during the work's program, they should not exceed those given in *Table 27* within the specified times.

Table 27. Maximum acceptable C-factors at nominated times during works

Lands	Maximum C-Factor	Remarks
Waterways and other areas subjected to concentrated flows, post construction.	0.05	Applies after ten working days from completion of formation and before they are allowed to carry any concentrated flows. Flows are limited to those indicated in "Blue Book". Foot and vehicular traffic are prohibited in these areas.
Stockpiles, post clearance	0.1	Applies after ten working days from completion of formation.
All lands, including waterways and stockpiles during construction	0.15	Applies after 20 working days of inactivity, even though works might continue later.

Note: *working days* does not include public holidays, weekends or days when work is not possible due to wet weather.

The required C factors can be achieved in the short term (temporary protection for up to six months) with either:

- a suitable soil binder in areas of sheet flow, e.g. topsoil stockpiles
- anionic bitumen emulsion sprayed over hessian cloth (at 0.5 L/m2) in areas of concentrated flow, e.g. diversion banks and waterways
- a temporary vegetative cover.

Apply any soil binders employed following the manufacturer's instructions.

A suggested listing of suitable plant species is shown in *Table 28.* Before sowing, additional tests should be undertaken to assess the requirements of ameliorants such as lime to help plant growth.

Table 28. Plant Species for Temporary Cover

Sowing Season	Seed Mix
Autumn/Winter	Oats @ 40kg/Ha Japanese Millet @ 10kg/Ha
Spring/Summer	Oats @ 20kg/Ha Japanese Millet @ 20kg/Ha

While ever the C-factor is higher than 0.1, maintain the lands in a condition that resists removal by wind. This can be achieved by:

- keeping moist (not wet) by sprinkling with water
- where practicable, leaving the surface in a cloddy state.

Notwithstanding the above, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than:

- 10 days on slopes steeper than 30 per cent
- 20 days on slopes less steep than 30 per cent.

Lands planted recently with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Follow-up seed and fertiliser will be applied as necessary in areas of minor soil erosion and/or inadequate vegetative protection.

Where practicable, keep foot and vehicular traffic away from all recently stabilised areas.

Stockpiles of topsoil to be located at least five metres from areas of likely concentrated or high velocity flows, especially drainage lines and access roads. If necessary, earth banks or drains will be constructed to divert localised run-on.

Replace soil materials in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils remain on the surface at the completion of works.

Earth batters can have maximum gradients of 2(H):1(V) during the works program but will be laid back to lower grades before the rehabilitation program starts. Final batter gradients should not exceed 4:1 on northerly and westerly facing batters and 3:1 on batters with other aspects.

All waterways, drains, spillways and outlets will be constructed to be stable in accordance with the "Blue Book" for soils with high erodibilities.

Topsoil stockpiles are not to exceed 3m in height with a minimum crest width of 3m and are to be seeded with a temporary vegetation cover if stockpiles are to remain longer than 14 days.

Topsoil is to be stripped in a moist condition to avoid pulverisation and dust.

Section 7. Monitoring and Maintenance

Monitoring of the soil erosion, sediment and water is undertaken monthly and recorded on the Monthly Site Audit Checklist (see *Appendix L*).

- Topsoil stripping to be visually monitored to check moisture content of soil and depth of stripping.
- Stockpiles to be visually assessed at time of forming to check they do not exceed three metres high.
- Automatic data loggers to monitor the groundwater table to ensure extraction remains two metres above the wet weather groundwater level. Monitoring bore locations shown on *Figure C1.*
- Visual check of stability and operation of all banks, ponds, channels and spillways to be undertaken monthly. Effecting any necessary repairs.
- removal of spilled sand or other materials from hazard areas, including lands closer than five metres from areas of likely concentrated or high velocity flows, especially waterways and access roads.
- removal of trapped sediment whenever less than design capacity remains for the sediment basins.
- ensuring rehabilitated lands have effectively reduced the erosion hazard and initiate upgrading or repair as appropriate.
- constructing additional erosion and/or sediment control works as might become necessary to ensure the desired water control is achieved.

7.1. Reporting

- Any topsoil management issues will be reported annually to NSW Planning and Environment Services in the Conditions Compliance Report for the first 3 years after commencing extraction in the new areas
- Annual update of this plan to be provided to NOW. Compliance report annually for first three years to NSW Planning and Environment Services
- Any encounter with groundwater as advised by NOW is to be reported to the NSW Planning and Environment Services.

7.2. Emergency Response

- If extraction encounters groundwater, work will immediately cease and investigations into the water source are undertaken. The location and elevation of the possible groundwater encounter is to be reported to NOW so that they may determine whether the water table is within a perched aquifer or within the regional groundwater resource. Work is to cease until NOW advises. If no advice received within 24 hours, work will continue where possible in areas not affected by the encounter until such time as advice is received. Where not possible to move to another area of extraction, no further depth will be extracted until NOW advice received.
- Should areas of soil erosion be identified, steps will be taken to ensure no further erosion takes place as soon as practicable and remediation of the area will be

undertaken. This may entail the use of diversion banks, filling, shaping, revegetation, geo-fabrics, hydromulch and chemical binders to stabilise the soil and regular inspections and maintenance to monitor the rehabilitation progress.

7.3. Responsibility

- Plant Manager - for implementing sedimentation control measures and monitoring as required
- All staff - for identifying where sediment controls required and for implementing procedures.

Section 8. References

Ref. 1. ANZMEC and Minerals Council of Australia (2000) *Strategic Framework for Mine Closure*

Ref. 2. Managing Urban Stormwater Soils and Construction Volume 2E Mines and Quarries (DECC, 2008)

Ref. 3. New South Wales Coal Association (February 1995) – *Mine Rehabilitation*

Ref. 4. Pers. Com. Martin Hodgson- *Quarry Manager.*

Ref. 5. Nexus (1999)- *Environmental Impact Statement*

Ref. 6. Nexus (2015)- *Environmental Assessment*

Ref. 7. Sean Harris, Morse McVey and Associates Pty Ltd (1999)- *Soil and Water Management Plan*

Appendix A: Figures