

# BORAL BADGERYS CREEK: WATER MANAGEMENT PLAN



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# BORAL BADGERYS CREEK BRICKWORKS

# Water Management Plan

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Report No Date	AA004800-R01-03 3 September 2013	

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# 1 Introduction

Boral Bricks Pty Ltd (Boral) was granted project approval in September 2010 by the Minister for Planning for expansion of its existing quarrying and brick making activities at Badgerys Creek.

This Water Management Plan (the Plan) satisfies Condition 21 in Schedule 3 of the Project Approval issued by the NSW Department of Planning and Infrastructure on 27<sup>th</sup> September 2011 (DoPI, 2011).

This Plan has been prepared by Hyder Consulting on behalf of APP Corporation.

## 1.1 Purpose and Scope

In accordance with Condition 21 of the Project Approval, Boral are required to develop and implement an onsite surface and groundwater management plan for the site. The aim of this document is to be a dynamic document which will be updated over the life of quarry operations until September 2031. This plan is intended to be used for water management implementation over the next 5 year period commencing early to mid-2012, and will be progressively updated in association with the progressive expansion of the site operations. This will account for changes to site drainage over the life of the project, that have been broadly addressed within general measures to be implemented onsite throughout the course of the quarry operations beyond the scope of this report in Appendix A.

Table 1 summarises the Water Management conditions of approval, presented under Condition 21 Schedule 3 of the Project Approval (DoPI, 2011).

Schedule and Clause	Condition of Project Approval	Location of document where addressed
3 (21)	Plan must be prepared in consultation with EPA and NOW by persons suitably qualified and approved by the Director-General, and submitted to the Director-General by August 2013.	Section 1.5
2 (5)	Management Plan must be prepared in accordance with relevant guidelines	Section 2, 3 & 4
2 (5a)	Baseline Data	Section 2, 3 & 4
2 (5b)	<ul> <li>A description of:</li> <li>the relevant statutory requirements (including any relevant approval, licence or lease conditions);</li> <li>any relevant limits or performance measures/criteria;</li> <li>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;</li> </ul>	Section 2
2 (5c)	A description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	Section 5

#### Table 1: Conditions of Approval (DoPI, 2011)

Schedule and Clause	Condition of Project Approval	Location of document where addressed
2 (5d)	<ul> <li>A program to monitor and report on the:</li> <li>impacts and environmental performance of the project;</li> <li>effectiveness of any management measures (see c above);</li> </ul>	Section 5
2 (5e)	A contingency plan to manage any unpredicted impacts and their consequences;	Section 6
2 (5f)	A program to investigate and implement ways to improve the environmental performance of the project over time;	Section 7
2 (5g)	<ul> <li>A protocol for managing and reporting any:</li> <li>incidents;</li> <li>complaints;</li> <li>non-compliances with statutory requirements; and</li> <li>exceedances of the impact assessment criteria and/or performance criteria; and</li> </ul>	Section 6
2 (5h)	A protocol for periodic review of the plan.	Section 7.1
3 (21a)	<ul> <li>A Site Water Balance that includes details of:</li> <li>sources and security of water supply;</li> <li>water use on site;</li> <li>adequacy of water storage facilities to contain all surface water runoff; and</li> <li>reporting procedures; and</li> <li>describes what measures would be implemented to minimise potable water use on site.</li> </ul>	Section 4
3 (21b)	<ul> <li>A Surface Water Management Plan, that includes:</li> <li>a detailed description of the water management system on site, including the: <ul> <li>clean water diversion systems;</li> <li>erosion and sediment controls; and</li> <li>water storages;</li> </ul> </li> <li>detailed plans, including design objectives and performance criteria, for: <ul> <li>reinstatement of drainage lines on the rehabilitated areas of the site; and</li> <li>control of any potential water pollution from rehabilitated areas of the site;</li> <li>performance criteria for the following, including trigger levels for investigating any potentially adverse impacts on:</li> <li>the water management system;</li> </ul> </li> </ul>	Sections 5

Schedule and Clause	Condition of Project Approval	Location of document where addressed
	<ul> <li>surface water quality in creeks and other water bodies that could potentially affected by the project (including Badgerys Creek and Badgerys Creek tributary); the stream health, vegetation health and channel stability of water bodies that could potentially affected by the project; and</li> </ul>	
	<ul> <li>□a program to monitor:</li> </ul>	
	<ul> <li>the effectiveness of the water management system;</li> </ul>	
	<ul> <li>surface water flows and quality in creeks and other water bodies that could potentially affected by the project;</li> </ul>	
	<ul> <li>the stream health, riparian vegetation health and channel stability of creeks and other water bodies that could potentially affected by the project; and</li> </ul>	
	<ul> <li>a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project.</li> </ul>	
3 (21c)	<ul> <li>A Groundwater Management Plan, which includes:</li> <li>groundwater assessment criteria, including trigger levels for investigating and potentially adverse groundwater impacts;</li> <li>a program to monitor:</li> </ul>	Sections 5 & 6
	<ul> <li>groundwater inflows to the quarrying operation;</li> </ul>	
	<ul> <li>the impacts of the project on baseflows to Badgerys Creek and Badgerys Creek tributary; and</li> </ul>	
	• a plan to respond to any exceedances of the performance criteria.	

The following objectives are informed by the conditions of approval and have been used to guide the basis for site water management for this report:

- Maximise the amount of undisturbed areas onsite
- Separate clean and dirty water onsite
- Maximise opportunities for onsite water reuse.

## 1.2 Background

The Badgerys Creek facility has been operational since 1976 when a Deed of Agreement was issued between Liverpool City Council (LCC) and Pacific Brick Company Pty Ltd for the extraction of materials from the site. Most recently, Boral were issued a Project Approval granted under Section 75J of the *Environmental Planning and Assessment Act 1979* to enable the continuation of quarrying and brick-making operations (expansion of operations) at the Site until September 2031.

## 1.3 Site Overview

The Boral Badgerys Creek Brickworks (Site) is located at 235 Martin Road, Badgerys Creek, 41 kilometres to the south west of Sydney within the Liverpool City Council Local Government Area (LGA) (Figure 1).



#### Figure 1: Location map (DoPI, 2011a)

Primary access to the site is provided through Martin Road at the north eastern corner of the site. Features of the existing site are shown on Figure 2.



#### Figure 2: Project site layout

Under the approved operations expansion, Boral plans to excavate two new quarry sites, Pits 4 and 5 sequentially over the life of this project. This will gradually increase the site operating area from 64 hectares to approximately 114 hectares, resulting in the loss of existing sediment basins and an increase in catchment area. Sequential development operations proposed are outlined in Table 2.

Location	Year	Proposed End Date	Overlap period
Pit 3	Commenced	2016	N/A
Pit 4	2014	2022	2 Years
Pit 5	2020	2028	2 Years

#### Table 2: Existing and Proposed Pit Lifespans

## 1.4 Alignment to other Management Plans

This Plan builds upon existing water management plans prepared by ERM (2002) and AECOM (2010) for the Site.

Boral engaged AECOM to assess the impact that the proposed quarry expansion would have on water management at the site, in particular the ability to contain site runoff. The report was informed by water balancing modeling for achieving no offsite discharge over a 10 year period following excavation of the last pit (Pit 5) under the proposed operational expansion works. The AECOM assessment built upon the previous Soil and Water Management Plan prepared for the Site by ERM in 2002.

A rehabilitation program as part of the EA Document (Boral, 2010), including rehabilitation strategy, and Rehabilitation Management Plan in accordance with Conditions of Approval (DoPI, 2011) has been prepared for the Site, outlining management procedures including fencing, planting and weed control for a portion of Badgerys Creek and Badgerys Creek tributary. It is important that water management outcomes included in this Plan, are developed to complement future rehabilitation objectives for the Site.

## 1.5 Consultation

Condition 21, Schedule 3 of the Project Approval requires that the Water Management Plan be prepared in consultation with the Office of Environment and Heritage (OEH) and the NSW Office of Water (NOW). A draft copy of this Plan will be provided to each of these agencies for comment prior to submission of a final draft to the Department of Planning for approval. Telephone consultation has been undertaken with representatives from OEH and NOW to support the development of this Plan.

# 2 Statutory Requirements and Guidelines

## 2.1 Environmental Planning and Assessment Act 1979

The project was declared a 'major development' under the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and State Environmental Planning Policy (Major Development) 2005.

An Environmental Assessment for both Concept Plan and Project Application was approved in September 2011 and was made subject to Conditions of Approval issued by the DoPI on 27<sup>th</sup> September 2011. This plan addresses Condition 21 of the Conditions of Approval.

The quarrying and brick making operations will continue to be subject to the provisions of the EP&A Act for any subsequent changes or modifications to the operations. Additionally, the operations will need to be able to demonstrate compliance against the current Conditions of Approval issued under the provisions of the EP&A Act.

### 2.2 Water Management Act 2000

The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use, benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for the protection of catchment conditions. Chapter 3, Part 1 identifies basic landholder rights including harvestable water rights and when access licences are required. The harvestable water right has been defined in terms of an equivalent dam capacity called the Maximum Harvestable Right Dam Capacity (MHRDC). Any capacity of the total of all dams on the property greater than the MHRDC may require a licence.

Schedule 1 of the *Water Management (General) Regulation 2004 (WM Regulation)* identifies classes of dam which are exempt:

(3) Dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority to prevent the contamination of a water source, provided such dams are located on a minor stream referred to in section 53 (3)(b) of the Act.

Subject to the NSW Department of Water & Energy, Farm Dams - Do you need a licence (2008):

*"Minor streams are defined by the Strahler stream ordering method as 1<sup>st</sup> and 2<sup>nd</sup> order streams that do not have permanent river flow".* 

Consequently, as the on-site pits (dams) receive water from intermittent overland and through flow as opposed to a permanent river flow, the water source for the pits can be classed as a minor stream. Furthermore, the purpose of the pits is solely for the capture, containment and reticulation of drainage and/or effluent, consistent with best management practice to prevent the contamination of Badgerys Creek. Therefore, the provisions of Schedule 1 (3) of the WM Regulation are satisfied and the pits (dams) are exempt from the need to obtain a licence under the WM Act.

## 2.3 Protection of Environment Operations Act 1997

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

Section 120 deems it an Offence to pollute waters. Pollution is defined as a change in water quality.

A mine or quarry is a 'scheduled activity' under the POEO Act if it exceeds the thresholds set out in schedule 1 of that Act. An environment protection licence under the POEO Act must be obtained prior to the commencement of any works associated with a scheduled activity.

The Site is subject to an existing EPL (EPA Licence No. 684) which would need to be reviewed and updated based upon the proposed continued operations. An application would be made for a variation to the existing EPL to reflect the proposed future operations at the site. Clause 75V of the EP&A Act provides that, subsequent to the granting of Project Approval, an EPL cannot be refused and must be substantially consistent with the terms of Project Approval.

# 2.4 State Environmental Planning Policy (Growth Centres) 2006

Water management procedures developed for the Site are designed to facilitate site rehabilitation objectives, which will align to development considerations identified in the Growth Centres SEPP as they become defined for the surrounding area.

These considerations would include assessing implications of development controls and objectives for:

- Environment conservation and recreation zones;
- Flood prone and major creeks land;
- Vegetation; and
- Cultural heritage landscape areas.

## 2.5 Liverpool LEP

The Boral Badgerys Creek Brickworks site is zoned RU1 Rural – Primary Production under the Liverpool Local Environment Plan 2008 (LEP). The objectives of this zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.
- To ensure that development does not unreasonably increase the demand for public services or public facilities.
- To ensure that development does not hinder the development or operation of an airport on Commonwealth land in Badgery's Creek.
- To preserve bushland, wildlife corridors and natural habitat.

The existing development on the site was approved prior to the gazettal of LLEP 2008 as a 'clay extraction and brick and clay products industry'.

Works involving extractive industries are permitted by Council with consent. The Project has recently been granted Project Approval by the Department of Planning and Infrastructure.

Water management objectives outlined within this report align with the objectives of the LEP with the final rehabilitated site objectives being compatible with the surrounding land fabric.

# 2.6 Managing Urban Stormwater: Soils and Construction Vol. 1. and Vol. 2E (Mines and Quarries)

Design details for stormwater and sediment control structures for mine and quarry sites are detailed in Sections 5 and 6 of Volume 1 of the *Managing Urban Stormwater: Soils and Construction Guidelines* (the Blue Book). Additional measures are outlined within Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries (DECC, 2008). Appendix F of Volume 2E Mines and Quarries (DECC, 2008) details a procedure for selecting erosion and sedimentation control measures to be adopted onsite.

## 2.7 National Water Quality Management Strategy: Australia and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)

The Australian and New Zealand Environment Conservation Council (ANZECC) 2000) Guidelines identify water quality criteria to support water use objectives and inform investigation thresholds for receiving waters.

The ANZECC guidelines have been considered in this WMP on the basis of current uses of receiving waters to inform water quality criteria through performance and trigger values for on and off site uses. These uses include:

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

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

## 2.8 NSW State Groundwater Protection Policy and Framework

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

No groundwater interception is anticipated at the site given the geological and hydrogeological profile of the site. Management of sub surface waters on the site will be in accordance with guideline documents.

# 3 Catchment Description

## 3.1 Overview of Water Catchments

The Site is located within the South Creek sub-catchment which is part of the greater Hawkesbury-Nepean catchment area. The South Creek sub-catchment covers an area of 620 km<sup>2</sup> and is mostly made up of small rural farms, some light industrial and commercial and residential development. The portion of South Creek sub-catchment in the Liverpool LGA includes three major creeks; Kemps Creek, South Creek and Badgerys Creek. The main issues affecting the South Creek sub-catchment include loss of vegetation, poor water quality and high soil salinity.

South Creek is located approximately 300 metres to the east of the south eastern corner of the site, and flows in a northerly direction. Land along the eastern portion of the Site is contained within the South Creek sub-catchment. South Creek is an intermittent creek of average health and has a small tributary in the eastern portion of the Site, named South Creek Tributary. South creek is characterised by frequent erosion and high abundance of weed species along the creek edge. The creek provides a source of water supply for cattle which graze on the eastern portion of the Site (AECOM, 2010).

Badgerys Creek is a permanent stream located along the western perimeter of the Site that is also located within the South Creek sub-catchment. The western property boundary of the Site adjoins Badgerys Creek and a small tributary of Badgerys Creek. Badgerys Creek is reported to be of average health, characterised by scattered erosion and high abundance of weed species (ERM, 2002).

## 3.2 Topography and Surface Drainage

The site slopes naturally away from the centre of the site to the east towards South Creek, and to the west and north west towards Badgerys Creek. Areas of higher elevation are located within the central (65 m AHD) and southern (85 m AHD) portions of the site, while low points are found in the north western and south western portions of the site (50 m AHD), and on the eastern portion (55m AHD). A number of existing dams are located across the site, which are used as sediment basins for surface runoff (Figure 6).

Flows entering South Creek from the existing site comprise:

- Surface run-off from a portion of the raw material stockpiling area (southern end) and waste stockpiling area during high flow rainfall events.
- Overflow of Sediment Basin 3 via an ephemeral drainage line.

Flows entering Badgerys Creek from the existing site comprise:

- Surface run-off from the area of land used for agricultural purposes, irrigated with water sourced from Pit 1.
- Overflow via ephemeral drainage channel from Sediment Basin 2, which in turn is fed from Sediment Basin 1 overflow, which receives run off from site features described in Table 3.

Rehabilitation of the Western Stockpile, undertaken in March 2006 has eliminated stockpile run off into Badgerys Creek, an action measure prescribed in the SWMP (ERM, 2002). All other surface runoff is contained within the site prior to use or discharge. This is outlined in Table 3 below.

#### Table 3: Onsite water catchment areas

Water Storage Area	Catchment Area	Catchment Description
Sediment Basin 1 & 2	17.3 Hectares	Sediment Basin 1 collects runoff from the brick product storage area, gate house, pallet storage area, as well as water pumped from Pit 1 and overland flow. Sediment basin 1 spills to Sediment basin 2 in an overflow event, which in turn spills into Badgerys Creek via an ephemeral drainage line.
Sediment Basin 3	Unknown	Collects overland runoff from the south and west of the basin, as well as runoff from the brick plant roof located to the centre of the site. Overflow from Sediment basin 3 will enter South Creek via an ephemeral drainage line.
Pit 1	37.2 hectares	Runoff is collected from a portion of the raw materials stockpile, the waste and overburden stockpiles to the north of the pit, 5 and the heavy vehicle storage area.
Pit 2	8.5 Hectares	Run off is limited to quarrying area within Pit 2 and stored in a localised basin before being pumped to Pit 1.

## 3.3 Geology

The geology of the Site comprises the Wianamatta Group. This Group comprises Bringelly Shale, which is mined within the Site (AECOM, 2010).

The Wianamatta Group extends to a depth of up to 110 m within the southern Sydney Basin and is underlain by, Hawkesbury Sandstone which is known to contain significant amounts of groundwater in some parts of the Sydney Basin. According to AECOM (2010) extraction activities are unlikely to impact this source of groundwater as the depth of extraction will be limited to 35 m.

The creek systems adjacent to the Site (Badgerys Creek and South Creek) are flanked by Quaternary alluvial deposits comprising medium grained sands, clays and silts.

## 3.4 Hydrogeology

The Site is underlain by the lower 51 m of the Bringelly Shale. Bringelly Shale is typically characterised by low permeability and groundwater velocities. Groundwater associated with the Wianamatta Group is characteristically saline due to its formation within a marine environment, and is generally unsuitable for extraction and use.

Groundwater flow within the alluvial sediments flanking Badgerys Creek and South Creek adjacent to the Site are highly responsive to rainfall and stream flow (AECOM, 2010), thus stringent water management controls are required within these areas, particularly with regard to any potential future impacts associated with any quarrying activities for Pits 4 and 5.

# 3.5 Rainfall and Evaporation

A summary of average monthly rainfall and evaporation rates for Prospect reservoir (Station Number 067019), located approximately 13km from the site is provided in Figure 3 and Figure 4. Further details of water balance modelling are presented in Section 4.

#### Rainfall

Mean monthly rainfall data for the Prospect reservoir station shows relatively stable rainfall all year round, with summer months typically wetter (approximately 70mm – 100mm per month) than the winter months (50mm – 70 mm per month).



Figure 3: Recent, Average and Median rainfall at Station 067019 (Source: www.bom.gov.au)

#### Evaporation

Evaporation data is assumed to be relatively invariable for the data record period (AECOM, 2010). Monthly data for station 067019 was extracted from the BOM for the year 2009 and plotted for comparison of monthly evaporation data for the Prospect reservoir station. Data in Figure 4 shows a high range of evaporation throughout the year, with winter retaining more water (approximately 30 - 50 mm per month lost through evaporation) than the summer months (approximately 160 - 200 mm lost per month).





Figures 3 and 4 show a potential for net loss of rainfall across the site during the summer and early autumn months. This net loss will be offset by the onsite water surplus the sites main water storage, known as Pit 1.

# 4 Site Water Balance

An overview of inflows and outflows to the site is shown in Table 4.

#### Table 4: Site water inflows and outflows

Inflows	Outflows
Initial system storage	Evaporation from pit surfaces
Direct rainfall to pit surfaces and brick plant structure	Seepage losses (assumed to be negligible)
Catchment runoff	Extraction from pits for dust suppression
Negligible groundwater inflows	Spills
Potable water	

Recycled water from worth recycling facility

A water balance for the Badgerys Creek Brickworks site was previously developed by ERM and updated by AECOM (2010) under the environmental assessment associated with project application approval. The water balance model investigated the ability of the site to provide onsite water detention with no offsite discharge.

Surface water balance modelling was undertaken for a "worst case scenario" over a 10 year period by AECOM (2010) for the proposed operational expansion works to satisfy the EPL requirements for onsite storage. This scenario assumed Pit 5 was to be used as an active quarry (no water storage), with Pit 1, Pit 3 and Pit 4 (to be excavated) acting as water storage sites. Pit 3 has approximately balanced inflows and outflows under the expansions operations works. These assumptions were set against the model assessing the storage capacity required to contain runoff from the individual design rainfall event (90th percentile, 5 day) as required in the EPL for the Camden area.

The AECOM modelling indicated there is sufficient long term capacity for on-site capture and retention of surface waters using the final pit features (

Figure 5). The water balance for the next 5 years shows that the Site will provide on-site water retention with no off-site discharge.



1. Modelling based on a daily extraction rate of 30 kL/d (for dust suppression) from Pit 1 only. Pit 1 also assumed to be able to spill to Pit 4 and Pit 4 being able to spill to Pit 3.

2. Storage levels shown represent various pit combinations depending on whether Pit 1 is spilling to Pit 4 and if Pit 4 is spilling to Pit 3.

Figure 5: Water balance modelling for Badgerys Creek Brick Works system storage levels over 10 year water balance modelling period

#### 4.1 Water Use on Site

Current water usage for the Badgerys Creek quarry is reported to be approximately 24.5 ML pa projected to increase by up to 30ML pa over the next 5 years (AECOM, 2010). The majority of this increase in usage will be associated with demand from the brick making facility.

Surface water detained in Pit 1 is currently used primarily for dust suppression. Potable and recycled water, from an off-site facility is used in the brick making process. Potable water is used for drinking water, toilet flushing and other amenities. Forming water (roughly 22KL/day), currently sourced from the breakdown of offsite oily waste water processed by Worth Recycling facility, is used in the brick making process (AECOM, 2010).

A summary of water usage is presented in Table 5.

#### Table 5: Water usage requirements for Badgerys Creek brickworks

Usage Activity	Source	Approximate water usage (KL/day)
Dust Suppression	Recycled (Pit1)	30
Brick making process	Potable Water and Recycled water (Worth recycling)	22
Offices and amenities	Potable water	12

# 4.2 Water Sources and Security of Supply

The existing site contains approximately 57 hectares of pervious land with the remainder of the site impervious (AECOM, 2010). Water supply storage facilities, including sedimentation dams as well as surface water flows are presented in Figure 6 based on current operations for the site. On-site water storage and supply structures applicable to the 5 year horizon for this Plan are presented in Table 6.

Water Storage and Supply Structures	Water Flows
Pit 1	Catching run off from access roads, open grassed drains from various areas of the site and direct rainfall.
Pit 3	Active pit where quarrying is currently occurring. Water collected in this pit is pumped to Pit 1
Sediment Basins 1 and 2	Sediment Basin 1 overflows into Sediment Basin 2. The catchment of Sediment Basin 1 includes the area around the brick making facility, gate house, pallet storage area and a small overland flow component.
Sediment Basin 3	Receives roof drainage from the brick making facility flows via the gutter, downpipe, external perimeter open drain, pipe, then grass swale to Sediment Basin 3.

Table 6: Water storage and supply structures and on-site water flows

Pit 1 is currently the main on-site water storage, catching run off from access roads, open grassed drains from various areas of the site and direct rainfall. Three sedimentation basins are also in use to capture onsite stormwater flows and promote a zero residual discharge offsite. Pit 3 will also be used for on-site water storage following completion of quarrying at Pit 3 in 2016.

The expansion of operations within the site will gradually increase the site operating area from 64 hectares (existing site configuration) to approximately 80 hectares during the timeframe for this Plan. Stormwater runoff within the site will be diverted around clean areas where possible and into the onsite water storage pits.

The total capacity of Pit 1 is 6,607 ML. This pit is typically 30 per cent full, therefore providing approximately 782 ML of water for on-site reuse. This is well above predicted water requirements for the site over the next 5 years demonstrating security of supply.



#### Figure 6: Water supply and surface flows

# 4.3 Measures for Minimisation of Potable Water Use on Site

Periodic extraction regimes will be investigated to manage risks associated with uncontrolled off-site discharges. Water re-use options at Badgerys Creek brick works are currently limited to 30 kL/d for dust suppression. A range of additional on-site and off-site water reuse strategies will be explored for managing water storage levels. Examples could include opportunities for re-using water in the brick production process as well as toilet flushing and other amenities.. Key aspects of extraction regimes that will be investigated for each option will include water demand requirements, frequency of extraction, extraction rates and storage levels for triggering extraction activities.

## 4.4 Reporting Procedures

Any changes to the current site water balance will be presented in the Annual Environmental Management Report (AEMR). Provisions will be made to ensure that the water balance is updated on an annual basis or when appropriate. Potential options for minimisation of potable water use on site will also be reported in the first AEMR.

# 5 Surface Water Management Plan

### 5.1 Introduction

The water management actions presented in this section build upon actions included in an existing soil and water management plan for the site prepared by ERM (2002) which was subsequently updated by AECOM (2010) as part of the environmental assessment for expansion of quarrying operations on the site.

The progressive expansion of the site operations will result in changes to site drainage over the life of the project. The management actions to be implemented throughout the operational phases of the project have been developed to account for progressive changes in storage, morphology and water flows on site.

Sustainable water management actions have been developed for the site which is based around separation of clean and dirty water flows, capturing stormwater runoff for use in the quarry process, dust suppression and environmental controls. Further opportunities will also be pursued for re-use of water to minimise onsite potable water use. All management actions contained within this Plan are consistent with the legislative and best practice requirements identified in Section 2.

## 5.2 Surface Water Management System on Site

An overview of the onsite surface water management system consisting of clean water diversion, erosion and sediment controls and water storages is outlined in Sections 5.2.1 – 5.2.3. A summary of actions in accordance with Site surface water flows, presented in Figure 6 is detailed in Table 7.

#### 5.2.1 Clean Water Diversion System

Clean water onsite is defined as runoff that has not come into contact with any disturbed area of the site. As detailed in Table 7, the objective of site water management with respect to clean water is to minimise disturbed areas within the site and separate these areas from undisturbed by manipulating ground contours and implementing controls to divert clean water to Sediment Basins 1, 2 and 3, while diverting runoff from disturbed areas to Pit 1.

#### 5.2.2 Erosion and Sediment Controls

All erosion and sediment controls documented in this Plan have been developed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) and Volume 2E Mines and Quarries (DECC, 2008) (the Blue Book). The intent of erosion and sediment controls for the site is to minimise the mobilisation of sediment onsite, and where this is not achievable, to reduce sediment transport around and off the site. Priority areas for the application of erosion and sediment controls around the site are discharge points to local watercourses (Badgerys Creek, Badgerys Creek Tributaries, South Creek and South Creek Tributaries), disturbed downslopes, and the integrity of natural and formalised drainage channels responsible for the movement of clean and dirty water.

#### 5.2.3 Water Storages

As discussed in Section 4.2 there are a number of water management structures within the operational boundary of the Site. These structures are shown in Figure 6 and consist of Pit 1 and three sedimentation basins.

During the planning horizon for this Plan, Pit 3 will become part of the overall on site water management system network following completion of quarrying. Following finalisation of quarrying activities in Pit 3 water transfer infrastructure will be installed to enable water to be transferred from Pit 4 to Pit 3. This will provide a mechanism to promote drainage from Pit 4 to Pit 3 when it is the active quarry as well as to spill to Pit 3 when both pits are being used for onsite water storage. Infrastructure options for promoting transfer of water between pits include either:

- Installing pumping stations and lifting water from open channels draining to storage pits; or
- Installing pumping stations and rising mains to pump directly to storage pits (AECOM, 2010).

# 5.3 Shutdown Period Management Measures

In April 2012, the proponent, Boral Clay and Concrete (NSW) announced the temporary shutdown of the quarry and brick making facility with effect from 30 March 2012. As at September 2013, the facility remained shut down. Boral will review its operations at a future stage, considering market conditions and business needs to determine when operations will recommence. During the shutdown period, activities at the facility will be limited. Hence, the opportunity for interactions with the environment during this period is limited. Notwithstanding, the following water management measures will be employed during the shutdown.

At the time of shutdown, the water management system was internally-draining; hence the risk of polluted water discharges is negligible. Sufficient capacity remains in Pit 1 to easily store a forseeable storm event and water in Pit 2 and Pit 3 is at low levels. Should water levels exceed acceptable thresholds controlled releases would be made via the pollution control dams, with associated monitoring of receiving waters in accordance with Environment Protection Licence (EPL) requirements.

Priority areas for the application of erosion and sediment controls around the site are discharge points to local watercourses (Badgerys Creek, Badgerys Creek Tributaries, South Creek and South Creek Tributaries), disturbed downslopes, and the integrity of natural and formalised drainage channels responsible for the movement of clean and dirty water.

All disturbed stockpile areas and disturbed areas outside access roads will be seeded to ensure establishment of ground cover in accordance with Blue Book requirements. During the shutdown period Boral will continue to monitor the status and effectiveness of erosion and sediment control measures on the site on a regular basis. As required, erosion and sediment control measures will be maintained to ensure effectiveness and promote ongoing compliance with the EPL.

Site Feature	Description	Clean Water Management	Erosion and Sediment Control	Water Storage	Comment
Pit 1 (11)	Collects runoff from raw materials stockpile (5), eastern stockpile (6), south eastern stockpile (east and west) (7 and 8 respectively), Pit 3 (14) and the central stockpile (10).	N/A	Maintain stabilised diversion channels to Pit 1 from structure 5 through the use of contour berms. Clean out pipe transporting runoff from Eastern Stockpile (6) to Pit 1. Maintain contoured drainage pathways around stockpile areas (East West and central) (7, 8 and 10 respectively) to Pit 1 via formalised drainage channels. Install silt fence at toe of all disturbed downslopes. Maintain stabilisation of stockpiles and bunds in accordance with the Blue Book (SD 4-1).	All water from disturbed areas onsite to be diverted to Pit 1.	Clean water management not required as all catchment water runoff from disturbed area. As stockpile site morphology changes over time, sustain formalised drainage pathways around stockpiles to water storage areas so as to minimise flow velocity and slope length, thereby reducing erosion and sedimentation potential.
Pit 2 (12)	Pit 2 is currently being rehabilitated. It contains a sediment basin and pump out facilities. Runoff flowing to Pit 2 (12) is pumped into Pit 1 (11).	N/A	Slope of Pit 2 to be constructed in accordance with Landform guidelines for mines and quarries, Section 4.2 Volume 2E of the Blue Book (DECC, 2008). Install silt fence at toe of all disturbed downslopes. Dress and re-vegetate all areas following exposure including access roads.	All water from disturbed areas onsite to be diverted to Pit 1.	Clean water management not required as all catchment water runoff from disturbed area. Establishment of contour berms around hardstand areas to direct water to Pit 1 upon rehabilitation of Pit 2.
Sediment Basin 1 and 2 (1	Collects runoff from the brick product storage area (3), brick making facility (4),	Separate flows from brick making and storage facilities (4 and 3 respectively) to clean water runoff	Install contour berm or lined swale extending across brick making (4), brick storage facility (3), admin	Dirty water runoff (structures 3, 4, 16, and 17) to be diverted to Pit 1 (11), all clean water runoff	Assess capacity of Pit 1 (11) to receive additional flows from brick making

#### Table 7: Onsite water management systems including clean water, erosion and sediment control and water storages\*

Badgerys Creek Brickworks—Water Management Plan Hyder Consulting Pty Ltd-ABN 76 104 485 289

Site Feature	Description	Clean Water Management	Erosion and Sediment Control	Water Storage	Comment
and 2)	gate house (17) and overland flow. Sediment basin 1 (1) spills to Sediment basin 2 (2) in an overflow event, which in turn spills into Badgerys Creek via an ephemeral drainage line.	running into sediment basins 1 and 2 (1 and 2) to reduce water volume from disturbed areas.	office (16) and gate house (17) to divert dirty water from these areas to Pit 1 (11).	from the north western corner of the site to flow into Sediment Basins 1 and 2 (1 and 2) and Badgerys Creek.	and storage area. Investigate potential reuse options for dust suppression, brick processes and toilet flushing. Ensure length of slope is reduced through use of check dams or other flow retardant measures.
Sediment Basin 3 (15)	Collects overland runoff from the south and west of the basin, as well as runoff from the brick making facility (4). Overflow from Sediment basin 3 will enter South Creek via an ephemeral drainage line.	Separate clean water runoff on the eastern portion of site by diverting runoff from disturbed areas including the brick making facility (4) and storage area (3) currently draining to sediment basin 3 (15) through bunding contours.	Manage land formation using contour berms to direct surface flows from disturbed areas to Pit 1 via existing pathways channelling stockpile water (i.e. Structures 5 and 6).	Sediment basin 3 (15) to contain clean water runoff from the eastern portion of the site. Reshaping of drainage contours to redirect dirty flows from 3 and 4 to Pit 1. Upon completion of Pit 3 Extractions and commencement of Pit 4, reshape drainage contours to divert water from Pit 4 to Pit 3.	Assess capacity of Pit 1 to receive additional flows from brick making and storage area. Ensure length of slope is reduced through use of check dams or other flow retardant measures.
Project Area Boundary	Site is bordered by Badgerys Creek to the West. Noise attenuation bund is planned to be constructed along the Northern and Eastern site boundary along with a portion of the Western and Southern perimeters.	Areas beyond the Eastern site boundary naturally flow away from the site towards South Creek. Surface water flows towards the site from the west will be captured in Badgerys Creek and diverted north. Water flows naturally away for the site to the north. Silt fencing in accordance with Blue Book guidelines (SD 6-8) is to be installed along the back facing length of the noise attenuation bund (at the	During construction of noise bund, maintain single handling of topsoil during construction, ensure slope stability through methods that may include surface roughening, application of mulch of geo-fabric and stage works to ensure areas of exposure are minimised. Maintain silt fencing in place until bund is appropriately vegetated.	N/A	N/A

Site Feature	Description	Clean Water Management	Erosion and Sediment Control	Water Storage	Comment
		toe) to prevent sedimentation from the bund, mixing with clean offsite water. This is to be undertaken prior to the commencement of construction of the noise attenuation bund and is to be maintained until the entire bund has been appropriately vegetated.			
Whole of site	Catchment re-configuration associated with progressive rehabilitation	During rehabilitation, portions of existing disturbed areas currently classified as clean water areas, will be reclassified as dirty water areas, such as the areas designated for Pits 4 and 5. This will increase the onsite water supply and storage capacity.	Maintain drainage channels diverting dirty water around the site to Pit 1. Ensure separation of clean and dirty water onsite. Maintain stability of sloped areas and stockpiles. An erosion control measure selection process is to be employed in any area around the site resulting in land disturbance in accordance with Appendix F of the Blue Book, Volume 2E Mines and Quarries (DECC, 2008).	Dirty water to be diverted to Pit 1 to maximise undisturbed areas around the site under existing surface flow regimes. As Pit 3 is completed and Pits 4 and 5 are excavated, dirty water storage areas will occupy vacant pits in addition to Pit 1 to accommodate larger storage demand.	N/A

\*Site features listed in brackets in the above table correspond to Figure 6.

## 5.4 Rehabilitated Area Design Objectives And Performance Criteria

Design objectives and performance criteria for reinstatement of drainage lines on any rehabilitated areas of site as well as control of any pollution from rehabilitated areas of the site are shown in Table 8.

Aspect	Objectives	Performance Criteria	Comment
Drainage lines on any rehabilitated areas. Control of pollution from rehabilitated areas.	Reduce length of slope between water interception devices. Reduce velocity of surface water flows.	Low sediment transport from areas under rehabilitation. Nil sediment transport upon establishment of vegetation.	Site preparation for rehabilitation involves ripping along the contour and establishment of contour diversion banks no greater than 25m apart depending on slope. Slope diversions will be directed to current detention basins or interim basins such as turkey nest dams to align with rehabilitation objectives.

#### Table 8: Design objectives and performance criteria for rehabilitated areas

## 5.5 Onsite And Offsite Performance Criteria

Baseline criteria for assessment of performance of the Site with regard to the on-site water management system as well as potential off-site impacts on water quality and stream health are shown in Table 9. The off-site performance criteria and trigger values for water quality and stream health reflect the degraded environmental values in Badgery's Creek (AECOM, 2010).

#### Table 9: Onsite and offsite performance criteria and trigger values

Aspect	Trigger Levels	Performance Criteria
On-site		
Water Management System	Trigger levels for industrial water use in accordance with brick plant process design	Industrial process water meets processing plant design requirements
Off-site		
Water Quality in Creeks (Values are extracted from ANZECC (2000) default trigger values for slightly disturbed ecosystems in South-East Australia.)	Chlorophyll a: 5 µg P L <sup>-1</sup> Total Phosphorus: 50µg P L <sup>-1</sup> Filterable reactive phosphate: 20 µg P L <sup>-1</sup> Oxides of nitrogen: 40 µg P L <sup>-1</sup> Ammonium: 20 µg P L <sup>-1</sup> Dissolved Oxygen: 85 – 110 % saturation Total Nitrogen: 500 µg P L <sup>-1</sup> pH: 6.5 - 8	No exceedance of ANZECC guidelines (>80% of trigger level)
Stream Health	<ul> <li>Visual baseline to be established at points:</li> <li>(A) Confluence of Badgerys Creek tributary and Badgerys Creek;</li> <li>(B) 100 m upstream of point A;</li> <li>(C) 100 m downstream of Point A</li> <li>Establish transect for assessment of changes to channel morphology, including geo-referenced photo point monitoring at points A, B and C</li> <li>Condition assessment of riparian vegetation to establish baseline condition at points A, B and C</li> </ul>	No variation from baseline identified in biannual spring and autumn monitoring No observed variation from baseline vegetation condition identified in biannual spring and autumn monitoring

#### 5.5.1 Monitoring Program

A monitoring program to assess performance of the surface water system, including the effectiveness of the management system, surface water quality flows and quality in Badgerys Creek and South Creek, stream health and a plan for responding to any exceedances of performance criteria is documented below.

#### Surface Water Management System Effectiveness

The site environmental officer or other delegated Boral representative will undertake regular inspections to assess the integrity of on-site water management systems. This will comprise

assessment of permanent structures as well as those temporarily installed by contractors working in specific areas.

Maintenance actions applicable to the Badgerys Creek brick works site include the following:

- Inspection of permanent structures such as water storage pits and sedimentation basins are undertaken after rainfall events exceeding 25 mm in a 24 hour period.
- Inspection of temporary structures around construction areas, overburden stripping areas and unconsolidated stockpiles will be undertaken prior to the commencement of works and thereafter following 25 mm rainfall events and on a weekly basis.
- Inspections will include visual observations to check for erosion of surfaces on site as well
  as sedimentation within the water management network. An erosion and sediment control
  maintenance check list is provided in Appendix B.

Where structures or systems are found not to be functioning effectively this will be restored to ensure that they align with requirements outlined in this Plan as well as legislative and best practice requirements documented in Section 2.

#### Surface Water Flows, Quality and Stream Health in Badgerys Creek

A monitoring program, presented in Table 10, has been developed to meet two objectives as documented in the Project conditions of approval:

- Report on impacts and environmental performance of the project.
- Assess the effectiveness of surface water management actions in meeting their objectives as documented above.

This monitoring program will be implemented from the approval of this Plan and sustained for the next five years and will be subject to review thereafter.

Actio	on Description	Location	Performance Criteria	Target	Frequency
Monit (inclu at thr a b	tor stream health ding water quality) ee locations: Confluence of Badgerys Creek tributary and Badgerys Creek– 100m upstream from site A	Confluence of Badgerys Creek tributary and Badgery's Creek; 100 m upstream of confluence; 100 m downstream of confluence.	ANZECC Guidelines 2000 Chlorophyll a: 5 µg P L-1 Total Phosphorus: 50µg P L-1 Filterable reactive phosphate: 20 µg P L-1 Oxides of nitrogen: 40 µg P L-1	No deterioration in water quality within Badgerys Creek	Quarterly and following rainfall events exceeding 15mm in a 24 hour period
C	100m, downstream from site A		Ammonium: 20 µg P L-1 Dissolved Oxygen: 85 – 110 % saturation Total Nitrogen: 500 µg P L-1 pH: 6.5 - 8		

#### Table 10: Proposed surface water monitoring program

Action Description	Location	Performance Criteria	Target	Frequency
Monitor geomorphology and riparian vegetation condition in Badgery's Creek	Badgery's Creek – points (A), (B) and (C)	N/A	No deterioration from baseline for riparian vegetation condition and morphology	Quarterly
Monitor discharges prior to any event which requires discharge of dirty water from site	Discharge point source	EPL to be obtained from NSW EPA	Any water leaving the site should meet EPL and ANZECC guidelines	Event based
Prior to any reuse being undertaken on site monitoring undertaken to confirm water quality is appropriate for reuse object (re-use, rehabilitation, vegetation maintenance, dust suppression, processing or other site amenity e.g. landscaping)	Pit 1 (current) Pit 3 and 4 (future)	ANZECC Guidelines for water reuse	Water quality meets the requirements for use	Monthly
Monitor on-site rainfall, all water used on site, brought to site, discharged from site, transfers from site and water storage pit levels. This information will be used to update site water balance where deviations occur.	Site wide	N/A	N/A	Ongoing
Monitor water quality for recycled water from Worth Recycling facility	Point of offtake	EPL	Water quality meets EPL requirements	Quarterly

All monitoring, testing and assessment will be undertaken in accordance with:

- Australian Guidelines for Water Quality Monitoring and Reporting (ANXECC, 2000)
- Australian Standard AS 5667.1998 Water Quality Sampling.

Monitoring documentation will include:

- Sample dates
- Field sampling records
- Instrument calibration records

- Sample of chain of custody records
- Analytical requests.

All laboratory analysis will be undertaken at a NATA accredited laboratory under chain of custody.

#### Response Plan for Exceedances of Performance Criteria

A response plan for exceedances of surface water performance criteria is detailed in Section 5 of this Plan. Any exceedances will be reported through the AEMR.

# 6 Groundwater Management Plan

### 6.1 Introduction

Groundwater management issues within the Site consist of three key aspects:

- Alluvial materials adjacent to Badgerys Creek and South Creek on the east and west of the Site (Pit 4 and Pit 5) which are likely to contain higher quantities of groundwater when compared to shale units. These alluvial deposits are important in the maintenance of local groundwater dependent ecosystems and base flows for these creek systems.
- Bringelly Shale unit characterised by low permeability located across the majority of the site combined with limited localised occurrence of groundwater within the shale units.
- Deep groundwater located greater than 100m below the surface of the Site in the Hawkesbury Sandstone geological unit which is likely to be suitable for potable water supply. No controls are proposed for management of groundwater associated with this geology as the maximum depth of excavation is approximately 35m.

In addition to the below monitoring requirements, measures will be implemented to provide for the appropriate storage of fuels and hazardous chemicals, implementation of appropriate work procedures as well as regular inspections and maintenance of equipment and plant to minimise potential for contamination of groundwater associated with spills.

#### 6.1.1 Groundwater Assessment Criteria

Groundwater assessment criteria were not available at the time of writing this plan. Assessment criteria will be established upon implementation of this plan.

#### 6.1.2 Groundwater Monitoring Program

#### Groundwater inflows to quarrying operation

AECOM (2010) have proposed installation of two groundwater monitoring wells in the north western area of the Site which will be monitored in accordance with the details provided in Table 11. These locations are shown in Figure 7. Appropriate licenses will be sought from NOW prior to installation of monitoring wells.



Figure 7: Indicative drilling locations for alluvial assessment (Source: AECOM 2010)

#### Table 11: Bringelly shale groundwater monitoring program

Location	No. of Wells	Parameters	Frequency
Bringelly Shale – bedrock aquifer	2	Comprehensive analysis*	<b>Bi-annually</b>

\*Comprehensive analysis to include: pH, Conductivity, TDS, Na, K, Ca, Mg, HCO<sub>3</sub>, NO<sub>3</sub>, SO<sub>4</sub> and hardness.

#### Impacts of project on baseflows to Badgerys Creek

Groundwater movement within the Bringelly Shale unit which exists across the majority of the Site is relatively minor given the relatively impermeable nature of this geology. Therefore, impacts on baseflow are unlikely to be associated with this geology (AECOM, 2010).

Groundwater management controls for protection of alluvial aquifers for potential dewatering processes associated with quarrying are not addressed specifically in this Plan. This will be addressed under a separate alluvial aquifer assessment requirement documented under conditions 19 and 20, Schedule 3 of the project approval (DoPI, 2011). Proposed monitoring locations for the alluvial aquifers are shown in Figure 7.

#### Response Plan for Exceedances of Performance Criteria

A response plan for exceedances of groundwater assessment criteria will be developed following the establishment of the baseline groundwater quality extracted from groundwater monitoring. Any exceedances will be reported through the AEMR.

# 7 Reporting Protocol and Contingency Planning

Boral is committed to continually improving environmental performance at the Site. An appropriately qualified site representative will monitor surface water and groundwaters in accordance with the monitoring program detailed above. In the event of any exceedances of performance criteria further investigation by an appropriately qualified representative, will be initiated to characterise the source of exceedance and to recommend and implement solutions to mitigate any potential impacts. Additional monitoring may be required to identify the source of the impact and monitor the effectiveness of the remedial solution.

Consultation will be undertaken with authorities to notify them of any breaches to any regulatory requirements applicable to the Site as well as in the development of remedial strategies.

The results of investigations and subsequent implementation of controls, safeguards and management measures will be integrated into the overall quarry Environmental Management System to minimise the potential for future occurrences.

#### 7.1.1 Emergency Incident Plan

An emergency incident plan will also be developed to respond to uncontrolled discharges of fuels, oils and chemicals.

Response procedures for protection of the water environment will aim to:

- Contain and control emergency incidents
- Safeguard people on-site and offsite
- Protect drainage paths and waterways
- Minimise damage to the environment and property
- Identify appropriate disposal techniques for contaminated soils and water
- Facilitate remediation of the environment.

Suitable containment and clean up materials will be maintained within easy and quick access.

All reporting will be in accordance with Borals incident reporting management system. Similar complaints will be addressed through the site complaints register. Compliance with statutory requirements will be assessed through implementation of Boral's site audit program that is aligned to ISO 19011:2003. Results of the above mentioned aspects will be used to ensure appropriate corrective actions are in place and to verify appropriate close out actions, follow up and reporting has occurred.

## 7.2 Annual Environmental Management Report

The results of the water management monitoring program will be presented in the Annual Environmental Management Report (AEMR). This will include detailed assessment of monitoring results collected over the course of the annual monitoring program, an evaluation of any trends occurring across the site and within Badgerys Creek, and recommendations for management action. Through the AEMR management actions may include:

- Refinement of water management objectives and initiation of remedial action
- Alteration to monitoring frequency, parameters or locations.

# 8 Plan Review and Implementation

#### 8.1 Review

Water management actions included within this Plan will be reviewed annually and updated where necessary. The AEMR will provide the main mechanism for driving continual improvement in the performance of the Site.

### 8.2 Implementation Plan

#### 8.2.1 Responsibilities

The Site Environmental Officer or other suitably qualified delegate will be responsible for the implementation of the requirements of this Plan.

#### 8.2.2 Allocation of Resources

Resources and materials will be allocated to the timely implementation of actions documented within this Plan. Resources and materials will also be allocated for the routine and emergency maintenance of environmental protection works.

#### 8.3 Induction and Environmental Awareness Training

#### 8.3.1 Site Induction

Environmental matters will be highlighted in the site induction for all personnel, including subcontractors. The site induction will include issues relating to erosion minimisation, sediment control and water quality. Staff will be made aware of their responsibilities under relevant environmental legislation.

#### 8.3.2 Training

Informal training of water management issues applicable to the Site will be undertaken with site personnel.

# 9 References

AECOM Australia (AECOM), (2010). Environmental Assessment – Appendix C: Soil and Water Management Plan: Addendum Soil and Water Management Plan. AECOM Australia, NSW, May 2010.

ERM (2002). Soil and Water Management Plan: Badgerys Creek Brickworks Soil and Water Management Plan. ERM, NSW Australia, October 2002.

Department of Environment and Climate Change NSW (2008) Managing Urban Stormwater: Soils and Construction. Volume 2E Mines and Quarries. NSW, Australia.

Landcom (2004) Soils and Construction: Managing Urban Stormwater. Volume 1. NSW, Australia.

NSW Department of Planning and Infrastructure (DoPI), (2011). Project Approval No 10\_0014. NSW Government, Sydney, September 2011.

NSW Department of Planning and Infrastructure (DoPI) (2011a). Major Project Assessment: Boral Badgerys Creek Quarry and Brick Making Facility (10\_0033 and 10\_0014), September 2011. APPENDIX A

Site Management Principles for Quarry Life

Action ID	Environmental objective	Action Description	Location (where applicable)	Timeframe
Erosion	and Sediment Control			
ES1	Maintaining the integrity of clean and dirty water flows on site.	Direct clean water around and away from disturbed areas.	Runoff entering the site, rainfall landing on the North Western corner flowing towards Badgerys Creek.	Ongoing
ES2	Promote the achievement of nil discharges from the site to maintain values in South Creek and Badgerys Creek. Maintaining the integrity of clean and dirty water flows on site.	Direct dirty water towards water storage areas and away from clean water flow paths. Delineating areas to be disturbed and not encroaching beyond these areas.	Applicable to pits, brick plant, materials stockpiles, waste stockpiles, overburden areas, access roads, car parks etc.	Ongoing
ES3	Promote the achievement of nil discharges from the site to maintain values in South Creek and Badgerys Creek.	Establishment of water storage areas and stabilisation of drainage channels prior to excavations or other soil disturbance activities within the catchment.	Pit 2, Pit 3, Pit 4, Pit 5 and all other sediment basins constructed onsite	Ongoing
ES4	Maintaining the integrity of clean and dirty water flows on site.	Quarry slope morphology to be in accordance with Blue Book, Volume 2E (Section 4.2)	Pit 3, Pit 4, Pit 5	Ongoing
ES5	Maintaining the integrity of clean and dirty water flows on site.	Establishment and regular maintenance of sediment fences to contain sediment downslope of disturbed areas in accordance with Blue Book sediment fence guidance (SD 6-8). Stabilisation of stockpiles and bunds in accordance with the Blue Book (SD 4-1)	Along the outer perimeter of the noise attenuation bund, all stockpile and overburden areas, along areas of Badgerys Creek on the western perimeter of the site	Ongoing
ES6	Maintaining the integrity of clean and dirty water flows on site.	Construct sediment fencing along outer edge of noise attenuation berm extending along the eastern, northern and a portion of the western and southern site perimeters.	Noise attenuation bund	Ongoing

Action ID	Environmental objective	Action Description	Location (where applicable)	Timeframe
ES7	Maintaining the integrity of clean and dirty water flows on site.	Implement and maintain controls to manage runoff from access roads within the site. Maintaining stable site access with vehicle washdown register.	Access point in North East corner of site and access road to brick making plant facility.	Ongoing
ES6	Maintaining the integrity of clean and dirty water flows on site.	Strip topsoil when moist, Handle topsoil only once.	Quarry pit sites to be excavated, noise attenuation bund, stockpile sites	Ongoing
ES7	Maintaining the integrity of clean and dirty water flows on site.	Treat stockpiles and bunds with surface roughening, soil surface mulching	Stockpile sites and noise attenuation bund	Ongoing
Infrastr	ucture			
11	Promote the achievement of nil discharges from the site to maintain values in South Creek and Badgerys Creek.	Installing infrastructure (e.g. pumping station and rising mains) for the active transport of water between pits when multiple pits are used for water storage	Pit 4 to Pit 3, Pit 5 to Pit 4	During latter quarrying stages of Pit 4, during quarrying of Pit 5
Onsite	reuse strategies			
OR1	Explore opportunities for on-site water reuse to assist in reducing potable water demand as well as managing on-site water storage levels.	Investigate reuse methods including reuse in the brick production process and offsite reuse in industry and agriculture. Initiate discussions with OEH and NOW to determine controlled discharge program through enhanced water quality and monitoring if reuse unfeasible.	Water storage areas (Pit 1, Pit 2, Pit 3 Pit 4)	Ongoing
Mainter	nance			

Action ID	Environmental objective	Action Description	Location (where applicable)	Timeframe
M1	Promote the achievement of nil discharges from the site to maintain values in South Creek and Badgerys Creek. Maintaining the integrity of clean and dirty water flows on site.	Inspections of permanent water storage structures after rainfall events exceeding 25mm in a 24 hour period	Water storage areas	Weekly and/or immediately following rainfall events
M2	Promote the achievement of nil discharges from the site to maintain values in South Creek and Badgerys Creek.	Inspection of temporary structures will be undertaken prior to the commencement of works and thereafter following 25mm rainfall events and on a weekly basis. Where structures or systems are found not to be functioning effectively this will be restored to ensure that they align with requirements outlined in this Plan	Construction areas, overburden stripping areas and unconsolidated stockpiles.	Weekly and/or immediately following rainfall events
M3	Promote the achievement of nil discharges from the site to maintain values in South Creek and Badgerys Creek.	Regular water testing is required to certify sufficient rehabilitation was undertaken in 2006.	Down-stream of the western stockpile area	Quarterly
Ground	water			
GW1	Minimise impacts on onsite and offsite groundwater quantity and quality. Develop and implement a groundwater monitoring program to measure impacts of quarrying on quality, drawdown and recharge.	Installation of two groundwater monitoring wells. Appropriate licenses to be sought from NOW prior to installation of monitoring wells.	North western area of the project site	Bi-annually
GW2	Minimise impacts on onsite and offsite groundwater quantity and quality.	Appropriate storage of fuels and hazardous chemicals. Implementation of appropriate work procedures. Regular inspections and maintenance of equipment and plant	Site wide	Ongoing

APPENDIX B

**Erosion and Sediment Control Maintenance Checklist** 

#### EROSION AND SEDIMENT CONTROL CHECKLIST: Badgerys Creek Quarry

Date						
Start Time				Finish Time		
Conducted By						
Inspections to be Completed	Compliance with Water Management Plan			Comments/Corrective Actions Required	Action by/Date	Date Completed
	N/A	Yes	No			
Are quarrying, brickmaking and site access facilities confined to the minimum practicable area and are nearby waterways being protected?						
Is there any evidence of erosion onsite (e.g. gullies, landslips, rill erosion, sheet erosion, subsidence, stream bank instability) associated with project activities?						
Are there any areas around the site that require installation of erosion and sediment controls? (Check through flow chart, Appendix F, <i>Blue Book Volume</i> <i>2E</i> ).						
Are appropriate site control measures in place (barrier fencing, stormwater diversions etc.) and are they being properly maintained.						
Are clean water diversion structures in place prior to land disturbance and are they successfully minimising dirty runoff?						
Is there evidence of erosion on haul roads, quarry slopes or road side drainage networks?						
Is there an accumulation of sediment within onsite drainage networks or within water storage areas?						
Are sediment dams and water storage areas working within capacity? Does sediment need to be actively removed from these areas?						

Date				
Is there evidence of increased turbidity to Badgerys Creek tributary or any other watercourses downstream of the works attributable to project activities?				
Is topsoil being managed correctly, through progressive stripping when moist and not double handled?				
Is the noise attenuation bund being progressively stabilised in accordance with topsoil excavation?				
Is there any evidence of erosion or contamination around the Western stockpile area?				
Are there any signs of erosion at overburden stockpiles?				
Are weekly inspections being undertaken and after all rainfall events exceed 15mm in a 24 hour period?				